



TURBAN • McLEAN • WETHERBE



**INFORMATION
TECHNOLOGY
FOR MANAGEMENT**

**TRANSFORMING BUSINESS
IN THE DIGITAL ECONOMY**

3RD EDITION

PART I
IT in the Organization



- ▶ 1. Strategic Use of Information Technology in the Digital Economy
- ▶ 2. Information Technologies: Concepts and Management

CHAPTER

1

Strategic Use of Information Technology in the Digital Economy

1.1 Doing Business in the Digital Economy

1.2 Business Pressures, Organizational Responses, and IT Support

1.3 Information Systems: Definitions and Examples

1.4 Information Technology Developments and Trends

1.5 Why Should You Learn About Information Technology?

1.6 Plan of the Book

Minicases:

1. Dartmouth College
2. Wal-Mart

Appendix 1A: Porter's Models

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- ① Describe the characteristics of the digital economy and e-business.
- ② Recognize the relationships between business pressures, organizational responses, and information systems.
- ③ Identify the major pressures in the business environment and describe the major organizational responses to them.
- ④ Define computer-based information systems and information technology.
- ⑤ Describe the role of information technology in supporting the functional areas, public services, and specific industries.
- ⑥ List the new technology developments in the areas of generic and networked computing and Web-based systems.
- ⑦ Understand the importance of learning about information technology.



SIEMENS AG IS TRANSFORMING ITSELF INTO AN E-BUSINESS

➔ THE PROBLEM

Siemens AG (*siemens.com*) is a German-based 150-year-old diversified and global manufacturer. With 484,000 employees, Siemens does business in 190 countries and has 600 manufacturing and R & D (research and development) facilities in over 50 countries. Its product lines and services are extremely varied, including communication and information, automation and controls, power, transportation, medical equipment, and lighting. Besides its own 13 operating divisions, Siemens AG has interests in other companies like Bosch (household appliances), Framatome (in France's nuclear power industry), and Fujitsu computers.

Facing hundreds of competitors, most of which are in foreign countries, the company had difficulties expanding its business in a fast-changing business environment and was unable to enjoy the profit margin of some of its competitors. A major problem area was the coordination of the internal units of the company. Another one was the collaboration with so many suppliers and customers. In particular, its *supply chain*—the flow of materials from suppliers through manufacturing, distribution, and sales—is very complex. Finally, it was necessary to find ways to contain costs and to increase customer service.



Various icons are used throughout the book to identify a particular perspective or functional area related to the nearby example. This icon, for example, indicates an international perspective. See page •• in the preface for a listing of all of the icons.

➔ THE SOLUTION

By the late 1990s the company decided to transform itself into a 100 percent “e-business”—that is, a company that performs various business functions electronically. It would do so by introducing Web-based systems and electronic commerce applications in all of its operations. The reason for such an ambitious goal was the need to solve the problems caused by multiple supply chain operations. Embarking on a four-year plan, the company started the transformation in 1999.

Siemens had decided on a dual approach: It would use its own in-house information systems capabilities where it made sense to do so, but it would also go out-of-house to purchase some systems from major vendors. Siemens strategic goals were to:

- Improve its readiness for extended electronic commerce by standardizing hundreds of business processes across multiple divisions. (For example, the company went from over 300 different process applications to 29.)
- Redesign the information technology infrastructure to enable integration of “best-of-breed” software (software components that best fit the company's needs, each from a different vendor), integrated into an enterprisewide platform.

Besides being able to handle electronic transactions, Siemens also wanted to create an easily accessible central corporate *knowledge base*—a companywide storehouse of proven methodologies (known as “best practices”; see Chapter 10).

Using SAP R/3 systems (see Chapter 7), along with software from i2 Technology and IBM, the company built functional systems that link the enterprise, ensure support functions, and connect with the company's supply chain partners.

Each chapter opens with an example that illustrates the application of IT in a real-world organization and the relevance of the chapter topics.

The format—problem, solution, results—helps model a way to think about business problems.

1.1 DOING BUSINESS IN THE DIGITAL ECONOMY 3

Functions such as taking customer orders, online procuring of materials and components that go into the manufacturing process, collaborating with business partners in developing products, and transporting finished products were integrated across the company, using the Internet as much as possible. Also, the system was designed to provide better customer service to Siemens's business customers.

THE RESULTS

In its 2000 fiscal year, the company saw its online sales and its electronic procurement transactions reach 10 percent of its total sales and purchases, respectively. In 2002, online sales increased by 25 percent, and e-procurement grew 60 percent over its 2000 level.

As of January 2004, most employees are networked throughout the company. They have direct access to the Internet, and a portal through which employees can access corporate information is in use. This portal offers various workplace aids, including search engines, forms, travel booking, and electronic expense account reporting.

The transformation to an e-business and the managing of change cost Siemens around 1 billion euros. President and CEO Heinrich von Pierer says, "This will make us faster and help us further cut costs. . . . All of this is aimed at meeting today's e-economy goals directly, with the promise of operational economies in return."

Sources: Compiled from Schultz (2002), *aberdeen.com* (accessed September 2002), and *siemens.com* (accessed May 2004).

LESSONS LEARNED FROM THIS CASE

This case illustrates that fierce global competition drives even large corporations to find ways to reduce costs, increase productivity, and improve customer service, which increase competitive advantage. These efforts are best achieved by using Web-based systems, which are the major enablers in the transformation to an *e-business* or *e-company* in the digital economy.

In this chapter we present the characteristics and concepts of the digital economy and how it is changing business processes. In addition, we will describe the extremely competitive business environment in which companies operate today, the business pressures to which they are subject, and what companies are doing to counter these pressures, especially in strategic management. Furthermore, you will learn what makes information technology a necessity in supporting organizations, and what and why any manager in the twenty-first century should know about it.

This brief section ties the key points of the opening case to the topics that will be covered in the chapter.

1.1 DOING BUSINESS IN THE DIGITAL ECONOMY

Conducting business in the digital economy means using Web-based systems on the Internet and other electronic networks to do some form of electronic commerce. First we will consider the concepts of electronic commerce and networked computing and then look at the impact they have made on how companies do business.

4 CHAPTER 1 STRATEGIC USE OF INFORMATION TECHNOLOGY IN THE DIGITAL ECONOMY

Electronic Commerce and Networked Computing

As described in the opening case, Siemens AG was an established “old-economy” company that has seen the need to transform itself into an **e-business**, a company that performs most of its business functions electronically, in order to enhance its operations and competitiveness (Chapter 12). Its use of Web-based systems to support buying, selling, and customer service exemplifies **electronic commerce (EC or e-commerce)**. In e-commerce (Chapter 4), business transactions are done electronically over the Internet and other computing networks. EC is becoming a very significant global economic element in the twenty-first century (see Evans and Wurster, 2000 and Drucker, 2002).

The infrastructure for EC is **networked computing** (also known as *distributed computing*), which connects computers and other electronic devices via telecommunication networks. Such connections allow users to access information stored in many places and to communicate and collaborate with others, all from their desktop (or even mobile) computers. While some people still use a standalone computer exclusively, or a network confined to one location, the vast majority of people use multiple-location networked computers. These may be connected to the *global networked environment*, known as the **Internet**, or to its counterpart within organizations, called an **intranet**. In addition, some companies link their intranets to those of their business partners over networks called **extranets**. The connection typically is done via wireline systems, but since 2000 more and more communication and collaboration is done via wireless systems.

Networked computing is helping some companies excel and is helping others simply to survive. Broadly, the collection of computing systems used by an organization is termed **information technology (IT)**, which is the focus of this book. In the developed countries, almost all medium and large organizations, and many small ones, private or public, in manufacturing, agriculture, or services, use information technologies, including electronic commerce, to support their operations.

Why is this so? The reason is simple: IT has become the major facilitator of business activities in the world today. (See for instance, Dickson and DeSanctis, 2001; Huber, 2004; and Tapscott et al., 2000.) Note that here and throughout the book, in using the term “business” we refer not only to for-profit organizations, but also to not-for-profit public organizations and government agencies, which need to be run like a business. IT is also a catalyst of fundamental changes in the strategic structure, operations, and management of organizations (see Carr, 2001), due to the capabilities shown in Table 1.1. These capabilities, according to Wreden (1997), support the following five business objectives: (1) improving productivity (in 51% of corporations), (2) reducing costs (39%), (3) improving decision making (36%), (4) enhancing customer relationships (33%), and (5) developing new strategic applications (33%). Indeed, IT is creating a transformation in the way business is conducted, facilitating a transition to a digital economy.

What Is the Digital Economy?

The **digital economy** refers to an economy that is based on digital technologies, including digital communication networks (the Internet, intranets, and private *value-added networks* or VANs), computers, software, and other related information technologies. The digital economy is also sometimes called the *Internet economy*, the *new economy*, or the *Web economy* (see Brynjolfsson et al., 2003 and Liebowitz, 2002).

TABLE 1.1 Major Capabilities of Information Systems

- Perform high-speed, high-volume, numerical computations.
- Provide fast, accurate, and inexpensive communication within and between organizations.
- Store huge amounts of information in an easy-to-access, yet small space.
- Allow quick and inexpensive access to vast amounts of information, worldwide.
- Enable communication and collaboration anywhere, any time.
- Increase the effectiveness and efficiency of people working in groups in one place or in several locations.
- Vividly present information that challenges the human mind.
- Facilitate work in hazardous environments.
- Automate both semiautomatic business processes and manually done tasks.
- Facilitate interpretation of vast amounts of data.
- Facilitate global trade.
- Can be wireless, thus supporting unique applications anywhere.
- Accomplish all of the above much less expensively than when done manually.

In this new economy, digital networking and communication infrastructures provide a global platform over which people and organizations devise strategies, interact, communicate, collaborate, and search for information. This platform includes, for example, the following, according to Choi and Whinston (2000):

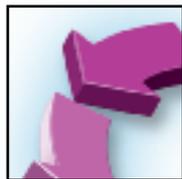
- A vast array of digitizable products—databases, news and information, books, magazines, TV and radio programming, movies, electronic games, musical CDs, and software—which are delivered over the digital infrastructure any time, anywhere in the world
- Consumers and firms conducting financial transactions digitally—through digital currencies or financial tokens carried via networked computers and mobile devices
- Physical goods such as home appliances and automobiles, which are equipped with microprocessors and networking capabilities

The following icon is used throughout the book to indicate that additional related resources are available at the book's Web site, www.wiley.com/college/turban.



The term *digital economy* also refers to the convergence of computing and communication technologies on the Internet and other networks, and the resulting flow of information and technology that is stimulating e-commerce and vast organizational change. This convergence enables all types of information (data, audio, video, etc.) to be stored, processed, and transmitted over networks to many destinations worldwide. The digital economy has helped create an economic revolution, which was evidenced by unprecedented economic performance and the longest period of uninterrupted economic expansion in history from 1991 until 2000. (See Online File W1.1 for some statistics related to the “digital revolution.”)

OPPORTUNITIES FOR ENTREPRENEURS. The new digital economy is providing unparalleled opportunities for thousands of entrepreneurs, some of them in their teens, to apply EC business models to many business areas. As we will see throughout the book, many of these initiatives were started by one or two individuals. Others were started by large corporations. These startup companies



IT at Work 1.1

DIAMONDS FOREVER—ONLINE



The gems market is a global one with thousands of traders buying and selling about \$40 billion worth of gems each year. This age-old business is very inefficient in terms of pricing: Several layers of intermediaries can jack up the price of a gem 1,000 percent between wholesale and final retail prices.

Chanthaburi, Thailand, is one of the world's leading centers for processing gems, and that is where Don Kogen landed, at the age of 15, to search for his fortune. And indeed, he found it there. After failing to become a gem cutter, Kogen moved into gem sorting, and soon he learned to speak Thai. After three years of observing how gem traders haggle over stones, he decided to try the business himself. Having only a small amount of "seed" money, Kogen started by purchasing low-grade gems from sellers who arrived early in the morning and selling them for a small profit to dealers from India and Pakistan who usually arrived late in the day. Using advertising, he reached the U.S. gem market and soon had 800 potential overseas customers. Using faxes, he shortened the order time, which resulted in decreasing the entire time from order to delivery. These various business methods enabled him to grow his mail-order business to \$250,000 per year by 1997.

In 1998, Kogen decided to use the Internet. Within a month, he established a Web site *thaigem.com* and sold his first gem online. By 2001, the revenue reached \$4.3 million, growing to \$9.8 million in 2002. Online sales account for 85 percent of the company's revenue. The buyers are mostly jewelry dealers or retailers such as Wal-Mart or QVC. Kogen buys raw or refined gems from all over the world, some online, trying to cater to the demands of his customers.

Thaigem's competitive edge is low prices. The proximity to gem-processing factories and the low labor cost enable Kogen to offer prices significantly lower than his online competitors (such as Tiffany's at *tiffany.com*). Kogen makes only 20 to 25 percent profit, much less than other dealers make. To make the business even more competitive, Kogen caters even to small buyers. Payments are made safely, securely, and conveniently using either PayPal or Escrow.com. Delivery to any place is made via Federal Express, at \$15 per shipment.

Dissatisfied customers can return merchandise within 30 days, no questions asked. No jewel is guaranteed, but Kogen's name is trusted by over 68,000 potential customers worldwide. Kogen enjoys a solid reputation on the Web. For example, he uses eBay to auction gems as an additional selling channel. Customers' comments on eBay are 99 percent positive versus 1 percent negative. In fact, *Thaigem.com* is further expanding its customer-service program. The company has implemented a 24-hour "Live Support" chat service, Monday through Friday, further augmenting this service with the addition of a 1-800 (toll-free) number for U.S. customers. This "Live Support" chat software allows *Thaigem.com* to track the movement of customers and know exactly what products or content pages customers are viewing.

Sources: Compiled from *thaigem.com* (April 2004) and from Mevedoth (2002).

For Further Exploration: Go to *blackstartrading.com* and compare the two sites; which one do you think is better? What kinds of business and revenue models were used? Were they effective? How is competitive advantage gained in this case?

"IT at Work" boxes spotlight innovations and technologies used by real organizations to solve business problems.

"Integrating IT" icons highlight examples of IT applications in major functional areas of business, in government, and in public services. The codes used in these turquoise-colored icons are:

ACC—accounting

POM—production/operations management

MKT—marketing

HRM—human resources management

FIN—finance

GOV—government and

SVC—other public services

not only sold products, but many also provided support services ranging from computer infrastructure to electronic payments. Known as *dot-coms*, these companies saw an opportunity to do global business electronically. An interesting example is entrepreneur Don Kogen and his *Thaigem.com* business, described in *IT at Work 1.1*.

The New vs. the Old: Illustrative Examples

The changes brought by the digital economy are indeed significant. Computer-based information systems of all kinds have been enhancing business competitiveness and creating strategic advantage on their own or in conjunction with e-commerce applications (see Carr, 2001; Basu and Muylle, 2003; and Li et al., 2003). In a study conducted by Lederer et al. (1998), companies ranked the number-one benefit of Web-based systems as “enhancing competitiveness or creating strategic advantage.” Let’s look at a few examples that illustrate differences between doing business in the new economy and the old one.

EXAMPLE #1: PAYING FOR GOODS: THE CHECKOUT EXPERIENCE. It sometimes takes more time to check out than to shop, which can be a really frustrating experience.

Old Economy. In the “old-old” economy, when you visited stores that sold any type of retail product (e.g., groceries, office supplies), you placed your items in a shopping cart and proceeded to checkout. At the checkout counter, you stood in line while a clerk punched in the price of each item on a manual adding machine. After the clerk added up all your items, you paid for them in cash. Note that in this situation no information was gathered about the item itself, other than the price.

Using the next generation of checkout technology, you take your items to a clerk, who swipes (sometimes twice or more) the barcode of each item over a “reader.” The reader captures data on the price and description of each item and automatically enters that data into the organization’s database. You receive an itemized account of your purchases and the total price.

New Economy. In the new economy, you take your items to a self-service kiosk, where you swipe the barcode of each item over a reader. After you have swiped all of your items, the kiosk gives you directions about how to pay (cash, credit card, or debit card). You still may have to wait if there are lines to get to the self-service kiosk; often, other shoppers need help to learn the technology. But, your checkout time is much faster.

In the coming generation of checkout technology, all items will have wireless radio frequency identification (RFID) tags (see Chapters 2 and 5) either attached to or embedded in them. After you have finished shopping, you will simply walk your cart with all its items through a device similar to an airport security scanner. This device will “read” the wireless signals from each item, generate an itemized account of all your purchases, total up the price, and debit your debit card or credit card (after recognizing your face or fingerprint), all in a few seconds. You will not wait in line at all, but will walk almost directly from the store to your car.

An ethical issue here is what happens to the tags. If they are not removed after you pay, it is theoretically possible for someone to track your whereabouts, which many consider an invasion of privacy. But removing these tags costs money and takes time, an added burden to retailers. Pending legislation in Massachusetts is attempting to force retailers to remove the tags. Pending legislation in California tries to limit the information placed on RFIDs to ensure privacy.

EXAMPLE #2: CROSSING INTERNATIONAL BORDERS. Assume you are traveling to another country, say Australia. Your plane lands after a long flight, but before you can make your way to your lodgings, you must first go through immigration.



8 CHAPTER 1 STRATEGIC USE OF INFORMATION TECHNOLOGY IN THE DIGITAL ECONOMY

Old Economy. You wait in line to be processed by the immigration officers. The inspectors are slow, and some are new and need help from time to time. Processing certain people takes several minutes. You are tired, upset, and stressed. You may wait 10 minutes, 20 minutes, or even close to an hour.

New Economy. You submit your passport and it is scanned. At the same time, a photo of your face is taken. A computer compares that picture with the picture in the passport and with one in a database. In 10 seconds you are through immigration and on your way out of the airport. The world's first system of this kind was initiated in Australia in 2003. In some countries (e.g., Israel), an image of your fingerprints is taken and compared to a stored image. Again, in seconds you are on your way. These systems use a technology called *biometrics* (see Chapter 15) that not only expedites processing but also increases security by eliminating the entry of people with false passports.

EXAMPLE #3: SUPPLYING COMMERCIAL PHOTOS. Thousands of companies around the globe provide photos of their products to retailers who advertise products in newspapers, in paper catalogs, or online. The new economy has changed the process by which these photos are supplied.

Old Economy. In the old economy, the retailer sends the manufacturer a request for a picture of the item to be advertised, say a Sony TV set. Sony then sends to a designated ad agency, by courier, alternative pictures that the agency can use. The agency selects a picture, designs the ad, gets an approval from the retailer and sends the picture by courier to the printer. There it is rephotographed and entered into production for the catalog. (An improvement introduced several years ago allows the ad agency to send the picture to a scanning house. There, a digital image is made, and that image is moved to the printer.) Both the retailer and the ad agency may be involved in a quality check at various times, slowing the process. The cycle time per picture can be four to six weeks. The total processing cost per picture is about \$80.

New Economy. Orbis Inc., a very small Australian company, changed the above old-economy linear supply chain to a hub-like supply chain, as shown in Figure 1.1. In the new process, the manufacturer (e.g., Sony) sends many

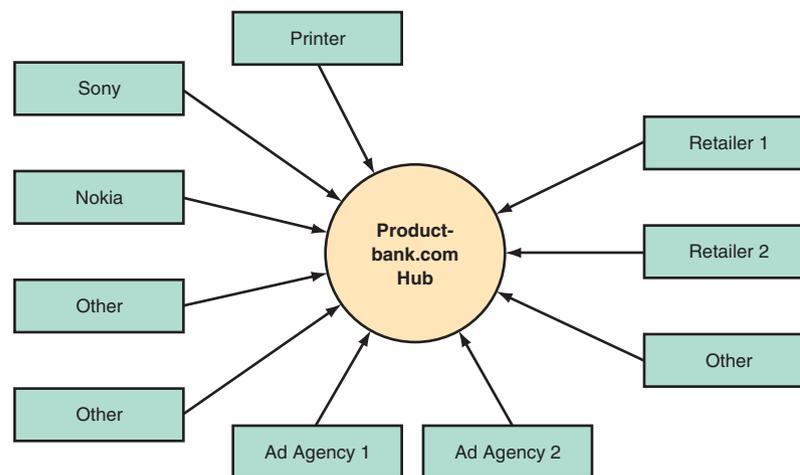


FIGURE 1.1 Changing a linear supply chain to a hub.

1.1 DOING BUSINESS IN THE DIGITAL ECONOMY 9

digitized pictures to Orbis (at *productbank.com.au*), and Orbis organizes the pictures in a database. When a retailer needs a picture, it enters the database and selects a picture, or several alternatives. The ID number of the chosen picture is e-mailed to the ad agency. The agency enters the database, views the digitized pictures, and works on them. Then, after the client's approval, either the final digitized pictures are e-mailed to the printer, or the printer is told to pick them up from the database. The entire process takes less than a week at a cost of about \$50 per picture.

EXAMPLE #4: PAYING FOR TRANSPORTATION IN NEW YORK CITY. Millions of people all over the world take public transportation. Metal tokens were the preferred solution in some major cities for generations.

Old Economy. For over 50 years, New Yorkers have used tokens to pay for transportation on buses and subways. The tokens save time and are liked by travelers. However, it costs \$6 million a year to manufacture replacement tokens and to collect the tokens out of turnstiles and fare boxes ("NYC Transit Tokens. . .," 2003). New York City needs this money badly for other services.

New Economy. The new-economy solution has been to switch to MetroCards. By 2002, only 9 percent of all commuters were still using tokens. Despite the fact that they have to occasionally swipe the MetroCard through the card reader several times, travelers generally like the new cards. (A new generation of contactless cards does not have this problem.) MetroCards are offered at discounts, which riders like. Other cities have made the transition to electronic cards as well. Chicago's transit moved to cards in 1999, replacing the century-old tokens. Washington, D.C., Paris, and London also use transit cards. In Hong Kong, millions use a contactless card not only for transportation but also to pay for telephone, Internet access, food in vending machines, and much more.

EXAMPLE #5: IMPROVING THE LAUNDRY EXPERIENCE FOR COLLEGE STUDENTS. Millions of college students use dorm laundry facilities worldwide. What is their experience?

Old Economy. You run to the laundry room only to find out that all machines are taken. You wait for a machine, and when you finally get one, you realize that you are short on coins. After using the dollar changer, you are set to go, but you do not remember what your mother instructed you to do with the dirty shirts. However, you put everything in to the washer, start it, and hope for the best. Rather than hang around the laundry room, you go away to study, and when you come back you find that someone took out your clean stuff and placed it on the dirty counter. You transfer the laundry to the dryer, and go back to study some more. This time you come back before the dryer is finished, so you must wait, wasting time again.

New Economy. Dryers and washers in your college are hooked to the Web. You punch a code into your cell phone or sign in at *esuds.net*, and you can check for availability of laundry machines. Furthermore, you can pay with your student ID or with a credit card, and you will receive e-mail alerts when your wash and dry cycles are complete. Once in the laundry room, you activate this system by swiping your student ID card (or key in a PIN number). The system automatically injects premeasured amounts of detergent and fabric softener, at the right cycle time.

10 CHAPTER 1 STRATEGIC USE OF INFORMATION TECHNOLOGY IN THE DIGITAL ECONOMY

The machine owners benefit too: They can monitor machine performance, arrange for some maintenance, eliminate vandalism (no cash in the machines), and enjoy higher utilization (more students use the campus machines). Sound great? If you do not have it on your campus yet, it will come soon.

EXAMPLE #6: THE POWER OF E-COMMERCE. The power of e-commerce is demonstrated in the following three examples:

Every year, Warren Buffett, the most famous U.S. stock investor and investment guru, invites eight people to lunch with him. The eight pay big money for the pleasure. The money is donated to San Francisco's needy people. In the past, Buffett charged \$30,000 per person. In 2003, Buffett placed the invitation in an online auction. Bidders pushed the price from \$30,000 to over \$200,000.

Initial public offerings (IPOs) of equity securities (stocks) can make their buyers rich, since on the first day of trading prices can go up considerably, frequently over 100 percent. Initial stock allocations typically have been offered for sale to stockbrokers and to some interest groups (e.g., mutual funds and pension funds). In 2004, Google.com went public with its IPO by conducting a Dutch auction on the Internet (see Chapter 4). Using this method for its stock offering, the company collected much more money and the shares were distributed in a fair manner.

Chris MoneyMaker won \$2.5 million in May 2003 in the World Series of Poker. Chris, a 27-year-old, had never before sat down at a poker tournament table. Yet, he cleaned out many skilled professionals. How did he do it? Although Chris had never sat in a room with players, he had played extensively online, where the game is much faster, but the money is just as real. (Interested? See Wayner, 2003 and *playwinningpoker.com*.)

In each of the examples above, we can see the advantage of the new way of doing business over the old one in terms of at least one of the following: cost, quality, speed, strategic competitive advantage, and customer service. What is amazing is the *magnitude* of this advantage. In the past, business improvements were in the magnitude of 10 to 25 percent. Today, improvements can be hundreds or even thousands of times faster or cheaper. For example, it is about 250 times faster to get through immigration now, and there are fewer mistakes (Walker, 2003). The new economy brings not only digitization but also the opportunity to use new business models, such as Don Kogen uses at *Thaigem.com*—selling from the Internet.

Business Models in the Digital Economy

The Internet is challenging the economic, societal, and technological foundations of the old economy. In essence a *revolution* has been underway. And like all successful revolutions, when it ends, the landscape will look significantly different. Entrepreneurs are developing new models for business, the economy, and government.

A **business model** is a method of doing business by which a company can generate revenue to sustain itself. The model spells out how the company creates (or adds) value that consumers are willing to pay for, in terms of the goods and/or services the company produces in the course of its operations. Some models are very simple. For example, Nokia makes and sells cell phones and generates profit from these sales. On the other hand, a TV station provides free broadcasting. Its survival depends on a complex model involving factors such as

advertisers and content providers. Internet portals, such as Yahoo, also use a similar complex business model.

Some examples of new business models brought about by the digital revolution are listed in *A Closer Look 1.1*. Further discussion of these models will be found throughout the book (especially in Chapter 4), and also in Afuah and Tucci (2003), Brynolfsson et al. (2003), Weill and Vitale (2001), and Turban et al. (2006), and at *digitalenterprise.org*. In part, these new business models have sprung up in response or reaction to business pressures, which is the topic we turn to next.

"A Closer Look" boxes contain detailed, in-depth discussion of specific concepts, procedures, or approaches.



A CLOSER LOOK

1.1 FIVE REPRESENTATIVE BUSINESS MODELS OF THE DIGITAL AGE



NAME-YOUR-OWN-PRICE. Pioneered by Priceline.com, this model allows the buyer to state a price he or she is willing to pay for a specific product or service. Using information in its database, Priceline will try to match the buyer's request with a supplier willing to sell on these terms. Customers may have to submit several bids before they find a price match for the product they want. Priceline's major area of operation is travel (airline tickets, hotels).

TENDERING VIA REVERSE AUCTIONS. If you are a big buyer, private or public, you are probably using a *tendering* (bidding) system to make your major purchases. In what is called a request for quote (RFQ), the buyer indicates a desire to receive bids on a particular item, and would-be sellers bid on the job. The lowest bid wins (if price is the only consideration), hence the name *reverse auction*. Now tendering can be done online, saving time and money (see Chapter 4). Pioneered by General Electric Corp. (*gxs.com*), tendering systems are gaining popularity. Indeed, several government entities are mandating electronic tendering as the only way to sell to them. Electronic reverse auctions are fast, they reduce administrative costs by as much as 85 percent, and products' prices can be 5 to 20 percent lower.

AFFILIATE MARKETING. *Affiliate marketing* is an arrangement in which marketing partners place a banner ad for a company, such as Amazon.com, on their Web site. Every time a customer clicks on the banner, moves to the advertiser's Web site, and makes a purchase there, the advertiser pays a 3 to 15 percent commission to the host site. In this way, businesses can turn other businesses

into their *virtual commissioned sales force*. Pioneered by CDNow (see Hoffman and Novak, 2000), the concept is now employed by thousands of retailers or direct sellers. For details see Chapter 4 and Helmstetter and Metiviers (2000).

GROUP PURCHASING. It is customary to pay less per unit when buying more units. Discounts are usually available for such quantity purchases. Using e-commerce and the concept of *group purchasing*, in which purchase orders of many buyers are aggregated, a small business or even an individual can participate and get a discount. EC brings in the concept of *electronic aggregation* for group purchasing, in which a third party finds the individuals or SMEs (small/medium enterprises) that want to buy the same product, aggregates their small orders, and then negotiates (or conducts a tender) for the best deal. The more that join the group, the larger the aggregated quantity, and the lower the price paid. Some leading aggregators are *buyerzone.com* and *allbusiness.com*.

E-MARKETPLACES AND EXCHANGES. Electronic marketplaces have existed in isolated applications for decades. An example is the stock exchanges, some of which have been fully computerized since the 1980s. But, since 1999, thousands of electronic marketplaces of different varieties have sprung up. E-marketplaces introduce operating efficiencies to trading, and if well organized and managed, they can provide benefits to both buyers and sellers. Of special interest are *vertical marketplaces*, which concentrate on one industry (e.g., *chemconnect.com* in the chemical industry). (Chapter 4 will explore e-marketplaces and exchanges in more detail.)

1.2 BUSINESS PRESSURES, ORGANIZATIONAL RESPONSES, AND IT SUPPORT

Environmental, organizational, and technological factors are creating a highly competitive business environment in which customers are the focal point. Furthermore, these factors can change quickly, sometimes unpredictably (see Tapscott et al., 2000). A Gartner Group survey, Gartner G2 (2004), revealed that the most important business issues of 2004 were retaining loyal customers, improving productivity, cutting costs, increasing market share, and providing timely organizational response. As we will see throughout the book, IT is a major enabler for dealing with these issues.

Companies need to react frequently and quickly to both the *problems* and the *opportunities* resulting from this new business environment (see Arens and Rosenbloom, 2003 and Drucker, 2001). Because the pace of change and the degree of uncertainty in tomorrow's competitive environment are expected to accelerate, organizations are going to operate under increasing pressures to produce more, using fewer resources.

Boyett and Boyett (1995) emphasize this dramatic change and describe it with a set of what they call **business pressures**, or *drivers*. These business pressures are forces in the organization's environment that create pressures on (that is, that "drive") the organization's operations.

Boyett and Boyett maintain that in order to succeed (or even merely to survive) in this dynamic world, companies must not only take traditional actions such as lowering costs, but also undertake innovative activities such as changing structure or processes or devise a competitive strategy (Chapter 12). We refer to these reactions, some of which are interrelated, as **critical response activities**. These activities can be performed in some or all of the processes of the organization, from the daily routines of preparing payroll and order entry, to strategic activities such as the acquisition of a company. A response can be a reaction to a pressure already in existence, an initiative intended to defend an organization against future pressures, or an activity that exploits an opportunity created by changing conditions. Most response activities can be greatly facilitated by information technology. In some cases IT is the only solution to these business pressures (see Simpson, 2003 and Arens and Rosenbloom, 2003).

The relationships among business pressures, organizational responses, and IT are shown in Figure 1.2. This figure illustrates a model of the new world of



FIGURE 1.2 IT support for organizational responses.

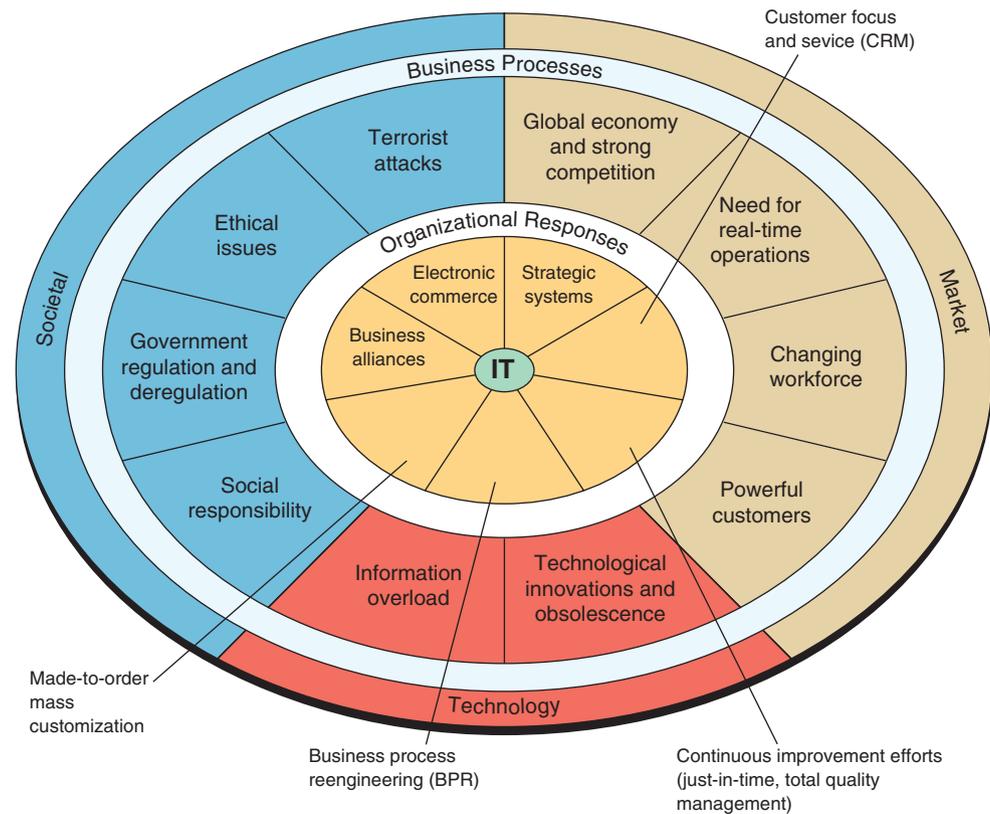
1.2 BUSINESS PRESSURES, ORGANIZATIONAL RESPONSES, AND IT SUPPORT 13

FIGURE 1.3 Business pressures, organizational responses, and IT support.

business. The business environment contains pressures on organizations, and organizations respond with activities supported by IT (hence the bidirectional nature of the arrows in the figure).

In the remainder of this section, we will examine two components of the model—business pressures and organizational responses—in more detail.

Business Pressures

The business environment consists of a variety of factors—social, technological, legal, economic, physical, and political (see Huber, 2004). Significant changes in any of these factors are likely to create business pressures on organizations. In this book, we will focus on the following business pressures: market pressures, technology pressures, and societal pressures. Figure 1.3 (the inner circle) presents a schematic view of these major pressures, which may interrelate and affect each other. These pressures are described next.

MARKET PRESSURES. The market pressures that organizations feel come from a global economy and strong competition, the changing nature of the workforce, and powerful customers.

Global Economy and Strong Competition. Within the last 20 or so years, the foundation necessary for a global economy has taken shape. This move to globalization has been facilitated by advanced telecommunication networks and especially by the Internet. Regional agreements such as the North American Free Trade Agreement (United States, Canada, and Mexico) and the creation of a unified European market with a single currency, the euro, have contributed to

increased world trade. Further, reduction of trade barriers has allowed products and services to flow more freely around the globe.

One particular pressure that exists for businesses in a global market is the cost of labor. Labor costs differ widely from one country to another. While the hourly industrial wage rate (excluding benefits) is over \$25 in some developed countries, it can be less than \$1 in many developing countries, including those in Asia, South America, Eastern Europe, and Africa. Therefore, many companies in labor-intensive industries have found it necessary to move their manufacturing facilities to countries with low labor costs. Such a global strategy requires extensive communication and collaboration, frequently in several languages and under several cultural, ethical, and legal conditions. This can be greatly facilitated with IT (Chapter 8).

Using IT in a multicountry/multicultural environment may create ethical issues, such as invasion of privacy of individuals whose private data are taken across borders (see Appendix 1A at the end of this chapter). *Global competition* is especially intensified when governments become involved through the use of subsidies, tax policies, import/export regulations, and other incentives. Rapid and inexpensive communication and transportation modes increase the magnitude of international trade even further. Competition is now becoming truly global.

Need for Real-Time Operations. The world is moving faster and faster. Decisions need to be made very quickly, and speed is needed to remain competitive (Gates, 1999; Davis, 2001; and Meyer, 2001). Led by Cisco Systems, some companies are even attempting to close their accounting books in a day—a process that used to take as many as 10 days (McClellan, 2002).

Changing Nature of the Workforce. The workforce, particularly in developed countries, is changing rapidly. It is becoming more diversified, as increasing numbers of women, single parents, minorities, and persons with disabilities work in all types of positions. In addition, more employees than ever prefer to defer retirement. Finally, more and more workers are becoming knowledge workers (Drucker, 2002). Information technology is easing the integration of this wide variety of employees into the traditional workforce, and it enables homebound people to work from home (telecommute). (For more, see the discussions of telecommuting in Chapter 3, and of support for the disabled in Chapter 16.)

Powerful Customers. Consumer sophistication and expectations increase as customers become more knowledgeable about the availability and quality of products and services. On the Web, consumers can now easily find detailed information about products and services, compare prices, and buy at electronic auctions. As we mentioned earlier, in some cases buyers can even name the price they are willing to pay. Therefore, consumers have considerable power (Pitt et al., 2002). Companies need to be able to deliver information quickly to satisfy these customers.

Customers today also want *customized products and services*, with high quality and low prices. Vendors must respond, or lose business. For example, a large department store in Japan offers refrigerators in 24 different colors with a delivery time of just a few days. Dell Computer will take an order over the Internet for a computer, made to specifications of your choice, and will deliver that computer to your home within 3 to 7 days. And Nike will let you design your own sneakers online and will make and ship them to arrive at your home in two weeks (*nike.com*). Finally, automakers are selling build-to-order cars whose configuration

1.2 BUSINESS PRESSURES, ORGANIZATIONAL RESPONSES, AND IT SUPPORT 15

is done on the Internet (see *jaguar.com*). The old saying, “The customer is king,” has never before been so true.

The importance of customers has created “competition over customers.” This competition forces organizations to increase efforts to acquire and retain customers. An enterprisewide effort to do just that is called **customer relationship management (CRM)** (see Greenberg, 2002). This topic will be addressed in detail in Chapter 6.

TECHNOLOGY PRESSURES. The second category of business pressures consists of those related to technology. Two major pressures in this category are technological innovation and information overload.

Technological Innovation and Obsolescence. Technology is playing an increased role in both manufacturing and services. New and improved technologies create or support substitutes for products, alternative service options, and superb quality. In addition, some of today’s state-of-the-art products may be obsolete tomorrow. Thus, technology accelerates the competitive forces. Many technologies affect business in areas ranging from genetic engineering to food processing. However, probably the technology with the greatest impact is Web-based information technology (see Evans and Wurster, 2000; Carr, 2001; and Motiwalla and Hashimi, 2003).

An example of technological obsolescence is illustrated in Minicase 1 (Maybelline) at the end of Chapter 2. The technology of interactive voice response (IVR), which is still new for many companies, is being replaced by mobile devices, which are being replaced by wireless devices and by voice portals.

Information Overload. The Internet and other telecommunication networks increase the amount of information available to organizations and individuals. Furthermore, the amount of information available on the Internet more than doubles every year, and most of it is free! The information and knowledge generated and stored inside organizations is also increasing exponentially. The world is facing a flood of information. Thus, the accessibility, navigation, and management of data, information, and knowledge, which are necessary for managerial decision making, become critical. The only effective solutions are provided by information technology (e.g., search engines, intelligent databases).

SOCIETAL PRESSURES. The third category of business pressures consists of those related to society. The “next society,” as Drucker (2001, 2002) calls it, will be a knowledge society, and also a society of aging populations. Both of these have important societal implications related to education and health care (e.g., see the case of Elite-Care in Chapter 5), and handling of such issues likely will involve various information technologies (see Sipior et al., 2004). Other important societal issues include social responsibility, government regulation/deregulation, spending for social programs, and ethics.

Social Responsibility. The interfaces between organizations and society are both increasing and changing rapidly. Social issues that affect business range from the state of the physical environment to companies’ contributions to education (e.g., by allowing interns to work in the companies). Corporations are becoming more aware of these and other social issues, and some are willing to spend time and/or money on solving various social problems. Such activity is known as organizational *social responsibility*. Online File W1.2 at the book’s Web site lists some major areas of social responsibility related to business.





Government Regulations and Deregulation. Several social responsibility issues are related to government regulations regarding health, safety, environmental control, and equal opportunity. For example, U.S. companies that spray products with paint must use paper to absorb the overspray. The paper must then be disposed of by a licensed company, usually at a high cost. A recent example is the Sonbanes-Oxley Act that requires extensive controls and reporting (see Online File W1.3). Government regulations cost money and make it more difficult to compete with countries that lack such regulations. In general, deregulation intensifies competition.

Terrorist Attacks and Protection. Since September 11, 2001, organizations have been under increased pressure to protect themselves against terrorist attacks. In addition, employees in the military reserves may be called up for active duty, creating personnel problems. Information technology and especially intelligent systems may make a valuable contribution in the area of protection, by providing security systems and possibly identifying patterns of behavior that will help to prevent terrorist attacks and cyberattacks against organizations.

Homeland Security. The National Strategy for Homeland Security of the United States includes a National Vision for the sharing of information related to the detection of terrorist activities. Its goals are to build a national environment that enables the sharing of essential homeland security information. It will be a system of systems that can integrate knowledge that resides across many disparate data sources, while ensuring that privacy and civil liberties are adequately safeguarded. Information will be shared across each level of government and among federal, state, and local governments, private industry, and citizens. With the proper use of people, processes, and technology, U.S. homeland security officials can have common awareness of threats and vulnerabilities as well as knowledge of the personnel and resources available to address these threats. Officials will receive the information they need so they can anticipate threats and respond rapidly and effectively.

These goals can be accomplished only if there is a means to facilitate the sharing of information among numerous agencies that currently maintain independent data silos. Border security alone engages 11 agencies. Ultimately a data warehouse of homeland security information will lead to increased security for the United States. It will be a model for how all countries can interact to protect their borders and ensure the safety of their citizenry. To accomplish the project, a data warehouse (Chapter 11) will be constructed. In Chapters 11 and 12 we will discuss the implementation of this project. Related to this project are some ethical issues about protecting the privacy of citizens. For further information, consult whitehouse.gov/homeland/book/index.html.

Ethical Issues. **Ethics** relates to standards of right and wrong, and *information ethics* relates to standards of right and wrong in information processing practices. Organizations must deal with ethical issues relating to their employees, customers, and suppliers. Ethical issues are very important since they have the power to damage the image of an organization and to destroy the morale of the employees. Ethics is a difficult area because ethical issues are not cut-and-dried. What is considered ethical by one person may seem unethical to another. Likewise, what is considered ethical in one country may be seen as unethical in another.

The use of information technology raises many ethical issues. These range from the monitoring of electronic mail to the potential invasion of privacy of millions of customers whose data are stored in private and public databases. At



Use of this icon highlights IT-related ethics discussions.

1.2 BUSINESS PRESSURES, ORGANIZATIONAL RESPONSES, AND IT SUPPORT  17

this chapter's Website, in Online File W1.4, you will find resources that will help you develop and strengthen your understanding of ethical issues related to business, and to IT in particular. The online file consists of two parts: (1) a general framework of ethics in business and society, and (2) an Ethics Primer that poses various ethical situations and asks you to think about responses to these situations. In addition to the materials in Online File W1.4, specific ethical issues are discussed in all chapters of the book (and are highlighted by an icon in the margin).



The environments that surrounded organizations are becoming more complex and turbulent. Advances in communications, transportation, and technology create many changes. Other changes are the result of political or economic activities. Thus, the pressures on organizations are mounting, and organizations must be ready to take responsive actions if they are to succeed. In addition, organizations may see opportunities in these pressures. (For a framework for change analysis, see Online File W1.5 at the book's Web site.) Organizational responses to the increasing business pressures are described next.

Organizational Responses

Traditional organizational responses may not be effective with new types of pressures. Therefore many old solutions need to be modified, supplemented, or eliminated. Organizations can also take *proactive* measures, to create a change in the marketplace. Such activities also include exploiting opportunities created by the external pressures.

Organizations' major responses are divided here into seven categories: strategic management and systems, customer focus, continuous improvement, restructuring, make-to-order and mass customization, business alliances, and e-business. These responses can be interrelated, so the categories sometimes overlap.

Strategic Management and Systems. An important response activity is to develop a corporate strategy of how to handle the business pressures. Once such strategy is developed (including the supporting role of IT), the company can develop its tactical and operational plans as well as specific strategic IT-supported systems. For discussion of a well-known framework for analyzing competitive forces and developing strategic responses, see Appendix 1A at the end of the chapter.

Strategic systems provide organizations with strategic advantages that enable them to increase their market share and/or profit, to better negotiate with suppliers, or to prevent competitors from entering their territory (Callon, 1996). There are a variety of IT-supported strategic systems, as we will show throughout the book. According to Moss-Kanter (2001), the Internet is transforming companies and their strategies, changing the competitive landscape and requiring commitment to change. In particular these days, Web-based systems are providing considerable strategic advantage to companies (Lederer et al., 2001; Li et al., 2003; and Basu and Muelle, 2003).

A prime example of strategic systems is Federal Express's overnight delivery system, which can track the status of every individual package, anywhere in the delivery chain. The Federal Express (FedEx) system is heavily supported by IT. A major challenge with this kind of strategic system is the difficulty of sustaining competitive advantage. Most of FedEx's competitors duplicated the system. So FedEx moved the system to the Internet. However, the competitors quickly followed, and FedEx is now continuously introducing new innovations to keep or expand market share. For example, in an application called "My Account,"

FedEx provides you comprehensive account management, including an online address checker (for shipping destinations) and an online wireless portal. An increasing number of mobile-computing-based strategic systems are appearing (e.g., see the Expedia case in Chapter 12). Strategic systems relate to appropriate decision-making practices and tools, as advocated by Huber (2004).

CUSTOMER FOCUS. Organizational attempts to provide super customer service sometimes make the difference between attracting and keeping customers, or losing them to other organizations. With a slew of IT tools, sophisticated mechanisms and innovations are designed to make customers happy (see Chapter 6).

CONTINUOUS IMPROVEMENTS. Many companies continuously conduct programs that attempt to improve their productivity and quality (see Brue, 2002), and they frequently do so with the facilitation of IT. Examples of such programs include total quality management (TQM) and Six Sigma, knowledge management, productivity and creativity improvements, just-in-time (JIT) processing, improvements in decision-making processes, change management, and customer service improvements. The underlying purpose of IT support in continuous improvement is (1) to monitor and analyze performance and productivity and (2) to gather, share, and better use organizational knowledge. (See Online File W1.6 for more details.) We will provide examples throughout the book of how IT is contributing to continuous improvement.



RESTRUCTURING BUSINESS PROCESSES. Organizations may discover that continuous improvement efforts have limited effectiveness in an environment full of strong business pressures. Therefore, a relatively new approach may be needed. This approach, initially called **business process reengineering (BPR)**, refers to a situation in which an organization fundamentally and radically redesigns its business processes to achieve dramatic improvements (Hammer and Champy, 2001). Such redesign effects a major innovation in an organization's structure and the way it conducts its business. If done on a smaller scale than corporatewide, the redesign process may be referred to as a *restructuring* (see El-Sawy, 2001). Technological, human, and organizational dimensions of a firm may all be changed in restructuring and BPR (see Chapter 14). The major areas in which IT supports restructuring are described in Chapter 14.

MAKE-TO-ORDER AND MASS CUSTOMIZATION. A major response area is the trend to produce customized products and services. This strategy is referred to as **build-to-order**. As today's customers demand customized products and services, the business problem is how to provide customization and do it efficiently. This can be done, in part, by changing manufacturing processes from mass production to mass customization (Anderson, 2002; Smith and Rupp, 2002; and Zhu and Kraemer, 2002; see also Appendix 2A in this book). In mass production, a company produces a large quantity of identical items. In **mass customization**, items are produced in a large quantity but are customized to fit the desires of each customer. IT and EC are ideal facilitators of mass customization, for example, by enabling interactive communication between buyers and designers so that customers can quickly and correctly configure the products they want. Also, electronic ordering reaches the production facility in minutes.

BUSINESS ALLIANCES. Many companies realize that alliances with other companies, even competitors, can be very beneficial. For example, General Motors and Ford created a joint venture to explore electronic-commerce applications, and the major airlines in Southeast Asia created a joint portal in 2003 that promotes travel to the region. There are several types of alliances: sharing resources, doing procurement jointly, establishing a permanent supplier-company relationship, and creating joint research efforts. Any of these might be undertaken in response to business pressures and usually is supported by IT.

One of the most interesting types of business alliance is the **virtual corporation**, which operates through telecommunications networks, usually without a permanent headquarters. (The term is used by some to describe a purely on-line business that does not have physical stores.) Virtual corporations may be temporary or permanent. A *temporary* virtual corporation is typically a joint venture in which companies form a special company for a specific, limited-time mission. A *permanent* virtual corporation is designed to create or assemble productive resources rapidly or frequently, on an ongoing basis. The virtual corporation form of organization could become common in the future. More details of virtual corporations are provided in Chapter 14.

All types of business alliances can be heavily supported by information technologies ranging from collaborative portals to electronic transmission of drawings.

ELECTRONIC BUSINESS AND E-COMMERCE. As seen in the opening case, companies are transforming themselves into e-businesses. Doing business electronically is the newest and perhaps most promising strategy that many companies can pursue (see Turban et al., 2006). Several of the business models introduced earlier (in *A Closer Look 1.1*) are in fact e-commerce. Chapter 4 will focus extensively on this topic, and e-commerce applications are introduced throughout the book.

To illustrate the importance of e-commerce, let's look at what a management guru, Peter Drucker, has to say about EC.

The truly revolutionary impact of the Internet Revolution is just beginning to be felt. But it is not "information" that fuels this impact. It is not "artificial intelligence." It is not the effect of computers and data processing on decision-making, policy-making, or strategy. It is something that practically no one foresaw or, indeed even talked about ten or fifteen years ago: e-commerce—that is, the explosive emergence of the Internet as a major, perhaps eventually *the* major, worldwide distribution channel for goods, for services, and, surprisingly, for managerial and professional jobs. This is profoundly changing economics, markets and industry structure, products and services and their flow; consumer segmentation, consumer values and consumer behavior, jobs and labor markets. But the impact may be even greater on societies and politics, and above all, on the way we see the world and ourselves in it. (Drucker, 2002, pp. 3–4)

E-business not only is revolutionizing business but, according to Earl and Khan (2001), is changing the face of IT by pushing companies to redefine technology's role in new business models. For example, many EC systems need to be built quickly and inexpensively since they are used only for a short time, due to rapid technological and market changes. Some companies are introducing dozens of EC projects that enable them to compete globally. For example, see Online Minicase W1.1 about Qantas Airlines at the book's Web site.



While some critical response activities can be executed manually, the vast majority require the support of information systems. Before we provide more examples on the role of information systems and IT, let us briefly explore the terms themselves.

1.3 INFORMATION SYSTEMS: DEFINITIONS AND EXAMPLES

What Is an Information System?



An **information system (IS)** collects, processes, stores, analyzes, and disseminates information for a specific purpose. Like any other system, an information system includes *inputs* (data, instructions) and *outputs* (reports, calculations). It *processes* the inputs by using technology such as PCs and produces outputs that are sent to users or to other systems via electronic networks. A *feedback* mechanism that controls the operation may be included (see Figure 1.4). Like any other system, an information system also includes people, procedures, and physical facilities, and it operates within an *environment*. An information system is not necessarily computerized, although most of them are. (For more general discussion of *systems*, see Online File W1.7 at the book's Web site.)

FORMAL AND INFORMAL INFORMATION SYSTEMS. An information system can be formal or informal. *Formal* systems include agreed-upon procedures, standard inputs and outputs, and fixed definitions. A company's accounting system, for example, would be a formal information system that processes financial transactions. *Informal* systems take many shapes, ranging from an office gossip network to a group of friends exchanging letters electronically. Both types of information systems must be studied.

WHAT IS A COMPUTER-BASED INFORMATION SYSTEM? A **computer-based information system (CBIS)** is an information system that uses computer technology to perform some or all of its intended tasks. Such a system can include as little as a personal computer and software. Or it may include several thousand computers of various sizes with hundreds of printers, plotters, and other devices, as well as communication networks (wireline and wireless) and databases. In most cases an information system also includes people. The basic

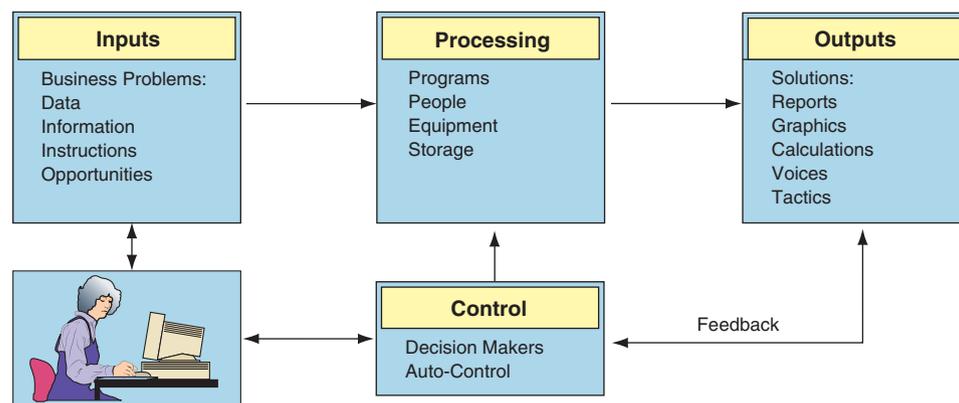


FIGURE 1.4 A schematic view of an information system.

1.3 INFORMATION SYSTEMS: DEFINITIONS AND EXAMPLES 21

components of information systems are listed below. Note that not every system includes all these components.

- *Hardware* is a set of devices such as processor, monitor, keyboard, and printer. Together, they accept data and information, process them, and display them.
- *Software* is a set of programs that instruct the hardware to process data.
- A *database* is a collection of related files, tables, relations, and so on, that stores data and the associations among them.
- A *network* is a connecting system that permits the sharing of resources by different computers. It can be wireless.
- *Procedures* are the set of instructions about how to combine the above components in order to process information and generate the desired output.
- *People* are those individuals who work with the system, interface with it, or use its output.

In addition, all information systems have a *purpose* and a *social context*. A typical purpose is to provide a solution to a business problem. In the Siemens case, for example, the purpose of the system was to coordinate internal units, to collaborate with the many suppliers and customers, and to improve costs and customer service. The social context of the system consists of the values and beliefs that determine what is admissible and possible within the culture of the people and groups involved.

THE DIFFERENCE BETWEEN COMPUTERS AND INFORMATION SYSTEMS.

Computers provide effective and efficient ways of processing data, and they are a necessary part of an information system. An IS, however, involves much more than just computers. The successful application of an IS requires an understanding of the business and its environment that is supported by the IS. For example, to build an IS that supports transactions executed on the New York Stock Exchange, it is necessary to understand the procedures related to buying and selling stocks, bonds, options, and so on, including irregular demands made on the system, as well as all related government regulations.

In learning about information systems, it is therefore not sufficient just to learn about computers. Computers are only one part of a complex system that must be designed, operated, and maintained. A public transportation system in a city provides an analogy. Buses are a necessary ingredient of the system, but more is needed. Designing the bus routes, bus stops, different schedules, and so on requires considerable understanding of customer demand, traffic patterns, city regulations, safety requirements, and the like. Computers, like buses, are only one component in a complex system.

WHAT IS INFORMATION TECHNOLOGY? Earlier in the chapter we broadly defined *information technology* as the collection of computer systems used by an organization. Information technology, in its narrow definition, refers to the technological side of an information system. It includes the hardware, software, databases, networks, and other electronic devices. It can be viewed as a subsystem of an information system. Sometimes, though, the term information technology is also used interchangeably with *information system*. In this book, we use the term *IT* in its broadest sense—to describe an organization's collection of information systems, their users, and the management that oversees them. The purpose of

this book is to acquaint you with all aspects of information systems/information technology.

Now that the basic terms have been defined, we present some examples of IS applications worldwide.

Examples of Information Systems

Millions of different information systems are in use throughout the world. The following examples are intended to show the diversity of applications and the benefits provided. At the end of each example, we list the *critical response activities* supported by the system.

As the examples in this section show, information systems are being used successfully in all functional areas of business. We provide here five examples, one for each of the major functional areas: accounting, production/operations management, marketing, human resource management, and finance. Beginning here, and continuing throughout this book, icons positioned in the margins will call out the functional areas to which our real-world examples apply. In addition we will point to IT applications in government and in other public services such as health care and education by using icons. Finally, you've already seen that other icons will identify global examples—IT used by non-U.S.-based companies or by any company with significant business outside the United States. For a key that identifies the icons, see the marginal note at left and the preface.



Managing Accounting Information Across Asia. Le Saunda Holding Company (Hong Kong) manages 32 subsidiaries in four Asian countries, mostly in the manufacture, import, and sale of shoes (*lesaunda.com.hk*). Managing the financing and cash flow is a complex process. All accounting information flows to headquarters electronically. Also, sales data are electronically collected at point-of-sale (POS) terminals. The sales data, together with inventory data (which are updated automatically when a sale occurs), are transferred to headquarters. Other relevant data, such as advertising and sales promotions, merchants, and cash flow, are also transmitted electronically and collected in a centralized database for storage and processing.

To cope with the rapid growth of the company, a sophisticated accounting software package was installed. The result was radical improvements in accounting procedures. For example, it now takes less than 10 minutes, rather than a day, to produce an ad-hoc complex report. The company's accountants can generate reports as they are needed, helping functional managers make quicker and better decisions. The system is also much more reliable, and internal and external auditing is easier. Headquarters knows what is going on almost as soon as it occurs. All these improvements have led to a substantial growth in revenue and profits for the firm. (*Source: lesaunda.com.hk*, press releases.)

Critical response activities supported: decision making, managing large amounts of information, improved quality, reduced cycle time, enhanced strategic competitiveness.

The Dallas Mavericks: Using IT for a Successful Play and Business. Mark Cuban, the owner of the Dallas Mavericks of the National Basketball Association (NBA), expects the franchise to play well and also to perform as a business. He wants to fill every seat at every game and to maximize sales from concessions and souvenir sales.

1.3 INFORMATION SYSTEMS: DEFINITIONS AND EXAMPLES  23

Cuban's strategy to reach his business goals is to give fans the best possible experience, with a high-quality team on the field and excellent service at arena bars, barbecue stands, and souvenir shops. In the 2002 season, the "Mavs" filled the 19,200-seat American Airlines Center to 103.7 percent capacity, bringing in folding chairs to handle the overflow demand for tickets. Dallas was named in 2003 the best NBA city by *The Sporting News*.

Filling seats is critical. To track attendance, the Mavs became the first NBA team to put barcodes on tickets and then scan them, in part to find out if group sales and community-organization giveaways were putting bodies in seats or just wasting tickets. The team's business managers have found other uses for the attendance information as well. By enabling improved attendance forecasting for particular games, for example, the system has helped reduce beverage inventories by 50 percent.

Each of the 144 luxury suites in the Center is equipped with PCs that handle orders for merchandise, food, and beverages. Wireless access from all seats in the arena is available so that fans can place orders directly from their seats. All 840 cash registers at concessions stands, restaurants, stores, and bars use a sophisticated point-of-sale system. In the big retail store on the ground floor, salespeople using hand-held computing devices ring up credit-card purchases when lines get too long. The system allows the Mavs to process credit-card transactions in only 3 seconds, because there is an always-on Internet connection to the processing facility. During a game, managers can see which concession stands are busy and which ones can be closed early to cut labor costs.

Technology also supports the Mavs on court. The team has 10 assistant coaches, and each has a laptop computer and a hand-held computing device. Game film is streamed over the Web for coaches to view on the road or at home. A digital content management system developed in-house matches game footage with the precise, to-the-minute statistics provided for every play of every game by the NBA. The searchable database allows coaches to analyze the effectiveness of particular plays and combinations of players in different game situations.

In 2002, the Mavs started using hand-held computers to track the performance of each referee in every one of their games. The coaches can look at trends—for example, to see which referee favors a given team or which one calls more 3-second violations—and they can tell the team's players. Another program logs different offensive and defensive schemes used against the Mavs. This system will let coaches make real-time adjustments in statistics from previous games. (Source: Cone, 2003.)

Critical response activities supported: Decision making, increased sales, improved customer service, improved inventory management, better utilization of capacity.

The Success Story of Campusfood.com. Campusfood.com's recipe for success was a simple one: Provide interactive menus to college students, using the power of the Internet to enhance traditional telephone ordering of meals. Launched at the University of Pennsylvania, the company has taken thousands of orders for local restaurants, bringing pizza, hoagies, and wings to the Penn community.

Founder Michael Saunders began developing the site in 1997, while he was a junior at Penn, and with the help of some classmates, launched the site in 1998. After graduation, Saunders began building the company's customer base.



This involved registering other schools, attracting students, and generating a list of local restaurants from which students could order food to be delivered. Currently, this activity is outsourced to a marketing firm, and schools nationwide are being added to the list. By 2003 there were more than 200 participating schools and more than 1,000 participating restaurants.

Financed through private investors, friends, and family members, the site was built on an investment of less than \$1 million. (For comparison, another company, with services also reaching the college-student market, has investments of \$100 million.) Campusfood.com's revenue is generated through transaction fees; the site takes a 5 percent commission on each order.

When you visit *Campusfood.com*, you can do the following: Search a list of local restaurants, their hours of operation, addresses, phone numbers, and other information. Browse an interactive menu, which shows each participating restaurant's standard print menus, including the latest prices and a listing of every topping, every special, and every drink offered. Bypass busy-signals and place an order without being placed on hold, and avoid miscommunications. Get access to more specials, including discounts and meal deals available online exclusively to Campusfood.com customers. Have access to electronic payment capabilities and your own account record ("My Account"). (Source: Prince, 2002 and *campusfood.com*.)

Critical response activities supported: customer service, improved cycle time, and innovative marketing method.



State-of-the-Art Human Resources Management in China. International Information Products Company LTD (IIPC) produces IBM personal computers (PCs) in Shenzhen, China. The company is one of China's top-10 exporters and one of the world's most efficient manufacturers of IBM PCs. The company's success is attributed, in part, to its world-class Human Resources Information System (powered by PeopleSoft's HRMS). In operation since October 2001, the system includes these basic elements: employee record management, recruitment, variable pay analysis, performance appraisal, payroll, and management of fringe benefits and absence records. In addition, employees can self-manage their personal data and report leaves and absences on the intranet. Using e-kiosks placed in several locations within the plant (e.g., the cafeteria), employees who do not have Internet access at work or home can use the system as well.

China's employee tax and benefits systems (e.g., health care and social insurance) are very complex, requiring many computations. Using HRMS and its Global Payroll component, IIPC was able to reduce the payroll cycle from 11 days to 4 days, and to reduce the computation run time from 6 hours to 2 hours, while eliminating errors. The system automates labor-intensive HR processes such as workforce administration, enabling HR staff to concentrate on staffing, training, career planning, rewards and promotions, and other nonclerical HR services. Furthermore, the data collected in the system are used by top management for supporting strategic decisions. (Source: Smith, 2002.)

Critical response activities supported: improved cycle time, improved dissemination of information, automated clerical tasks, use by employees for self-service.



Mobile Banking at Handelsbanken of Sweden. Handelsbanken of Sweden is the largest bank in Scandinavia, where more than 80 percent of the population over 15 years old carry mobile phones. Operating in a very competitive banking



environment, the bank is trying to meet customers' expectations of using their mobile phones to organize their personal and working lives while on the move. Mobile banking services, including stock trading, was an opportunity for the bank to gain a competitive edge, and so the bank become the world's first to have mobile banking applications.

An interactive service allows customers to access up-to-the-minute banking information, including the latest stock market and interest rate data, whenever and wherever they like. Handelsbanken's e-banking has become so popular that it is used by tens of thousands of customers. It opens up critical business and personal information to safe and easy access from mobile devices. Both the bank's financial advisors and its customers can access general and personalized stock market and account information, transfer money, request loans, buy and sell stocks and bonds, and pay bills. This move into mobile banking is a key first step in a strategy to exploit the potential of e-business, while also extending the bank's brand reach. (*Sources:* Compiled from IBM's case study: Handelsbanken at www-3.ibm.com/e-business/doc/content/casestudy/35433.html, accessed March 2003, and from press releases at handelsbanken.com.)

Critical response activities supported: improved customer service, innovative strategic marketing methods, competitive advantage.



In addition to functional areas, we can classify applications by the industry in which they are used. For example, retailing, financial services, education, health care, social services, and government are heavy users. An example of a government service is provided in Online Minicase W1.2.

Information Systems Failures

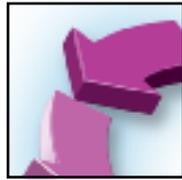


Use of this icon indicates a description of an IT failure, and discussion of the lessons that can be learned from it.

So far we have introduced you to many success stories. You may wonder, though, is IT always successful? The answer is, "Absolutely not." There are many failures. We will show you some of these (marked with a "lessons from failures" icon) in this book, and in some cases we present them on our Web site. (See, for example, the 2000 U.S. Presidential Election Case in Online File W1.8 at the Web site.) We can learn from failures as much as we can learn from successes, as illustrated in *IT at Work 1.2* (page 26).

As mentioned earlier, one area of failure is that of the dot-coms. As will be seen in Chapter 4, hundreds of dot-coms folded in 2000 and 2001. It was a shakeout that resulted from a rush to capitalize on e-commerce (see Kaplan, 2002). In addition there were many failures of Internet projects in established companies. (For example, the Go.com project of Walt Disney Company was supposed to manage all the Web sites owned by Disney and generate money from advertisers at the sites. Unfortunately, the income generated from advertising was not sufficient to keep the site going.) Like the gold rush and the rush to create companies when the automobile was invented, only a relatively few made it. The rest failed. According to Barva et al. (2001), the reason for EC failures is that many of the models used were too narrow. In place of these models, they offer an e-business value model, which we describe in Chapter 4.

Another reason for failure is that it is hard to predict the future. It is especially hard to predict the future in the field of information technology, which is evolving and continuously changing, as shown next.



IT at Work 1.2

HOW NIKE'S \$400 MILLION SUPPLY CHAIN MANAGEMENT SOFTWARE SYSTEM FAILED



In certain retail stores, fans of Nike's Air Terra Humara 2 running shoe have hit the jackpot. Once selling for over \$100 US, they were selling for less than \$50 in fall 2001. The cheaper shoes were the aftermath of the breakdown in Nike's supply chain, a breakdown attributed to a software problem.

Nike had installed a \$400 million supply chain system in early 2001. The system was supposed to forecast sales demand and plan supplies of raw materials and finished products accordingly. However, the newly deployed demand and supply planning application apparently overestimated the demand for certain shoes in some locations and underestimated demand in others. As a result, some raw materials were overpurchased, while inventory levels of other materials were insufficient. Some shoes were overmanufactured, while the most-demanded ones were undermanufactured. To speed the right shoes to market, Nike had to spend around \$5 a pair in air freight cost, compared to the usual cost of 75 cents by ocean shipping. In all, Nike attributed some \$100 million in lost sales in the third quarter of 2001 alone to this problem.

What went wrong? The system was developed with software from i2, a major software producer. However, Nike insisted on modifying the i2 standard software, customizing it to its needs. Specifically, Nike wanted a forecast by style, by color, and by size (several thousand combinations). This resulted in a need to make thousands of forecasts, very rapidly, to quickly respond to changing market

conditions and consumer preferences. To meet Nike's need it was necessary to customize the standard software, and to do so quickly because Nike wanted the system fast. The reprogramming was apparently done *too* fast. The software had bugs in it when it was deployed. Almost any new software contains bugs that need to be fixed; appropriate testing is critical, and it is a time-consuming task (see Murphy, 2003). Nike and i2 failed to recognize what was achievable.

Customizing standard software requires a step-by-step systematic process (see Chapter 14). It should be done only when it is absolutely necessary, and it must be planned for properly. Furthermore, Nike could have discovered the problem early enough if they had used appropriate deployment procedures (see Chapter 14).

To avoid disasters such as the one Nike experienced, companies must fully understand what they are trying to achieve and why. They must use performance-level indicators to properly measure the system during testing. Incidentally, Nike fixed the problem after spending an undisclosed amount of time and money in 2002.

Sources: Compiled from Sterlicchi and Wales (2001) and from *nike.com* press releases, 2002, 2003.

For Further Exploration: Why did Nike need the detailed forecasting? How can a company determine if it really needs to customize software? Whose responsibility is it to test and deploy the software: the software vendor's or the user's?

1.4 INFORMATION TECHNOLOGY DEVELOPMENTS AND TRENDS

In the previous sections, we described the role of IT in supporting business activities. We also pointed out (in Table 1.1) some of the capabilities that enable IT to play a support role. Next we will describe some of IT's developments and trends, and especially the move toward Web-based computing, wireless applications, and intelligent systems.

First imagine this scenario: It's a Monday morning in the year 2008. Executive Joanne Smith gets into her car, and her voice activates a wireless telecommunications-access workstation. She requests that all voice and mail messages open and pending, as well as her schedule for the day, be transmitted to her car. The office workstation consolidates these items from home and office databases. The message-ordering "knowbot" (knowledge robot), which is an enhanced e-mail messaging system, delivers the accumulated messages (in the order she prefers) to the voice and data wireless device in Joanne's car. By the time

1.4 INFORMATION TECHNOLOGY DEVELOPMENTS AND TRENDS  27

Joanne gets to the office, she has heard the necessary messages, sent some replies, revised her day's schedule, and completed a to-do list for the week, all of which have been filed in her virtual database by her personal organizer knowbot. She has also accessed the Internet by voice and checked the traffic conditions, stock prices, and top news stories.

The virtual organizer and the company intranet have made Joanne's use of IT much easier. No longer does she have to be concerned about the physical location of data. She is working on a large proposal for the Acme Corporation today; and although segments of the Acme file physically exist on several databases, she can access the data from her *wireless workstation* wherever she happens to be. To help manage this information resource, Joanne uses an *information visualizer* that enables her to create and manage dynamic relationships among data collections. This information visualizer has extended the graphical user interface to a three-dimensional graphic structure.

Joanne could do even more work if her car were able to drive itself and if it were able to find an empty parking space on its own. Although this kind of car is still in an experimental stage, it will probably be in commercial use before 2015 due to developments in pervasive computing (see Chapter 5).

It may be possible for parts of this year-2008 scenario to become a reality even sooner, owing to important trends in information technology. For example, voice access to the Internet is already becoming popular (e.g., see *tellme.com* and *bevocal.com*). These trends, which are listed in Table 1.2 (page 28), fall into two categories: general and networked computing. Here we describe only *selected* items from Table 1.2. The rest are described in Chapter 2 and in the Technology Guides on the book's Web site.

Six Technology Guides at the book's Web site provide up-to-date presentations on hardware, software, databases, telecommunications, and the Internet.



General Technological Trends

General trends are relevant to any computing system. Two representative examples are discussed below. Additional trends are presented in Chapter 2 and in the online Technology Guides.

COST-PERFORMANCE RATIO OF CHIPS: IMPROVEMENT BY A FACTOR OF AT LEAST 100. In about 10 years, a computer will cost the same as it costs today but will be about 50 times more powerful (in terms of processing speed, memory, and so on). At the same time labor costs could double, so the cost-performance ratio of computers versus manual work will improve by a factor of 100. This means that computers will have increasingly greater *comparative advantage* over people in performing certain types of work. This phenomenon is based on a prediction made in 1965 by Gordon Moore, the co-founder of Intel. Popularly called **Moore's Law**, this prediction was that the processing power of silicon chips would double every 18 months. And so it has, resulting in enormous increases in computer processing capacity and a sharp decline in cost (see Chapter 13).

Moore's Law applies to electronic chips. An extension of Moore's Law, according to McGarvey (2000) and *tenornetworks.com*, states that the performance of optical communication networks (see Technology Guide 4) is growing by a factor of 10 every three years. For example, according to Donofrio (2001), IBM is working on a supercomputer that will run at a petaflop (10^{15}) operations per second—which is 500 times faster than the fastest supercomputer of 2002. Such a computer will tackle brain-related diseases (such as Alzheimer's and stroke). It is expected to reach a speed of 20 to 30 petaflops in 2010.

TABLE 1.2 Major Technological Developments and Trends*General Developments and Trends*

- The cost-performance advantage of computers over manual labor will increase.
- Graphical and other user-friendly interfaces will dominate PCs.
- Storage capacity will increase dramatically.
- Data warehouses will store ever-increasing amounts of information.
- Multimedia use, including virtual reality, will increase significantly.
- Intelligent systems, especially artificial neural computing and expert systems, will increase in importance and be embedded in other systems.
- The use of intelligent agents will make computers “smarter.”
- There is a push for open architecture (e.g., the use of Web Services and Linux).
- Object-oriented programming and document management will be widely accepted.
- Artificial intelligence systems are moving to learning-management systems.
- Computers will be increasingly compact, and more portable.
- There is proliferation of embedded technologies (especially intelligent ones).
- The use of plug-and-play software will increase.

Networked Computing Developments and Trends

- Optical computing will increase network capacity and speed, facilitating the use of the Internet.
- Storage networks will become popular.
- Mobile and wireless applications will become a major component of IT.
- Home computing will be integrated with the telephone, television, and other electronic services to create smart appliances.
- The use of the Internet will grow, and it will change the way we live, work, and learn.
- Corporate portals will connect companies with their employees, business partners, and the public.
- Intranets will be the dominating network systems in most organizations.
- E-commerce over the Internet will grow rapidly, changing the manner in which business is conducted.
- Intelligent software agents will roam through databases and networks, conducting time-consuming tasks for their masters.
- Interpersonal transmission will grow (one-to-one, one-to-many, many-to-many).
- More transactions among organizations will be conducted electronically, in what is called business-to-business (B2B) commerce.
- Networks and intelligent systems will be major contributors toward improved national security and counter-terrorism efforts.
- RFID (radio frequency identification) will change supply chains and retailing.

STORAGE. Whereas Moore’s Law expresses computing speed, improvements in storage contribute to the cost-performance ratio in a similar way. Large storage capabilities are essential for advanced applications. There are several new devices and methods to increase storage (see Technology Guide 3). Of special interest are memory sticks that in 2004 were capable of storing 150 gigabytes in a device the size of a credit card.

OBJECT-ORIENTED ENVIRONMENT, COMPONENTS, AND WEB SERVICES. An *object-oriented environment* is an innovative way of programming and using computers that is significantly reducing the costs of building and maintaining information systems. **Object technology** enables the development of self-contained units of software that can be shared, purchased, and/or reused. This technology enables developers to assemble information systems rather than building them from scratch. This is a faster and cheaper process. This environment

1.4 INFORMATION TECHNOLOGY DEVELOPMENTS AND TRENDS  29

includes object-oriented programming, databases, and operating systems (Elrad et al., 2001). Object technology applications include component-based development and Web Services, both of which are based in part on object-oriented technology (described in Chapter 14 and Technology Guide 6).

SELF-HEALING COMPUTERS. IBM Corp. is developing computers, called *self-healing computers*, that can take of themselves. The first such computer (named eLiza), a supercomputer at the National Center for Atmosphere Research, was installed at Blue Sky. With 2 trillion calculations per second, this computer (which, incidentally, is the world's most powerful) has the ability to repair itself and keep running without human intervention. For details see Van (2003).

QUANTUM COMPUTING. Researchers are looking into using the basic quantum states of matter as a fundamental unit of computing. If successful, quantum computers will be hundreds of times faster than today's fastest supercomputers.

NANOTECHNOLOGY. Sometime in the future there will be superfast molecular computers. Built on a crystalline structure, these still-experimental computers will be very tiny so they could be woven into our clothing. They will require very little power, yet they will have huge storage capacities and be immune to computer viruses, crashes, and other glitches.

Networked and Distributed Computing

The technology of networked and distributed computing enables users to reach other users and to access databases anywhere in the organization and in any other place, using intranets and the Internet. The networks' power stems from what is called **Metcalfe's Law**. Robert Metcalfe, a pioneer of computer networks, claimed that the value of a network grows roughly in line with the square of the number of its users (or nodes). Thus, if you increase the number of users, say from 2 to 10, the network's value will change from 2^2 (4) to 10^2 (100), or 25 times more. With 350 million Internet users, the value is $(350 \text{ million})^2$, an astronomical number.

Kelly (1999), in what is called *Kelly's Extension* of Metcalfe's Law, claims that the value of the Internet is actually much larger. The reason is that Metcalfe's Law of n^2 is based on the idea of the telephone network, where the connections are point-to-point. On the Internet we can make multiple simultaneous connections between groups of people. So, claims Kelly, the potential value of the Internet is n^n , which is obviously a much larger number.

Network-based technologies are some of the most exciting IT developments, which we will discuss throughout the text. Here we provide an overview of some representative network-based technologies.

THE INTERNET AND THE WEB. From about 50 million Internet users in 1997, there could be as many as 1.46 billion by 2007 (*Computer Industry Almanac*, 2004). The wireless devices that access the Internet and the integration of television and computers will allow the Internet to reach every home, business, school, and other organization. Then the **information superhighway** will be complete. This is a national fiber-optic-based network and wireless infrastructure that will connect all Internet users in a country, and will change the manner in which we live, learn, and work. Singapore is likely to be the first country to have such a national information superhighway completely installed. Maui, Hawaii, is the first community in the United States to have a wireless Internet all over the island.

INTRANETS AND EXTRANETS. Just as use of the Internet is becoming common, so too is the use of *intranets* (“internal networks”) that connect the computing devices within individual organizations. As the intranet concept spreads and the supporting hardware and software are standardized, it is logical to assume that most organizations will use an intranet for internal communication. In addition, combining an intranet with the Internet, in what is called an *extranet*, creates powerful interorganizational systems (Chapter 8) for communication and collaboration.

MOBILE COMPUTING AND M-COMMERCE. **M-commerce (mobile commerce)** refers to the conduct of e-commerce via wireless devices. It is the commercial application of **mobile computing**, which is computing using *mobile devices* and done primarily by *wireless networks* (see Chapter 5). There is a strong interest in the topic of mobile commerce because according to industry research firms, the number of mobile commerce users will grow from about 95 million in 2003 to about 1.7 billion by 2008. In addition, revenues from mobile commerce are expected to grow globally from nearly \$7 billion in 2003 to over \$554 billion in 2008 (*cellular.co.za*, 2004). Furthermore, these devices can be connected to the Internet, enabling transactions to be made from anywhere and enabling many applications (see Sadeh, 2002 and *A Closer Look 1.2*). For example, m-commerce can offer customers the location information of anything they want to purchase. This is a useful feature for customers, but it is even more important for merchants because it enables customers to act instantly on any shopping impulse. This wireless application is referred to as *location-based commerce*, or **l-commerce**. (For details, see Chapter 5.)

PERVASIVE COMPUTING. Strongly associated with m-commerce and wireless networks is **pervasive computing**, in which computation becomes part of the environment. The computer devices (personal computer, personal digital assistant, game player) through which we now relate to computation will occupy only a small niche in this new computational world. Our relationship to pervasive computing will differ radically from our current relationship with computers. In pervasive computing, computation will be embodied in many things, not in what we now know as computers (e.g., RFID).

RFID. *Radio frequency identification* uses tiny tags that contain a processor and an antenna and can communicate with a detecting unit. (See Chapter 5 for details.) With their declining cost, RFIDs will have many applications, one of which is supply chain improvement and inventory control (see Minicase 2 at the end of this chapter).

We can already put computation almost anywhere. Embedded computation controls braking and acceleration in our cars, defines the capability of medical instruments, and runs virtually all machinery. Hand-held devices (especially cell phones and pagers) are commonplace; useful computational wristwatches and other wearables are becoming practical; computational furniture, clothes, and rooms are in the demonstration stage. Soon, **smart appliances**, which are home appliances that are connected to the Internet and among themselves for increased capabilities, will be integrated and managed in one unit. (See Chapter 5 for further discussion.)

At present, most large-scale applications of pervasive computing, such as intelligent cities, hospitals, or factories, are still under development. However,



A CLOSER LOOK

1.2 MOBILE AND WIRELESS APPLICATIONS: A SAMPLER

Mobile computing supports existing and entirely new kinds of applications. For example, each of the following can be done from any place, at any time.

- **Mobile personal communications capabilities.** such as personal digital assistants (PDAs) and cell phones for networked communications and applications.
- **Online transaction processing.** For example, a salesperson in a retail environment can enter an order for goods and also charge a customer's credit card to complete the transaction.
- **Remote database queries.** For example, a salesperson can use a mobile network connection to check an item's availability or the status of an order, directly from the customer's site or on the road.
- **Dispatching,** like air traffic control, rental car pickup and return, delivery vehicles, trains, taxis, cars, and trucks.
- **Front-line IT applications.** Instead of the same data being entered multiple times as they go through the value chain (the series of business activities that add value to a company's product or service), they are entered only once at any time and place and transmitted electronically thereafter.
- **M-commerce.** Users of wireless devices can access the Internet, conduct information searches, collaborate with others and make decisions jointly, and buy and sell from anywhere.

Wireless communications support both mobile computing applications and low-cost substitutions for communication cables. For example:

- Temporary offices can be set up quickly and inexpensively by using wireless network connections.
- Wireless connections to permanent office locations are often practical in difficult or hazardous wiring environments.
- Installing a wireless connection can replace leased lines that are used to connect local area networks (LANs), thus eliminating the costs of monthly line leases.

There are mobile and wireless application opportunities in many industries, such as:

- **Retail.** Retail applications have been very successful to date, particularly in department stores where there

are frequent changes of layout. Also, retail sales personnel can conduct inventory inquiries or even sales transactions on the retail floor with wireless access from their PCs or cell phones. Radio-frequency devices are helping retailers in inventory and security management.

- **Wholesale/distribution.** Wireless networking is used for inventory picking in warehouses with PCs mounted on forklifts, and for delivery and order status updates with mobile PCs inside distribution trucks.
- **Field service/sales.** Mobile computing can be used for dispatching, online diagnostic support from customer sites, and parts-ordering/inventory queries in all types of service and sales functions.
- **Factories/manufacturing.** Environments and applications include mobile shop-floor quality control systems or wireless applications that give added flexibility for temporary setups.
- **Health care/hospitals.** Health care personnel can access and send data to patient records, or consult comparative diagnosis databases, wherever the patient or the health care worker may be located.
- **Education.** Pilot applications equip students with PCs in lecture halls, linked by a wireless network, for interactive quizzes, additional data and graphics lecture support, and online handout materials. (See Minicase 1 at the end of the chapter and Chapter 5.)
- **Finance.** Mobile transactional capabilities can assist in purchasing, selling, inquiry, brokerage, and other dealings, using wireless devices.
- **Banking.** Mobile personal, programmable communications devices (e.g., hand-held computers such as PDAs) are effective for authorizing and managing payment and banking transactions.
- **Entertainment.** New technologies, such as GPRS, accelerate the quality of the end-user experience of mobile entertainment services. With the improvement of ringtone quality (from monophonic to polyphonic) and the development of streaming audio, mobile music creates immense revenues for operators and content providers. Through third-generation networks and improved multimedia, mobile video offers a widely touted capability that will enrich the mobile entertainment experience immeasurably.

smaller-scale applications, such as the “intelligent restaurant” described in *IT at Work 1.3*, are already in place.

CORPORATE PORTALS. A **corporate portal** refers to a company’s Web site that is used as a *gateway* to the corporate data, information, and knowledge. Corporate portals may be used both by employees and by outsiders, such as customers or suppliers. (Employees have a password that allows them to access data through the portal that are not available to the public.) A variety of corporate portals provide a wide range of functionalities (see Chapter 3 for details).

THE NETWORKED ENTERPRISE. The various components and technologies just described can be integrated together into an *enterprisewide network* that is a seamless system, extending the corporate contacts to all entities a company does business with. The networked enterprise provides two primary benefits: First, by creating new types of services, businesses can engage customers in a direct interactive relationship that results in customers getting precisely what they want when they want it, resulting in stronger customer relationships and better relationships with suppliers and other business partners. Second, by taking the entire product design process online—drawing partners and customers into the process and removing the traditional communication barriers that prevent rapid product design and creation—companies can bring products and services to market far more quickly.

The networked enterprise is shown schematically in Online File W1.9 at the book’s Web site. As a result of the technology pressures discussed earlier, companies that implement standards-based intranets can quickly create or join extranets, as we discuss in Chapters 4 and 8.

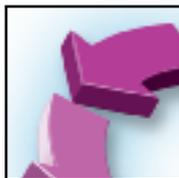


THE NETWORK COMPUTER. In 1997, the *network computer* was introduced. This computer does not have a hard drive. Instead, it is served by a central computing station. At a “dumb” (passive) terminal, it temporarily receives and can use applications and data stored elsewhere on the network. Also called “thin clients,” network computers are designed to provide the benefits of desktop computing without the high cost of PCs. Prices of network computers are getting close to \$200. A variation of the thin client is the **Simputer** or “simple computer” (see *simputer.org*).

OPTICAL NETWORKS. A major revolution in network technology is *optical networks*. These are high-capacity telecommunication networks that convert signals in the network to colors of light and transmit these over fiber-optic filaments. Optical networks are useful in Internet, video, multimedia interaction, and advanced digital services. (For more, see Technology Guide 4.)

STORAGE NETWORKS. **Network storage devices** are attached to the corporate network (usually intranets) and can be accessed from network applications throughout the enterprise. Their benefits are optimal data sharing, simplicity, scalability (ability to adapt to increased demands), and manageability. Online storage is also available from independent vendors.

Rather than handling their own server computers, many corporations are relying on outside outfits to manage their technology at remote data centers, which pipe data to their premises via the Web. Ferelli (2004) discusses the issue of



IT at Work 1.3

PERVASIVE COMPUTING AT ROYAL MILE PUB



All of us are familiar with the service at restaurants, and most of us have encountered inconvenient scenarios such as long waits, cold food, or even service of a wrong order. These inconveniences are the result of a conventional process that works like this: A server takes your drink order and then walks to the bar to place the order. She or he knows that after approximately five minutes your drink will be ready, so in the meantime the server takes an order from someone else and then heads back to the bar. If your order is not ready, the server comes to your table, apologizes for the delay, and takes your food order. That order is written on a piece of paper, which the server carries to the kitchen and places on a revolving wheel, which the chef rotates into view when he or she is ready to begin preparing the next order. At that point, the server may find that the kitchen is out of this selection, so he or she comes to your table and asks you to reorder. Sometimes, the server makes a mistake in writing your order, or the chef reads the handwritten order incorrectly. In such a case, after a long wait, the customer is frustrated at getting the wrong food.

The situation is different at Royal Mile Pub (Silver Springs, Maryland), thanks to pervasive computing. The Royal Mile is a medium-size restaurant (about 20 tables), with a bar that specializes in a wide selection of beverages. But what is really different about the Royal Mile is that the servers' green order pads have been replaced with iPaq PDAs connected to the kitchen using wireless networking.

The new system works as follows: The server uses a special PDA to take the orders. Most menu items are visible on the PDA, which also has handwriting capabilities for writing in special instructions. To take drink or food orders requires only one or two keystrokes. The server glances at the screen to verify that the correct item has appeared. Experienced servers can be trained in about 15 minutes on how to use the devices.

The Wi-Fi (wireless fidelity) system, which is a local area network, transmits the orders within the range of the restaurant (described further in Chapter 5). The orders appear immediately on screens in the kitchen and bar. After transmitting an order, the server can move to the next table rather than hurrying off to hand the orders to the cooks or bartenders.

The system is liked by all. Servers can spend more time with each customer and handle more tables because they make half as many trips out of the serving area. The PDA

interface tells servers which menu items are unavailable; getting that information immediately to the customers reduces servers' trips to the kitchen, thus eliminating another source of customer and server dissatisfaction. Because the kitchen becomes aware of orders immediately, the food arrives more quickly. The system also totals each bill, eliminating arithmetic errors.

The owner is very positive about the system's effects on his business. The order system costs about \$30,000 to install. Its benefits include fewer errors, better inventory control, and smaller payrolls. As orders transmit, they are processed against the inventory database, allowing kitchen managers to track raw material purchases against the food orders and identify waste or other delivery and processing problems. Integration with the enterprise database and inventory control systems is fundamental to realizing cost reductions, improved workflow, and inventory and personnel management. The pervasive order system has reduced the error rate from several wrong meals per night to about one every two nights. Improvements occur not only in wasted (and replacement) meals, but also in customer satisfaction. In addition, now only three food servers are needed, meaning lasting cost reductions and lower overhead. Also, three data-entry stations on the serving floor for processing credit card charges were reduced to one, freeing up space on the serving floor.

Sources: Compiled from Stanford (2003), and *royalmilepub.com* (accessed March 2003).

For Further Exploration: Why would customers appreciate this pervasive computing system? What strategic advantage is generated? If such a system is beneficial to all, why have not all restaurants adopted it? Why is it classified as pervasive computing?



PPT 8800 from Symbol Technologies, another type of personal digital assistant, used for the same purpose as an iPaq PDA.

34  **CHAPTER 1** STRATEGIC USE OF INFORMATION TECHNOLOGY IN THE DIGITAL ECONOMY

security in storage networks, as well as major benefits and implementation issues. Data centers are operated by a third party, such as application service providers (ASPs) (see Chapters 13 and 14). Major software vendors including IBM and SAP are in this business. For details on storage networks, see Technology Guide 3.

WEB SERVICES. By using universal prefabricated business process software, called **Web Services**, computer users will soon be able to integrate applications, business processes, databases, and more into all kinds of applications, and do so rapidly and inexpensively. By using agreed-upon protocols and standards for the Web Services, developers can create a truly open computing environment independent of any vendor or product. Web Services will impact e-business application development, application integration, and application access. See Chapters 2, 3, 4, and 14 for details. Also see Clark et al. (2002).

All of these developments and prospects will increase the importance of IT both at home and at work. Therefore, it is obvious that to function effectively in the digital era, it makes sense to learn about IT.

1.5 WHY SHOULD YOU LEARN ABOUT INFORMATION TECHNOLOGY?

The field of IT is growing rapidly, especially with the introduction of the Internet and e-commerce, so the organizational impacts keep increasing. We are becoming more and more dependent on information systems. For example, on March 1, 2003, a computer glitch disturbed hundreds of flights in Japan.

In this part of the chapter we describe some specific benefits you can derive from studying IT.

Benefits from Studying IT

A major role of IT is being a *facilitator* of organizational activities and processes. That role will become more important as time passes. Therefore, it is necessary that every manager and professional staff member learn about IT not only in his or her specialized field, but also in the entire organization and in interorganizational settings as well.

Obviously, you will be more effective in your chosen career if you understand how successful information systems are built, used, and managed. You also will be more effective if you know how to recognize and avoid unsuccessful systems and failures. Also, in many ways, having a comfort level with information technology will enable you, off the job and in your private life, to take advantage of new IT products and systems as they are developed. (Wouldn't you rather be the one explaining to friends how some new product works, than the one asking about it? For help in that role, by the way, see *howthingswork.com*.) Finally, you should learn about IT because being knowledgeable about information technology can also increase employment opportunities. Even though computerization eliminates some jobs, it also creates many more.

The demand for traditional information technology staff—such as programmers, systems analysts, and designers—is substantial. In addition, many well-paid opportunities are appearing in emerging areas such as the Internet and e-commerce, m-commerce, network security, object-oriented programming, telecommunications, multimedia design, and document management. (See Online File W1.10 at the book's Web site for a listing of jobs in e-commerce.) According to a study by the U.S. Bureau of Labor Statistics, each of the top seven



fastest-growing occupations projected through 2010 fall within an IT- or computer-related field. These top seven occupations are (Pollock, 2003):

1. Computer software applications engineers
2. Computer support specialists
3. Computer software systems engineers
4. Network and computer systems administrators
5. Network systems and data communications analysts
6. Desktop publishers
7. Database administrators

At about \$60,000 per year, workers in the software and information services industries were the highest-paid U.S. wage earners in 2000, about twice that of the average worker in the private sector. Furthermore, earnings of IT employees were growing twice as fast as those in the entire private sector. Thus, salaries for IT employees are generally high.

To exploit the high-paying opportunities in IT, a college degree in any of the following fields, or combination of them, is advisable: computer science, computer information systems (CIS), management information systems (MIS), electronic commerce, and e-business. Within the last few years, many universities have started e-commerce or e-business degrees (e.g., see *is.cityu.edu.hk* and *cgu.edu*). Many schools offer graduate degrees with specialization in information technology.

Majoring in an IT-related field can be very rewarding. For example, students graduating with baccalaureate degrees in MIS usually earn the highest starting salaries of all undergraduate business majors (more than \$45,000 per year). MBAs with experience in Web technologies and e-commerce are getting starting salaries of over \$100,000/year, plus bonuses. Many students prefer a double major, one of which is MIS. Similarly, MBAs with an undergraduate degree in computer science have little difficulty getting well-paying jobs, even during recessionary times. Many MBA students select IS as a major, a second major, or an area of specialization. In addition, nondegree programs are also available on hundreds of topics. For details about careers in IT, see *techjourney.com* and also "Career resources" and "Technology careers" at *wageweb.com*.

Finally, another benefit from studying IT is that it may contribute to future organizational leadership. In the past, most CEOs came from the areas of finance and marketing. Lately, however, we see a trend to appoint CEOs who have strong IT knowledge and who emerge from the technology area.

1.6 PLAN OF THE BOOK

A major objective of this book is to demonstrate how IT in general and Web systems in particular support different organizational activities. In addition, we will illustrate the role that networked computing plays in our society today and will play tomorrow. Furthermore, we describe how information systems should be developed, maintained, and managed.

The book is divided into six parts. Figure 1.5 (page 36) shows how the chapters are positioned in each part and how the parts are connected. Notice that in the center of the figure are the six Technology Guides. These guides can be found on the book's Web site (*wiley.com/college/turban*).

36 CHAPTER 1 STRATEGIC USE OF INFORMATION TECHNOLOGY IN THE DIGITAL ECONOMY

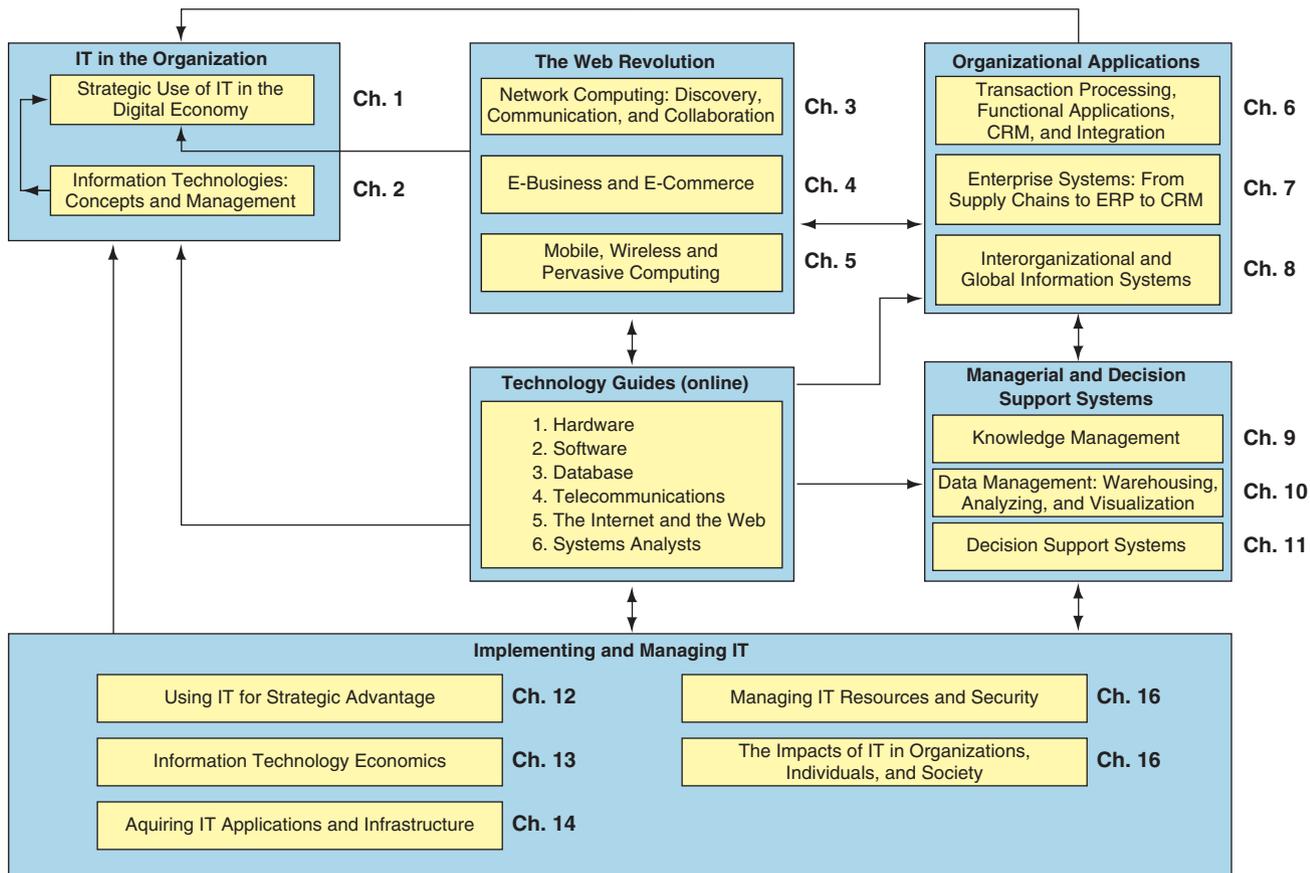


FIGURE 1.5 Plan of the book.

MANAGERIAL ISSUES

At the end of every chapter, you will find a list of some of the special concerns managers face as they adapt technology to their organization's needs.

- 1. Recognizing opportunities for using IT and Web-based systems for strategic advantage.** These opportunities are highlighted and discussed in most chapters of the book, but especially in Chapters 3, 4, 5, 6, 7, and 13.
- 2. Who will build, operate, and maintain the information systems?** This is a critical issue because management wants to minimize the cost of IT while maximizing its benefits. Some alternatives are to outsource portions, or even all, of the IT activities, and to divide the remaining work between the IS department and the end users. Details are provided in Chapters 13 through 15 and in Technology Guide 6.
- 3. How much IT?** This is a critical issue related to IT planning. IT does not come free, but *not* having it may be much costlier. Chapters 12 and 13 deal with this issue.
- 4. How important is IT?** In some cases, IT is the only approach that can help organizations. As time passes, the *comparative advantage* of IT increases.
- 5. Is the situation going to change?** Yes, the pressures will be stronger as time passes. Therefore, the IT role will be even more important.



6. Globalization. Global competition will have an impact on many companies. However, globalization opens many opportunities, ranging from selling and buying products and services online in foreign markets, to conducting joint ventures or investing in them. IT supports communications, collaboration, and discovery of information regarding all the above (Chapter 8).



7. Ethics and social issues. The implementation of IT involves many ethical and social issues that are constantly changing due to new developments in technologies and environments. These topics should be examined any time an IT project is undertaken. Appendix 1A at the end of this chapter presents an introduction to ethics. Ethical issues are highlighted in most chapters throughout the book.

8. Transforming the organization to the digital economy. The transformation can be done on several fronts, as Siemens AG did. Management should study the opportunities, consider alternatives, and prioritize them. A prime area to start with is e-procurement (Chapters 4 and 7).

KEY TERMS

Build-to-order <i>xx</i>	E-business <i>xx</i>	Metcalf's Law <i>xx</i>
Business model <i>xx</i>	Electronic commerce (EC) <i>xx</i>	M-commerce <i>xx</i>
Business pressures <i>xx</i>	Ethics <i>xx</i>	Mobile computing <i>xx</i>
Business process reengineering (BPR) <i>xx</i>	Extranet <i>xx</i>	Moore's Law <i>xx</i>
Computer-based information system (CBIS) <i>xx</i>	Information superhighway <i>xx</i>	Network storage device <i>xx</i>
Corporate portal <i>xx</i>	Information system (IS) <i>xx</i>	Networked computing <i>xx</i>
Critical response activities <i>xx</i>	Information technology (IT) <i>xx</i>	Object technology <i>xx</i>
Customer relationship management (CRM) <i>xx</i>	Internet <i>xx</i>	Pervasive computing <i>xx</i>
Digital economy <i>xx</i>	Intranet <i>xx</i>	Simputer <i>xx</i>
	L-commerce <i>xx</i>	Smart appliances <i>xx</i>
	Mass customization <i>xx</i>	Virtual corporation <i>xx</i>
		Web Services <i>xx</i>

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- The world is moving to a digital economy, which can be viewed as a major economic, societal, and organizational revolution. This revolution automates business processes by using the Internet, intranets, VANs, and extranets to connect organizations and people.
- The digital economy is characterized by extensive use of information technology in general and the Internet in particular. These drive new business models that dramatically reduce cost and increase quality, customer service, and speed.
- Companies are trying to transform themselves to e-businesses by converting their information systems to Web-based and by automating as many business processes as possible.
- Many market, technology, and societal pressures surround the modern organization, which is responding with critical response activities supported by information technology.
- An accelerated rate of technological change, complexity, and turbulence and a move toward a global economy

38  **CHAPTER 1** STRATEGIC USE OF INFORMATION TECHNOLOGY IN THE DIGITAL ECONOMY

today characterize the business environment. In addition, the competition faced by businesses is ever increasing.

- 3 Organizational responses include strategic information systems, continuous improvements, business process restructuring, electronic commerce, and business alliances. IT plays a major role in all of these.
- 3 Organizations are adopting a customer-focused approach in order to succeed.
- 3 Organizations are changing their mode of operation by using IT-supported innovative approaches such as e-commerce, mass customization, CRM, and business alliances.
- 4 An information system collects, processes, stores, and disseminates information for a specific purpose. A computer-based information system uses computers to perform some or all of these activities.
- 4 Information technology refers to the network of all information systems in an organization.

- 5 Information technology is a major agent of change, supporting critical response activities in all functional areas, in all industries, and in both the private and the public sectors.
- 6 The major generic technological developments in IT are: increasing cost/performance, proliferation of object technology, and introduction of component-based development.
- 6 The major networked-computing developments are: increasing use of the Internet and intranets, mobile commerce, portals, optical networks, storage networks, and Web Services.
- 7 Learning about IT is essential because the role of IT is rapidly increasing in the support of organizations. We are getting more dependent on IT as time passes. Also, more IT-related jobs with high salaries are available.

VIRTUAL COMPANY ASSIGNMENT

Instructions for accessing The Wireless Café on the Student Web Site

1. Go to wiley.com/college/turban
2. Select Turban/Leidner/McLean/Wetherbe's *Information Technology for Management, Fifth Edition*.
3. Click on Student Resources site, in the toolbar on the left.
4. Click on the link for Virtual Company Web Site.
5. Click on Wireless Café.

Starting Your Internship at The Wireless Café

Go to The Wireless Café's link on the Student Web site. There you will find a description of your internship at this diner, as well some assignments that will help you learn more about how IT solutions could help the restaurant improve its business.

More Resources

More resources and study tools are located on the Student Web site. You'll find additional chapter materials and useful Web links. In addition, self-quizzes that provide individualized feedback are available for each chapter.

QUESTIONS FOR REVIEW

1. Define an information system and list its major components.
2. Define digital economy and list its major characteristics.
3. Define a business model by giving an example of one.
4. What are the major pressures in the business environment?
5. List the major critical response activities used by organizations.
6. Define information technology.
7. What is a virtual corporation?
8. Define mobile computing and m-commerce.
9. Define corporate portals.

10. Describe mass customization.
11. What are Moore's Law and Metcalfe's Law?
12. What is cycle-time reduction? Why is it so important?
13. Define Web Services.
14. List the major capabilities of IT.
15. Define optical networks and network storage.
16. Describe a Simputer (simple computer).
17. Define the Internet, an intranet, and an extranet.
18. Define networked computing and networked organizations.
19. Describe pervasive computing.

QUESTIONS FOR DISCUSSION

1. Discuss the motivation for becoming an e-business.
2. Review the examples of the new versus the old economy cases. In what way did IT make the difference?
3. Explain why IT is a business pressure and also an enabler of response activities that counter business pressures.
4. Why is m-commerce perceived as being able to increase EC applications?
5. Explain why the cost-performance ratio of IT will improve by a factor of 100, while performance is expected to improve only by a factor of 50.
6. Is IT a strategic weapon or a survival tool? Discuss.
7. It is said that networked computing changes the way we live, work, and study. Why?
8. Relate cycle-time reduction to improved financial and business performance.
9. Distinguish between network computers and networked computing.
10. Why is the Internet said to be the creator of new business models?
11. Explain why mass customization is desirable.
12. Discuss why some information systems fail.
13. Discuss the potential impact of utility computing.
14. Discuss the ethics related to use of RFID tags.

EXERCISES

1. Review the examples of IT applications in Section 1.3, and identify the business pressures in each example.
2. The market for optical copiers is shrinking rapidly. It is expected that by 2005 as much as 85 percent of all duplicated documents will be done on computer printers. Can a company such as Xerox Corporation survive?
 - a. Read about the problems and solution of Xerox in 2000–2003 at *fortune.com*, *findarticles.com*, and *google.com*.
 - b. Identify all the business pressures on Xerox.
 - c. Find some of Xerox's response strategies (see *xerox.com*, *fortune.com*, and *forbes.com*).
 - d. Identify the role of IT as a contributor to the business technology pressures.
 - e. Identify the role of IT as a facilitator of the critical response activities.
3. Reread the Siemens case at the start of the chapter and prepare a presentation to the CEO of a competing company. Stress both the benefits and the cost and limitations of such a transformation.

GROUP ASSIGNMENTS

1. Review the *Wall Street Journal*, *Fortune*, *Business Week*, and local newspapers of the last three months to find stories about the use of Web-based technologies in organizations. Each group will prepare a report describing five applications. The reports should emphasize the role of the Web and its benefit to the organizations. Cover issues discussed in this chapter, such as productivity, quality, cycle time, and globalization. One of the groups should concentrate on m-commerce and another on electronic marketplaces. Present and discuss your work.
2. Identify Web-related new business models in the areas of the group's interests. Identify radical changes in the operation of the functional areas (accounting, finance, marketing, etc.), and tell the others about them.
3. Enter *digitalenterprise.org*; go to Net-centrism and read the latest "hungry minds" items there. Prepare a report regarding the latest in the digital age.

INTERNET EXERCISES

1. Enter the Web site of UPS (*ups.com*).
 - a. Find out what information is available to customers before they send a package.
 - b. Find out about the “package tracking” system; be specific.
 - c. Compute the cost of delivering a 10" × 20" × 15" box, weighing 40 pounds, from your hometown to Long Beach, California. Compare the fastest delivery against the least cost.
2. Surf the Internet (use *google.com*, *brint.com*, or a similar engine) to find information about:
 - a. International virtual corporations (at least two examples).
 - b. Virtual corporations in general.
3. Enter *digitalenterprise.org*. Prepare a report regarding the latest EC developments in the digital age.
4. Visit some Web sites that offer employment opportunities in IT (such as *execunet.com* and *monster.com*). Compare the IT salaries to salaries offered to accountants.

For other information on IT salaries, check *Computer-world's* annual salary survey and *techjourney.com*.
5. Prepare a short report on the role of information technology in government. Start with *whitehouse.gov/omb/egov/2003egov-strat.pdf*, *ctg.albany.edu*, *e-government.govt.nz*, and *worldbank.org/publicsector/egov*. Find e-government plans in Hong Kong and in Singapore (*cca.gov.sg*; check action plan).
6. Enter *x-home.com* and find information about the easy life of the future.
7. Enter *tellme.com* and *bevocal.com*. Observe the demos. Write a report on the benefits of such technologies.
8. Experience customization by designing your own shoes at *nike.com*, your car at *jaguar.com*, your CD at *saregama.com*, and your business card at *iprint.com*. Summarize your experiences.
9. Enter *dell.com* and configure the computer of your dreams. (You do not have to buy it.) What are the advantages of such configuration?



Minicase 1

Dartmouth College Goes Wireless



Dartmouth College, one of the oldest in the United States (founded in 1769), was one of the first to embrace the wireless revolution. Operating and maintaining a campuswide information system with wires is very difficult, since there are 161 buildings with more than 1,000 rooms on campus. In 2000, the college introduced a campuswide wireless network that includes more than 500 Wi-Fi (wireless fidelity; see Chapter 5) systems. By the end of 2002, the entire campus became a fully wireless, always-connected community—a microcosm that provides a peek at what neighborhood and organizational life may look like for the general population in just a few years.

To transform a wired campus to a wireless one requires lots of money. A computer science professor who initiated the idea at Dartmouth in 1999 decided to solicit the help of alumni working at Cisco Systems. These alumni arranged for a donation of the initial system, and Cisco then provided more equipment at a discount. (Cisco and other companies now make similar donations to many colleges and universities, writing off the difference between the retail and the discount prices for an income tax benefit.)

As a pioneer in campuswide wireless, Dartmouth has made many innovative usages of the system, some of which are the following:

- Students are developing new applications for the Wi-Fi. For example, one student has applied for a patent on a personal-security device that pinpoints the location of campus emergency services to one's mobile device.
- Students no longer have to remember campus phone numbers, as their mobile devices have all the numbers and can be accessed anywhere on campus.
- Students primarily use laptop computers on the network. However, an increasing number of Internet-enabled PDAs and cell phones are used as well. The use of regular cell phones is on the decline on campus.
- An extensive messaging system is used by the students, who send SMSs (Short Message Services) to each other. Messages reach the recipients in a split second, any time, anywhere, as long as they are sent and received within the network's coverage area.
- Usage of the Wi-Fi system is not confined just to messages. Students can submit their classwork by using the network, as well as watch streaming video and listen to Internet radio.

- An analysis of wireless traffic on campus showed how the new network is changing and shaping campus behavior patterns. For example, students log on in short bursts, about 16 minutes at a time, probably checking their messages. They tend to plant themselves in a few favorite spots (dorms, TV room, student center, and on a shaded bench on the green) where they use their computers, and they rarely connect beyond those places.
- Some students invented special complex wireless games that they play online.
- One student has written a code that calculates how far away a networked PDA user is from his or her next appointment, and then automatically adjusts the PDA's reminder alarm schedule accordingly.
- Professors are using wireless-based teaching methods. For example, students armed with Handspring Visor PDAs, equipped with Internet access cards, can evaluate material presented in class and can vote on a multiple-choice questionnaire relating to the presented material. Tabulated results are shown in seconds, promoting discussions. According to faculty, the system "makes students want to give answers," thus significantly increasing participation.
- Faculty and students developed a special voice-over-IP application for PDAs and iPAQs that uses live two-way voice-over-IP chat.

Sources: Compiled from McHugh (2002), Hafner (2003), and *dartmouth.edu* (March 2003).

Questions for Minicase 1

1. In what ways is the Wi-Fi technology changing the life of Dartmouth students?
2. Some say that the wireless system will become part of the background of everybody's life—that the mobile devices are just an afterthought. Explain.
3. Is the system contributing to improved learning, or just adding entertainment that may reduce the time available for studying? Debate your point of view with students who hold a different opinion.
4. What are the major benefits of the wireless system over the previous wireline one? Do you think wireline systems will disappear from campuses one day? (Do some research on the topic.)



Minicase 2

Wal-Mart Leads RFID Adoption



In the first week of April 2004, Wal-Mart Stores Inc. (walmart.com) launched its first live test of RFID-tracing technology. Using one distribution center and seven stores, 21 products from participating vendors were in the pilot test.

In the supply chain pilot application, passive RFID chips with small antennae are attached to cases and pallets. When passed near an RFID “reader,” the chip activates, and its unique product identifier code is transmitted back to an inventory control system. Cases and pallets containing the 21 products featuring RFID tags are delivered to the distribution center in Sanger, Texas, where RFID readers installed at the dock doors notify both shippers and Wal-Mart what products enter the Wal-Mart distribution center and where the products are stored. RFID readers are also installed in other places, such as conveyor belts, so that each marked case can be tracked. Readers used by Wal-Mart have an average range of 15 feet. (For more detail, see Chapter 5’s discussion of how RFID works.)

Wal-Mart has set a January 2005 target for its top 100 suppliers to be placing RFID tags on cases and pallets destined for Wal-Mart stores, and believes that the implementation of this pilot scheme will pave the way for achieving this goal. The system is expected to improve flows along the supply chain, reduce theft, increase sales and reduce inventory costs (by eliminating both overstocking and understocking), and gain visibility and accuracy throughout Wal-Mart’s supply chain.

While some of Wal-Mart’s suppliers are late in implementing the system, it is clear that if the pilot is successful (and so far it is), RFID will become an industry standard.

After all, nearly \$70 billion is lost in the retail sector in the United States every year, due to products lost in the supply chain or being stored in wrong places.

The next step in Wal-Mart’s pilot is to mark each individual item with a tag. This plan raises a possible privacy issue: What if the tags are not removed from the products? People fear that they will be tracked after leaving the store. Wal-Mart also can use RFIDs for many other applications. For example, it could attach tags to shoppers’ children, so if they are lost in the megastore, they could be tracked in seconds.

Retailers such as Wal-Mart believe that the widespread implementation of RFID technology marks a revolutionary change in supply chain management, much as the introduction of barcodes was seen as revolutionary two decades ago.

Sources: Condensed from Landoline (2003), BusinessWeek Online (2004), and *FoodProductionDaily.com* (2004).

Questions for Minicase 2

1. Assuming the cost of RFID is low (less than \$0.05 per item), what advantages can you see for tagging individual items in each store? Is it necessary to do it?
2. Find some information regarding the advantages of RFIDs over regular barcodes.
3. Is this an e-business application? Why, or why not? If yes, can you identify the business model used?
4. What are some of the business pressures that drive use of RFID in retailing?

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APPENDIX 1A

PORTER'S MODELS

Researcher Michael Porter has proposed two models that have become classic ways to study and explain basic business activities—the *competitive forces model* and the *value chain model*. We present an overview of these two models in this appendix, and will refer to these models throughout the book.

Porter's Competitive Forces Model and Strategies

The most well-known framework for analyzing competitiveness is Porter's **competitive forces model** (Porter, 1985). It has been used to develop strategies for companies to increase their competitive edge. It also demonstrates how IT can enhance the competitiveness of corporations.

The model recognizes five major forces that could endanger a company's position *in a given industry*. (Other forces, such as those cited in Chapter 1, including the impact of government, affect all companies in the industry and therefore may have less impact on the relative success of a company within its industry.) Although the details of the model differ from one industry to another, its general structure is universal.

The five major forces in an industry can be generalized as follows.

1. The threat of entry of new competitors
2. The bargaining power of suppliers
3. The bargaining power of customers (buyers)
4. The threat of substitute products or services
5. The rivalry among existing firms in the industry

The strength of each force is determined by factors related to the industry's structure, as shown in Figure 1A.1. Companies need to protect themselves against the forces, or they can use the forces to improve their position or to challenge the leaders in the industry.

Some have suggested semiradical changes in Porter's model. For example, Harmon et al. (2001) proposed adding a sixth force—bargaining power of employees—to the original five. Another major force is the Internet, which has changed the nature of doing business as well as the nature of competition in many industries.

Porter's model identifies the forces that influence competitive advantage in the marketplace. Of greater interest to most managers is the development of a *strategy* aimed at performing activities differently from a competitor. Porter (1985) proposed three such strategies—cost leadership, differentiation, and niche strategies. Other strategic-management authors have proposed additional strategies (e.g., see Neumann, 1994; Wiseman, 1988; and Frenzel, 1996).

In Table 1A.1 we cite 12 general strategies for competitive advantage. Each of these strategies (and some others) can be enhanced by IT, as will be shown throughout the book and especially in Chapter 12. Forthcoming chapters will show: (1) how different information technologies impact the five forces, and (2) how IT facilitates the 12 strategies.

Porter's Value Chain Model

According to Porter's **value chain model** (Porter, 1985), the activities conducted in any manufacturing organization can be divided into two parts: *primary activities and support activities*.

The **primary activities** are those business activities through which a company produces goods, thus creating value for which customers are willing to pay. Primary activities involve the purchase of materials, the processing of materials into products, and delivery of products to customers. Typically, there are five primary activities:

1. Inbound logistics (inputs)
2. Operations (manufacturing and testing)
3. Outbound logistics (storage and distribution)
4. Marketing and sales
5. Services

The primary activities usually take place in a sequence from 1 to 5. As work progresses according to the sequence, value is added to the product in each activity. To be more specific, the incoming materials (1) are processed (in receiving, storage, etc.) in activities called *inbound logistics*. Next, the materials are used in *operations* (2), where significant value is added by the process of turning raw materials into products. The products need to be prepared for

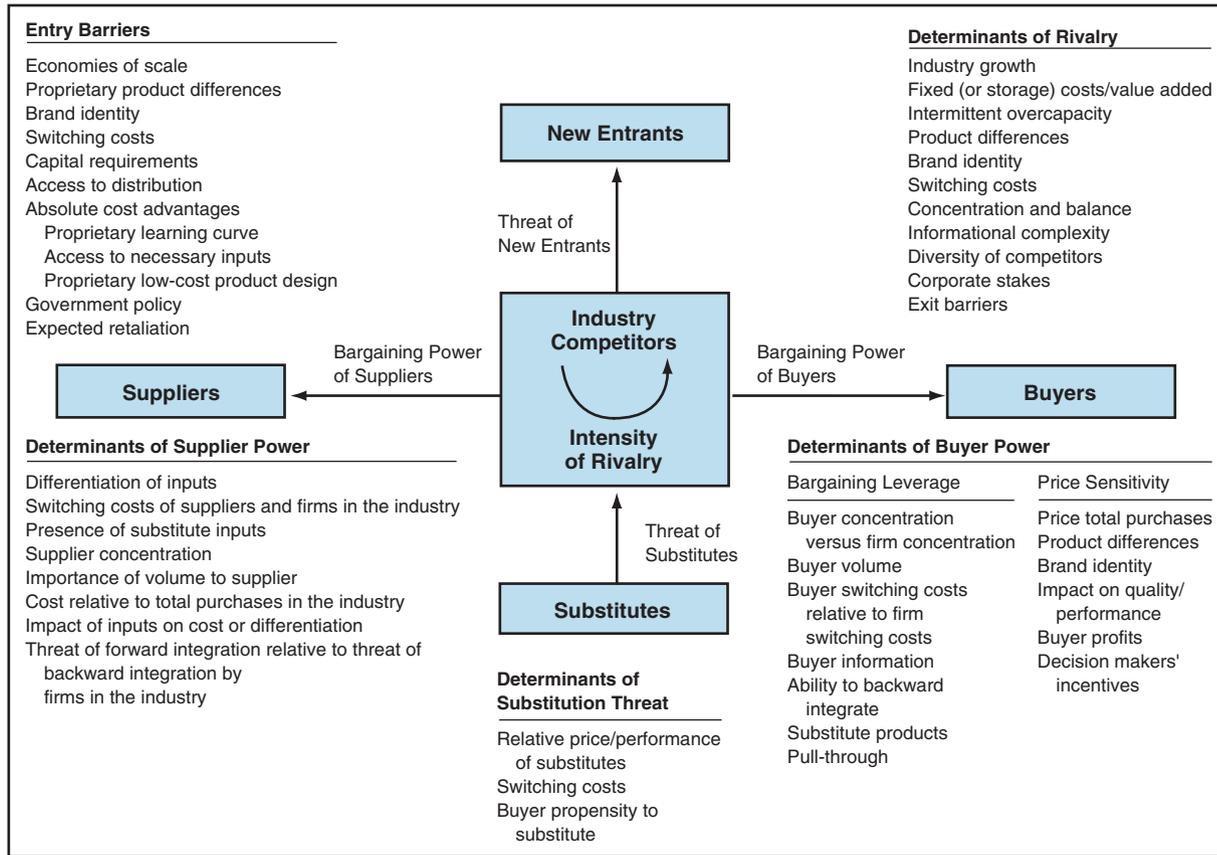


FIGURE 1A.1 Porter's five forces model, including the major determinant of each force. (Source: Adapted with permission of the Free Press, a division of Simon & Schuster, Inc., from Michael Porter, *Competitive Advantage: Creating and Sustaining Superior Performance*, p. 6. © 1985, 1998 by Michael Porter.)

TABLE 1A.1 Twelve Strategies for Competitive Advantage	
Strategy	Description
Cost leadership	Produce product/service at the lowest cost in the industry.
Differentiation	Offer different products, services, or product features.
Niche	Select a narrow-scope segment (<i>market niche</i>) and be the best in quality, speed, or cost in that market.
Growth	Increase market share, acquire more customers, or sell more types of products.
Alliance	Work with business partners in partnerships, alliances, joint ventures, or virtual companies.
Innovation	Introduce new products/services; put new features in existing products/services; develop new ways to produce products/services.
Operational effectiveness	Improve the manner in which internal business processes are executed so that the firm performs similar activities better than rivals.
Customer-orientation	Concentrate on customer satisfaction.
Time	Treat time as a resource, then manage it and use it to the firm's advantage.
Entry-barriers	Create barriers to entry. By introducing innovative products or using IT to provide exceptional service, companies can create entry barriers to discourage new entrants.
Lock in customers or suppliers	Encourage customers or suppliers to stay with you rather than going to competitors. Locking in customers has the effect of reducing their bargaining power.
Increase switching costs	Discourage customers or suppliers from going to competitors for economic reasons.

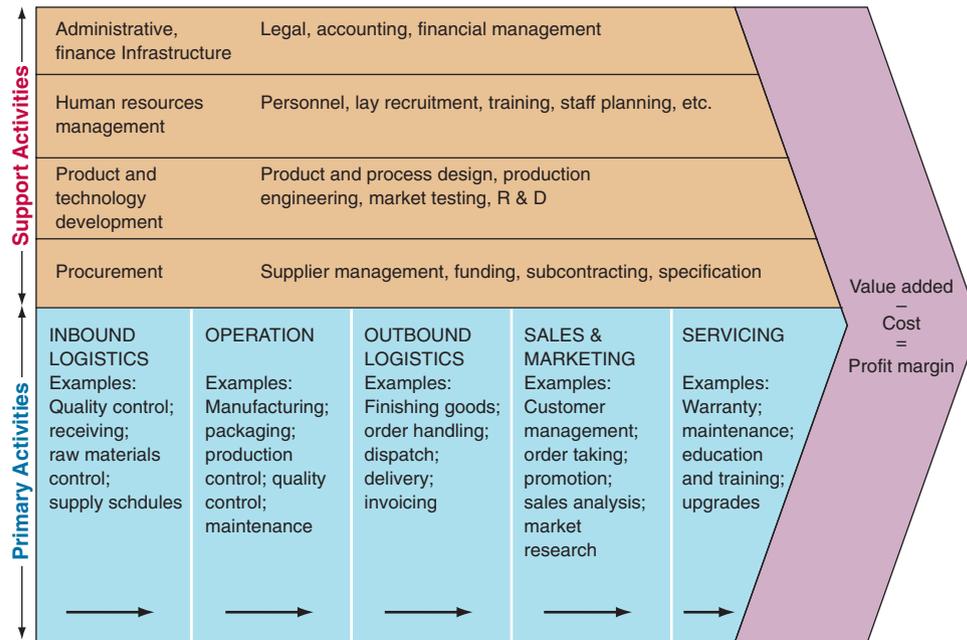


FIGURE 1A.2 The firm's value chain. The arrows illustrate the flow of goods and services (the internal part of the supply chain). (Source: Drawn by E. Turban.)

delivery (packaging, storing, and shipping) in the *outbound logistics* activities (3). Then *marketing and sales* (4) attempt to sell the products to customers, increasing product value by creating demand for the company's products. (The value of a sold item is much larger than that of an unsold one.) Finally, *after-sales service* (5) such as warranty service or upgrade notification is performed for the customer, further adding value. The goal of these value-adding, primary activities is to make a profit for the company.

Primary activities are sustained and furthered by the following **support activities**:

1. The firm's infrastructure (accounting, finance, management)
2. Human resources management
3. Technology development (R&D)
4. Procurement

Each support activity can be applied to any or all of the primary activities, and the support activities may

also support each other (see Figure 1A.2). For an example of Porter's value chain model applied to the airline industry, see Online File W1.11.

A firm's value chain is part of a larger stream of activities, which Porter calls a value system. A **value system** (also called an *industry value chain*) includes the suppliers that provide the inputs necessary to the firm and their value chains. Once the firm creates products, these products pass through the value chains of distributors (which also have their own value chains), all the way to the buyers (customers). All parts of these chains are included in the value system. Gaining and sustaining a competitive advantage, and supporting that advantage by means of IT, requires an understanding of this entire value system.

In forthcoming chapters, we will show how different functional departments relate to Porter's value chain model and how IT impacts the addition of value (and hopefully profit) in companies. For in-depth discussion, see Chapter 12.

KEY TERMS FOR APPENDIX 1A

Competitive forces model *xx*

Primary activities *xx*

Support activities *xx*

Value chain model *xx*

Value system *xx*

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PART I
IT in the Organization



- ▶ 1. Information Technology in the Digital Economy
- ▶ 2. Information Technologies: Concepts and Management
- ▶ 3. Strategic Information Systems for Competitive Advantage

CHAPTER

2

Information Technologies: Concepts and Management

Building an E-Business at
FedEx Corporation

2.1

Information Systems:
Concepts and Definitions

2.2

Classification and Evolution of
Information Systems

2.3

Transaction Processing versus
Functional Information
Systems

2.4

How IT Supports Various
Types of Organizational
Activities

2.5

How IT Supports Supply
Chain and CRM Operations

2.6

Information Systems,
Infrastructure, and
Architecture

2.7

Web-Based Systems

2.8

New Computing Environments

2.9

Managing Information Resources
Minicases: (1) Maybelline / (2) JCPenney

Appendix 2.1

Build-To-Order Production

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Describe various information systems and their evolution, and categorize specific systems you observe.
- 2 Describe and contrast transaction processing and functional information systems.
- 3 Identify the major internal support systems and relate them to managerial functions.
- 4 Describe the support IT provides along the supply chain, including CRM.
- 5 Discuss information infrastructure and architecture.
- 6 Compare client/server architecture, mainframe-based legacy systems, and P2P architecture and comment on their differences.
- 7 Describe the major types of Web-based information systems and understand their functionalities.
- 8 Describe new computing environments.
- 9 Describe how information resources are managed and what are the roles of the ISD and end users.



BUILDING AN E-BUSINESS AT FEDEX CORPORATION

FedEx Corporation was founded in 1973 by entrepreneur Fred Smith. Today, with a fully integrated physical and virtual infrastructure, FedEx's business model supports 24–48 hour delivery to anywhere in the world. FedEx operates one of the world's busiest data-processing centers, handling over 100 million information requests per day from more than 3,000 databases and more than 500,000 archive files. It operates one of the largest real-time, online client/server networks in the world. The core competencies of FedEx are now in express transportation and in e-solutions.

➡ THE PROBLEM/OPPORTUNITY

Initially, FedEx grew out of pressures from mounting inflation and global competition. These pressures gave rise to greater demands on businesses to expedite deliveries at a low cost and to improve customer services. FedEx didn't have a business problem per se but, rather, has endeavored to stay ahead of the competition by looking ahead at every stage for opportunities to meet customers' needs for fast, reliable, and affordable overnight deliveries. Lately, the Internet has provided an inexpensive and accessible platform upon which FedEx has seen further opportunities to expand its business scope, both geographically and in terms of service offerings. FedEx is attempting to fulfill two of its major goals simultaneously: 100 percent customer service and 0 percent downtime.

➡ THE IT SOLUTION/PROJECT

A prime software application used by FedEx is e-Shipping Tools, a Web-based shipping application that allows customers to check the status of shipments through the company's Web page. FedEx is also providing integrated solutions to address the entire selling and supply chain needs of its customers. Its e-Commerce Solutions provides a full suite of services that allow businesses to integrate FedEx's transportation and information systems seamlessly into their own operations. These solutions have taken FedEx well beyond a shipping company.

FedEx markets several e-commerce hardware/software solutions: FedEx PowerShipMC (a multicarrier hardware/software system), FedEx Ship Manager Server (a hardware/software system providing high-speed transactions and superior reliability, allowing an average of eight transactions per second), FedEx ShipAPI™ (an Internet-based application that allows customization, eliminating redundant programming), and FedEx Net-Return® (a Web-based item-return management system). This infrastructure is now known as FedEx Direct Link. It enables business-to-business electronic commerce through combinations of global virtual private network (VPN) connectivity, Internet connectivity, leased-line connectivity, and VAN (value-added network) connectivity.

Figure 2.1 provides an example of one of FedEx's e-commerce solutions. It shows how FedEx customers can tap into a network of systems through the Internet. When a customer places an online order, the order is sent to a FedEx Web server. Information about the order and the customer is then sent to the merchant's PC, and a message is sent to the customer to confirm receipt of the order. After the order is received and acknowledged, the FedEx Web server sends

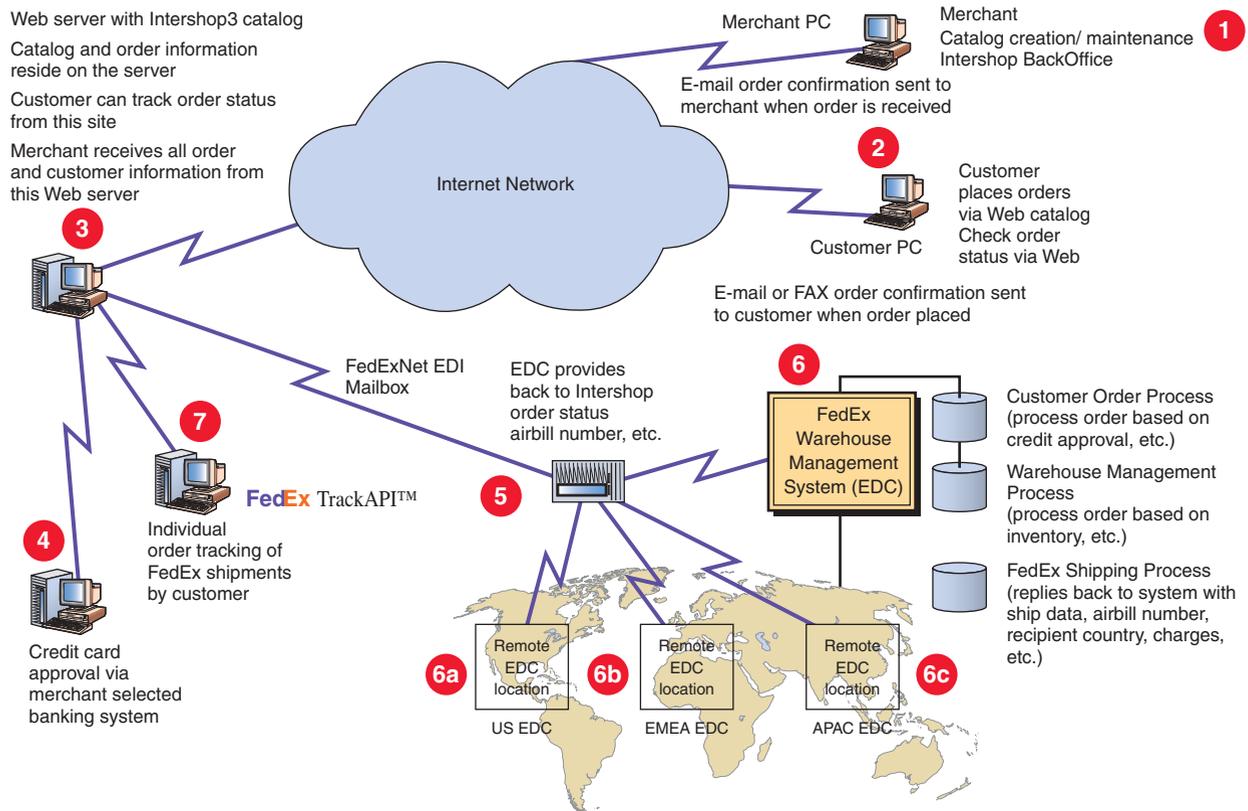


FIGURE 2.1 An example of a FedEx e-commerce solution. (Source: Based on a SIM 2000 award-winning paper written by William L. Conley, Ali F. Farhoomand, and Pauline S.P. Ng, at simnet.org/library/doc/2ndplace.doc. Courtesy of William Conley.)

a message to the merchant's bank to obtain credit approval. At the same time, the order is sent via electronic data interchange (EDI) to a FedEx mainframe that activates the *warehouse management system*. The order is processed (goods are picked and packed), the warehouse inventory system is updated, and the shipping process is activated. Information regarding the processing of the order is accessible at the three remote electronic data centers (EDCs) located in the United States, the Europe/Mediterranean (EMEA) region, and the Asia Pacific (APAC) region. During the entire process the customer, the merchant, and FedEx employees may track at any time the status of the order and its fulfillment via the Web.

THE RESULTS

The new e-commerce-based FedEx business model creates value for its customers in a number of ways: It facilitates better communication and collaboration between the various parties along the selling and supply chains. It promotes efficiency gains by reducing costs and speeding up the order cycle. It encourages customers not only to use FedEx as a shipper but also to outsource to FedEx all their logistics activities. It also provides FedEx a competitive edge and increased revenue and profits. Thus, FedEx has changed from an old-economy shipping company to an e-business logistics enterprise.

Sources: Based on a SIM 2000 award-winning paper written by William L. Conley, Ali F. Farhoomand, and Pauline S.P. Ng, simnet.org/library/doc/2ndplace.doc. Courtesy of William Conley. Updated with information from fedex.com, accessed February 2003.

LESSONS LEARNED FROM THIS CASE

In the digital economy, how well companies transform themselves from traditional modes of operation to e-business will depend on how well they can adapt their structure and processes to take advantage of emerging technologies and what architecture and infrastructure they use. FedEx has transformed itself into an e-business by integrating physical and virtual infrastructures across information systems, business processes, and organizational bounds. FedEx's experience in building an e-business shows how a company can successfully apply its information technology expertise in order to pioneer "customercentric" innovations with sweeping structural and strategic impacts. It also shows the role of outsourcing, which frees companies to concentrate on their core business. In this chapter we describe how information systems of different kinds are structured, organized, and managed so that they can support businesses in the twenty-first century.

2.1 INFORMATION SYSTEMS: CONCEPTS AND DEFINITIONS

In Chapter 1 we defined an **information system (IS)** as one that collects, processes, stores, analyzes, and disseminates information for a specific purpose. The composition of information systems is usually the same: Each contains hardware, software, data, procedures, and people. Key elements of a simple desktop information system are shown in the nearby photo.



Another possible component of an information system is one or more smaller information systems. Information systems that contain smaller systems are typical of large companies. For example, FedEx's corporate information system contains hundreds of smaller information systems, which are referred to as "applications." An **application program** is a computer program designed to support a specific task or a business process (such as execute the payroll) or, in some cases, another application program.

There are dozens of applications in each functional area. For instance, in managing human resources, it is possible to find one application for screening job applicants and another for monitoring employee turnover. Some of the applications might be completely independent of each other, whereas others are interrelated. The collection of application programs in a single department is usually considered a *departmental information system*, even though it is made up of many applications. For example, the collection of application programs in the human resources area is called the *human resources information system (HRIS)*.

Information systems are usually connected by means of *electronic networks*. The connecting networks can be *wireline* and/or *wireless*. Information systems can connect an entire organization, or even multiple organizations. If the entire company is networked and people can communicate with each other and access information throughout the organization, then the arrangement is known as an *enterprisewide information system*. An *interorganizational information system*, such as FedExNet, involves information flow among two or more organizations, and is used primarily in e-business applications.

The organization and management of information systems is emerging as a theoretical discipline, rather than simply as an applied field of study (O'Donovan and Roode, 2002). Before we focus on the details of IT and its management, it is necessary to describe the major concepts of information systems and organize the systems in some logical manner. That is the major purpose of this chapter.

Data, Information, and Knowledge

Information systems are built to attain several goals. One of the primary goals is to economically process data into information or knowledge. Let us define these concepts:

Data items refer to an elementary description of things, events, activities, and transactions that are recorded, classified, and stored, but not organized to convey any specific meaning. Data items can be numeric, alphanumeric, figures, sounds, or images. A student grade in a class is a data item, and so is the number of hours an employee worked in a certain week. A **database** consists of stored data items organized for retrieval.

Information is data that have been organized so that they have meaning and value to the recipient. For example, a student's grade point average is information. The recipient interprets the meaning and draws conclusions and implications from the data. Data items typically are processed into information by means of an application. Such processing represents a more specific use and a higher value-added than simple retrieval and summarization from a database. The application might be a Web-based inventory management system, a university online registration system, or an Internet-based buying and selling system.

Finally, **knowledge** consists of data and/or information that have been organized and processed to convey understanding, experience, accumulated learning, and expertise as they apply to a current problem or activity. Data that are processed to extract critical implications and to reflect past experiences and expertise provide the recipient with *organizational knowledge*, which has a very high potential value. Currently, *knowledge management* is one of the hottest topics in the IT field (see Chapter 10).

Data, information, and knowledge can be *inputs* to an information system, and they can also be *outputs*. For example, data about employees, their wages, and time worked are processed as inputs in order to produce an organization's payroll information (output). The payroll information itself can later be used as an input to another system that prepares a budget or advises management on salary scales.

Information Systems Configurations

Information systems are made out of components that can be assembled in many different configurations, resulting in a variety of information systems and applications, much as construction materials can be assembled to build different homes. The size and cost of a home depend on the purpose of the building, the availability of money, and constraints such as ecological and environmental legal requirements. Just as there are many different types of houses, so there are many different types of information systems. We classify houses as single-family homes, apartments (or flats), townhouses, and cottages. Similarly, it is useful to classify information systems into groups that share similar characteristics. Such a classification may help in identifying systems, analyzing them, planning new

systems, planning integration of systems, and making decisions such as the possible outsourcing of systems. This classification can be done in several alternative ways, as shown next.

2.2 CLASSIFICATION AND EVOLUTION OF INFORMATION SYSTEMS

Information systems are classified in this section by organizational levels and by the type of support provided. The section also looks at the evolution of support systems.

Classification by Organizational Levels

Organizations are made up of components such as divisions, departments, and work units, organized in hierarchical levels. For example, most organizations have functional departments, such as production and accounting, which report to plant management, which report to a division head. The divisions report to the corporate headquarters. Although some organizations have restructured themselves in innovative ways, such as those based on cross-functional teams, today the vast majority of organizations still have a traditional hierarchical structure. Thus, we can find information systems built for headquarters, for divisions, for the functional departments, for operating units, and even for individual employees. Such systems can stand alone, but usually they are interconnected.

Typical information systems that follow the organizational structure are *functional (departmental)*, *enterprisewide*, and *interorganizational*. These systems are organized in a hierarchy in which each higher-level system consists of several (even many) systems from the level below it, as shown in Figure 2.2. As can be seen in the figure, a departmental system supports the functional areas in each company. At a higher level, the enterprisewide system supports the entire company, and interorganizational systems connect different companies.

FUNCTIONAL (DEPARTMENTAL) INFORMATION SYSTEMS. The major functional information systems are organized around the traditional departments—

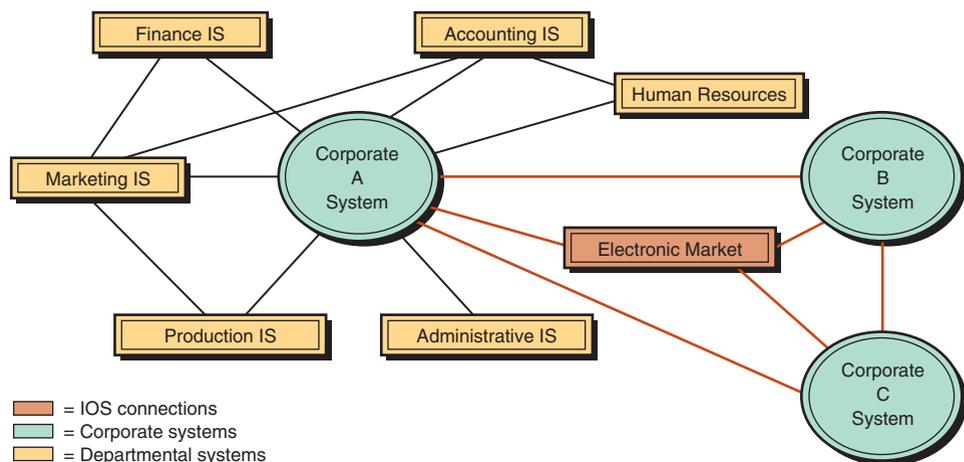


FIGURE 2.2 Departmental, corporate, and interorganizational information systems

functions—in a company: manufacturing (operations/production), accounting, finance, marketing, and human resources.

ENTERPRISE INFORMATION SYSTEMS. While a departmental information system is usually related to a functional area, other information systems serve several departments or the entire enterprise. These information systems together with the departmental applications comprise the **enterprisewide information system (EIS)**. One of the most popular enterprise applications is *enterprise resources planning (ERP)*, which enables companies to plan and manage the resources of an entire enterprise. ERP systems present a relatively new model of enterprisewide computing (see Chapter 8).

A special enterprise system that crosses several departments is the *transaction processing system (TPS)*. The TPS automates routine and repetitive tasks that are critical to the operation of the organization, such as preparing a payroll or billing customers. Transaction processing systems are described in Section 2.3 and in Chapter 7.

INTERORGANIZATIONAL SYSTEMS. Some information systems connect two or more organizations. They are referred to as **interorganizational information systems (IOSs)**. For example, the worldwide airline reservation system is composed of several systems belonging to different airlines. Of these, American Airlines' SABRE system is the largest; thousands of travel agents and hundreds of airlines are connected to it. Such systems are common among business partners. Those that support international or global operations may be especially complex (see Mol and Koppius, 2002). Interorganizational information systems play a major role in e-commerce, as well as in supply chain management support.

Classification by the Type of Support Provided



The Evolution of Support Systems

Another way to classify information systems is according to the type of support they provide, regardless of the functional area. For example, an information system can support office workers in almost any functional area. Likewise, managers working from various geographical locations can be supported by a computerized decision-making system. The main types of support systems are listed and described in Table 2.1, together with the types of employees they support. The evolution of these systems and a brief description of each follow. For more detail, see Online File W2.1.

The first business applications of computers did repetitive, large-volume, transactions-computing tasks. The computers “crunched numbers,” summarizing and organizing transactions and data in the accounting, finance, and human resources areas. Such systems are called, generally, *transaction processing systems*.

As the cost of computing decreased and computers' capabilities increased, a new breed of information system, called *management information systems (MISs)*, started to develop. These systems accessed, organized, summarized, and displayed information for supporting routine decision making in the functional areas. *Office automation systems (OAS)* such as word processing systems and airline reservation systems were developed to support office workers. Computers also were introduced in the manufacturing environment,

TABLE 2.1 Main Types of IT Support Systems

System	Employees Supported	Description	Detailed Description in:
Transaction processing system (TPS)	All employees	Processes an organization's basic business transactions (e.g., purchasing, billing, payroll).	Chapter 7
Management information system (MIS)	All employees	Provides routine information for planning, organizing, and controlling operations in functional areas.	Chapter 7
Office automation system (OAS)	Office workers	Increases productivity of office workers; includes word processing.	Chapters 4, 7
Word processing system	Office workers	Helps create, edit, format, distribute, and print documents.	Chapter 4
CAD/CAM	Engineers, draftspersons	Allows engineers to design and test prototypes; transfers specifications to manufacturing facilities.	Chapter 7
Communication and collaboration systems (e.g., e-mail, voice mail, call centers, others)	All employees	Enable employees and customers to interact and work together more efficiently.	Chapter 4
Desktop publishing system	Office workers	Combines text, photos, graphics to produce professional-quality documents.	Chapter 4
Document management system (DMS)	Office workers	Automates flow of electronic documents.	Chapter 11
Decision support system (DSS)	Decision makers, managers	Combines models and data to solve semistructured problems with extensive user involvement.	Chapter 12
Executive support system (ESS)	Executives, senior managers	Supports decisions of top managers.	Chapter 12
Group support system (GSS)	People working in groups	Supports working processes of groups of people (including those in different locations).	Chapter 12
Expert system (ES)	Knowledge workers, nonexperts	Provides stored knowledge of experts to nonexperts and decision recommendations based on built-in expertise.	Chapters 10, 11
Knowledge work system (KWS)	Managers, knowledge workers	Supports the gathering, organizing, and use of an organization's knowledge.	Chapters 10, 11, 12
Neural networks, case-based reasoning	Knowledge workers, professionals	Learn from historical cases, even with vague or incomplete information.	Chapters 10, 11
Data warehouse	Managers, knowledge workers	Stores huge amounts of data that can be easily accessed and manipulated for decision support.	Chapter 11
Business intelligence	Decision makers, managers	Gathers and uses large amounts of data for analysis by DSS, ESS and intelligent systems.	Chapter 11
Mobile computing systems	Mobile employees	Support employees who work with customers or business partners outside the physical boundaries of the organization.	Chapter 6

with applications ranging from robotics to computer-aided design and manufacturing (CAD/CAM).

Additional increasing computing capabilities and reduced costs justified computerized support for a growing number of nonroutine applications, and *decision support systems* were developed to provide computerized support for complex, nonroutine decisions. The microcomputer revolution, which started around 1980, began the era of **end-user computing**, in which analysts, managers, and many other professionals can build and use systems on their own desktop computers. Decision support expanded in two directions: first, toward executives and then managers (*executive support systems* and *enterprisewide information systems*), and second, to people working in groups (*group support systems*).

Eventually, interest in programming computers to perform intelligent problem solving led to commercial applications known as *intelligent support systems (ISSs)*. These include *expert systems*, which provide the stored knowledge of experts to nonexperts, and a new breed of intelligent systems with *machine-learning* capabilities (such as artificial neural networks and case-based reasoning) that can learn from historical cases.

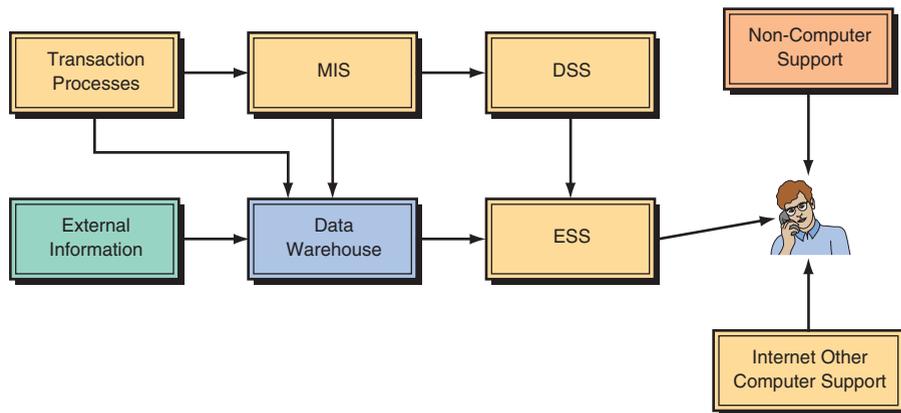
As our economy has become more focused on knowledge work, *knowledge work systems* have been developed specifically to support the creating, gathering, organizing, integrating, and disseminating of an organization's knowledge. Included in this category are software for word processing, document management, and desktop publishing.

A major innovation in the evolution of support systems has been the development of *data warehousing*. A data warehouse is a database designed to support DSS, ESS, and other analytical and end-user activities. The use of data warehouses is a part of *business intelligence*, the gathering and use of large amounts of data for query or analysis by DSS, ESS, and intelligent systems.

The latest support system in organizations is **mobile computing**. Mobile computing supports mobile employees, those who are working with customers or business partners, at least part of the time, outside the physical boundaries of their companies. The mobile employees carry portable devices, ranging from PDAs to cell phones and digital cameras, that can access the Internet. These devices enable communication with organizations and other individuals via wireline or wireless networks.

The information systems described so far were designed mostly to support the activities inside organizations. However, companies discovered that their *external* activities also can be improved with IT. The first type of IT system that was developed in the 1980s to improve communications with business partners was **electronic data interchange (EDI)**, which involved computer-to-computer direct communication of standard business documents (such as orders and order confirmations) between business partners. These systems became the basis for *electronic markets*, which later developed into *electronic commerce*. These expanded later to improved *collaboration* of planning and other business activities among business partners, and some of the enterprisewide systems expanded to include more formalized business partner relationships. Later on came a wave of systems intended to support customers; these were grouped under the umbrella term *customer relationship management (CRM)*, and they include services such as *call centers* (Chapter 7). Some of these external support systems are described further in Section 2.5.

FIGURE 2.3 Interrelated support systems. The TPS collects information that is used to build the DSS and ESS. The information in the data warehouse and DSS can be used as an input to the ESS.



Major advances in external support are attributed to Web-based and mobile systems. *Web-based systems* started to be developed in the mid-1990s and picked up momentum in 2000. As their name implies, these systems deliver business applications via the Internet. As shown in the Siemens case in Chapter 1 and the FedEx case here, organizations are using Web-based systems to transform themselves into e-businesses. As will be shown *throughout the text*, today many—and probably most—of the innovative and strategic systems in medium and large organizations are Web-based. Using their browsers, people in these organizations communicate, collaborate, access vast amounts of information, and run most of the organization’s tasks and processes by means of Web-based systems. (For more, see Section 2.7.)

In summary, the relationship among the different types of support systems can be described as follows: Each support system has sufficiently unique characteristics that it can be classified as a special entity. Yet there is information flow among these entities and systems. For example, an MIS extracts information from a TPS, and an ESS receives information from data warehouses and MIS (see Figure 2.3). In many cases, two or more support systems can be integrated to form a hybrid system, as is the case in business intelligence or mobile computing. Finally, as the technologies change, the interrelationships and coordination among the different types of systems continue to evolve. Ten years from now, the relationships shown in Figure 2.3 will probably look different from the way they look today.

INTEGRATED SUPPORT SYSTEMS. From the time of their inception, support systems were used both as standalone systems and as integrated systems composed of two or more of the support systems. Notable were systems that include some intelligent components (e.g., a DSS-ES combination). Such integration provides extended functionalities, making these systems more useful. As will be discussed in Section 2.7 and in Chapter 8, there is an increasing trend to integrate the various support systems as well as to integrate support systems with other systems. Integrated support systems can provide solutions to complex problems, as shown in *A Closer Look 2.1*.

Now that we have completed an overview of the different types of support systems and their evolution, we will look at some of the key systems in more detail.



A CLOSER LOOK

2.1 INTELLIGENT PRICE SETTING IN RETAILING



Pricing several thousands of items at Longs Drug Stores (a U.S. chain of about 400 drug stores) is decentralized. Each store is empowered to price each of the items it carries in the store, in order to better compete locally. Pricing traditionally was done manually by modifying the manufacturer's suggested retail price. Similar practices existed in most other retail chains, including supermarkets. Furthermore, when a price war occurred, or when a seasonal sales time arrived, prices were slashed across the board, without paying attention to demand forecast, profitability, pricing strategy, or price consistency across stores.

Now price setting is undergoing a radical change, largely as a result of improved IT support systems. Following what airlines and car leasing companies were doing for years, the retail industry, including Longs Drug Stores and about half of all other U.S. retailers, is introducing *price-optimization* programs. How do these programs work? Price-optimization programs (offered by Demand-Tech Inc., and others) combine support systems such as DSS, intelligent systems, data warehouses, and more to form a system that recommends a price for each item in each store. The input data used are seasonal sales figures, actual sales at each store (in real time), each

product's price-demand curve, competitors' prices, profitability metrics, and more. The process is illustrated in Online File at the book's Web site. Using the program, retailers can identify the most price-sensitive products, and they can test what impact a price change would have on profit margin (or other desired goal, such as sales volume) within seconds. Using each store's priorities, strategies can be developed and tested.

The models used are similar to *yield-management* models pioneered by the airline industry in the 1980s and since adopted by the car-leasing, financial services, consumer electronics, transportation, and other industries. Even casinos are introducing similar programs to determine the optimal payout for slot machines.

Initial results at Longs Drugs and at other retail stores that have used similar programs show volume, revenue, and profit increases of between 2 and 10 percent. The software is still fairly expensive, so only large retailers can use it now. As more competitors produce similar software, it will become cheaper in the future, and consumers will be the ultimate beneficiaries.

Source: Condensed from Cortese, 2002.

2.3 TRANSACTION PROCESSING VERSUS FUNCTIONAL INFORMATION SYSTEMS

Any organization that performs periodic financial, accounting, and other routine business activities faces repetitive tasks. For example, employees are paid at regular intervals, customers place purchase orders and are billed, and expenses are monitored and compared to the budget. Table 2.2 presents a list of representative routine, repetitive business transactions in a manufacturing organization. The information system that supports such processes is called the *transaction processing system*.

Transaction Processing Systems

A **transaction processing system (TPS)** supports the monitoring, collection, storage, processing, and dissemination of the organization's basic business transactions. It also provides the input data for many applications involving support systems such as DSS. Sometimes several TPSs exist in one company. The transaction processing systems are considered critical to the success of any organization since they support core operations, such as purchasing of materials, billing customers, preparing a payroll, and shipping goods to customers.

TABLE 2.2 Routine Business Transactions in a Manufacturing Company	
Payroll	Sales returns
Employee time cards	Shipping
Employee pay and deductions	Production
Payroll checks	Production reports
	Quality-control reports
Purchasing	Finance and accounting
Purchase orders	Financial statements
Deliveries	Tax records
Payments (accounts payable)	Expense accounts
	Inventory management
Sales	Material usage
Sales records	Inventory levels
Invoices and billings	
Accounts receivable	

The TPS collects data continuously, frequently on a daily basis, or even in *real time* (i.e., as soon as they are generated). Most of these data are stored in the corporate databases and are available for processing.

EXAMPLES OF TPS. In retail stores, data flow from POS (point-of-sale) terminals to a database where they are aggregated. Sales reduce the level of inventory on hand, and the collected revenue from sales increases the company’s cash position. TPS data may be analyzed by data mining tools to find emerging patterns in what people buy. Such transactions occur all the time.

In banking, TPSs cover the area of deposits and withdrawals (which are similar to inventory levels). They also cover money transfers between accounts in the bank and among banks. Generating monthly statements for customers and setting fees charged for bank services are also typical transaction-processing activities for a bank.

Payroll is another area covered by TPSs for a business. Further details on TPS are provided in Chapter 7.

Functional Management Information Systems

The transaction-processing system covers the core activities of an organization. The *functional areas*, however, perform many other activities; some of these are repetitive, while others are only occasional. For example, the human resources department hires, advises, and trains people. Each of these tasks can be divided into subtasks. Training may involve selecting topics to teach, selecting people to participate in the training, scheduling classes, finding teachers, and preparing class materials. These tasks and subtasks are frequently supported by information systems specifically designed to support functional activities. Such systems are referred to as **functional management information systems**, or just **MIS**.*

Functional management information systems are put in place to ensure that business strategies come to fruition in an efficient manner. Typically, a

*The term MIS here refers to a specific *application* in a functional area. The term MIS is also used in another context to describe the area of *management of* information systems.

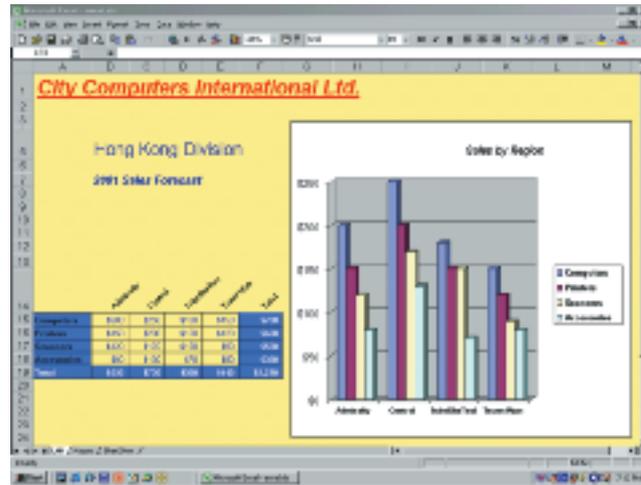


FIGURE 2.4 Sales forecast by region generated by marketing MIS.

functional MIS provides periodic information about such topics as operational efficiency, effectiveness, and productivity by extracting information from databases and processing it according to the needs of the user.

Management information systems are also used for planning, monitoring, and control. For example, a sales forecast by region is shown in Figure 2.4. Such a report can help the marketing manager make better decisions regarding advertising and pricing of products. Another example is that of a human resources information system (HRIS), which provides a manager with a daily report of the percentage of people who were on vacation or called in sick, as compared to forecasted figures.

So far we described what the support systems are. Now let's see *how* they support employees in organizations.

2.4 HOW IT SUPPORTS VARIOUS TYPES OF ORGANIZATIONAL ACTIVITIES

Another important way to classify information systems is by the nature of activities they support. Such support can be for operational, managerial, or strategic activities, as well as for knowledge workers in an organization.

Operational Activities *Operational activities* deal with the day-to-day operations of an organization, such as assigning employees to tasks and recording the number of hours they work, or placing a purchase order. Operational activities are short-term in nature. The information systems that support them are mainly TPSs, MISs, and mobile systems. Operational systems are used by supervisors (first-line managers), operators, and clerical employees.

Managerial Activities *Managerial activities*, also called tactical activities or decisions, deal in general with middle-management activities such as short-term planning, organizing, and control. Computerized managerial systems are frequently *equated with MISs*, because MISs are designed to summarize data and prepare reports. Middle managers also can get quick answers to queries from such systems as the need for answers arises.

TABLE 2.3 Support Provided by MISs for Managerial Activities

Task	MIS Support
Statistical summaries	Summaries of new data (e.g., daily production by item, monthly electricity usage).
Exception reports	Comparison of actual performances to standards (or target). Highlight only deviations from a threshold (e.g., above or below 5%).
Periodic reports	Generated at predetermined intervals.
Ad-hoc reports	Generated as needed, on demand. These can be routine reports or special ones.
Comparative analysis and early detection of problems	Comparison of performance to metrics or standards. Includes analysis such as trends and early detection of changes.
Projections	Projection of future sales, cash flows, market share, etc.
Automation of routine decision	Standard modeling techniques applied to routine decisions such as when and how much to order or how to schedule work.
Connection and collaboration	Internal and external Web-based messaging systems, e-mail, voice mail, and groupware (see Chapter 4).

Managerial information systems are broader in scope than operational information systems, but like operational systems, they use mainly internal sources of data. They provide the types of support shown in Table 2.3.

Strategic Activities

Strategic activities are basically decisions that deal with situations that significantly may change the manner in which business is done. Traditionally, strategic decisions involved only long-range planning. Introducing a new product line, expanding the business by acquiring supporting businesses, and moving operations to a foreign country, are prime examples of long-range activities. A long-range planning document traditionally outlines strategies and plans for the next five or even 10 years. From this plan, companies derive their shorter-range planning, budgeting, and resource allocation. In the digital economy, the planning period has been dramatically reduced to one to two years, or even months. Strategic activities help organizations in two other ways.

First, *strategic response* activities can react quickly to a major competitor's action or to any other significant change in the enterprise's environment. Although they can sometimes be planned for as a set of contingencies, strategic responses are frequently not included in the long-range plan because the situations they respond to are unpredictable. IT is often used to support the response or to provide the response itself. For instance, when Kodak Corporation learned that a Japanese company was developing a disposable camera, Kodak decided to develop one too. However, Kodak faced a time problem because the Japanese were already in the middle of the development process. By using computer-aided design and other information technologies, Kodak was able to cut its design time by half and beat the Japanese in the race to be the first to have the cameras in retail outlets.



Second, instead of waiting for a competitor to introduce a major change or innovation, an organization can be the *initiator of change*. Such innovative strategic activities are frequently supported by IT, as shown by FedEx in the opening case and by many startup companies that exploit opportunities by using IT (e.g., see the Amazon.com story, in Chapter 5).

E-BUSINESS STRATEGIC SYSTEMS. As we saw in Chapter 1, e-commerce and e-business have become a new way of conducting business in the last decade or so. In this new approach, business transactions take place via telecommunications networks, primarily the Internet. E-commerce refers not only to buying and selling electronically, but also involves e-collaboration and e-learning. It aims at increasing productivity, reaching new customers, and sharing knowledge across institutions for competitive advantage. EC-supported strategic systems are changing how business is done. We will provide e-business strategic examples throughout the book.

Who Performs What Activities in Organizations?

So far in this section, we have looked at operational, managerial, and strategic activities, and at how IT supports them. Here, we take a different look at these activities by looking at the people who typically perform them in an organization. For example, line managers and operators usually make operational decisions, and middle managers make most of the managerial decisions. Strategic decisions are made almost entirely by an organization's top managers. The relationships between the people supported and the decision type are shown in Figure 2.5. The triangular shape of the figure also illustrates the quantity of employees involved in the various types of activities and the decisions relating to those activities. Top managers are few, and they sit at the top of the triangle.

KNOWLEDGE WORKERS, CLERICAL STAFF, AND DATA WORKERS. As you can see in Figure 2.5, an additional level of *staff support* is introduced between top and middle management. These are professional people, such as financial and marketing analysts. They act as advisors and assistants to both top and middle management. Many of these professional workers are classified as **knowledge workers**, people who create information and knowledge as part of their work and integrate it into the business. Knowledge workers are engineers, financial and marketing analysts, production planners, lawyers, and accountants, to mention just a few. They are responsible for finding or developing new knowledge for the organization and integrating it with existing knowledge. Therefore they must keep abreast of all

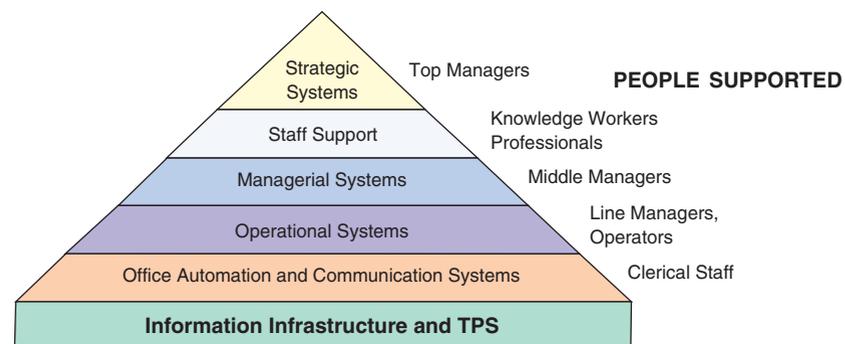


FIGURE 2.5 The information systems support of people in organizations

developments and events related to their profession. They also act as change agents by introducing new procedures, technologies, or processes. In many developed countries, 60 to 80 percent of all workers are knowledge workers.

Information systems that support knowledge workers range from Internet search engines (which help knowledge workers find information) and expert systems (which support information interpretation), to Web-based computer-aided design (which shape and speed the design process) and sophisticated data management systems (which help increase productivity and quality of work). Knowledge workers are the major users of the Internet for business purposes.

Another large class of employees is *clerical workers*, who support managers at all levels. Among clerical workers, those who use, manipulate, or disseminate information are referred to as **data workers**. These include bookkeepers, secretaries who work with word processors, electronic file clerks, and insurance claim processors. Data workers are supported by office automation and communication systems including document management, workflow, e-mail, and coordination software.

INFRASTRUCTURE FOR THE SUPPORT SYSTEMS. All of the systems in the support triangle are built on *information infrastructure*. Consequently, all of the employees who are supported work with infrastructure technologies such as the Internet, intranets, corporate portals, and corporate databases. Therefore, the information infrastructure is shown as the *foundation* of the triangle in Figure 2.5 and it is described in more detail in Section 2.6.

2.5 HOW IT SUPPORTS SUPPLY CHAIN AND CRM OPERATIONS

As indicated in Chapter 1, organizations work with business partners in several areas, frequently along the supply chain.

The Basics of Supply Chains and Their Management

A **supply chain** is a concept describing the flow of materials, information, money, and services from raw material suppliers through factories and warehouses to the end customers. A supply chain also includes the *organizations* and *processes* that create and deliver these products, information, and services to the end customers. The term *supply chain* comes from a picture of how the partnering organizations are linked together. As shown in Figure 2.6, a simple linear supply chain links a company that processes food (middle of the chain) with its suppliers (on the bottom) and its distributors and customers (on the top). The supply chain shown in Figure 2.6 is fairly simple. As will be shown in Chapter 8, supply chains can be much more complex. Note that the supply chain shows both physical flows and the flow of information. Not shown is the flow of money, which goes in the direction opposite to the flow of the physical materials.

SUPPLY CHAIN PARTS. A supply chain can be broken into three major parts: upstream, internal, and downstream as shown in Figure 2.6.

- **The upstream supply chain.** The *upstream* part of the supply chain includes the activities of a manufacturing company with its first-tier suppliers (which can be manufacturers and/or assemblers) and their connection to their second-tier suppliers. The supplier relationship can be extended to the left in several tiers, all the way to the origin of the material (e.g.,

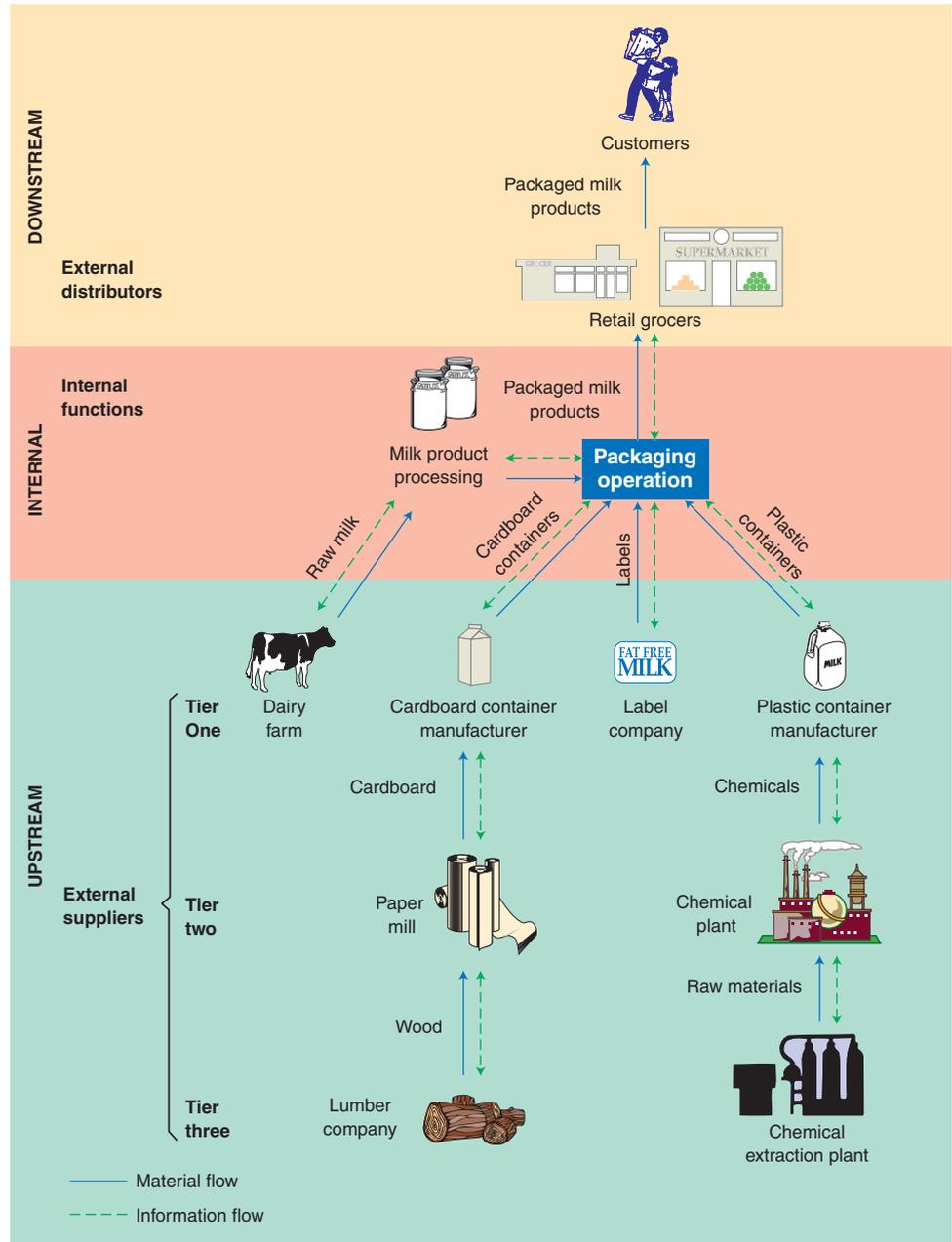


FIGURE 2.6 A simple supply chain for a manufacturer

mining ores, growing crops). In the upstream supply chain, the major activity is *procurement*.

- The internal supply chain.** The *internal* part of the supply chain includes all of the *in-house* processes used in transforming the inputs received from the suppliers into the organization's outputs. It extends from the time the inputs enter an organization to the time that the products go to distribution outside of the organization. The internal supply chain is mainly concerned with production management, manufacturing, and inventory control.

- **The downstream supply chain.** The *downstream* part of the supply chain includes all the activities involved in delivering the products to the final customers. The downstream supply chain is directed at distribution, warehousing, transportation, and after-sale services.

A company's supply chain involves an array of business processes that not only effectively transform raw items to finished goods or services but that also make those goods or services attractive to customers. The activities that add value to the company's goods or services are part of what is called the *value chain*, which we discuss in Chapter 3.

IT Support of Supply Chains

Managing supply chains can be difficult due to the need to coordinate several business partners, several internal corporate departments, numerous business processes, and possibly many customers. Managing medium to large supply chains manually is almost impossible. IT support of supply chains can be divided according to the three segments of the supply chain.

SUPPORT OF THE INTERNAL SUPPLY CHAIN. The IT support of the internal supply chain was described in the previous two sections. It involves the TPS and other corporatewide information systems, and it includes all of the functional information systems. (These will be described in detail in Chapter 7.) It also supports the various types of activities and people described in Section 2.4.

SUPPORT OF THE UPSTREAM SUPPLY CHAIN. The major IT support of the upstream supply chain is to improve procurement activities and relationships with suppliers. As will be seen in Chapters 5 and 7, using e-procurement is becoming very popular, resulting in major savings and improvements in buyer-seller relationships. E-procurement is done in private and public exchanges (Chapter 5 and Turban et al., 2004). Relationship with suppliers can be improved by using a supplier portal and other supplier-relationship IT tools.

SUPPORT OF THE DOWNSTREAM SUPPLY CHAIN. IT support of the downstream segment of the supply chain is done in two areas. First, IT supports customer relationship management activities such as providing a customer call center (see Chapter 7), and second, IT supports order taking and shipments to customers (Chapters 5 and 8)

Many companies provide IT support to both the upstream and downstream segments of the supply chain, as described in the story about Best Buy in Online File W2.3).



MANAGING SUPPLY CHAINS. IT provides two major types of software solutions for managing—planning, organizing, coordinating, and controlling—supply chain activities. First is the *enterprise resource planning (ERP)* software, which helps in managing both the internal and the external relationships with the business partners. Second is the *supply chain management (SCM)* software, which helps in decision making related both to internal segments and to their relationships with external segments. Both types of software are described in Chapter 8.

Finally, the concept of build-to-order production that comes and of e-commerce has put a new spin on supply chain management; see Appendix 2.1 at the end of this chapter.

2.6 INFORMATION SYSTEMS INFRASTRUCTURE AND ARCHITECTURE

Infrastructure An **information infrastructure** consists of the physical facilities, services, and management that support all shared computing resources in an organization. There are five major components of the infrastructure: (1) computer hardware, (2) software, (3) networks and communication facilities (including the Internet and intranets), (4) databases, and (5) information management personnel. Infrastructures include these resources as well as their integration, operation, documentation, maintenance, and management. If you go back and examine Figure 2.1 (which describes the architecture of the FedExNet), and introduce specific names instead of general ones (e.g., instead of “Merchant PC,” say “Dell server”), you will get a picture of the system’s infrastructure. Infrastructures are further discussed in Chapter 9, and in Broadbent and Weill (1997) and Weill and Vitale (2001). IT infrastructure is derived from the IT architecture.

The IT Architecture **Information technology architecture*** is a high-level map or plan of the information assets in an organization including the physical design of the building that holds the hardware. On the Web, IT architecture includes the content and organization of the site and the interface to support browsing and search capabilities. The IT architecture of an e-business (a travel agency) is shown in Figure 2.7. It is a guide for current operations and a blueprint for future directions. It assures managers that the organization’s IT structure will meet its strategic business needs. (See the *Journal of Information Architecture* for examples, tutorials, news, products, etc.)

Creating the IT architecture is a cyclical process, which is driven by the business architecture. **Business architecture** describes organizational plans, visions, objectives and problems, and the information required to support them. The potential users of IT must play a critical role in the creation of business

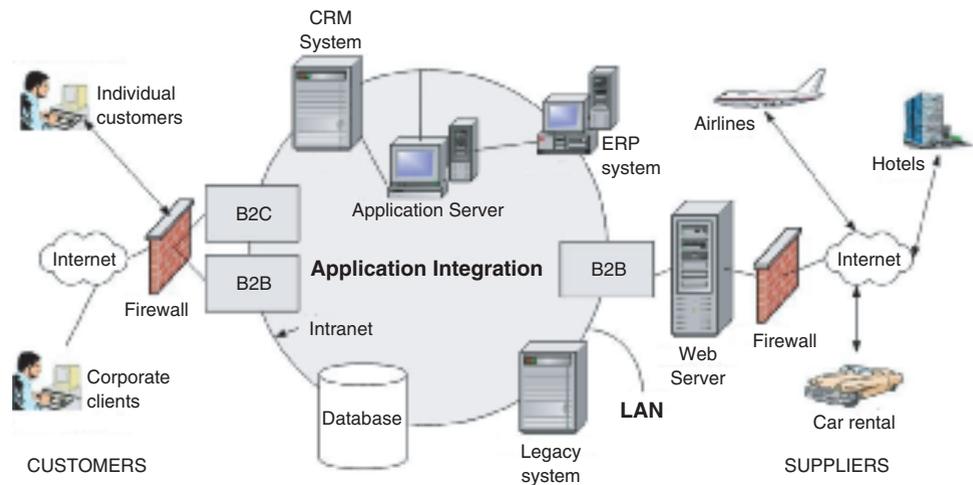


FIGURE 2.7 Architecture of an online travel agency

*Information technology architecture needs to be distinguished from computer architecture (see Technology Guide 1). For example, the architecture for a computer may involve several processors, or it may have special features to increase speed such as reduced instruction set computing (RISC). Our interest here is in information architecture only.

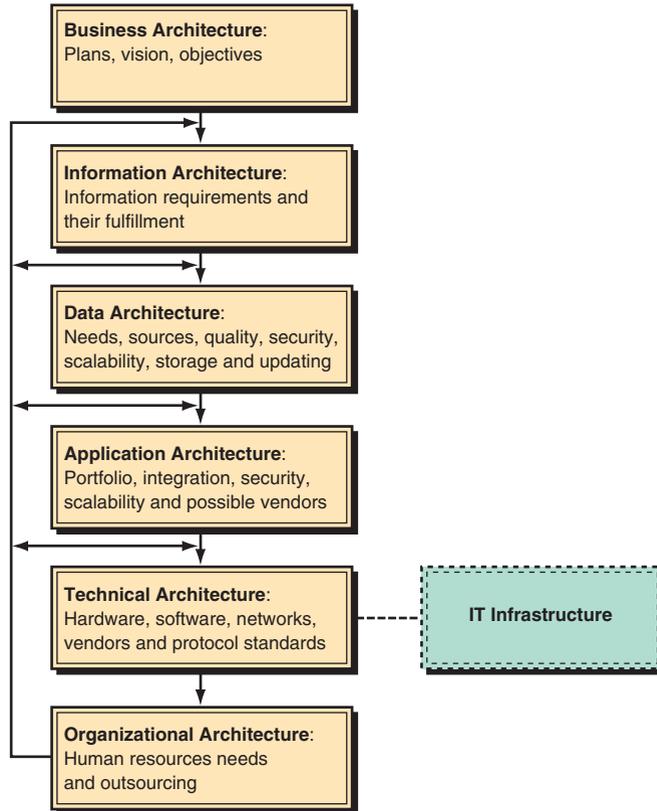


FIGURE 2.8 The steps in constructing IT architecture

architecture, in order to have both a business architecture *and* an IT architecture that meets the organization’s long-term needs. We can use the architecture of a house as an analogy. When preparing a conceptual high-level drawing of a house, the architect needs to know the requirements of the dwellers and the building constraints (time, money, materials, etc.). In preparing IT architecture, the designer needs similar information. This initial information is contained in the business architecture.

Once the business architecture is finished, the system developer can start a five-step process of building the IT architecture, as shown in Figure 2.8. The details and definitions of those steps are provided by Koontz (2000) and are shown in Online File W2.4 at the book’s Web site. Notice that translating the business objectives into IT architecture can be a very complex undertaking. For a translation guide in the e-business environment, see Whipple (2001).

Let’s look now at various basic elements of IT architecture.

Information Architecture According to Computing Paradigms (Environments)

A common way to classify information architecture is by computing paradigms, which are the core of the architecture. The major computing paradigms are: the mainframe environment, the PC environment, distributed computing, client/server architecture, and legacy systems.

MAINFRAME ENVIRONMENT. In the mainframe environment, processing is done by one or more mainframe computers. The users work with passive (or



“dumb”) terminals, which are used to enter or change data and access information from the mainframe and are controlled by it. This was the dominant architecture until the mid-1980s. Very few organizations use this type of architecture exclusively today due to its inflexibility and poor price-to-performance ratio (Ahmad, 2000).

An extension of this paradigm is an architecture that combines a mainframe with a number of PCs that are used as smart terminals. A **smart terminal** (also called *intelligent terminal*) contains a keyboard and screen (as does a “dumb terminal”), but it also comes with a disk drive that enables it to perform limited processing tasks when not communicating directly with the central computer. Yet, the core of the system is the mainframe with its powerful storage and computational capabilities. The network computers (NCs) that were introduced in 1997 (see the discussion of client/server architecture, below) redefined the role of the centralized mainframe computing environment (for details see Amato-McCoy, 2002, and Ahmad, 2000).

PC ENVIRONMENT. In the PC configuration, *only* PCs (no mainframes) provide the computing power in the information system. Initially there was only one PC in each information system. Later it became possible to network several together.

PC-LANs. When PCs are connected via local area networks (LANs), a more flexible PC system is created. New functionalities can be added, including e-mail, Internet access, and the sharing of devices such as printers. This paradigm offers scalability (the ability to handle an increased load) and effectiveness, but it generally lacks the high security and integrity of a mainframe system, as well as efficient device coordination capability.

DISTRIBUTED COMPUTING. **Distributed processing** (*distributed computing*) divides the processing work between two or more computers, using a network for connection. The participating computers can be all mainframes, all PCs, or as in most cases, a combination of the two types. They can be in one location or in several. **Cooperative processing** is a type of distributed processing in which two or more geographically dispersed computers are teamed together to execute a specific task.

Thanks to communication networks and especially the Internet and intranets, distributed computing has become the dominant architecture of most organizations. This architecture permits intra- and interorganizational cooperation in computing; accessibility to vast amounts of data, information, and knowledge; and high efficiency in the use of computing resources. The concept of distributed computing drives today’s new architectures, including those that are Web-based. An example is provided in *IT at Work 2.1*.

The Impact of Distributed Computing on IT. Traditional applications such as word processing were modeled as standalone applications: they offered users the capabilities to perform tasks using data stored on the system. Most new software programs, in contrast, are based on the *distributed computing* model, where applications collaborate to provide services and expose functionality to each other. As a result, the primary role of many new software programs is to support information exchange (through Web servers and browsers), collaboration (through e-mail and instant messaging), and individual expression (through



IT At Work 2.1

FLEXIBLE IT ARCHITECTURE AT CHASE MANHATTAN BANK



Chase Manhattan Bank and Chemical Bank merged in 1996, creating the then-largest bank in the United States. (It has since merged with J.P. Morgan, and now is J.P. Morgan Chase Company, *jpmorganchase.com*.) The unified Chase Manhattan Bank had to process 16 million checks daily across 700 locations in 58 countries. It also had to serve 25 million retail customers and thousands more institutional customers, with the customer base expected to grow by 6 to 10 percent a year. The problem was how to merge the different information systems of the two banks and create an IT architecture that would support the new bank's activities, including its future growth and additional planned acquisitions.

Previous mergers and acquisitions involving both Chase and Chemical had resulted in many problems in developing the IT architecture. "We needed to blueprint an architectural platform that provided operational excellence and customer privacy," says Dennis O'Leary, CEO and executive vice president of the new bank. "The platform also had to be functional and have the ability to integrate business at the retail, national, and global enterprise levels." One problem was the worldwide connectivity among more than 60,000 desktop computers, 14 large mainframes, 300 minicomputers, 1,100 T1 telecommunication lines, and more than 1,500 core applications.

The new architecture was constructed incorporating the Internet and intranets. (Specifically, the new architecture was based on the TCP/IP model, as described in Technology Guide 5.) An innovative three-layer system was designed. First was a global infrastructure; second were distribution networks that routed traffic among business units; and third were numerous access networks. This flexible

structure allowed the addition of networks whenever needed. The global infrastructure was a network built on wide area networks (WANs), satellites, and related technologies. The architectural plan included several security devices called *firewalls*, mainly in the distribution network layer. The access networks were the internal networks of the different business units, now reformulated as intranets. The system also had many client/server applications as well as mainframes. All the desktops were managed on Windows NT.

In 1998/99 Chase Manhattan embarked on a major e-banking initiative, based on improved architecture. By 2003 the bank offered a wide range of online services such as Chase Online Plus for managing multiple accounts, extensive online shopping, online deep-discount investment services, an online service for small businesses, and a special online payroll system (called Powerpay). In addition the bank offered services to large businesses and partners. Mobile banking was on the planning board for 2004. All of these initiatives are easily scalable, so accommodating more acquisitions and mergers, like the one with J.P. Morgan, creates no problems.

All of this massive networking has one goal: giving customers extensive real-time access to accounts and a view of their assets.

For Further Exploration: Why are banks dependent on networks? Why is a three-layer system preferable to a single layer? What are the advantages of moving to e-business?

Sources: Condensed from Girishankar, 1997, and from miscellaneous Chase Manhattan and J/P. Morgan Chase press releases in 2002 and 2003 (e.g., see 1/13/2003).

Weblogs, and e-zines). Essentially, this software provides services rather than discrete functionality.

The most important configuration of distributed processing is the *client/server architecture*, where several computers share resources and are able to communicate with many other computers via networks. The Internet, intranets, and extranets are based on the client/server model of distributed computing.

Client/Server Architecture. **Client/server architecture** divides distributed computing units into two major categories, *clients* and *servers*, all of which are connected by a network of some sort. A **client** is a computer such as a PC attached to a network, which is used to access shared network resources. A **server** is a machine that is attached to this same network and provides clients

with some services. Examples of servers are a *database server* that provides a large storage capacity, or a *communication server* that provides connection to another network, to commercial databases, or to a powerful processor. In some client/server systems there are additional computing units, referred to as *middleware* (see Technology Guide 2).

There are several models of client/server architecture. In the most traditional model, the mainframe acts as a database server, providing data for analysis done by the PC clients using spreadsheets, database management systems, and application software. For other models and more details see Technology Guide 2.

The Benefits of Client/Server Architecture. The purpose of client/server architecture is to maximize the use of computer resources. Client/server architecture provides a way for different computing devices to work together, each doing the job for which it is best suited. For example, large storage and heavy computation power is more cost-effective on a mainframe than on a PC. Common office computing, such as word processing, is more conveniently handled by a PC. The role of each machine need not be fixed. A PC, for example, can be a client in one task and a server in another. Another important element is *sharing*. The clients, which are usually inexpensive PCs, share more expensive devices, the servers.

Client/server architecture gives a company as many access points to data as there are PCs on the network. It also lets a company use more tools to process data and information. Client/server architecture has changed the way people work in organizations. For example, people are empowered to access databases at will.

Enterprisewide Computing. Client/server computing can be implemented in a small work area or in one department, where its main benefit would be the sharing of resources within that department. However, many users frequently need access to data, applications, services, electronic mail, and real-time flows of data from different departments or in different databases. The solution is to deploy **enterprisewide computing**, a client/server architecture that connects data within an entire organization. This combination of client/servers and broad access to data forms a cohesive, flexible, and powerful computing environment. An example of such an architecture is provided in the FedExNet opening case. This architecture is the core of Web-based systems.

An enterprisewide client/server architecture provides total integration of departmental and corporate IS resources. It thereby allows for an additional class of applications that span the enterprise and benefit both corporate central management (providing controls) and end-user systems (providing empowerment). It also provides better control and security over data in a distributed environment. By implementing client/server computing as the architecture for enterprisewide information systems, organizations can maximize the value of information by increasing its availability.

Many new IT developments are based on the client/server concept. These include enterprise group support technologies such as Lotus Notes/Domino, Microsoft Exchange, Netscape Communicator, and Microsoft Outlook (see Chapter 4) as well as Web-based systems and the Internet, intranets, and extranets. Client/server architecture is quickly becoming a part of, or is being replaced by, Web-based systems.

We need to discuss a couple more topics related to information architecture—legacy systems and peer-to-peer architecture—before we close this section.

LEGACY SYSTEMS. Legacy systems are older, usually mature, information systems. Although legacy systems are normally less desirable than and less compatible with modern equivalents, they are still, in some cases, part of the backbone of the overall IT infrastructure within an organization. They are usually part of a pure mainframe system or a distributed system in which the mainframe plays the major role. Newer legacy systems may include one or more LANs and even early client/server implementations.

Legacy systems were developed from the late 1950s through the 1980s for general-purpose business use in medium- to large-size companies. They were the primary mechanism for high-volume processing applications. Legacy systems typically are housed in a secured and costly computer center, operated by IS professional staff rather than by end users. Much of their work is repetitive, mainly in transaction processing. Some legacy systems are very large, including hundreds or even thousands of remote terminals networked to the mainframe processor.

Because companies invested lots of money and expertise in building legacy systems, many companies try to reengineer these systems rather than to replace them (see Chapter 14 and Martin, 2002). Erlikh (2002) provides some guidelines on how to leverage legacy systems with Web-based architecture. A futuristic way to integrate legacy systems with Web-based systems is by using Web services (described in Chapter 14).

PEER-TO-PEER ARCHITECTURE. In a client/server architecture some computers or devices serve others. Peer-to-peer architecture is a special client/server architecture that provides some additional new and useful functionalities.

Peer-to-peer (P2P) architecture is a type of network in which each client computer *shares* files or computer resources (like processing power) *directly* with others *but not through a central server*. This is in contrast with the traditional client/server architecture in which some computers serve other computers via a central server. P2P sharing typically had been done over private networks, but recently it moved to the Internet. P2P architecture is really two different things—the direct sharing of digital files, and the sharing of different computers' processing power.

The main benefit of P2P is that it can expand enormously the universe of information accessible from a personal computer or a mobile device. Additionally, some proponents claim that a well-designed P2P architecture, especially when done on the Web, can offer better security, reliability, and availability of content than the client/server model, on which the Web is currently based (e.g., see Agre, 2003, and Kini, 2002). Other advantages over client/server are that there is no need for a network administrator, the network is fast and inexpensive to set up and maintain, and each PC can make a backup copy of its data to other PCs for improved security. The technology is more productive than client/server because it enables direct connections between computers, so there is no need to incur the cost of setting up and maintaining servers.

P2P architecture is the basis of *file sharing* over the Web and the basis on which companies such as Napster, Kazaa, and Gnutella operate (see Chapters 4 and 16).

2.7 WEB-BASED SYSTEMS

The concept of client/server architecture has dominated IT architecture for several decades. But the specially structured client/server applications that were considered revolutionary in the mid-1990s may soon become obsolete due to the rapid development of Web-based systems, as well as the introduction of new concepts such as utility computing and software services (presented in Section 2.8). Although all of these new technologies are based on the client/server concept, their implementation is considerably less expensive than that of many specially structured client/server systems. Furthermore, the conversion of existing systems to Web-based ones can be easy and fast, and the functionalities of the Web-based can be larger than those available in non-Web-based client/server systems. Therefore, as is shown throughout the book and especially in Chapters 4 and 5, the Internet, intranets, and sometimes extranets are becoming an indispensable part of most IT architectures. New Web-based architectures may replace old architectures, or may integrate legacy systems into their structure (see Erlich, 2002).

Technically, the term **Web-based systems** refers to those applications or services that are resident on a server that is accessible using a Web browser and is therefore accessible from anywhere in the world via the Web. The only client-side software needed to access and execute Web-based applications is a Web browser environment, and of course the applications must conform to the Internet protocols. An example of such an application would be an online store. Additionally, two other very important features of Web-based functionalities are (1) that the generated content/data are updated in real time, and (2) that Web-based systems are universally accessible via the Web to users (dependent on defined user-access rights). The major communication networks of the Web environments are the Internet, intranets, and extranets.

The Internet Sometimes called simply “the Net,” the *Internet* is a worldwide system of computer networks—a network of networks, in which users at any one computer can get information from any other computer (and sometimes talk directly to users at other computers). Today, the Internet is a public, cooperative, and self-sustaining facility accessible to hundreds of millions of people worldwide.

Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/Internet Protocol). The Internet applications and technology are discussed in more detail in Technology Guide 5. Two adaptations of Internet technology, intranets and extranets, also make use of the TCP/IP protocol.

Intranets The concept of an intranet is a natural progression in the marriage of the enterprise and the Internet. An **intranet** is the use of Web technologies to create a private network, usually within one enterprise. Although an intranet may be a



single local area network (LAN) segment that uses the TCP/IP protocol, it is typically a complete LAN, or several intraconnected LANs. A security gateway such as a firewall is used to segregate the intranet from the Internet and to selectively allow access from outside the intranet. (See Online Minicase W2.1 for an example in academia.)

Intranets have a variety of uses, as we show throughout the book and especially in Chapters 4 and 5. They allow for the secure online distribution of many forms of internal company information. Intranets are used for workgroup activities and the distributed sharing of projects within the enterprise. Other uses include controlled access to company financial documents, use of knowledge management, research materials, online training, and other information that requires distribution within the enterprise. Intranets are usually combined with and accessed via a corporate portal.

CORPORATE PORTALS. **Corporate portals** are Web sites that provide the gateway to corporate information from a single point of access. They aggregate information from many files and present it to the user. The function of corporate portals is often described as “corecasting,” since they support decisions central to particular goals of the enterprise. Corporate portals also help to personalize information for individual customers and for employees. For further discussion of corporate portals, see Chapter 4.

Extranets **Extranets** connect several intranets via the Internet, by adding to the Internet a security mechanism and possibly some functionalities. They form a larger virtual network that allows remote users (such as business partners or mobile employees) to securely connect over the Internet to the enterprise’s main intranet. Typically, remote access software is used to authenticate and encrypt the data that pass between the remote user and the intranet. Extranets allow two or more enterprises to share information in a controlled fashion, and therefore they play a major role in the development of business-to-business electronic commerce (see Chapter 5 for details).

Web-Based E-Commerce Systems

Most e-commerce applications run on the Internet, intranet and extranets, using Web-based features. Therefore, Web-based systems are the engines of e-commerce. They enable business transactions to be conducted seamlessly 24 hours a day, seven days a week. A central property of the Web and e-commerce is that you can instantly reach millions of people, anywhere, any time. The major components of Web-based EC are electronic storefronts, electronic markets, mobile commerce, and the Enterprise Web.

ELECTRONIC STOREFRONTS. An **electronic storefront** is the Web-equivalent of a showroom or a physical store. Through the electronic storefront, an e-business can display and/or sell its products. The storefront may include electronic catalogs that contain descriptions, graphics, and possibly product reviews. Most electronic storefronts have the following common features and functions: an e-catalog, a shopping cart, a checkout mechanism (for shipments), payment processing, and an order-fulfillment system (see Chapter 5 and Turban et al., 2004).

ELECTRONIC MARKETS. Web-accessed *electronic markets* (see Chapter 5) are rapidly emerging as a vehicle for conducting e-commerce. An **electronic market** is a network of interactions and relationships over which information, products,



services, and payments are exchanged. When the marketplace is electronic, the business center is not a physical building but a Web-based location where business interactions occur. In electronic markets, the principal participants—transaction handlers, buyers, brokers, and sellers—not only are at different locations but seldom even know one another. The means of interconnection vary among parties and can change from event to event, even between the same parties. Electronic markets can reside in one company, where there is either one seller and many buyers, or one buyer and many sellers. These are referred to as *private marketplaces*. (See Online Minicase W2.2 for an example of a Web-based private marketplace.) Alternatively, electronic markets can have many buyers and many sellers. Then they are known as *public marketplaces* or *exchanges*.

Electronic Exchanges. A form of electronic markets is **electronic exchanges**, which are Web-based public marketplaces where many buyers and many sellers interact dynamically. They were originally set as trading places for commodities. Since then a variety of exchanges have emerged for all kinds of products and services (see Chapter 5).

MOBILE COMPUTING AND MOBILE COMMERCE. *Mobile computing* is a computing paradigm designed for mobile employees and others who wish to have a real-time connection between a mobile device and other computing environment. **Mobile commerce** or **m-commerce** (see Chapter 6) is commerce (buying and selling of goods and services) in a wireless environment, such as through wireless devices like cellular telephones and PDAs. Also called “next-generation e-commerce,” m-commerce enables users to access the Internet without needing to find a place to plug in. So-called *smart phones* offer Internet access, fax, e-mail, and phone capabilities all in one, paving the way for m-commerce to be accepted by an increasingly mobile workforce as well as millions of consumers. As **wireless computing**—content delivery over wireless devices—becomes faster, more secure, and scalable, there is wide speculation that m-commerce will surpass wireline e-commerce as the method of choice for digital commerce transactions (see *IT at Work 2.2*).

ENTERPRISE WEB. The **Enterprise Web** is an open environment for managing and delivering Web applications. The Enterprise Web combines services from different vendors in a technology layer that spans rival platforms and business systems, creating a foundation for building applications at lower cost. This foundation consists of the services most commonly used by Web applications, including business integration, collaboration, content management, identity management, and search, which work together via integrating technologies such as middleware (see Technology Guide 2), component-based development (Chapter 14), and Web services (Chapter 14).

The result is an environment that spans the entire enterprise, is open to all platforms for which adapters are available (or completely open with Web services), and is available to all audiences. Providing a common foundation for Web applications built on any platform lowers infrastructure and development costs; integrating resources from different systems into Web applications increases the return on those systems; and creating a common user experience for audiences across the enterprise to work together drives enterprise productivity and increases profits. Enterprise Web environments are available from all major software vendors (e.g., Microsoft, IBM, SAP, Oracle, BEA, PeopleSoft, and more). For more on the Enterprise Web, see Online File W2.5 at the book’s Web site.





IT At Work 2.2

WIRELESS PEPSI INCREASES PRODUCTIVITY



Pepsi Bottling Group (PBG), the largest manufacturer, seller, and distributor of Pepsi-Cola, has a mountainous job stocking and maintaining their Pepsi vending machines—including a huge amount of paperwork and frustrating searches for parts and equipment necessary to fix the machines. Any time a machine is out of stock or not functioning, the company loses revenue and profits. There are tens of thousands of machines to serve.

In 2002, the company began to equip its service technicians with hand-held devices, hooked into a wireless wide area network (WWAN). A mobile database application allows wireless communications around the country in real time. The database includes the repair parts inventory that is available on each service truck, so dispatchers know where and who to send for maintenance at any given moment. It also has a back-office system that maintains the overall inventory. In the near future the company will also

be able to locate the whereabouts of each truck in real time, using global positioning systems (GPSs). The aim is to make scheduling and dispatching more effective.

In the summer of 2002 only about 700 technicians used the wireless system, but already the company was saving \$7 million per year. Each technician has been able to handle one more service call each day than previously. PBG provided the wireless capability to about 300 more technicians in 20 more locations in late 2002, and many more technicians will be similarly equipped later on.

For Further Exploration: What are the capabilities of the hand-held devices? Relate the hand-held devices to the mobile database. The case deals with the maintenance issue. In what ways, if any, can wireless help with stocking issues?

Sources: Compiled from Rhey (2002) and from *pepsi.com* (March 2003).

2.8 NEW COMPUTING ENVIRONMENTS



During the last decade several new computing environments have emerged, some of which are based on Web technology. These systems are in the early stages of usage, and some are still under development, but they may reshape the IT field. In this section we provide several examples of these new initiatives. For a discussion of the issues that new networked computing systems need to address, see Online File W2.6. The following are representative initiatives of emerging computing environments.

Utility Computing

According to Bill Gates, **utility computing** is computing that is as available, reliable, and secure as electricity, water services, and telephony (Gates, public speech, January 2003). The vision behind utility computing is to have computing resources flow like electricity on demand from virtual utilities around the globe—always on and highly available, secure, efficiently metered, priced on a pay-as-you-use basis, dynamically scaled, self-healing, and easy to manage. In this setting, enterprises would plug in, turn on the computing, and (it is hoped) save lots of money. IBM (On-Demand Project), HP, Microsoft, Oracle, Sun Microsystems, SAP and other major software companies are backing the idea (see Cone, 2001).

If (or when) it becomes successful, utility computing will change the way software is sold, delivered, and used in the world. Some experts believe that all software will become a service and be sold as a utility one day (Cone, 2001). Preparing for this day, IBM is moving aggressively into the application services provider (ASP) area. The ASPs will operate the supply channels of utility computing (see Chapters 13 and 14).

Despite the bright promises and the efforts of the major vendors, progress is slow. According to Margulius (2002), key pieces of the technology are still missing. For example, utility computing is hard to do in heterogeneous data centers. Also, the utility concept works better for some applications than for others. Furthermore, utility computing needs extra security when traveling online. Finally, distributing software differs from that of distributing utilities (see Wainwright, 2002). These differences need to be overcome by vendors in order to offer utility computing in a way that appeals to customers. However, it looks like utility computing will start inside companies, where the IT department can offer utility-style services to business units for internal use, and from there may eventually spread to the computing public (see Margulius, 2002).



Grid Computing

SUBSCRIPTION COMPUTING. **Subscription computing**, a variety of utility computing, puts the pieces of a computing platform together as services, rather than as a collection of separately purchased components (Bantz et al., 2002). Users can get programs, information, or storage over the Internet (usually protected by virtual private networks; see Technology Guide 4). The services provided by subscription computing and their value to users are summarized in Online File W2.7.

Conventional networks, including the Internet, are designed to provide communication among devices. The same networks can be used to support the concept of **grid computing**, in which the unused processing cycles of all computers in a given network can be harnessed to create powerful computing capabilities. Grid computing is already in limited use, and most of the current grid applications are in areas that formerly would have required supercomputers. The grid does the computing at a much lower cost.

A well-known grid-computing project is the SETI (Search for Extraterrestrial Intelligence) @Home project. In this project, PC users worldwide donate unused processor cycles to help the search for signs of extraterrestrial life by analyzing signals coming from outer space. The project relies on individual volunteers to allow the project to harness the unused processing power of the users' computers. This method saves the project both money and resources.

A major commercial application of grid computing in the consumer market is Sony's attempt to link online thousands of Sony video-game consoles. For details see Lohr (2003).

Pervasive Computing

As discussed in Chapter 1, with *pervasive computing* we envision a future in which computation becomes part of the environment. Computation will be embedded in *things*, not in computers. Relentless progress in semiconductor technology, low-power design, and wireless technology will make embedded computation less and less obtrusive. Pervasive computing is closely related with IT support systems, especially intelligent systems and DSS. For more details about pervasive computing, see Chapter 6.

Web Services

Web services are self-contained, self-describing business and consumer modular applications, delivered over the Internet, that users can select and combine through almost any device, ranging from personal computers to mobile phones. By using a set of shared protocols and standards, these applications permit disparate systems to "talk" with one another—that is, to share data and services—without requiring human beings to translate the conversation. The result promises to be on-the-fly and in real-time links among the online processes of

different systems and companies. These links could shrink corporate IT departments, foster new interactions among businesses, and create a more user-friendly Web for consumers. Web services provide for inexpensive and rapid solutions for application integration, access to information, and application development. See Chapters 4, 5, and 14.

Commercial Efforts in New Computing Environments



Three software companies currently are developing major products in the emerging computer environments. All will incorporate utility computing, pervasive computing, and Web services sometime in the future. Microsoft is launching a major research effort, known as *Microsoft.Net* (www.microsoft.com/net/default.asp). IBM is developing its WebSphere platform (ibm.com/software/websphere). And Sun Microsystems is building a new system architecture in its N1 Project. For more about these commercial ventures, see the Online File W2.8

Whether an organization uses mainframe-based legacy systems or cutting-edge Web-based ones, its information resources are extremely important organizational assets that need to be protected and managed. This topic is presented in Section 2.9.

2.9 MANAGING INFORMATION RESOURCES

A modern organization possesses many information resources. In addition to the infrastructures, numerous applications exist, and new ones are continuously being developed. Applications have enormous strategic value. Firms rely on them so heavily that, in some cases, when they are not working even for a short time, an organization cannot function. Furthermore, the acquisition, operation, security, and maintenance of these systems may cost a considerable amount of money. Therefore, it is essential to manage these information systems properly. The planning, organizing, implementing, operating, and controlling of the infrastructures and the organization's portfolio of applications must be done with great skill.

Which IT Resources Are Managed and By Whom

The responsibility for the management of information resources is divided between two organizational entities: the *information systems department (ISD)*, which is a corporate entity, and the *end users*, who are scattered throughout the organization. This division of responsibility raises important questions such as: Which resources are managed by whom? What is the role of the ISD, its structure, and its place in the organization? What are the relationships between the ISD and the end users? Brief answers to these questions are provided in this section.

There are many types of information systems resources, and their components may be from multiple vendors and of different brands. The major categories are *hardware* (all types of computers, servers, and other devices), *software* (development tools, languages, and applications), *databases*, *networks* (local, wide, Internet, intranets and extranets, and supporting devices), *procedures*, *security facilities*, and *physical buildings*. The resources are scattered throughout the organization, and some of them change frequently. Therefore, it may be rather difficult to manage IS resources.

There is no standard menu for the division of responsibility for the development and maintenance of IS resources between the ISD and end users. In some organizations, the ISD manages most of these resources, regardless of where they are located and how they are used. In others, the ISD manages only a few. The division depends on many things: the size and nature of the organization, the amount and type of IT resources, the organization's attitudes toward

TABLE 2.4 The Changing Role of the Information Systems Department*Traditional Major IS Functions*

Managing systems development and systems project management
 Managing computer operations, including the computer center
 Staffing, training, and developing IS skills
 Providing technical services

New (Additional) Major IS Functions

Initiating and designing specific strategic information systems
 Infrastructure planning, development, and control
 Incorporating the Internet and electronic commerce into the business
 Managing system integration including the Internet, intranets, and extranets
 Educating the non-IS managers about IT
 Educating the IS staff about the business
 Supporting end-user computing
 Partnering with the executive level that runs the business
 Managing outsourcing
 Proactively using business and technical knowledge to “seed” innovative ideas about IT
 Creating business alliances with vendors and IS departments in other organizations

computing, the attitudes of top management toward computing, the maturity level of the technology, the amount and nature of outsourced IT work, and even the country in which the company operates.

Generally speaking, the ISD is responsible for corporate-level and *shared resources*, while the end users are responsible for departmental resources. Sometimes the division between the ISD and the end users is based on other approaches. For example, the ISD may acquire or build systems and the end users operate and maintain them.

Because of interdependencies of information resources, it is important that the ISD and the end users work closely together and cooperate regardless of who is doing what. We discuss this below and also in Chapter 15.

The Role of the IS Department

As Table 2.4 shows, the role of the ISD is changing from purely technical to more managerial and strategic. As a result of this changing role, the position of the ISD within the organization is tending to be elevated from a unit reporting to a functional department (such as accounting) to a unit reporting to a senior vice president of administration or even to the CEO. In this new role, the ISD must be able to work closely with external organizations such as vendors, business partners, consultants, research institutions, and universities. In addition, the ISD and the end-user units must be close partners. The mechanisms that build the required cooperation are described in Chapter 15.

The role of the director of the ISD is also changing, from a technical manager to a senior executive, sometimes referred to as the **chief information officer** (CIO), or the *chief technology officer* (CTO). Details are provided by Ball (2002) and in Chapter 15.

IT ISSUES. In early 2003, the major issues in IT management were how to cope with declining budgets, how to move an organization’s IT systems to fit the digital age, how to integrate applications, how to secure information systems, how much to outsource, how to measure the return on IT investment, and how to deal with emerging technologies such as Web services. All of these issues are covered in many places throughout this book.

 **MANAGERIAL ISSUES**

1. ***The transition to e-business.*** Converting an organization to a networked-computing-based e-business may be a complicated process. The e-business requires a client/server architecture, an intranet, an Internet connection, and e-commerce policy and strategy, all in the face of many unknowns and risks. However, in many organizations this potentially painful conversion may be the only way to succeed or even to survive. When to do it, how to do it, what will be the role of the enabling information technologies and what will be the impacts of such a conversion are major issues for organizations to consider.
2. ***From legacy systems to client/server to intranets, corporate portals, and Web-based systems.*** A related major issue is whether and when and how to move from the legacy systems to a Web-based client/server enterprisewide architecture. While the general trend is toward Web-based client/server, there have been several unsuccessful transformations, and many unresolved issues regarding the implementation of these systems. The introduction of intranets seems to be much easier than that of other client/server applications. Yet, moving to any new architecture requires new infrastructure and a decision about what to do with the legacy systems, which may have a considerable impact on people, quality of work, and budget. A major aspect is the introduction of wireless infrastructure. These important issues are discussed in detail in Chapters 13 and 14.

It should be noted that many companies need high-speed computing of high-volume data. Here the client/server concept may not be effective. In such cases, management should consider transformation of the legacy systems to new types of mainframes that use innovations that make the systems smaller and cheaper.

3. ***How to deal with the outsourcing and utility computing trends.*** As opportunities for outsourcing (e.g., ASPs) are becoming cheaper, available, and viable, the concept becomes more attractive. In the not-so-distant future, we will see outsourcing in the form of utility computing. How much to outsource is a major managerial issue (see Chapters 13 and 14).
4. ***How much infrastructure?*** Justifying information system applications is not an easy job due to the intangible benefits and the rapid changes in technologies that often make systems obsolete. Justifying infrastructure is even more difficult since many users and applications share the infrastructure that will be used for several years in the future. This makes it almost impossible to quantify the benefits. Basic architecture is a necessity, but there are some options. Various justification methodologies are discussed in Chapter 13.
5. ***The roles of the ISD and end users.*** The role of the ISD can be extremely important, yet top management frequently mistreats it. By constraining the ISD to technical duties, top management may jeopardize an organization's entire future. However, it is not economically feasible for the ISD to develop and manage all IT applications in an organization. End users play an important role in IT development and management. The end users know best what their information needs are and to what degree they are fulfilled. Properly managed end-user computing is essential for the betterment of all organizations (see Chapters 9 and 14).



6. **Ethical issues.** Systems developed by the ISD and maintained by end users may introduce some ethical issues. The ISD's major objective should be to build efficient and effective systems. But, such systems may invade the privacy of the users or create advantages for certain individuals at the expense of others. See Ethics in IT Management (Appendix 1.1 in Chapter 1), the Ethics Primer (Chapter 1 online), and Chapter 16 (online) for details.



ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; other cases; tables and figures; updates; additional exercises; links; and demos and activities can be found on the book's Web site.

KEY TERMS

Application program (p. ●●●)	Electronic storefront (p. ●●●)	Machine learning (p. ●●●)
Business architecture (p. ●●●)	Enterprise Web (p. ●●●)	Mobile commerce (m-commerce) (p. ●●●)
Chief information officer (CIO) (p. ●●●)	Enterprisewide computing (p. ●●●)	Mobile computing (p. ●●●)
Client (p. ●●●)	Enterprisewide information system (EIS) (p. ●●●)	Peer-to-peer (p2P) architecture (p. ●●●)
Client/server architecture (p. ●●●)	Extranets (p. ●●●)	Server (p. ●●●)
Cooperative processing (p. ●●●)	Functional MIS (p. ●●●)	Smart terminal (p. ●●●)
Corporate portals (p. ●●●)	Grid computing (p. ●●●)	Subscription computing (p. ●●●)
Data item (p. ●●●)	Information (p. ●●●)	Supply chain (p. ●●●)
Data workers (p. ●●●)	Information infrastructure (p. ●●●)	Transaction processing system (TPS) (p. ●●●)
Database (p. ●●●)	Information system (IS) (p. ●●●)	Utility computing (p. ●●●)
Desktop publishing systems (p. ●●●)	Information technology architecture (p. ●●●)	Web-based systems (p. ●●●)
Distributed processing (p. ●●●)	Interorganizational information system (IOS) (p. ●●●)	Web services (p. ●●●)
Document management system (DMS) (p. ●●●)	Intranet (p. ●●●)	Wireless computing (p. ●●●)
Electronic data interchange (EDI) (p. ●●●)	Knowledge (p. ●●●)	Word processing systems (p. ●●●)
Electronic exchanges (p. ●●●)	Knowledge workers (p. ●●●)	
Electronic markets (p. ●●●)	Legacy system (p. ●●●)	

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- Information systems can be organized according to organizational hierarchy (e.g., departmental, enterprisewide, and interorganizational) or by the nature of supported task (e.g., operational, managerial, and strategic).
- Interorganizational information systems (IOSs) connect two or more organizations and play a major role in e-business.
- The transaction processing system (TPS) covers the core repetitive organizational transactions such as purchasing, billing, or payroll.
- The data collected in a TPS are used to build other systems.
- The major functional information systems in an organization are accounting, finance, manufacturing (operations), human resources, and marketing.

- 2, 3 The term *management information system* refers to the department that manages information systems in organizations. (The acronym MIS is also used more generally to describe the field of IT.)
- 3 The main general support systems are office automation systems, decision support systems, executive support systems, group support systems, knowledge management systems, enterprise information systems, expert systems, and artificial neural networks.
- 3 Managerial activities and decisions can be classified as operational, managerial (tactical), and strategic.
- 4 Two of the major IT-supported managerial activities are improving supply chain operations and the introduction of a variety of customer relationship management (CRM) activities. IT is a major enabler of both.
- 5 Information architecture provides the conceptual foundation for building the information infrastructure and specific applications. It maps the information requirements as they relate to information resources.
- 5 There are three major configurations of information architecture: the mainframe environment, the PC environment, and the distributed (networked) environment. An emerging architecture is peer-to-peer.
- 5 The information infrastructure refers to the shared information resources (such as a corporate database) and their linkages, operation, maintenance, and management.
- 6 In client/server architecture, several PCs (the clients) are networked among themselves and are connected to databases, telecommunications, and other devices (the servers) that provide services.
- 6 An enterprisewide information system is a system that provides communication among all the organization's employees. It also provides accessibility to any data or information needed by any employee at any location.
- 6 Legacy systems are older systems in which the mainframe is at the core of the system.
- 7 Web-based systems refer to those applications or services that reside on a server that is accessible using a Web browser. Examples are the Internet, intranets, extranets, e-commerce and storefronts, corporate portals, electronic markets and exchanges, and mobile commerce.
- 8 There is a trend for renting application software as needed rather than buying it. This way, there is no need to build systems or own software. This approach, called *utility computing*, is similar to buying water or electricity when needed.
- 8 Wireless is becoming the network of choice for many applications.
- 9 Information resources are extremely important, and they must be managed properly by both the ISD and end users. In general, the ISD manages shared enterprise information resources such as networks, while end users are responsible for departmental information resources, such as PCs.
- 9 The role of the ISD is becoming more managerial, and its importance is rapidly increasing.

QUESTIONS FOR REVIEW

- 1. Define data, information, and knowledge.
- 2. Describe a TPS.
- 3. What is an MIS?
- 4. Explain the role of the DSS.
- 5. How does a KMS work?
- 6. Describe operational, managerial, and strategic activities.
- 7. What information systems support the work of groups?
- 8. What is an enterprisewide system?
- 9. What is information architecture?
- 10. Define information infrastructure.
- 11. Describe the evolution of support systems over time.
- 12. What is a Web-based system?
- 13. Define the Internet, intranet, and extranet.
- 14. What is mobile commerce?
- 15. List the information resources that are usually managed by end users.
- 16. Distinguish between a mainframe and a distributed environment.
- 17. Define a legacy system.
- 18. What is a client/server system?
- 19. Define utility computing.
- 20. What/who are knowledge workers?
- 21. Define peer-to-peer architecture.
- 22. Define grid computing.

QUESTIONS FOR DISCUSSION

1. Discuss the logic of building information systems in accordance with the organizational hierarchical structure.
2. Distinguish between interorganizational information systems (IOS) and electronic markets.
3. Describe how business architecture, IT architecture, and information infrastructure are interrelated.
4. Explain how operational, managerial, and strategic activities are related to various IT support systems.
5. Relate the following concepts: client/server, distributed processing, and enterprisewide computing.
6. Discuss the capabilities of P2P architecture.
7. Web-based applications such as e-commerce and e-government exemplify the platform shift from client/server computing to Web-based computing. Discuss the advantages of a Web-based operating environment.
8. Is the Internet an infrastructure, architecture, or application program? Why? If none of the above, then what is it?
9. There is wide speculation that m-commerce will surpass wireline e-commerce (e-commerce that takes place over wired networks) as the method of choice for digital commerce transactions. What industries or application areas will be most affected by m-commerce?
10. Some speculate that utility computing will be the dominating option of the future. Discuss why or why not.

EXERCISES

1. Relate each of the following systems as one (or more) of the IT support systems:
 - a. A student registration system in a university.
 - b. A system that advises farmers about which fertilizers to use.
 - c. A hospital patient-admission system.
 - d. A system that provides a marketing manager with demand reports regarding the sales volume of specific products.
 - e. A robotic system that paints cars in a factory.
2. Select two companies you are familiar with and find their mission statement and current goals (plans). Explain how these goals are related to operational, managerial, and strategic activities on one-to-one basis. Then explain how information systems (by type) can support the activities (be specific).
3. Review the list of key IT management issues (see the subsection titled, "The Role of the IS Department," page ●●●).
 - a. Present these issues to IT managers in a company you can access. (You may want to develop a questionnaire.)
 - b. Have the managers vote on the importance of these items. Also ask them to add any items that are important to them but don't appear on the list. Report the results.
4. Review the following systems in this chapter and identify the support provided by IT:
 - Chase Manhattan Bank
 - Best Buy online
 - Bomb detection by the FAA
 - Maybelline (Minicase 1)
 - JCPenney (Minicase 2)

GROUP ASSIGNMENTS

1. Observe a checkout counter in a supermarket that uses a scanner. Find some material that describes how the scanned code is translated into the price that the customers pay.
 - a. Identify the following components of the system: inputs, processes, and outputs.
 - b. What kind of a system is the scanner (TPS, DSS, ESS, ES, etc.)? Why did you classify it as you did?
 - c. Having the information electronically in the system may provide opportunities for additional managerial uses of that information. Identify such uses.
 - d. Checkout systems are now being replaced by self-service checkout kiosks and scanners. Compare the two.
2. Divide the class into teams. Each team will select a small business to start (a restaurant, dry cleaning business, small travel agency, etc.). Assume the business wants to become an e-business. Each team will plan the architecture for the business's information systems, possibly in consultation with Microsoft or another vendor. Make a class presentation.



Minicase 1

E-Commerce Supports Field Employees at Maybelline

The Business Problem

Maybelline is a leader in color cosmetics products (eye shadow, mascara, etc.), selling them in more than 70 countries worldwide (*maybelline.com*). The company uses hundreds of salespeople (field merchandising representatives, or “reps”), who visit drugstores, discount stores, supermarkets, and cosmetics specialty stores, in an attempt to close deals. This method of selling has proved to be fairly effective, and it is used by hundreds of other manufacturers such as Kodak, Nabisco, and Procter & Gamble. Sales reps from any company need to know, as quickly as possible, when a deal is closed or if there is any problem with the customer.

Information technology has been used extensively to support sales reps. Until 2000, Maybelline, as well as many other large consumer product manufacturers, equipped reps with an interactive voice response (IVR) system, by means of which they were to enter, every evening, information about their daily activities. This solution required that the reps collect data with paper-based surveys completed for every store they visited each day. For example, the reps note how each product is displayed, how much stock is available, how items are promoted, etc. In addition to the company’s products the reps survey the competitors’ products as well. In the evening, the reps translated the data collected into answers to the voice response system, which asked them routine questions. The reps answered by pressing the appropriate telephone keys.

The IVR system was not the perfect way to transmit sales data. For one thing, the old system consolidated information, delivering it to top management as a hard copy. Also, unfortunately, these reports sometimes reached top management days or weeks too late, missing important changes in trends and the opportunities to act on them in time. Frequently, the reps themselves were late in reporting, thus further delaying the needed information.

Even if the reps did report on time, information was inflexible, since all reports were menu-driven. With the voice system the reps answered only the specific questions that applied to a situation. To do so, they had to wade through over 50 questions, skipping the irrelevant ones. This was a waste of time. In addition, some of the material that needed to be reported had no matching menu questions. Considered a success in the 1990s, the system was unable to meet the needs of the twenty-first century. It was cumbersome to set up and operate and was also prone to input errors.

The E-business Solution

Maybelline replaced the IVR system by equipping its reps with a mobile system, called Merchandising Sales Portfolio (MSP), from Thinqe Corp. (*thinqe.com*). It runs on handheld, pen-based PDAs (personal digital assistants), which have handwriting recognition capability (from NEC), powered by Microsoft’s CE operating system. The system enables reps to enter their information by hand-writing

INTERNET EXERCISES

1. Enter the site of Federal Express (*fedex.com*) and find the current information systems used by the company or offered to FedEx’s customers. Explain how the systems’ innovations contribute to the success of FedEx.
2. Surf the Internet for information about airport security regarding bomb- and weapon-detecting devices. Examine the available products, and comment on the IT techniques used.
3. Enter the Web site of Hershey (*hersheys.com*). Examine the information about the company and its products and markets. Explain how an intranet can help such a company compete in the global market.
4. Investigate the status of utility computing by visiting *infoworld.com/forums/utility*, *aspnews.com* (discussion forum), *google.com*, *ibm.com*, *oracle.com*, and *cio.com*. Prepare a report that will highlight the progress today and the current inhibitors.
5. Enter *argus-acia.com* and learn about new developments in the field of information architecture. Also, view the tutorials at *hotwired.com/webmonkey* on this topic. Summarize major new trends.
6. Investigate the status of pervasive computing by looking at *ibm.com/software/pervasive*, *computer.org/pervasive*, and *percom.org*. Prepare a report.
7. Enter *cio.com* and find recent information on the changing role of the CIO and the ISD. Prepare a report.
8. Enter *sap.com* and *mysap.com* and identify material related to supply chain and enterprisewide systems. Prepare a report.

their reports directly at the clients' sites. From the handheld device, data can be uploaded to a Microsoft SQL Server database at headquarters every evening. A secured Internet connection links the PDA to the corporate intranet (a synchronization process). The new system also enables district managers to electronically send daily schedules and other important information to each rep.

The system also replaced some of the functions of the EDI (electronic data interchange) system, a pride of the 1990s. For example, the reps' reports include inventory-scanned data from retail stores. These are processed quickly by an *order management system*, and passed whenever needed to the shipping department for inventory replenishment.

In addition to routine information, the new system is used for decision support. It is not enough to speed information along the supply chain; managers need to know the *reasons why* certain products are selling well, or not so well, in every location. They need to know what the conditions are at retail stores affecting the sales of each product, and they need to know it in a timely manner. The new system offers those capabilities.

The Results

The system provided managers at Maybelline headquarters with an interactive link with the mobile field force. Corporate planners and decision makers can now respond much more quickly to situations that need attention. The solution is helping the company forge stronger ties with its retailers, and it considerably reduces the amount of after-hours time that the reps spend on data transfer to headquarters (from 30–50 minutes per day to seconds).

The new system also performs market analysis that enables managers to optimize merchandising and customer service efforts. It also enables Maybelline to use a more sophisticated interactive voice response unit—to capture data for special situations. Moreover, it provides browser-based reporting tools that enable managers, regardless of where they are, to view retail information within hours of its capture. Using the error-checking and validation feature in the MSP system, reps make significantly fewer data entry errors.

Finally, the quality of life of Maybelline reps has been greatly improved. Not only do they save 30 to 40 minutes per day, but also their stress level has been significantly reduced. As a result, employee turnover has declined appreciably, saving money for the company.

Questions for Minicase 1

1. IVR systems are still popular. What advantages do they have over even older systems in which the reps mailed or faxed reports?
2. Summarize the advantages of the new system over the IVR one.
3. Explain why Maybelline's new reporting system is an e-commerce application.
4. The existing technology enables transmission of data any time an employee can access the Internet with a wireline. Technically, the system can be enhanced so that the data can be sent *wirelessly* from any location as soon as they are entered. Would you recommend a wireless system to Maybelline? Why or why not?

Source: Compiled from "Industry Solutions—Maybelline," at *thinque.com* (accessed May 15, 2002).



Minicase 2

Two Faces of JCPenney

In 2000, Dallas retailer JCPenney (*JCPenney.com*) enhanced its e-retail position in time for the holiday rush by adding homegrown site features that let customers more quickly locate and pay for merchandise. With *JCPenney.com*, the company unveiled express checkout services that let customers zip through a purchase in as few as two clicks. It also inaugurated electronic gift certificates that can be redeemed online, plus improved order tracking to give customers more accurate delivery estimates. These features followed the early November 2000 launch of Mercado Search, a search engine that lets shoppers prowl JCPenney's site by product category and receive results ranked according to relevance. In 2001, the company rolled out specialized sites dedicated to name-brand merchandise, making it easier for customers to find certain products. All these steps were designed to boost the company's online strategy.

The success of JCPenney.com, in large measure, is a result of a customer service and logistics infrastructure built to support a multibillion-dollar catalog business that has been extended online. JCPenney.com broadened its appeal by launching specialty sites to promote high-margin brands, including Sony, Levi Strauss, Nike, and Kitchen Aid appliances. The idea is to drive purchases of name-brand merchandise by providing more detailed information on those products, as well as direct links to the manufacturers. JCPenney is also conducting auctions on its Web site.

The company boasts strong integration between its Web site and its offline infrastructure that helps the site reach its aggressive sales targets. Anything purchased online can be picked up or returned at any JCPenney or Eckerd store. JCPenney has 14 customer-service centers nationwide that handle catalog and phone inquiries, and employees have been cross-trained in e-mail. United Parcel Service (UPS) delivers most merchandise ordered online within 24 to 72 hours.

JCPenney serves customers via three sales channels—stores, catalogs, and the Web site. Integrating these three channels will eventually pay off, according to Forrester Research analyst Seema Williams. “As the number of on-line shoppers grows, the impact from multiple channels will be felt much more on JCPenney's bottom line,” Williams said.

Despite the strong Web performance, e-commerce alone most likely cannot turn around a company of JCPenney's size. “The Web is such a small part of their business; there's no way it's going to turn around the company,” said an expert. “The Web is icing on the cake, but the biggest part of the company, by far, is struggling.”

Questions for Minicase 2

1. How does a search engine help JCPenney to do a better job in customer service?
2. Does its existing legacy system help JCPenney.com accomplish its goal in promoting its online business? Can any of the emerging technologies be used to further improve the situation?
3. What kind of information technologies can be used to help JCPenney to promote its business? To accomplish its business strategies?
4. Visit *JCPenney.com* to see how the company uses its storefront to provide customer services.
5. Visit *sears.com* and *marksandspencer.com*, and find out these companies' e-commerce strategies. Compare the functionalities offered there with those of JCPenney.

Sources: Compiled from “The Two Faces of J.C. Penney,” www.internetweek.com/lead/lead_112400.htm (November 2000) and from *jcpenney.com*, press releases Jan.–Feb. 2003.



Virtual Company Assignment

TWC Information Architecture

You've enjoyed a few meals at TWC, and you're starting to learn your way around the restaurant's back office. Now, you need to get to work on a preliminary study of the restaurant's information architecture.

In addition to managing the restaurant operations, Jeremy has implemented most of the information technologies at TWC, though he has not had the time to document what he has done. To better understand where the restaurant's IT is headed, you need to understand it now. Jeremy has also asked you to help him document the existing infrastructure.

1. Identify three people you want to interview at TWC to help you understand the current information architecture
 - a. For each person, prepare three questions you'll ask them to elicit information about their perspective on information needs
 - b. To better prepare yourself for the interviews, go online and do some research on the software and hardware available for the restaurant industry
2. What kinds of information does TWC collect at the transaction level?
3. What kind of management and decision support information do Barbara and Jeremy need?
4. What competitive opportunities do you see for IT at TWC?

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APPENDIX 2.1

BUILD-TO-ORDER PRODUCTION

The concept of build-to-order means that you start to make a product (service) only *after* an order for it is placed. This concept is as old as commerce itself, and was the only method of production until the Industrial Revolution began. According to this concept, if you need a pair of shoes, you go to a shoemaker who takes the measurement. You negotiate quality, design, and price, and you make a down payment. The shoemaker buys the materials and makes a customized product for you. Customized products were expensive, and it took a long time to finish them. This changed with the coming of the Industrial Revolution.

The Industrial Revolution started with the concept of dividing work into small parts. Such *division of labor* makes the work simpler, requiring less training for employees. It also allows for *specialization*. Different employees become experts in executing certain tasks. Because the work segments are simpler, it is easier to *automate* them. All this reduces the prices to consumers, and demand increases. So the concept of *build-to-market* was created. To build to market, it was necessary to design standard products, produce them, store them, and then sell them. The creation of standard products by automation drove prices down still further and demand accelerated. To meet the ever-increasing demand, the solution of mass production was created.

According to the concept of *mass production*, a manufacturer produces large amounts of standard products at a very low cost, and then “pushes” (markets) them to consumers. With increased competition and the desire to sell in remote markets, it was necessary to create special marketing organizations to do the sales. This new model also required the creation of large factories, and finance, accounting, personnel, and other departments to keep track of the many new and specialized business activities. In mass production, the workers do not know who the customers are, and frequently do not care about customers’ needs or product quality. But the products are inexpensive, and their price fueled demand, so the concept became a dominant one. Mass production also required inventory systems at various places in the supply chain, which were based on forecasted demand. If

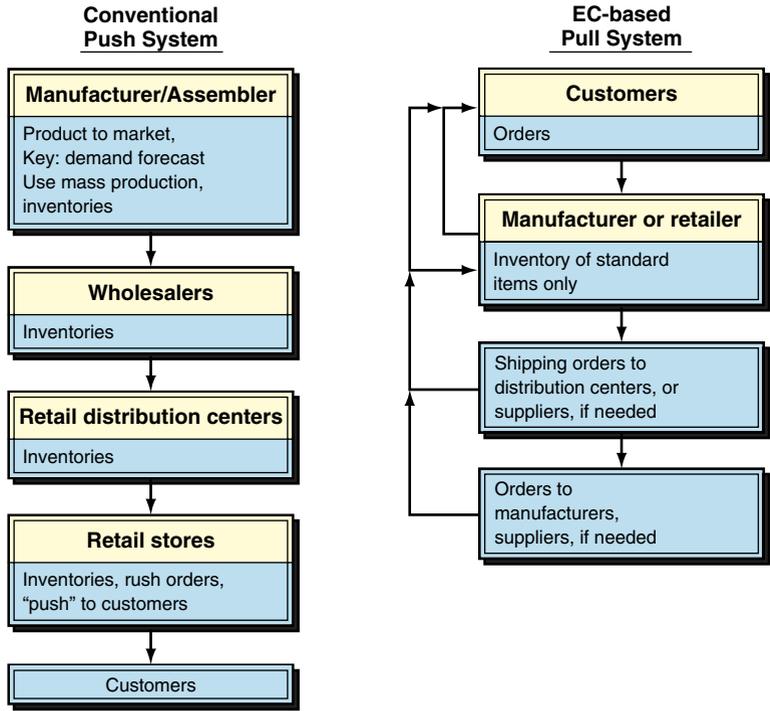
the forecasted demand was wrong, the inventories were incorrect: Either the inventories were insufficient to meet demand, or there was too much inventory at hand.

As society became more affluent, the demand for customized products, especially cars, increased. To make sales, manufacturers had to meet this kind of demand. As long as the demand for customized product was small, there was no problem of meeting it. In purchasing a new car, for example, customers were asked to pay a premium and wait for a long time, and they were willing to do so. Slowly, the demand for customized products and services increased. In the 1970s, Burger King introduced the concept of “having it your way,” and manufacturers began looking for solutions for providing customized products in large quantities. This idea is the essence of *mass customization*. Such solutions were usually enhanced by some kind of information technologies (Pine and Gilmore, 1999).

The introduction of customized PCs by Dell Computers was so successful that many other industries wanted to try mass customization. However, they found that it is not so easy to do so (Zipkin, 2001, Agrawal et al., 2001). Using e-commerce can facilitate the use of customization and even the use of mass customization (Holweg and Pil, 2001). To understand it, let’s look first at a comparison of mass production, also known as a *push system*, with mass customization, also known as a *pull system*, as shown in the attached figure.

Notice that one important area in the supply chain is ordering. Using EC a customer can self-configure the desired product online. The order is received in seconds, and once it is verified and payment arranged, the order is sent electronically to the production floor. This saves processing time and money. For complex products, customers may collaborate in real time with the manufacturer’s designers, as is done at Cisco Systems. Again, time and money are saved, and errors are reduced due to better communication and collaboration.

Other contributions of EC to mass customization are the following: The customers’ needs are visible to all partners in the order-fulfillment chain (fewer delays, faster response time); inventories are



reduced due to rapid communication; and digitizable products and services can be delivered electronically, at almost no additional cost.

Another key area in mass customization is understanding what the customers want, and EC is also very helpful here (see Chapter 4 and Holweg and Pil, 2001). E-commerce can help in expediting the production changeover from one item to another. Also, since most mass production is based on assembly of standard components, EC can help make the production configuration in minutes, including the identification of the needed components and their location. Furthermore, a production schedule can be

automatically generated, detailing deployment of all needed resources, including money. This is why many industries, and particularly the auto manufacturers, are planning to move to build-to-order using EC. As a result of this change in production methods, they are expecting huge cost reductions, shorter order-to-delivery time, and lower inventory costs. (See Exhibit 1 in Agrawal et al., 2001, and Holweg and Pil, 2001.)

Mass customization on a large scale is not easy to attain (Zipkin, 2001; Agrawal et al., 2001), but if properly performed, it may become the dominant model in many industries.

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PART I
IT in the Organization



1. Information Technology in the Digital Economy
2. Information Technologies: Concepts and Management
- ▶ 3. Strategic Information Systems for Competitive Advantage

CHAPTER

3

Strategic Information Systems for Competitive Advantage

Rosenbluth International:
Competing in the Digital
Economy

3.1

Strategic Advantage and
Information Technology

3.2

Porter's Competitive Forces
Model and Strategies

3.3

Porter's Value Chain Model

3.4

Interorganizational Strategic
Information Systems

3.5

A Framework for Global
Competition

3.6

Strategic Information
Systems: Examples and
Analysis

3.7

Implementing and Sustaining
SIS

Minicases: (1) Cisco Systems/
(2) Aeronautica Civil

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Describe strategic information systems (SISs) and explain their advantages.
- 2 Describe Porter's competitive forces model and how information technology helps companies improve their competitive positions.
- 3 Describe 12 strategies companies can use to achieve competitive advantage in their industry.
- 4 Describe Porter's value chain model and its relationship to information technology.
- 5 Describe how linking information systems across organizations helps companies achieve competitive advantage.
- 6 Describe global competition and global business drivers.
- 7 Describe representative SISs and the advantage they provide to organizations.
- 8 Discuss the challenges associated with sustaining competitive advantage.



ROSENBLUTH INTERNATIONAL: COMPETING IN THE DIGITAL ECONOMY

➔ THE PROBLEM

Rosenbluth International (*rosenbluth.com*) is a major global player in the extremely competitive travel agent industry. Rosenbluth's mission is "to be the quality leader in the development and distribution of global travel services and information." The digital revolution has introduced various threats and business pressures to Rosenbluth and other agencies in the industry:

1. Airlines, hotels, and other service providers are attempting to displace travel agents by moving aggressively to electronic distribution systems (e.g., airlines are issuing electronic tickets and groups of airlines are sponsoring selling portals for direct sale of tickets and packages).
2. Some travel service providers have reduced commissions caps and have cut the commission percentage for travel agents from 10 percent to 8 and then to 5 percent.
3. A number of new online companies such as *expedia.com* are providing diversified travel services as well as bargain prices, mostly to attract individual travelers. These services are penetrating to the corporate travel area, which has been the "bread and butter" of the travel agents' business.
4. The competition among the major players is rebate-based. The travel agencies basically give back to their customers part of the commission they get from travel service providers.
5. Innovative business models that were introduced by e-commerce, such as auctions and reverse auctions, were embraced by the providers in the industry, adding to competitive pressures on travel agencies (see Turban et al., 2004).

All of these business pressures threatened the welfare of Rosenbluth.

➔ THE SOLUTION

The company responded with two strategies. First, it decided to get out of the leisure travel business, instead becoming a purely corporate travel agency. Second, it decided to rebate customers with the *entire* commission the agency receives and instead bill customers by service provided. Rosenbluth charges fees, for example, for consultation on how to lower costs, for development of in-house travel policies, for negotiating for their clients with travel providers, and for calls answered by the company staff. To implement this second strategy, which completely changed the company's business model, it was necessary to use several innovative information systems.

Rosenbluth uses a comprehensive Web-based business travel management solution that integrates Web-based travel planning technology, policy and profile management tools, proprietary travel management applications, and seamless front-line service/support. This browser-based service allows corporate travelers to book reservations any time, anywhere—within corporate travel policy—in minutes. Three of the customer-facing tools that comprise this system are:

- **DACODA (Discount Analysis Containing Optimal Decision Algorithms).** This is a patented yield-management system that enables travel managers to decipher complex airline pricing and identify the most favorable airline contracts. Use of this system optimizes a client corporation's travel savings.
- **Global Distribution Network.** This network electronically links the corporate locations and enables instant access to any traveler's itinerary, personal travel preferences, or corporate travel policy.
- **iVISION.** This proprietary back-office application provides Rosenbluth's clients with consolidated, global data to enable them to negotiate better prices with airlines, hotels, car rental companies, and other travel providers.

THE RESULTS

Using its IT innovations, Rosenbluth grew from sales of \$40 million in 1979 to over \$5 billion in 2002. Today, the company has physical offices in 57 countries and employs over 4,700 associates. The company not only survived the threats of elimination but has become the third-largest travel management company in the world and a leader in customer service, travel technology, and integrated information management.

Sources: Compiled from Clemons and Hann (1999) and from information at rosenbluth.com.

LESSONS LEARNED FROM THIS CASE

This opening case is a vivid example of a company that has achieved competitive advantage in the digital era by using IT. Rosenbluth's experience illustrates the following points:

- It is sometimes necessary to completely change business models and strategies to succeed in the digital economy.
- Web-based IT enables companies to gain competitive advantage and to survive in the face of serious corporate threat.
- Global competition is not just about price and quality; it is about service as well.
- IT may require a large investment over a long period of time.
- Extensive networked computing infrastructure is necessary to support a large global system.
- Web-based applications can be used to provide superb customer service.
- It is necessary to patent innovative systems to assure competitive advantage. Otherwise, competitors will copy the systems, and the advantage will disappear.

The most important lesson learned from this case is the double-sided potential of the Internet: It can become a threat to an entire industry, yet it can also be an extremely important tool for gaining strategic advantage for an innovative company. As a matter of fact, many executives who until 1998 were cynical about the strategic advantages of IT have completely reversed their attitudes. They are seeing the potential of Web-based systems to provide competitive advantage to organizations, and Web-based opportunities and risks are now attracting universal attention in executive boardrooms.

As a matter of fact, computer-based information systems of all kinds have been enhancing competitiveness and creating strategic advantage for several decades (e.g., see Griffiths et al., 1998, Galliers et al., 1999, and Ward and Peppard, 2002). Through numerous examples, this chapter demonstrates how different kinds of strategic information systems work. We also present some classic models upon which strategic information systems have been built and utilized from the 1970s to this very day.

3.1 STRATEGIC ADVANTAGE AND INFORMATION TECHNOLOGY

Strategic Information Systems

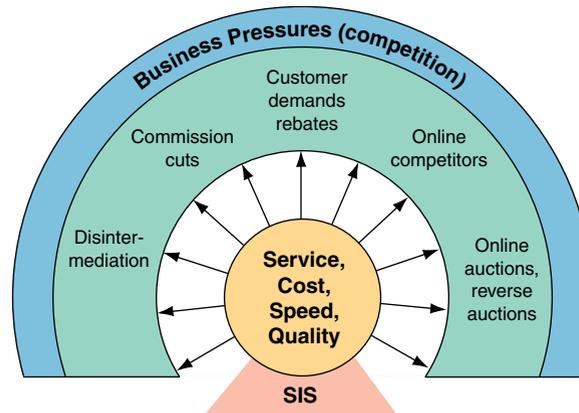
Strategic information systems (SISs), like the ones developed at Rosenbluth International, are systems that *support* or *shape* a business unit's competitive strategy (Callon, 1996, and Neumann, 1994). An SIS is characterized by its ability to *significantly* change the manner in which business is conducted, in order to give the firm strategic advantage. An SIS cannot be classified by organizational structure, functional area, or support system as described in the previous chapter. Any information system—EIS, OIS, TPS, KMS—that changes the goals, processes, products, or environmental relationships to help an organization gain a competitive advantage or reduce a competitive disadvantage is a strategic information system.

A *competitive strategy* is a broad-based formula for how a business is going to compete, what its goals should be, and what plans and policies will be required to carry out those goals (Porter, 1985). Through its competitive strategy an organization seeks a **competitive advantage** in an industry—an advantage over competitors in some measure such as cost, quality, or speed. Competitive advantage is at the core of a firm's success or failure (Porter and Millar, 1985, and Porter, 1996); such advantage seeks to lead to control of the market and to larger-than-average profits. A strategic information system helps an organization gain a competitive advantage through its contribution to the strategic goals of an organization and/or its ability to significantly increase performance and productivity. An SIS enables companies to gain competitive advantage and to benefit greatly at the expense of those that are subject to competitive disadvantage.

Competitive advantage in the digital economy is even more important than in the old economy, as will be demonstrated throughout this chapter. For some businesses the impact of the digital economy is revolutionary. Frequent changes in technologies and markets and the appearance of new business models can introduce radical changes in industry structure (Deise et al., 2000) and the nature of competition can shift rapidly (Afuah and Tucci, 2003, and Choi and Whinston, 2000).

At the same time, the digital economy has not changed the *core business* of most firms. For most businesses, Internet technologies simply offer the tools, sometimes very powerful tools, that can increase their success through their traditional sources of competitive advantage—be that low cost, excellent customer service, or superior supply chain management. For the overwhelming majority of businesses, the first step to competitive advantage in the digital economy is to ask and answer the question, "Where, given my industry and position, does my competitive advantage come from?" Then the follow-up question, "How can

FIGURE 3.1 Strategic information systems at Rosenbluth—defending against business pressures and competition.



information technology, especially the Internet, help my business?" will be easier to answer (Bithos, 2001).

Let's examine Rosenbluth's competitive situation in light of the business pressures and organizational responses described in Chapter 1. As Figure 3.1 shows, there were five business pressures on the company. Rosenbluth's strategic response was (1) to eliminate the retailing activities, which were most likely to be impacted by the pressures, and (2) to change the revenue model from commission-based to fee-for-service-based. Such strategy required extensive IT support.

Originally, strategic information systems were considered to be *outwardly focused*—that is, aimed at increasing direct competition in an industry and visible to all. For example, strategic systems have been used to provide new services to customers and/or suppliers, to increase customer switching costs, and to lock in suppliers, all with the specific objective of achieving better results than one's competitors. But since the late 1980s, strategic systems have also been viewed *inwardly*: They are focused on enhancing the competitive position of the firm by increasing employees' productivity, streamlining business processes, and making better decisions. These approaches may not be visible to the competitors (and therefore are not as easily copied). An example of an inward-focused SIS is RadioShack Online, as described in *IT at Work 3.1*.

In order to better understand strategic information systems, next we will examine the role information technology plays in strategic management.

The Role of IT in Strategic Management

Strategic management is the way an organization maps the strategy of its future operations. The term *strategic* points to the long-term nature of this mapping exercise and to the large magnitude of advantage the exercise is expected to give an organization. Information technology contributes to strategic management in many ways (see Kemerer, 1997, and Callon, 1996). Consider these eight:

1. **Innovative applications.** IT creates innovative applications that provide direct strategic advantage to organizations. For example, Federal Express was the first company in its industry to use IT for tracking the location of every package in its system. Next, FedEx was the first company to make this database accessible to its customers over the Internet. FedEx has gone on to provide



IT At Work 3.1

RADIOSHACK ONLINE PROVIDES ALL THE ANSWERS



RadioShack's advertising tagline, "You've got questions. We've got answers" reflects a change from a geek-oriented business model to a for-everyone model that is intended to attract and keep customers who are not so technically literate and not so interested in "do-it-yourself" electronics. A key component of this new strategy is RadioShack Online (*radioshack.com*), an intranet that educates in-store associates about business processes and product information, making them better equipped to address customer questions and needs.

Applications supported by RadioShack Online include:

- **Customer ticket look-up.** Returns can be verified from any store, on any sale, for any date, with or without a receipt.
 - **Parts look-up.** Each store is able to maintain catalogs featuring 100,000 items not ordinarily kept on-hand. Items can be ordered in the store and shipped directly to customers' homes.
 - **Service contracts.** When a customer returns a defective product under a service contract, associates can go online to instantly verify that there is a contract and to get approval for fixing the merchandise.
 - **Product availability.** When a desired item is out of stock, employees can search for it through the entire stock file for all stores in all regions.
- **Testing.** Tests that are part of the RadioShack's employee-certification program can now be taken online in a store, with immediate feedback.
 - **Electronic memos and manuals.** Paper manuals have now been put online for easier access and updating.
 - **Online credit card applications.** Associates can type credit card applications directly into the online network and receive an approval or rejection within 60 seconds.
 - **Sales reports.** These can illustrate performance by associate, store, and region.

Customers never see, touch, or use this internal network, but they benefit from its existence. Bob Gellman, Vice President for On-line Strategies at RadioShack says that thanks to RadioShack Online, shoppers view associates as "friendly, knowledgeable people who are very adept at de-mystifying technology." RadioShack benefits too by retaining happy customers.

For Further Exploration: How does RadioShack Online fit into RadioShack's new business model? In addition to the benefits for customers and for RadioShack that were highlighted in the case, how do in-store associates benefit? Why would RadioShack Online qualify as a strategic information system?

Source: Fox (2002).

e-fulfillment solutions based on IT and is even writing software for this purpose (Bhise et al., 2000).

2. **Competitive weapons.** Information systems themselves have long been recognized as a competitive weapon (Ives and Learmouth, 1984, and Callon, 1996). Amazon.com's one-click shopping system is considered so significant and important to the company's reputation for superior customer service that it has patented the system. Michael Dell, founder of Dell Computer, puts it bluntly: "The Internet is like a weapon sitting on the table, ready to be picked up by either you or your competitors" (Dell, 1999).
3. **Changes in processes.** IT supports changes in business processes that translate to strategic advantage (Davenport, 1993). For example, Berri is Australia's largest manufacturer and distributor of fruit juice products. The principal goal of its enterprise resource planning system implementation was "to turn its branch-based business into a national organization with a single set of unified business processes" in order to achieve millions of dollars in cost-savings (J.D. Edwards, 2002a). Other ways in which IT can change business processes

include better control over remote stores or offices by providing speedy communication tools, streamlined product design time with computer-aided engineering tools, and better decision-making processes by providing managers with timely information reports.

4. **Links with business partners.** IT links a company with its business partners effectively and efficiently. For example, Rosenbluth's Global Distribution Network allows it to connect agents, customers, and travel service providers around the globe, an innovation that allowed it to broaden its marketing range (Clemons and Hann, 1999). Other examples of interorganizational strategic information systems are presented later in this chapter.
5. **Cost reductions.** IT enables companies to reduce costs. For example, a Booz-Allen & Hamilton study found that: a traditional bank transaction costs \$1.07, whereas the same transaction over the Web costs about 1 cent; a traditional airline ticket costs \$8 to process, an e-ticket costs \$1 ([ibm.com/partnerworld/pwhome.nsf/vAssetsLookup/ad2.pdf/\\$file/ad2.pdf](http://ibm.com/partnerworld/pwhome.nsf/vAssetsLookup/ad2.pdf/$file/ad2.pdf)). In the customer service area, a customer call handled by a live agent costs \$33, but an intelligent agent can handle the same request for less than \$2 (Schwartz, 2000).
6. **Relationships with suppliers and customers.** IT can be used to lock in suppliers and customers, or to build in switching costs (making it more difficult for suppliers or customers to switch to competitors). For example, Master Builders sells chemical additives that improve the performance characteristics of concrete. The company offers customers MasterTrac, a tank-monitoring system that automatically notifies Master Builders when additive inventories fall below an agreed-on level. Master Builders then resupplies the tanks on a just-in-time basis. The customer benefits from an assured supply of product, less capital tied up in inventory, and reduced inventory management time and processing. Master Builders benefits because competitors face a more difficult task to convince concrete companies to switch to them (Vandenbosch and Dawar, 2002).
7. **New products.** A firm can leverage its investment in IT to create new products that are in demand in the marketplace. Federal Express's package-tracking software is one example. In Australia, ICI Explosives no longer views its business model as just selling explosives; it now also writes contracts for broken rock. ICI engineers developed computer models that specify drilling procedures and explosives use for different types of rockfaces to produce rock in the sizes that the customer needs. According to Vandenbosch and Dawar (2002), "The redefinition of ICI's role not only generated much higher margins for the business, it also gave ICI a much more defensible competitive position" (p. 38).
8. **Competitive intelligence.** IT provides competitive (business) intelligence by collecting and analyzing information about products, markets, competitors, and environmental changes (see Guimaraes and Armstrong, 1997). For example, if a company knows something important before its competitors, or if it can make the correct interpretation of information before its competitors, then it can act first, gaining strategic advantage through *first-mover advantage* (the competitive advantage gained by being the first to offer a particular product or service that customers deem to be of value). Because competitive intelligence is such an important aspect of gaining competitive advantage, we look at it in some detail next.

Competitive Intelligence

As in war, information about one's competitors can mean the difference between winning and losing a battle in business. Many companies continuously monitor the activities of their competitors to acquire **competitive intelligence**. Such information-gathering drives business performance by increasing market knowledge, improving knowledge management, and raising the quality of strategic planning. For example, consider the following uses of competitive intelligence, cited by Comcowich (2002):

- A sporting goods company found an activist group planning a demonstration and boycott months in advance, enabling the company to implement a counter strategy.
- Within days of launch, a software firm found dissatisfaction with specific product features, enabling the technicians to write a "patch" that fixed the problem within days instead of the months normally required to obtain customer feedback and implement software fixes.
- A packaging company was able to determine the location, size, and production capacity for a new plant being built by a competitor. The otherwise well-protected information was found by an automated monitoring service in building permit documents within the Web site of the town where the new plant was being built.
- A telecommunications company uncovered a competitor's legislative strategy, enabling the company to gain an upper hand in a state-by-state lobbying battle. (Remarkably, the strategy was posted on the competitor's own Web site.)
- The creative team embarking on development of a new video game used the Internet to identify cutting-edge product attributes that game-players prefer. The intensive research uncovered three key "gotta haves" that were not identified in focus groups and had not been included in the original design specification.

Competitive intelligence can be done with technologies such as optical character recognition, intelligent agents (Desouza, 2001), and especially the Internet.

The Internet is a company's most important tool to support competitive intelligence (see Teo, 2000, Bell and Harari, 2000, and Buchwitz, 2002). The visibility of information that a competitor places on the Internet and the power of Web-based tools to interrogate Web sites for information about prices, products, services, and marketing approaches have generated increased corporate interest in these intelligence-gathering activities. For example, online niche bookseller Fatbrain.com (now part of *barnesandnoble.com*) uses "e-spying" firm Rivalwatch.com to keep track of competitors in Fatbrain's specialist professional and educational book market. By tracking prices at rival firms such as Amazon.com, Fatbrain can offer competitive prices without giving away profit margins when it does not need to (Cross, 2000).

Power and Sharda (1997) proposed a framework in which the Internet capabilities are shown to provide information for strategic decisions. According to the framework, shown in Figure 3.2, the external information required (upper left) and the methods of acquiring information (upper right) can be supported by Internet tools for communication, searching, browsing and information retrieval. Power and Sharda emphasize the search capability of the various tools of the Internet. Using these tools an organization can implement specific search strategies, as illustrated in *A Closer Look 3.1*.

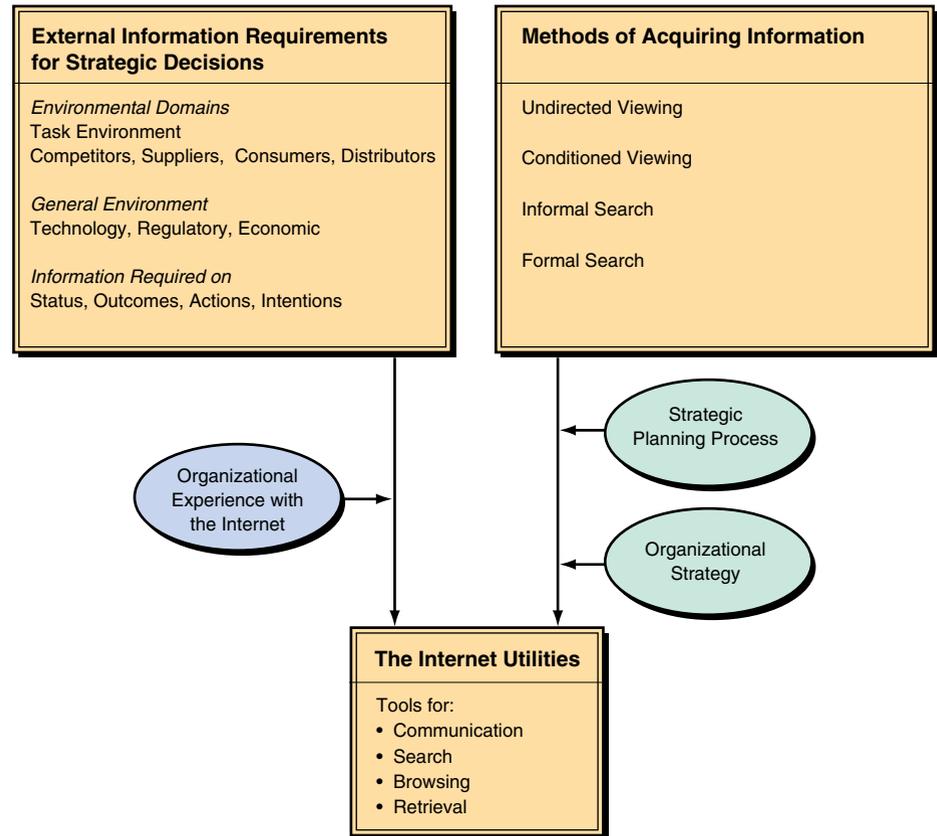


FIGURE 3.2 A framework for the Internet as a source of information for strategic decision making. (Source: Reprinted from *Long Range Planning*, 30, B. S. Pawar and R. Sharda, "Obtaining Business Intelligence on the Internet," 1997. With Permission from Excerpta Media Inc.)

However, it's not enough just to gather information on a competitor. Analyzing and interpreting the information is as important as collecting it. For these tasks, one can use IT tools ranging from *intelligent agents* (software tools that allow the automation of tasks that require intelligence; see Chapter 11) to *data mining* (searching in large databases for relationships among bits of data, using specialized logic tools, see Chapter 11). For example, J.P. Morgan Chase (New York) uses data mining to track several sources of information. Chase's goal is to determine the possible impact of the information on the bank, the customers, and the industry.

Another, more sinister, aspect of competitive intelligence is *industrial espionage*. Corporate spies, which actually do exist in some industries, look for confidential marketing plans, cost analyses, proposed products/services, and strategic plans. Industrial espionage is considered to be unethical and usually illegal. One type of industrial espionage is the theft of portable computers at airports, hotels, and conferences. Many of the thieves are interested in the information stored in the computers, not the computers themselves. Protecting against such activities is an important part of maintaining competitive advantage. This topic is discussed in Chapter 15, and in McGonagle and Vella (1998).

This section has shown that IT can contribute to a firm's competitive advantage, and profitability, in many ways. In order to understand how and why this is so we next examine two classical strategic models.



A CLOSER LOOK

3.1 COMPETITIVE INTELLIGENCE ON THE INTERNET

The Internet can be used to help a company conduct competitive intelligence easily, quickly, and relatively inexpensively in the following ways.

1. **Review competitor's Web sites.** Such visits can reveal information about new products or projects, trends in budgeting, advertising strategies, financial strength, and much more. Potential customers and business partners can be found by use of the Link:URL command in search engines to reveal what companies link to competitors' Web sites.
2. **Analyze related electronic discussion groups.** Internet newsgroups and Web site discussion boards can help you find out what people think about a company and its products. For example, newsgroup participants state what they like or dislike about products provided by you and your competitors. (For example, see *obo.co.nz* for a discussion board about field hockey equipment.) You can also examine potential customers' reactions to a new idea by posting a question.
3. **Examine publicly available financial documents.** This can be accomplished by entering a number of databases. Most charge nominal fees. The most notable database of financial documents is the Securities and Exchange Commission EDGAR database. (*sec.gov/edgar.shtml*).
4. **Do market research at your own Web site.** You can conduct surveys or pose questions to visitors at your site. You can even give prizes to those visitors who best describe the strengths and weaknesses of competitors' products.
5. **Use an information delivery service to gather news on competitors.** Information delivery services (such as Info Wizard, My Yahoo) find what is published in the Internet, including newsgroup correspondence about your competitors and their products, and send it to you. Known as *push technologies*, these services provide any desired information including news, some in real time, for free or for a nominal fee.
6. **Use corporate research companies.** Corporate research and ratings companies such as Dun & Bradstreet (*dnb.com*) and Standard & Poor's (*standardandpoors.com*) provide, for a fee, information ranging from risk analysis to stock market analysts' reports about your competitors.
7. **Dig up the dirt on your competitors.** Individual and business background checks are available from *knowx.com*. Credit report services such as the Red Book Credit Service (*thepacker.com*) can provide a credit history of competitors. "Actionable intelligence" on competitors is available from *rivalwatch.com*.
8. **Find out what are the "going rates" for employee pay.** Try *wageweb.com* for a free analysis of compensation rates.
9. **Find corporation credit history.** Dun & Bradstreet (*dnb.com*) offers credit histories for some companies. Other places to look would be court records, banks, annual reports, and credit bureaus.

3.2 PORTER'S COMPETITIVE FORCES MODEL AND STRATEGIES

The Impact of the Internet on Competition

The most well-known framework for analyzing competitiveness is Michael Porter's **competitive forces model** (Porter, 1985). It has been used to develop strategies for companies to increase their competitive edge. It also demonstrates how IT can enhance the competitiveness of corporations.

The model recognizes five major forces that could endanger a company's position in a given industry. (Other forces, such as those cited in Chapter 1, including the impact of government, affect all companies in the industry and therefore may have less impact on the relative success of a company within its industry.) Although the details of the model differ from one industry to another, its general structure is universal. The five major forces can be generalized as follows.

1. The threat of entry of new competitors
2. The bargaining power of suppliers

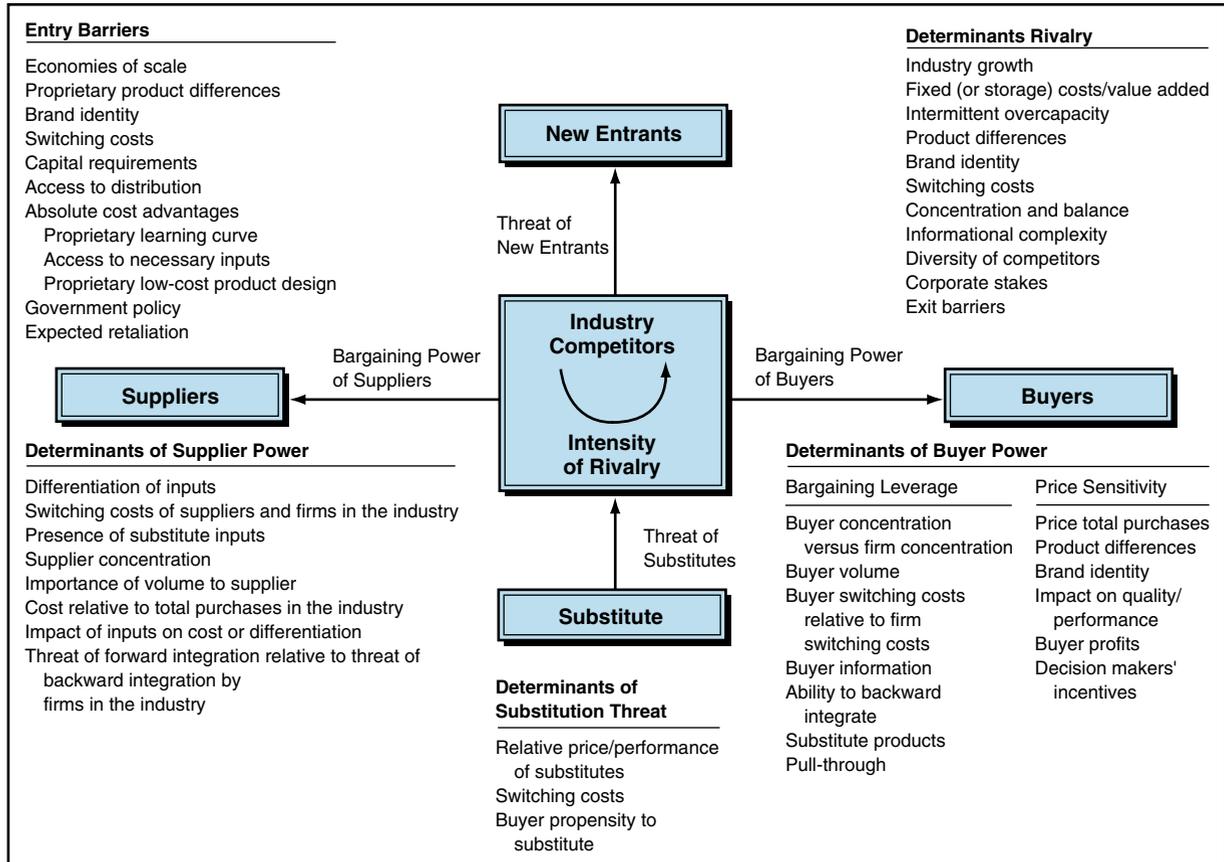


FIGURE 3.3 Porter's five forces model, including the major determinant of each force. (Source: Adapted with permission of the Free Press, a division of Simon & Schuster, Inc., from Michael Porter, *Competitive Advantage: Creating and Sustaining Superior Performance*, p. 6. © 1985, 1998 by Michael Porter.)

3. The bargaining power of customers (buyers)
4. The threat of substitute products or services
5. The rivalry among existing firms in the industry

The strength of each force is determined by factors related to the industry's structure, as shown in Figure 3.3.

Just as the Internet has changed the nature of doing business, it has also changed the nature of competition. Some have suggested semiradical changes in Porter's model. For example, Harmon et al. (2001) propose adding a sixth force—bargaining power of employees—to the original five. Porter himself argues that the Internet doesn't change the model, but that it is only another tool to be used in seeking competitive advantage. In his words, "The Internet per se will rarely be a competitive advantage. Many of the companies that succeed will be the ones that use the Internet as a complement to traditional ways of competing, not those that set their Internet initiatives apart from their established operations" (Porter, 2001, p. 64).

Porter (2001) and Harmon et al. (2001) suggest some ways the Internet influences competition in the five factors:

1. **The threat of new entrants.** For most firms, the Internet *increases* the threat of new competitors. First, the Internet sharply reduces traditional barriers to entry, such as the need for a sales force or a physical storefront to sell goods and services. All a competitor needs to do is set up a Web site. This threat is especially acute in industries that perform an intermediation role as well as industries in which the primary product or service is digital. Second, the geographical reach of the Internet enables distant competitors to bring competition into the local market, or even an indirect competitor to compete more directly with an existing firm.
2. **The bargaining power of suppliers.** The Internet's impact on suppliers is mixed. On the one hand, buyers can find alternative suppliers and compare prices more easily, reducing the supplier's bargaining power. On the other hand, as companies use the Internet to integrate their supply chain and join digital exchanges, participating suppliers will prosper by locking in customers and increasing switching costs.
3. **The bargaining power of customers (buyers).** The Web greatly increases a buyer's access to information about products and suppliers, Internet technologies can reduce customer switching costs, and buyers can more easily buy from downstream suppliers. These factors mean that the Internet greatly increases customers' bargaining power.
4. **The threat of substitute products or services.** Information-based industries are in the greatest danger here. Any industry in which digitalized information can replace material goods (e.g., music, books, software) must view the Internet as a threat.
5. **The rivalry among existing firms in the industry.** The visibility of Internet applications on the Web makes proprietary systems more difficult to keep secret, reducing differences among competitors. In most industries, the tendency for the Internet to lower variable costs relative to fixed costs encourages price discounting at the same time that competition migrates to price. Both are forces that encourage destructive price competition in an industry.

Porter concludes that the *overall* impact of the Internet is to increase competition, which negatively impacts profitability. According to Porter, "The great paradox of the Internet is that its very benefits—making information widely available; reducing the difficulty of purchasing, marketing, and distribution; allowing buyers and sellers to find and transact business with one another more easily—also make it more difficult for companies to capture those benefits as profits" (2001, p. 66).

In many other ways Web-based systems are changing the nature of competition and even industry structure. Consider the following.

- Bookseller Barnes & Noble, hardware sales giant The Home Depot, and other companies have created independent online divisions, which are competing against the parent companies. Such companies are termed "click-and-mortar" companies, because they combine both "brick-and-mortar" and e-commerce operations.
- Any company that sells direct to consumers is becoming a distributor (wholesaler or retailer), competing against its own traditional distributors.



IT At Work 3.2

TECHNOLOGY INTRODUCES NEW COMPETITION FOR BRITANNICA



For generations *Encyclopaedia Britannica* was known for its world's-best content and brand name. However, in 1997 the company lost so much money that it was liquidated and sold for a fraction of its book value. What happened?

Microsoft started to sell a much-less-known encyclopedia, *Funk & Wagnalls*, on CD-ROMs for \$50, under the name *Encarta*. Later on, the CD-ROMs were given away free with Microsoft PCs. In contrast, *Britannica's* price was about \$2,000. Furthermore, *Encarta* was media-rich. It included video clips, voices, and many pictures.

Britannica's sales declined rapidly. To compete, the company created a media-rich CD-ROM version, which was

given free with the printed version. Without the print version, the CD-ROM was sold for \$1,000. But very few people were willing to pay \$1,000 when a competing product was available essentially for free.

For Further Exploration: What were the critical events that led to the demise of *Britannica*? What was the role of the Internet and Web in the demise of *Britannica*? Consult *britannica.com* to find out in what form *Britannica* has survived.

Source: Venkatraman, 2000.

- The variable cost of a digital product is close to zero. Therefore, if large quantities are sold, the product's price can be so low that it might be given away, for free. For example, some predict that commissions for online stock trading will go to zero for this reason.
- Competitors are getting together and becoming more willing to share information. Examples are the vertical exchanges owned by industry leaders. The "Big Three" auto manufacturers, for example, operate the auto exchange *covisint.com*. Similar exchanges exist in the paper, chemical, and many other industries. (See Turban et al., 2004.)

In some cases it is not a specific strategic information system that changes the nature of competition, but it is the Web technology itself that renders obsolete traditional business processes, brand names, and even superior products. One example is provided in *IT at Work 3.2*.

Strategies for Competitive Advantage

Porter's model identifies the forces that influence competitive advantage in the marketplace. Of greater interest to most managers is the development of a *strategy* aimed at establishing a profitable and sustainable position against these five forces. To establish such a position, a company needs to develop a strategy of performing activities differently from a competitor.

Porter (1985) proposed cost leadership, differentiation, and niche strategies. Additional strategies have been proposed by other strategic-management authors (e.g., Neumann, 1994; Wiseman, 1988; Frenzel, 1996). We cite 12 strategies for competitive advantage here.

1. **Cost leadership strategy:** Produce products and/or services at the lowest cost in the industry. A firm achieves cost leadership in its industry by thrifty buying practices, efficient business processes, forcing up the prices paid by competitors, and helping customers or suppliers reduce their costs. A cost leadership example is the Wal-Mart automatic inventory replenishment system. This system enables Wal-Mart to reduce storage requirements so that Wal-Mart stores have one of the highest ratios of sales floor space in the

industry. Essentially Wal-Mart is using floor space to sell products, not store them, and it does not have to tie up capital in inventory. Savings from this system and others allows Wal-Mart to provide low-priced products to its customers and still earn high profits.

2. **Differentiation strategy:** Offer different products, services, or product features. By offering different, “better” products companies can charge higher prices, sell more products, or both. Southwest Airlines has differentiated itself as a low-cost, short-haul, express airline, and that has proven to be a winning strategy for competing in the highly competitive airline industry. Dell has differentiated itself in the personal computer market through its mass-customization strategy.
3. **Niche strategy:** Select a narrow-scope segment (niche market) and be the best in quality, speed, or cost in that market. For example, several computer-chip manufacturers make customized chips for specific industries or companies. Some of the best-selling products on the Internet are niche products. For example, *dogtoys.com* and *cattoys.com* offer a large variety of pet toys that no other pet toy retailer offers.
4. **Growth strategy:** Increase market share, acquire more customers, or sell more products. Such a strategy strengthens a company and increases profitability in the long run. Web-based selling can facilitate growth by creating new marketing channels, such as electronic auctions. An example is Dell Computer (*dellauction.com*), which auctions both new and used computers mainly to individuals and small businesses.
5. **Alliance strategy:** Work with business partners in partnerships, alliances, joint ventures, or virtual companies. This strategy creates synergy, allows companies to concentrate on their core business, and provides opportunities for growth. Alliances are particularly popular in electronic commerce ventures. For example, in August 2000 Amazon.com and Toysrus.com launched a co-branded Web site to sell toys, capitalizing on each others’ strengths. In spring 2001 they created a similar baby-products venture. Of special interest are alliances with suppliers, some of whom monitor inventory levels electronically and replenish inventory when it falls below a certain level (e.g., Wal-Mart, Master Builders). Alliances can also be made among competitors in a strategy known as “co-opetition” (cooperation + competition). For example, airlines in global alliances such as OneWorld and the Star Alliance compete for ticket sales on some routes, but once the ticket is sold they may cooperate by flying passengers on competitor’s planes to avoid half-full planes. Additional examples of alliances are provided in Chapters 5 through 8.
6. **Innovation strategy:** Introduce new products and services, put new features in existing products and services, or develop new ways to produce them. Innovation is similar to differentiation except that the impact is much more dramatic. Differentiation “tweaks” existing products and services to offer the customer something special and different. Innovation implies something so new and different that it changes the nature of the industry. A classic example is the introduction of automated teller machines (ATM) by Citibank. The convenience and cost-cutting features of this innovation gave Citibank a huge advantage over its competitors. Like many innovative products, the ATM changed the nature of competition in the banking industry so that now an ATM network is a competitive necessity for any bank. Eight

TABLE 3.1 Areas of IT Related to Technological Innovations

Innovation	Advantage
New business models	Being the first to establish a new model puts one way ahead of possible competitors. The Web enables many innovative new business models, such as Priceline's "name-your-own-price" and Auto-by-Tel's infomediary model. Creating and applying these models can provide strategic advantage.
New markets, global reach	Finding new customers in new markets. Using the Web, Amazon.com is selling books in over 200 countries, all by direct mail. Rosenbluth International expanded to 57 countries backed by its communication systems.
New products	Constantly innovating with new competitive products and services. Electronic Art Inc. was first to introduce CD-ROM-based video games. MP3 Inc. enabled downloading of music from its Web site.
Extended products	Leveraging old products with new competitive extensions. When a Korean company was the first to introduce "fuzzy logic" in its washing machines, sales went up 50 percent in a few months.
Differentiated products	Gaining advantage through unique products or added value. Compaq Computers at one time became the leading PC seller after providing self-diagnostic disks with its computers. Dell Computer pioneered the concept of home delivery of customized computers.
Supersystems	Erecting competitive barriers through major system developments that cannot be easily duplicated. American Airlines' reservation system, SABRE, became so comprehensive that it took years to duplicate; a supersystem always stays ahead of the competition. Caterpillar's multibillion-dollar equipment maintenance system is difficult to duplicate.
Interorganizational systems	Linking two organizational information systems together can lock out the competition. In the 1980s, American Hospital Supply installed supply-reordering systems in hospitals, to their competitive advantage.
Computer-aided sales	Offering systems that provide computer support to marketing and sales. For example, a company might equip salespeople with wireless hand-held computers that allow them to provide price quotations at the customer's location.

ways that IT can introduce technological innovation for competitive advantage are shown in Table 3.1, and others will be provided in Chapter 11.

In the late 1990s innovation became almost synonymous with electronic commerce. The Internet, especially, enabled dot-com entrepreneurs to create innovative Web-based business models, such as Priceline's name-your-own-price model, Auto-by-Tel's infomediary model, and Amazon.com's affiliate program.

A key consideration in introducing innovation is the need to continually innovate. When one company introduces a successful innovation, other companies in the industry need to respond to the threat by attempting to duplicate or better that innovation. Especially in electronic commerce, the visibility of technologies on the Web makes keeping innovations secret more difficult.

7. Operational effectiveness strategy: Improve the manner in which internal business processes are executed so that a firm performs similar activities better than rivals (Porter, 1996). Such improvements increase employee and customer satisfaction, quality, and productivity while decreasing time to market. Improved decision making and management activities also contribute to improved efficiency. Web-based systems can improve the administrative efficiency of procurement, for example, by 20- to 30-fold.

8. **Customer-orientation strategy:** Concentrate on making customers happy, as is the case with RadioShack Online. Strong competition and the realization that the customer is king (queen) is the basis of this strategy. Web-based systems that support customer relationship management are especially effective in this area because they can provide a personalized, one-to-one relationship with each customer.
9. **Time strategy:** Treat time as a resource, then manage it and use it to the firm's advantage. "Time is money," "Internet time" (i.e., three months on the Internet is like a year in real time), first-mover advantage, just-in-time delivery or manufacturing, competing in time (Keen, 1988), and other time-based competitive concepts emphasize the importance of time as an asset and a source of competitive advantage. One of the driving forces behind time as a competitive strategy is the need for firms to be immediately responsive to customers, markets, and changing market conditions. A second factor is the time-to-market race. As Louis Gerstner, former CEO of IBM, has said, "A disproportionate amount of the economic value occurs in the early states of a product's life. That's when the margins are most significant. So there is real value to speed, to being first" (quoted in Frenzel, 1996, p. 56).
10. **Entry-barriers strategy:** Create barriers to entry. By introducing innovative products or using IT to provide exceptional service, companies can create barriers to entry from new entrants. For example, Priceline.com has received U.S. patent 5,794,207 on its name-your-own-price business model (Lipton, 1998). Cisco's Dynamic Configuration Tool (cisco.com/appcontent/apollo/configureHomeGuest.html) allows prospective buyers to complete an online configuration of a Cisco product and receive intelligent feedback about compatibility and ordering. Service levels such as this make it difficult for new entrants to compete against Cisco.
11. **Lock in customers or suppliers strategy:** Encourage customers or suppliers to stay with you rather than going to competitors. Locking in customers has the effect of reducing their bargaining power. A classic example is frequent-flyer and similar buyer-loyalty programs in the airline, hospitality, and retail industries. Companies that have such programs have more customers who are "locked in" by the incentives the loyalty programs offer. A business-to-business example in the car industry is e-procurement system Covisint, which locks in car manufacturers as customers and part manufacturers as suppliers.
12. **Increase switching costs strategy:** Discourage customers or suppliers from going to competitors for economic reasons. For example, Master Builders builds in switching costs with its concrete additive tank-monitoring system, as described earlier. Interorganizational information systems (discussed below) increase buyer and seller dependencies, making it difficult or more expensive for buyers to turn to competitors. E-procurement systems that record sales in a buyer's purchasing system can be difficult to set up, but offer a great deal of reliability and convenience for the buyer. Once set up, the buyers face switching costs to add or change suppliers.

These strategies may be interrelated. For example: Some innovations are achieved through alliances that reduce cost and increase growth; cost leadership improves customer satisfaction and may lead to growth; and alliances are key to



IT At Work 3.3

HOW EXPEDIA IS USING WEB SERVICES



Expedia.com is a leading online travel service in the United States, with localized versions in the United Kingdom, Canada, and Germany. Expedia operates in a very competitive marketplace with competition from similar services such as Travelcity and Orbitz, ticket discounters such as Priceline.com and Lastminute.com, traditional travel agencies such as Rosenbluth, and, increasingly, airlines and hotels themselves. Expedia harnesses the power of Web services to distinguish itself in this market.

Expedia's competitive strategy is driven by nearly every traveler's need to receive up-to-the-second, diverse information at any time and any place. Expedia actively supplies travelers with dynamic and real-time personalized information, such as flight status. This information is *pushed to* travelers (sent to them from Expedia) as well as *pulled from* the company's portal (accessed by the travelers through specific inquiries). Travelers use desktop computers, cell phones, and other Web-enabled devices to receive or access the information. This multichannel provision of timely travel information is the key for attracting new customers and for keeping existing customers.

To make this happen Expedia needs to connect to many service providers (airlines, hotels, car rental companies) as well as airports, news services, map services, and more. By using Web services the company solves the integration problem as well as creating device-independent information delivery. This way Expedia can write information only once and then deliver it via whichever method the customer wants—eliminating the need to rewrite the information for each delivery method. Expedia can also can tie information into the users' existing "buddy lists" and calendars. This way customers do not have to reconstruct their contact lists and schedules within Expedia.

The solution is based on Microsoft's .NET Passport. A single sign-in for customers provides authentication and eliminates redundant log-on procedures. Using Passport's notification service, a user can choose to receive alerts to any device, including wireless ones. Furthermore, customers can, for example, automatically send notifications of flight plans to people on their contact lists. The users can also enter their itinerary schedule to their computer calendars in a second, moving it from .NET calendar.

The architecture of the system, shown in Online File W3.1, is flexible enough to work with non-Internet devices. For example, many people with PDAs do not have wireless capabilities. So they can receive information from Expedia via a synchronized solution (the users can synchronize the information from a PC to their PDAs and vice versa). By using a system development vendor (Microsoft), Expedia did not have to build its own services such as authentication, message notification, and calendaring. This enabled the company to be a first mover in getting these services to market. Using this XML-based service, Expedia adds value for its customers, which provides Expedia with an edge over its competitors.



For Further Exploration: How many of the competitive strategies described in this section are exemplified in this case study? What is the advantage of being the first mover in this case? How can small travel agencies that cannot build such a system (at least for several years, until technology will be affordable) respond?

Source: Compiled and condensed from Microsoft (2001) (microsoft.com/servers/evaluation/casestudies/Expedia.doc).

locking in customers and increasing switching costs. The Expedia case study in *IT at Work 3.3* illustrates several of the competitive strategies described above.

Porter's model is industry-related, assessing the position of a company in its industry. Companies can use the model for competitive analysis, to suggest specific actions. In most cases such actions involve the use of IT. With Porter's five forces model and various competitive strategies in mind, let us see an example of how the generic model works in practice. We will use Wal-Mart as an example (see Figure 3.4) to demonstrate the four steps involved in using Porter's model.

Step 1. List the players in each competitive force. An illustration of a competitive threat is online shopping, which may be offered by *e-tailers* (electronic retailers). In 2002, for example, Amazon.com started to sell clothes

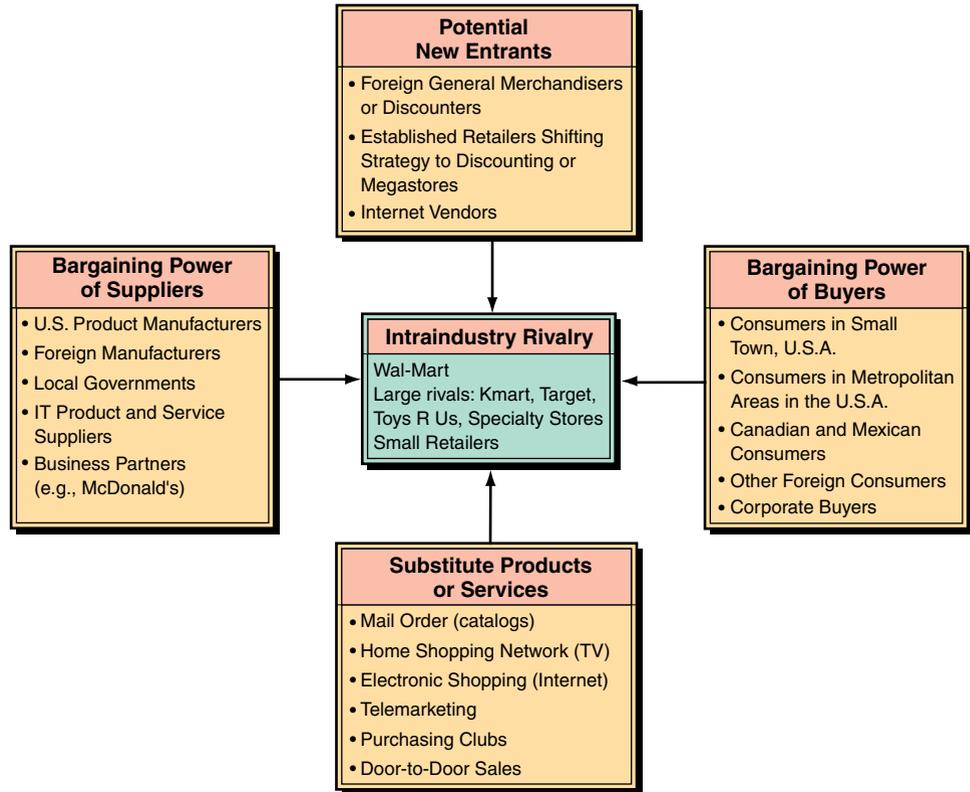


FIGURE 3.4 Porter's model for Wal-Mart. (Source: Adapted by Callon (1996) and reprinted by permission of *Harvard Business Review*. From Michael Porter, "How Competitive Forces Shape Strategy" March – April 1979. © 1979 by Harvard Business School Publishing Corporation; all rights reserved.)

online, competing directly with Wal-Mart in one of Wal-Mart's largest product lines.

Step 2. Relate the major determinants of each competitive force (shown in Figure 3.3, p. ••) to each player in the market. For example, for Wal-Mart, with respect to online shopping, we can check the switching cost for the buyers, the buyers' propensity to substitute, and the convenience advantage of online shopping.

Step 3. Devise a strategy with which Wal-Mart can defend itself against the competitive forces, based on the specific players and the determinants. For example, to counter online shopping, Wal-Mart can provide playgrounds for children, hand out free samples of products, and recognize frequent shoppers personally. Wal-Mart can also respond by imitating the competition. In fact, the company did just that by introducing Wal-Mart Online.

Step 4. Look for supportive information technologies. An illustration of this step for online shopping is a technology for managing frequent shoppers. Wal-Mart uses a gigantic database, data-mining techniques, smart cards, and decision support capabilities to analyze shoppers' activities accurately and to act competitively in response. Wal-Mart uses IT extensively both to defend itself against the competition and to create innovative services and cost reduction, especially along its supply chain. (We'll provide more specific examples in Chapter 8.)

Almost 20 years after it was first published, Porter's competitive forces model remains the dominant framework for analyzing competitive advantage within an industry. A different way to analyze competition and the role of IT is provided in Porter's value chain model, which is the subject we turn to next.

3.3 PORTER'S VALUE CHAIN MODEL

The Model According to the **value chain model** (Porter, 1985), the activities conducted in any manufacturing organization can be divided into two parts: *primary activities* and *support activities*. The five **primary activities** are those activities in which materials are purchased, processed into products, and delivered to customers. They are:

1. Inbound logistics (inputs)
2. Operations (manufacturing and testing)
3. Outbound logistics (storage and distribution)
4. Marketing and sales
5. Service

The primary activities usually take place in a sequence from 1 to 5. (An exception to this sequencing is Dell Computer's build-to-order strategy, as described in *IT at Work 3.4*.) As work progresses according to the sequence, *value* is added to the product or service in each activity. To be more specific, the incoming materials (1) are processed (in receiving, storage, etc.), and in this processing, value is added to them in activities called *inbound logistics*. Next, the materials are used in *operations* (2), where significant value is added by the process of turning raw materials into products. The products need to be prepared for delivery (packaging, storing, and shipping) in the *outbound logistics* activities (3), and so more value is added in those activities. Then *marketing and sales* (4) attempt to sell the products to customers, increasing product value by creating demand for the company's products. (The value of a sold item is much larger than that of an unsold one.) Finally, *after-sales service* (5) such as warranty service or upgrade notification is performed for the customer, further adding value. All of these value-adding, primary activities result (it is hoped) in profit.

Primary activities are supported by the following **support activities**:

1. The firm's infrastructure (accounting, finance, management)
2. Human resources management
3. Technology development (R&D)
4. Procurement

Each support activity can support any or all of the primary activities, and the support activities may also support each other.

A firm's value chain is part of a larger stream of activities, which Porter calls a value system. A **value system** includes the suppliers that provide the inputs necessary to the firm and their value chains. Once the firm creates products, they pass through the value chains of distributors (which also have their own value chains), all the way to the buyers (customers). All parts of these chains are included in the value system. Gaining and sustaining a competitive advantage, and supporting that advantage by means of IT, requires an understanding of this entire value system.



IT At Work 3.4

HOW DELL COMPUTER BTOs ITS VALUE CHAIN



Dell Computer is well-known for its ability to mass-produce computers that are customized to a customer's order, a production and operations process known as *mass-customization* or, in a value-chain context, a *build-to-order (BTO) strategy*. The ability to build to order depends on how well a company can efficiently meet customer demands at each stage of the value chain. At Dell, this ability depends on computer systems that link customer order information to production, assembly, and delivery operations.

At Dell the BTO process begins with receipt of the customer order from the Internet, fax, or telephone. It takes approximately one day to process the order and for production control to ensure that the necessary parts are in stock. Assembly and shipment takes another day, and delivery to the customer's home or office takes a final 1 to 5 days.

The value chain in place at most firms assumes a *make-to-forecast strategy*. That is, standard products are produced from long-term forecasts of customer demand. Thus the primary activities of the value chain move from inbound logistics to operations to outbound logistics and then marketing and sales, all based on projections of what customers will be buying and in what quantities. A make-to-forecast strategy offers efficiencies in production, but if the forecasts are inaccurate, as they frequently are, the results are lost sales (inadequate supply) or heavy discounting to move excess product (oversupply). Then the bottom line is, literally, less profit. Another major disadvantage of the make-to-forecast strategy is the inability of the firm to track ongoing changes in customer demand.

Dell's value chain moves the marketing and sales activity forward to the front of the value chain. In its build-to-order strategy, Dell assembles the product only after the customer has placed the order, so marketing and sales comes first. The primary disadvantage of the BTO strategy is system sensitivity to short-term changes in customer demand. For example, if a particular computer component suddenly becomes wildly popular or temporarily unavailable, the standard two-week supply in inventory

may diminish fast and customer orders will not be completed on time.

A successful build-to-order strategy offers companies like Dell numerous benefits in process, product, and volume flexibility. For example, customer requirements are linked directly to production. As a result production decisions are based on up-to-the-minute customer demand, not long-range forecasts, which can be wildly inaccurate. This increases management's knowledge about trends in the marketplace and decreases inventory holding costs. BTO also offers partners in Dell's value system increased visibility to the demand and flow of goods. As noted in the text, understanding this entire value system can give additional insight and opportunities for competitive advantage. In addition, the support structures for BTO are naturally more flexible, creating a higher sense of responsiveness within the firm and a more flexible and agile company. One outcome of such flexibility is that adjustable price and sales incentives can be used to manage demand levels, rather than reactively discounting excess stock. Finally, because the customer gets exactly what he or she wants, first-time customers are likely to become repeat customers and recommend Dell to friends and colleagues.

Executing a build-to-order strategy isn't easy, as many companies have found out. Not only must interconnected information systems be built, but BTO frequently requires a change in organizational culture, managerial thinking, and supplier interactions and support. Inevitably the process begins by acquiring a better understanding of customer demand; then improvements in information flow will produce the ability to increase responsiveness in all areas of the value chain.

For Further Exploration: Use the Internet, if necessary, to find other companies that use a BTO strategy. How would a BTO strategy work in another industry, for example, automobiles or toys? What are the implications of BTO for the value chains of suppliers of Dell components?

Source: Holweg and Pil (2001).

The value chain and value system concepts can be diagrammed for both products and services and for any organization, private or public. The initial purpose of the value chain model was to analyze the internal operations of a corporation, in order to increase its efficiency, effectiveness, and competitiveness. The model has since then been used as a basis for explaining the support IT can provide. It is also the basis for the *supply chain management* concept, which we will present in Chapter 8.



FIGURE 3.5 The airline industry value chain superimposed on Porter's value chain. (Source: Adapted by Callon (1996) and reprinted by permission of *Harvard Business Review*. From Michael Porter, "How Competitive Forces Shape Strategy," March – April 1979. © 1979 by Harvard Business School Publishing Corporation; all rights reserved.)

The value chain model can be used in different ways. First, we can use it to do company analysis, by systematically evaluating a company's key processes and core competencies. To do so, we first determine strengths and weaknesses of performing the activities and the values added by each activity. The activities that add more value are those that might provide strategic advantage. Then we investigate whether by adding IT the company can get even greater added value and where in the chain its use is most appropriate. For example, Caterpillar uses EDI to add value to its inbound and outbound activities; it uses its intranet to boost customer service. In Chapters 5 through 12, we include many examples of how IT supports the various activities of the value chain for individual firms.

A second use for the value chain model is to do an industry analysis, as shown for the airline industry in Figure 3.5. As in the company analysis, once the various activities have been identified, then it is possible to search for specific information systems to facilitate these activities. For example, in "Marketing and Sales," agent training can be conducted on the corporate portal. Similarly, technology now allows preticketed customers to self-check their baggage at some airports.

Finally, the value chain model can be used either for an individual company or for an industry by superimposing different types of information systems that may help special activities. For example, EDI can help inbound and outbound logistics; virtual reality can help both advertising and product development.

Porter's Models in the Digital Age

The application of Porter's models is still valid today. But some adjustments may be needed to take into account the realities of business in the digital economy. Consider a company such as Amazon.com. Who are Amazon's competitors? It

depends. In books they compete mainly against Barnes & Noble Online, in toys against Kmart, Wal-Mart, and Sears, and in music against CDNOW.com. Amazon.com could also be seen to compete against television, video games, and the Internet itself, because each of these compete for customers' leisure time. In that view, Amazon.com is not necessarily in the book-selling business, but in the entertainment business. Could we use one diagram such as Figure 3.3 (p. ••) to describe Amazon.com's competitive environment? Probably not. We might need several figures, one for each of Amazon's major products. Furthermore, due to alliances (such as between Amazon.com and Toysrus.com), the competition and the value chain analysis can be fairly complex and frequently in flux.



For a presentation of strategic information systems frameworks proposed by other researchers, see Online File W3.2 at the books Web site.

3.4 INTERORGANIZATIONAL STRATEGIC INFORMATION SYSTEMS

Many of the strategic information systems of the 1970s through the 1990s were developed and implemented by individual companies. With the emergence of the Internet as a tool that could easily connect businesses, companies began to look outside their own operations to form alliances and business partnerships based on Internet connectivity. As discussed in Chapter 2, such systems are called *interorganizational information systems (IOSs)*, and they are considered a part of electronic commerce.

Several of the electronic markets (or exchanges) that emerged in the 1990s used private lines and/or EDI. (For more detail on how EDI works, see Appendix 5.1.) An example is Citus Belgium (*citus.be*). Citus acts as a hub between customers and suppliers, hosting suppliers' catalogs electronically. Using a pioneering technology, the company gained incredible competitive advantage by significant cost reduction and the building of a loyal customer community (see Timmers, 1999).

However, traditional EDI was difficult and expensive to implement. "Old EDI" required the use of complex standards (e.g., ANSI or EDIFACT), expensive value-added networks (VANs), complex application-to-application software, and across-the-board buy-in (agreement) within the industry. Today, new interorganizational SISs use *Internet-based EDI*. In this "new EDI" the proprietary standards have been replaced by extensible markup language (XML), the VAN has been replaced by the Internet, and system-to-system connectivity gives organizations much greater flexibility in terms of internal implementation. The strategic benefits of Internet-based EDI—a faster business cycle, automation of business procedures, and increased reduced costs—have spurred the growth of interorganizational information systems and have provided many organizations greater advantage in a fierce competitive environment.

Another way in which groups of companies are using IT and the Internet to create interorganizational information systems to create or sustain competitive advantage include establishing *consortia*—electronic exchanges for suppliers and buyers. Consortia can be considered either vertical or horizontal. *Vertical (industry) consortia* are organized, operated, and controlled by the major players in an industry (e.g., steel, paper, insurance, oil, cars, mining). These exchanges are used primarily for purchasing and are designed to reduce the bargaining power of suppliers. *Horizontal consortia* are organized by large companies from different

industries for the purpose of purchasing maintenance, replacement, and operations (MRO) items. In Australia, all the largest corporations are organized in an e-purchasing exchange (see *corprocure.com*).

In a connected world, no organization can stand alone. Instead, competitive advantage is enhanced when businesses use the Internet and private networks to exchange information and conduct business as partners. Competitive strategies such as alliance and value systems imply organizations working together to achieve common goals, and all participants benefiting from the use of IT for executing competitive strategies.

3.5 A FRAMEWORK FOR GLOBAL COMPETITION

Many companies are operating in a global environment. First, there are the fully global or multinational corporations. Second, there are the companies that export or import. Third, a large number of companies face competition from products created in countries where labor and other costs are low, or where there is an abundance of natural resources. Other companies have low-cost production facilities in these same countries. Finally, electronic commerce facilitates global trading by enabling even small companies to buy from or sell to business partners in other countries. Thus, globalization is rapidly increasing.

Doing business in a global environment is becoming more and more challenging as the political environment improves and as telecommunications and the Internet open the door to a large number of buyers, sellers, and competitors worldwide. The increased competition forces companies to look for better ways to do global business. Porter and Youngman (1995), for example, propose an approach that focuses on employment policies and government regulations. Similarly, Ghemawat (2001) proposes a framework in which companies are urged to consider cultural, administrative, geographical, and economic dimensions to assess their ability to compete in global markets. Ghemawat calls this a “CAGE distance” framework, an acronym for the four dimensions to be considered by businesses that are selling products outside their local area, especially internationally.

A comprehensive framework that connects IT and global business was suggested by Ives et al. (1993). According to this *global business driver framework*, the success of companies doing business in a competitive global environment depends on the alignment of a company’s information system and its global business strategy. This connection is demonstrated by Rosenbluth International, whose strategy enables it to compete with local travel agencies in 57 countries, and by Caterpillar Corporation, which employs a business strategy of strong support to dealers and customers worldwide by means of its effective global information system. The success of multinational firms and companies engaged in global activities, in a highly competitive global market, thus strongly depends on the link between their information systems and their business strategy. Information managers must be innovative in identifying the IT systems that a firm needs in order to be competitive worldwide and must tie them to the strategic business imperatives.

The global business driver framework provides a tool for identifying business entities, such as customers, suppliers, projects, and orders, that will benefit most from an integrated global IT management system. The basic idea is to apply IT through a firm’s **global business drivers**. These are business factors that benefit from global economies of scale or scope and thus add value to a global business strategy. Typical global business drivers are risk reduction, availability of a skilled

and/or inexpensive workforce, quality products/services, location of materials, supply and suppliers, location of customers, and a country's infrastructure. The idea of the global business drivers framework is to look at the drivers in terms of current and future information needs and to focus on worldwide implementation.

Advances in Internet availability and electronic commerce are of special interest to global traders. First, many of the business drivers can be facilitated by the Internet, which is much cheaper and more accessible than private communication networks. Second, the Internet and e-commerce are answers to several of the analysis questions related to global business drivers. Additional analysis of some global business drivers is available at the book's Web site.



3.6 STRATEGIC INFORMATION SYSTEMS: EXAMPLES AND ANALYSIS

The models, strategies, and frameworks presented in the previous sections suggest opportunities that companies can pursue to gain strategic advantage. Several SISs developed in the 1970s and 1980s are considered classic illustrations of the power of IT to provide companies with strategic advantage (see Online File W3.3 at the book's Web site). In this section, we provide several contemporary examples of how IT has successfully supported the various strategies that companies use to gain competitive advantage.



Wiring the “Customer Supply Chain” at 1-800-Flowers. 1-800-Flowers sits in the middle of a complex and critical “customer supply chain.” On one side of this supply chain are the customers who call the 1-800 number or visit the Web site (*800flowers.com*) to order flowers or gifts. On the other side are the 1,400 floral affiliates who actually create and deliver the product. Maintaining satisfactory customer relationships on both sides of this supply chain is critical to 1-800-Flowers's success, and the key to those relationships is the wired communication system the company has built.

When 1-800-Flowers opened for business in 1986 it was one of the first businesses to promote the 1-800 toll-free number system on a nationwide basis. The initial 1-800-Flowers system included a complex but effective system for directing incoming calls to agents in various call centers across the nation.

It was only natural that an intermediary that based its business on connecting customers and suppliers by a telephone network would be one of the first companies to see the potential of the Web. In 1995, 1-800-Flowers was one of the first three beta testers of the Netscape platform and launched its Web site later that year. Web-sourced orders, which amounted to approximately half of all orders in 2001, were woven into the existing telephone-based business through data networking services. Customer purchases, customer profiles, and internal information created an efficient, wired customer supply chain that helped 1-800-Flowers maintain a competitive advantage.

The next step was to wire-up the connection to the florists. In 1997, 1-800-Flowers initiated BloomLink, an extranet that sends orders out to affiliates and tracks progress in getting the shipments to customers. Additionally, BloomLink offers training programs and access to wholesale flower supply networks. This network helps lock in the suppliers and create switching costs. The significance of BloomLink is its ability to support both the business goal of order fulfillment and the competitive-advantage goal of supplier relationship management.

Like many companies in numerous industries, establishing and maintaining excellent relationships with customers and suppliers is critical to the success of



1-800-Flowers. By wiring up customers and suppliers on both side of its supply chain, 1-800-Flowers has achieved its goals. (*Sources: Reda, 2002; Kemp, 2001; 800flowers.com.*)

Increasing Tax Collection Efforts at the Wisconsin Department of Revenue. How does an organization in a noncompetitive industry measure competitiveness? Without the usual measures of market share or profitability, how does a charity, an association, a nongovernmental agency such as the Red Cross, or a governmental agency strive for competitive advantage?

One approach is to compete against yourself. Each year's goals are set higher than last year's performance, and "competitive strategies" are put into place to achieve those goals. Essentially, an organization is competing against its former performance. This was the approach adopted by the State of Wisconsin Department of Revenue for the collection of delinquent taxes.

The Department is responsible for processing and auditing various state taxes as well as for recovering delinquent taxes, to ensure that the state maximizes the income from its largest source of revenue. To realize its goals in the collection area, the Department implemented the Delinquent Tax System (DTS) "for case management and coordinating the actions involved in collections, including hearings, installment agreements, wage certifications, levies, bankruptcy, and warrant filing." The DTS was built in an object-oriented environment using IBM's DB2 database.

Some of the benefits from the DTS implementation have been increased productivity, ease of access to case information in geographically remote offices, reduction of overhead costs, and more standard treatment of cases. Competitively, it has achieved its greatest benefit in the results it has produced. Vicki Siekert, Director of Compliance for the Department, says, "In the last couple years, we've been much more successful at meeting our collection goals; I can say that the Delinquent Tax System has certainly helped our efforts." (*Source: "Customer Case Study: State of Wisconsin Department of Revenue," no date.*)

Time-Based Competitive Advantage at Cannondale. Companies in the motorsports bike industry are in a constant race to introduce new, innovative products. So when Cannondale introduced the FX400, its first-ever all-terrain vehicle, it wasn't surprised to learn that Suzuki and market leader Honda were not far behind. Challenged to put constant innovation into its design, test, and production process to stay ahead, Cannondale turned to a relatively new kind of application—product life-cycle management (PLM) software.

The promise of PLM software is to share information associated with all phases of a product's life-cycle with everyone in an organization—engineering, purchasing, manufacturing, marketing, sales, aftermarket support—as well as with key suppliers and customers. Most PLM packages contain elements of project management, workflow, and collaboration software.

What have been the results for Cannondale? Paul Hammerstrom, head of R&D for Cannondale's Motorsport Division, says the PLM software has given his company the ability to react quickly in the rapidly changing marketplace. "They [Suzuki] will make 25,000 units in one factory run, and they'll be stuck with them. Thanks to this software we can constantly improve features even in the middle of a production run" (Raskin, 2002). The software "gives the 50-plus people involved in upgrading the bikes for 2003 near-instant access to constantly moving requests for design changes, product specifications, and work orders." He cites this example: "If five dealers walked in today and said "This seat is way too



hard,' I could have new ones in production in a couple of days. Speed is our friend" (Raskin, 2002).

As discussed earlier in this chapter, time is one of the major strategies for achieving competitive advantage. Just as speed enables its motorsport customers to win races, having speed as a friend helps Cannondale beat competitors in the marketplace. (*Source: Raskin, 2002, and Stackpole, 2003.*)



Southwest Airlines Flies High with SWIFT. Southwest Airlines is an outstanding success story in an industry in which many of the major carriers—American, United, and Canada Air, for example—are in or near bankruptcy. Southwest's success can be attributed to its well-known innovations—no-frills flights, no seating assignments, and an aircraft fleet of efficient 737 airplanes. Each of Southwest's 2,600 daily flights requires data about the flight route, fuel requirements, and in-route weather. If these data aren't in the right place at the right time, flights can be delayed or canceled. Efficient dispatching of a growing volume of flight information can be as critical a success factor as moving baggage or customers.

To handle Southwest's requirements for efficient delivery of flight information, Southwest created SWIFT—the Southwest Integrated Flight Tracking System. SWIFT is a set of applications for managing the aircraft fleet and dispatching flights. "SWIFT was developed using a multi-threaded, open server architecture. Clients are connected to the system database and a replication server that captures completed transactions. All clients are X-Motif applications executed on UNIX stations." One innovative piece of software in SWIFT is SmartSockets from Talarian, Inc. "SmartSockets functions as the transport mechanism for distributing real-time updates for Southwest's fleet management and operations and enables processes to communicate reliably and securely." This messaging software replaced a remote procedure call solution. The result has been elimination of system outages and a more stable SWIFT.

Innovations like SWIFT allow Southwest to fly higher than its competition in system sophistication, integration, and ease-of-use. These factors keep Southwest in the skies, flying ahead of its competitors in airline efficiency and profitability. (*Source: Talarian, 2000.*)



Using ERP to Meet to Strategic Challenges at Turner Industries. Turner Industries is a Forbes 500 company that provides a variety of construction, maintenance, cleaning, and environmental services to its customers in the refining, petrochemical, power generation, and other industries. It does so through 25,000 employees, a \$100 million fleet of construction equipment, and advanced software applications designed to meet strategic challenges in time, cost, and customer satisfaction.

Two of the challenges Turner Industries faces is completing projects on time and within budget. A strategic solution to this challenge is Interplan. At the heart of Interplan is a J.D. Edwards ERP system with bolt-on applications that include scheduling software and project control and estimating systems. Interplan contributes to the goal of meeting or exceeding customer expectations by enabling the company to complete projects on time and without cost overruns. This keeps customers happy and wins Turner Industries repeat business and an increasing list of customers. Interplan is so effective that the company typically receives an increased profit margin on projects that use Interplan and is even able to pass on some of these cost savings to its customers.

An even larger contributor to meeting the customer-satisfaction challenge is Turner-Direct.com. Recognizing the need to help customers help themselves, in

1996 Turner Industries began to give customers Internet access to real-time manufacturing and shipping information. Lowell Vice, CIO of Turner Industries, attributes a dramatic rise in the pipe-fabrication facility—from \$20 million to \$120 million in just several years—to Turner-Direct.com.

These systems have not gone unnoticed by industry peers. Interplan was the winner of *Constructech's* 2000 Vision award for software innovation in the heavy construction industry. That same year, Turner-Direct.com received *CIO Magazine's* CIO-100 award for customer service and customer relationship management.

None of this success has caused Turner Industries to sit on its laurels. The company is building a business intelligence system that will collect up-to-the-minute data about the cost and revenue margins of any project and provide that data to the customer so that inefficiencies and glitches in projects can be identified early and fixed immediately. (Source: J.D. Edwards, 2002b).



The Port of Singapore Exports Its Intelligent Systems Over Its Enterprise Portal. The Port of Singapore is the world's busiest and largest container port in the world. Over 250 shipping companies use the port to ship goods to 600 ports in 123 countries. However, the port is experiencing strong competition from neighboring ports in Malaysia, Indonesia, and the Philippines. In these neighboring countries, labor, space, utilities, and services are significantly cheaper.

What has been the response? PSA, the company that operates the Port of Singapore, uses its Computer Integrated Terminal Operations System (CITOS) to automate many of its port services and reduce costs. Additionally, the port's intelligent systems reduce the cycle time of unloading and loading vessels. This cycle time is very important to ships, since their fixed cost is very high; the longer they stay in port, the higher the cost. An intelligent system is used to expedite trucks' entry into and exit from the port. As a result of using neural computing, the time is down to 30 seconds per truck instead of 3 to 5 minutes in other countries. Expert systems plan vessel loading, unloading, and container configuration, so cycle time can be as little as 4 hours (versus 16 to 20 hours in a neighboring port).

PSA's newest innovation is the export of its port operations expertise to other ports. Portnet.com, a fully owned subsidiary of PSA, has joint venture, franchise, or licensing agreements with 14 different ports in 9 different countries in all parts of the world. Essentially PSA is selling its e-business systems and expertise to its competitors. (Sources: Field, 2002; Tung and Turban, 1996; corporate sources in Singapore, July 2000; *portnet.com*.)

SUMMARY. The relationships between the competitiveness strategies presented earlier in the chapter and some of the company examples are summarized in Table 3.2.

TABLE 3.2 Company Examples and Competitiveness Strategies

Company	Cost Leadership	Differentiation	Alliance	Innovation	Time	Customer Orientation	Lock in Suppliers or Customers
Rosenbluth	X	X		X		X	X
RadioShack		X				X	
Expedia	X	X	X		X	X	X
Cannondale					X		X
1-800Flowers		X	X		X		X

3.7 IMPLEMENTING AND SUSTAINING SIS

SIS Implementation

Implementing strategic information systems may be a complex undertaking due to the magnitude and the complex nature of the systems. In this section we will briefly look at several related issues: (1) SIS implementation, (2) SIS risks and failures, (3) finding appropriate SISs, and (4) sustaining SIS and strategic advantage.

Most SISs are large-scale systems whose construction may take months or even years. In later chapters we will discuss at more length various important issues relating to SIS implementation: Chapter 9 covers the development process of such systems, which starts with generic IS planning. Chapter 13 addresses the methodologies of how to justify strategic information systems, whose sometimes-intangible benefits may be difficult to value. Finally, Chapter 14 discusses in detail the general topic of systems development and implementation.

The magnitude and complexity of the continuous changes occurring both in technology and in the business environment may result in partial or even complete SIS failures. When SISs succeed, they may result in huge benefits and profits. When they fail, the cost can be extremely high. In some cases, SIS failure can be so high that a company may even go bankrupt as a result. For example, FoxMeyer, a large distributor of drugs in the United States, filed for bankruptcy in 1996 after failing to implement a SIS that cost several times its projected cost and processed far fewer orders per hour than its predecessor (McHugh, 2000). The failure occurred despite the use of a major IT consulting firm and the leading enterprise resource planning (ERP) software.



Identifying appropriate strategic information systems is not a simple task. Two major approaches exist: One approach is to start with known problems or areas where improvements can provide strategic advantage, decide on a strategy, and then build the appropriate IT support. This is a *reactive approach*. It is basically what Rosenbluth International did. The second approach is to start with available IT technologies, such as Web-based EDI or e-procurement, and try to match the technologies with the organization's current or proposed business models. This is a *proactive approach*. In either case a SWOT (strengths, weaknesses, opportunities, threats) analysis or an application portfolio analysis tool such as an Internet portfolio map (Tjan, 2001) can be used to decide what systems to implement and in what order.

Sustaining SIS and Strategic Advantage

Strategic information systems are designed to establish a profitable and sustainable position against the forces that determine industry competition. A **sustainable strategic advantage** is a strategic advantage that can be maintained for some length of time. During the period from 1970 through the late 1990s, businesses implemented numerous successful IT-based strategic systems that lasted many years. These SISs enabled the companies that owned them to enjoy a competitive advantage for several years before competitors imitated their systems. For example, Federal Express's package-tracking system gave FedEx a competitive advantage for three to five years before it was copied by UPS, DHL, and others.

However, in the first decade of the twenty-first century, it has become increasingly difficult to *sustain* an advantage for an extended period. Due to advances in systems development, outward systems can now be quickly duplicated, sometimes in months rather than years. Also, innovations in technology may make even new systems obsolete rather quickly.

Therefore, the major problem that companies now face is how to sustain their competitive advantage. Ross et al. (1996) suggest the three IT assets—people, technology, and “shared” risk and responsibility—as a way to develop sustainable competitiveness. Porter (1996) expanded his classic competitive forces model to include strategies such as growth and internal efficiency that facilitate sustainability. Here we present some ways to accomplish competitive sustainability with the help of IT.

One popular approach is to use *inward systems* that are not visible to competitors. Companies such as General Motors and American Airlines, for example, use intelligent systems to gain strategic advantage, but the details of those systems are secret because they are in inward systems. It is known that several companies (such as John Deere Corp.) are using neural computing for investment decisions, but again the details are not known. The strategic advantage from use of such inward systems is sustainable as long as the systems remain a secret, or as long as competitors do not develop similar or better systems.

If a company uses outward systems to sustain competitive advantage, one way to protect those systems is to patent them, as Rosenbluth, Amazon.com, and Priceline did. Another approach to sustaining competitive advantage is to develop a comprehensive, innovative, and expensive system that is very difficult to duplicate. This is basically what Rosenbluth did, as did Caterpillar Corporation.

Finally, experience indicates that information systems, by themselves, can rarely provide a sustainable competitive advantage. Therefore, a modified approach that combines SISs with structural changes in the business may be likely to provide a sustainable strategic advantage. For example, Barnes & Noble not only started to sell on the Web but also created a completely independent organization to do so (*bn.com*). This strategy can work very well if the online and offline parts of a company can work in synergy. Barnes & Noble made a strategic move to regain market share lost to Amazon.com. Frequently this approach is implemented through business process reengineering and organizational transformation, which are described in Chapter 9.

MANAGERIAL ISSUES

1. **Risk in implementing strategic information systems.** The investment involved in implementing an SIS is high. Frequently these systems represent a major step forward and utilize new technology. Considering the contending business forces, the probability of success, and the cost of investment, a company considering a new strategic information system should undertake a formal risk analysis.
2. **Planning.** Planning for an SIS is a major concern of organizations (Earl, 1993). Exploiting IT for competitive advantage can be viewed as one of four major activities of SIS planning. The other three (which will be discussed later in the book) are aligning investment in IS with business goals (Chapter 9), directing efficient and effective management of IS resources (Chapters 13 and 15), and developing technology policies and architecture (Chapter 9).
3. **Sustaining competitive advantage.** As companies become larger and more sophisticated, they develop sufficient resources to quickly duplicate the successful systems of their competitors. For example, Alamo Rent-a-Car now offers a frequent-renter card similar to the one offered by National car rental.

Sustaining strategic systems is becoming more difficult and is related to the issue of being a risk-taking leader versus a follower in developing innovative systems.



4. **Ethical issues.** Gaining competitive advantage through the use of IT may involve actions that are unethical, illegal, or both. Companies use IT to monitor the activities of other companies, which may invade the privacy of individuals working there. In using business intelligence (e.g., spying on competitors), companies may engage in tactics such as pressuring competitors' employees to reveal information or using software that is the intellectual property of other companies without the knowledge of these other companies. Companies may post questions and place remarks about their competitors with Internet newsgroups. Many such actions are technically not illegal, due to the fact that the Internet is new and its legal environment is not well developed as yet, but many people would certainly find them unethical.



ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; SIS frameworks; cases, tables, and figures; updates; additional exercises; links; and demos and activities can be found on the book's Web site.

KEY TERMS

Alliance strategy (p. ●●●)	Growth strategy (p. ●●●)	Strategic information system (SIS) (p. ●●●)
Competitive advantage (p. ●●●)	Increase switching costs strategy (p. ●●●)	Strategic management (p. ●●●)
Competitive forces model (p. ●●●)	Innovation strategy (p. ●●●)	Support activities (p. ●●●)
Competitive intelligence (p. ●●●)	Lock in customers or suppliers strategy (p. ●●●)	Sustainable strategic advantage (p. ●●●)
Cost leadership strategy (p. ●●●)	Niche strategy (p. ●●●)	Time strategy (p. ●●●)
Customer-orientation strategy (p. ●●●)	Operational effectiveness strategy (p. ●●●)	Value chain model (p. ●●●)
Differentiation strategy (p. ●●●)	Primary activities (p. ●●●)	Value system (p. ●●●)
Entry-barriers strategy (p. ●●●)		
Global business drivers (p. ●●●)		

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 Strategic information systems (SISs) support or shape competitive strategies.
- 1 SIS can be outward (customer) oriented or inward (organization) oriented.
- 1 Information technology can be used to support a variety of strategic objectives, including creation of innovative applications, changes in business processes, links with business partners, reduction of costs, acquiring competitive intelligence, and others.
- 2 The Internet has changed the nature of competition, altering the traditional relationships between customers, suppliers, and firms within an industry.
- 3 Cost leadership, differentiation, and niche were Porter's first strategies for gaining a competitive advantage, but today many other strategies exist. All of the competitive strategies can be supported by IT.
- 4 Porter's value chain model can be used to identify areas in which IT can provide strategic advantage.
- 5 Interorganizational information systems offer businesses opportunities to work together in partnerships to achieve strategic objectives.
- 6 Multinational corporations and international traders need a special IT approach to support their business strategies.

- 6 Strategic information systems can be found in all types of organizations around the globe.
- 7 Some SISs are expensive and difficult to justify, and others turn out to be unsuccessful. Therefore, careful planning and implementation are essential.
- 8 Acquiring competitive advantage is hard, and sustaining it can be just as difficult because of the innovative nature of technology advances.

QUESTIONS FOR REVIEW

1. What is an SIS?
2. What is a competitive strategy and how is it related to competitive advantage?
3. What has been the impact of the digital economy on competition?
4. List eight ways IT can support the objectives of strategic management.
5. List the five forces in Porter's competitive forces model.
6. What has been the impact of the Internet on Porter's competitive forces model?
7. List 12 strategies for competitive advantage.
8. List the primary and support activities of Porter's value chain model.
9. What are the potential uses of Porter's value chain model in analyzing competitive advantage?
10. What are vertical consortia? What are horizontal consortia?
11. Compare the value chain to the value system.
12. Describe the global business drivers model.
13. Describe two approaches for identifying appropriate SISs for implementation.
14. List two reasons why it is difficult for businesses to sustain a competitive advantage.

QUESTIONS FOR DISCUSSION

1. A major objective of the Rosenbluth strategy was to create a very close relationship with the customer. Relate this objective to Porter's two models.
2. What is the importance of competitive intelligence in SIS? What role does the Internet play in intelligence gathering?
3. Discuss the relationship between the critical organizational responses of Chapter 1 and a *differentiation* strategy.
4. Give two examples that show how IT can help a defending company *reduce* the impact of the five forces in Porter's model.
5. Give two examples of how attacking companies can use IT to *increase* the impact of the five forces in Porter's model.
6. Why might it be difficult to justify an SIS?
7. Explain what unique aspects are provided by the global business drivers model.
8. Discuss the idea that an information system by itself can rarely provide a sustainable competitive advantage.

EXERCISES

1. Review the applications in Section 3.6 and relate them to Porter's five forces.
2. One area of intensive competition is selling cars online (see Slater, 1999). Examine the strategy of the players cited in the paper (available at *cio.com*). Identify the related new business models and relate them to the strategies promoted in this chapter.
3. Study the Web sites of Amazon.com and Barnes & Noble online (*bn.com*). Also, find some information about the competition between the two. Analyze Barnes & Noble's defense strategy using Porter's model. Prepare a report.
4. Identify the major competitors of Rosenbluth International. Visit three other travel agent Web sites, and compare their strategies and offerings to those of Rosenbluth.

GROUP ASSIGNMENTS

1. Assign group members to each of the major car rental companies. Find out their latest strategies regarding customer service. Visit their Web sites, and compare the findings. Have each group prepare a presentation on why its company should get the title of “best customer service provider.” Also, each group should use Porter’s forces model to convince the class that its company is the best competitor in the car rental industry.
2. The competition in retailing online is growing rapidly as evidenced in goods such as books, toys, and CDs. Assign groups to study online competition in the above industries and more. Identify successes and failures. Compare the various industries. What generalizations can you make?
3. Assign group members to each of the major airlines. Read Callon’s (1996) chapter on competition in the airline industry. Visit the Web sites of the major airlines. Explain how they deal with “buyers.” What information technologies are used in the airlines’ strategy implementation? Have each group make a presentation explaining why its airline has the best strategy.
4. Assign each group member to a company to which he or she has access, and have each member prepare a value-chain chart. The objective is to discover how specific IT applications are used to facilitate the various activities. Compare these charts across companies in different industries.
5. Assign members to UPS, FedEx, DHL, and the U.S. Postal Service. Have each group study the e-commerce strategies of one company. Then have members present the company, explaining why it is the best.



Minicase 1 Net Readiness at Cisco Systems

Cisco Systems (*cisco.com*) richly deserves its self-designated title of “the worldwide leader in networking for the Internet.” Virtually all of the data packets that swirl through the Internet pass through a Cisco-manufactured router on their way to their destination. However, Cisco doesn’t see itself as a computer hardware company. Instead, Cisco considers its main product to be networking solutions. Through initiatives such as its Internet Business Solutions Group, Cisco provides businesses with the software, support, service, training, and, yes, hardware, they need to create an information infrastructure to become e-businesses. In 2003, Cisco sells its products in over 100 countries and employs 34,500 employees. In fiscal year 2002, Cisco Systems had almost \$19 billion of revenue and ranked 95 on the Fortune 500.

How does Cisco fulfill its vision to be a complete network solution provider? Three key strategic information systems that embody many of the principles discussed in this chapter enable Cisco to reach up and down its value system. Cisco has built a network linking its customers, prospects, business partners, suppliers, and employees in a seamless value chain (Hartman and Sifonis, 2000, p. 239). The SISs that support that seamless value chain include the three described below.

Cisco Connection Online (CCO) is its customer-facing SIS. The Cisco Web site (*cisco.com*) is the gateway for customers to price and configure orders, place orders, and check order status. CCO also offers customers the opportunity to help

themselves to the information they need to do business with Cisco. And they do access it: CCO is accessed over 1.5 million times each month by its 150,000 active registered users. Customers use CCO to get answers to questions, diagnose network problems, and collaborate with other customers and Cisco staff. Currently Cisco is working with its major customers to integrate their enterprise applications directly into Cisco’s back-end systems. The goals of this project are to provide better and speedier customer service, lock in customers, and generate operating expense savings of \$350 million per year.

Manufacturing Connection Online (MCO) is an extranet application that links Cisco’s partners up and down its supply chain. Its purpose is to provide real-time manufacturing information to Cisco’s suppliers and employees in support of the manufacturing, supply, and logistics functions. MCO delivers forecast data, real-time inventory data, purchase orders, and related information through a secure connection and a graphical user interface. One of the most successful aspects of MCO is direct fulfillment. The old process had all products coming to Cisco for storage and then shipment to the customer. MCO’s connections to Cisco’s suppliers allows Cisco to forward a customer’s order to a third-party supplier, who ships it directly to the customer. By pushing information down the supply chain instead of product up the supply chain, Cisco is able to reduce shipping time, save money, and make customers happy.

INTERNET EXERCISES

1. McKesson Drugs is the largest wholesale drug distributor in the world. Visit the company Web site (*mckesson.com*). What can you learn about its strategy toward retailers? What is its strategy toward its customers? What e-commerce initiatives are evidenced?
2. Enter the Web site of Dell Computer (*dell.com*) and document the various services available to customers. Then enter IBM's site (*ibm.com*). Compare the services provided to PC buyers at each company. Discuss the differences.
3. Research the online toys competition. Visit the sites of *toysrus.com*, *lego.com*, *KBKids.com*, and also check toy sales online by *sears.com*, *amazon.com*, and *walmart.com*. Finally, examine *dogtoys.com*. Prepare a report with your findings.
4. Enter some EDGAR-related Web sites (*edgar-online.com*, *hottools.com*, *edgar.stern.nyu.edu*). Prepare a list of the documents that are available, and discuss the benefits one can derive in using this database for conducting a competitive intelligence (see Kambil and Ginsburg, 1998).



Cisco Employee Connection (CEC) is Cisco's inward-looking SIS, an intranet that addresses the unique needs of every Cisco employee. CEC offers ubiquitous communications (e.g., distribution of marketing materials, major corporate announcements), streamlined business processes (e.g., travel expense reimbursement), and integrated business systems (e.g., scheduling meetings, a problem-reporting system).

One application that illustrates CEC's benefits to both Cisco and its employees is Metro, a travel-expense reporting system. Assume an employee uses a corporate credit card to charge an expense. Metro displays all expenses on a current credit card statement, and the employee can then move all relevant charges to an expense report. In pre-Metro days, a travel reimbursement took four to five weeks; Metro reimburses the employee in two to three days.

Cisco has benefited richly from these strategic information systems. For example:

- Eighty percent of technical support requests are filled electronically, reducing help desk labor costs and almost always with a customer satisfaction rate that exceeds that of human intervention.
- Providing technical support to customers over the Internet has enabled Cisco to save more than \$200 million annually, more money than what some of its competitors spend on research and development.
- CCO metrics show 98 percent accurate, on-time repair shipments, and customer satisfaction increased by 25 percent between 1995 and 2000.
- By outsourcing 70 percent of its production means, Cisco has quadrupled output without the time and investment required to build new plants.

- MCO has allowed Cisco to lower business costs in processing orders (from \$125 per order to less than \$5), improved employee productivity, and reduced order cycle times.
- Metro not only reimburses employees faster, it increases employee productivity and saves Cisco auditing costs. Today Cisco employs only two auditors to audit expenses for 15,000 Metro users per month.
- Cisco estimates total annual savings from CEC at \$58 million, including \$25 million in employee training savings and \$16 million in employee communication.

A recent Cisco advertising campaign featured children and adults from all over the world asking the viewer, "Are you ready?" for the Internet. Cisco not only promotes Net readiness through its advertising, but also lives Net readiness by applying network connectivity throughout the company to maintain its competitiveness in network technology.

Questions for Minicase 1

1. How does each of Porter's five forces apply to Cisco?
2. The case emphasizes benefits to Cisco. How do suppliers benefit? How do customers benefit?
3. Are the initiatives in place at Cisco available only to such a high-tech company? Specifically, what difficulties would a more traditional company face in becoming Net ready?
4. How can Cisco use the knowledge it has acquired from internal implementation of these systems to fulfill its goal to be a network solution provider to its customers?

Sources: Hartman and Sifonis (2000); *newsroom.cisco.com*.



Minicase 2

Aeronautica Civil: Achieving Competitive Advantage in a Noncompetitive Industry

As noted in the chapter, competitiveness in government agencies can sometimes be expressed as “competing against yourself.” Essentially, an organization sets goals that are significantly higher than current performance and puts processes and systems in place to meet those goals, thus effectively competing against its former performance.

Aeronautica Civil (aerocivil.gov.co) is Colombia’s air-control agency. A division of the Colombian Ministry of Transportation, Aeronautica Civil is responsible for overseeing and developing Colombia’s air transportation system, including 73 airports and 3,000 officers. The agency is responsible for efficiently managing the movement of more than 10 million passengers and 957,000 aircraft take-offs and landings each year.

In its review of computer systems for the Y2K problem, Aeronautica Civil became aware of significant deficiencies in the control of its financial operations. Billing was consistently in a three-month backlog, processing a customer statement took three days, bank accounts were being reconciled manually, and closing the monthly balance sheet was taking three months. Something needed to change, and the business drivers behind that change were:

- Increase the company’s revenues and improve accounts receivable turnover.
- Prevent economic losses from bad debts plus generate and control revenue from other sources.
- Minimize resources wasted in responding to claims.
- Allow for procurement controls and control of fixed assets.

After a three-month evaluation process of ERP vendors, Aeronautica Civil selected consultant J.D. Edwards to develop and implement a system that could address the problems in the agency’s financial operations and improve its performance. The system was successfully implemented in only nine months. Key factors in that implementation success were the full commitment of Aeronautica Civil’s executives toward the initiative and an implementation team that included some of the best professionals in each of the agency’s financial and administrative areas.

Success was defined as meeting many of the goals defined for the project. In comparison, and in competition, with its former self, now billing is up-to-date, customer

statements are processed in two minutes, bank accounts are reconciled automatically every day, and the balance sheet is closed by the twentieth of the following month. More generally, these are the results: Management of accounts receivable and collections has been significantly improved. Managers have access to timely and reliable information for decision making. Decision-making and immediate response capabilities are more efficient, a critical factor in an air transport agency. Costs and execution times have been reduced. And operations and corruption control have been automated.

Today the new, more competitive Aeronautica Civil projects “an image of continuous modernization, better service, efficiency, control, and transparency among its customers and other governmental entities. Aeronautica Civil has become a model government-owned company, and a prototype of systematization for aeronautics companies in other countries” (J.D. Edwards, 2002c, p. 2). Aeronautica Civil is one of many examples of not-for-profit or government agencies who have implemented a strategic information system to become more competitive in an industry in which the normal rules of competition do not apply.

Questions for Minicase 2

1. Who is Aeronautica Civil competing against? What other approaches to measuring competitiveness can not-for-profit and government agencies use in measuring competitiveness?
2. Can profit-making organizations use the approach adopted by Aeronautica Civil? Why or why not?
3. What were some of the keys to success for Aeronautica Civil?
4. How did Aeronautica Civil measure competitive success? Specifically, compare “before” and “after” on the performance measures identified in this case.
5. Use the Internet to find another, similar organization that is competing against itself to achieve competitive advantage.

Source: J.D. Edwards (2002c).

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PART II
The Web Revolution



- ▶ 4. Network Computing: Discovery, Communication, and Collaboration
- 5. E-Business and E-Commerce
- 6. Mobile, Wireless, and Pervasive Computing Environments

CHAPTER

4

Network Computing: Discovery, Communication, and Collaboration

National Semiconductor
Corporation

4.1

Network Computing—
An Overview

4.2

Discovery

4.3

Communication

4.4

Collaboration

4.5

Collaboration-Enabling Tools:
from Workflow to Groupware

4.6

E-Learning, Distance
Learning, and Telecommuting

4.7

Some Ethical and Integration
Issues

Minicases: (1) General Motors/
(2) Cisco Systems

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Understand the concepts of the Internet and the Web, their importance, and their capabilities.
- 2 Understand the role of intranets, extranets, and corporate portals for organizations.
- 3 Identify the various ways in which communication is executed over the Internet.
- 4 Demonstrate how people collaborate over the Internet, intranets, and extranets using various supporting tools, including voice technology and teleconferencing.
- 5 Describe groupware capabilities.
- 6 Describe and analyze the role of e-learning and distance learning.
- 7 Analyze telecommuting (teleworking) as a technosocial phenomenon.
- 8 Consider ethical and integration issues related to the use of network computing.



NATIONAL SEMICONDUCTOR CORPORATION

THE PROBLEM

The semiconductor (or chip) industry is one of the most competitive global industries. The rivalry among Japan, Korea, Taiwan, and the United States is fierce, and prices are continuously being driven down. When the economy is weak, demand for computers weakens, resulting in price cuts and losses to the chip manufacturers.

One way to survive is to customize products. National Semiconductor Corporation (NSC) (*national.com*) has over 10,000 products. However, this creates a problem for customers: When they need a chip, customers provide specifications to several chip manufacturers, collect catalogs and samples from the manufacturers, and then contact them for prices and technical details. This takes a considerable amount of time and effort.

Connectivity problems due to different hardware, software, and communication standards had forced NSC to resort to the telephone, fax, and regular mail to communicate and collaborate with its customers. The communication channels that were available prior to the Internet were either regular telephone lines or private communication lines, both of which were expensive. Electronic data interchange (EDI) was in use, but it was limited to transaction processing and was carried on an expensive value-added network (VAN), so many customers refused to use it. Transmission of pictures, charts, and diagrams, a major part of the NSC product catalog, was a very difficult task. NSC found it just too expensive and cumbersome to handle communication and collaboration with customers over its old system.

THE SOLUTION

NSC introduced an innovative solution. The company posts detailed descriptions of its 10,000 products on its *corporate portal** (*national.com*). The portal allows NSC's customers to access product information 24 hours a day. *Browsing* through the information, customers are able to download the documents they need. The Web site is also used by the company's employees to search out information quickly and accurately, and to receive more direct feedback from customers.

NSC's Web site visitors use a *search engine* that helps them find a matching product, based on product specifications in the online "Knowledge Base." It also uses custom software that can extract information from existing databases and automatically format it in the *HTML* programming language. (HTML helps in preparing documents that appear on the Internet; see Technology Guide 5.) Since 2002, National's customers also use a sophisticated *open system* customer interface based on WebMethods integrated platform and B2B standards introduced by RosettaNet. This enables fast search by customers for parts and components.

NSC customers can also build personalized Web sites (titled "My Bill of Materials"). These personalized sites can host information related to customer



*The Internet terms italicized in this case are defined later in this chapter, or in Technology Guide 5, or in Chapter 5. Another, generic source for Internet terms you do not know is the Web site *whatis.com*.

projects and their requirements, and any other pertinent information. Customers can select the information to be made accessible to NSC. Through the personalized Web sites, NSC delivers the latest product information of interest to individual customers. This application is part of the corporate *extranet* system. The arrangement also allows NSC to watch the inventory level of chips at customers' facilities, and automatically ship products to them when the inventories are low. For example, the Internet links enabled Tektronix Inc. (a major customer) to discontinue paper files of past and current inventory parts. Product specifications and availability are automatically updated and linked to Tektronix's system. This in turn has enabled NSC to reengineer its distribution system.

The search process is supported by an *electronic form* that is easily filled in by customers, and by a menu of *hyperlinks* to related products and services. The system is used both by customers and by NSC engineers. Its benefits are the following: reducing the sample-ordering process by days or weeks; expediting the design of new products; increasing the exposure of NSC products by a factor of 10 (customers now download 10 times as many documents as they did using just e-mail); providing more information to customers; providing direct and expeditious feedback from customers; increasing quality and productivity; improving the company's relations with its business partners; and increasing profitability and competitiveness.

The NSC Web site offers design assistants and simulators to guide customers in designing their products. Using this facility, customers can input their system specifications, find the devices that fit the specifications, validate design by simulation, and order the required parts. NSC also provides behavioral models and software to support the design process. NSC's design-assistant tool kit was estimated to save National's design customers \$50 million in the first year.

A visit to the site in April 2003 revealed many new features. For example, the *analog university* provides many online seminars, and there are an online technical journal, an online biweekly newsletter, online research tools, a locator to find the nearest distributors, a list of job openings, and much more. Information is available in several languages.

THE RESULTS

The Internet solution enables NSC to use *electronic catalogs* instead of paper ones, thus saving the company typesetting, printing, and mailing expenses. The electronic catalog also can be kept much more current than paper catalogs could. In addition, customers can view catalogs and download detailed documents in order to analyze products more closely. Large customers get customized catalogs. The e-mail capabilities allow rapid communication between NSC engineers and customers. The site also offers a configuration that helps customers to configure the chips they need. Added software and hardware, such as videoconferencing and screen sharing, let NSC engineers collaborate with customers electronically, allowing them to work simultaneously on the same documents from different locations. All this is done at a relatively low cost.

NSC's sales and profitability increased significantly immediately after the introduction of the Web-based applications and Internet solution. In 1998, NSC



earned the best extranet application award from *Internet Week* and *Network Computing*. The system also has enabled the company to minimize the damage caused by the slowdown of sales of new technology by 20 to 40 percent in recent years.

Sources: Compiled from *Internet Week*, March 9, 1998; National Semiconductor press release, October 16, 2000, *WebMethods.com* (National Semiconductor Success Story, accessed May 5, 2003); and visit at *national.com* on April 19, 2003.



LESSONS LEARNED FROM THIS CASE

The NSC opening case demonstrates the increasing role that the Internet, intranets, extranets, and corporate portals play in organizations, as well as their potential benefits. Using various Web-based applications, NSC enabled its employees to collaborate with its customers, to speed up design, and to cut costs. NSC made full use of Web technologies both for internal and external applications. Customers use the Web to discover information, to communicate with NSC's employees, and to collaborate with the technical staff.

In this chapter we learn about the major capabilities of network computing to support discovery of information, communication, and collaboration activities in organizations. We also learn how organizations are exploiting network computing for e-learning and telecommuting.

4.1 NETWORK COMPUTING—AN OVERVIEW

An Overview of the Internet and the Web



Many aspects of the way we work and live in the twenty-first century will be determined by the vast web of electronic networks, which was referred to generally as the **information superhighway** but now is usually called the Internet. As you know from Chapter 1, the **Internet** is a *global network of computer networks*. It links the computing resources of businesses, government, and educational institutions using a common computer communication protocol, TCP/IP (described in Technology Guide 5). Because of its capabilities, the Internet (frequently referred to as “the Net”) is rapidly becoming one of the most important information technologies today. It is clearly the most widely discussed IT topic of the new century.

Future versions of the Internet will allow even larger volume and a more rapid flow of information. Eventually we may see several information superhighways. It is probable that the original concept of a scientific-educational system will be separated from the commercial one. For example, in order to support advanced network applications and technologies, over 180 U.S. universities, working in partnership with industry and government, are working on a project named **Internet2** (*internet2.edu*). On Internet2, advanced next-generation applications such as remote diagnosis, digital libraries, distance education, online simulation, and virtual laboratories will enable people to collaborate and access information in ways not possible using today's Internet (Choi and Whinston, 2000). Another vision is that there will be several types of interrelated Internets, one for e-commerce, one for education, and so forth.

THE WORLD WIDE WEB. The **World Wide Web—the Web**—is the most widely used application on the Internet. Are the Internet and the World Wide Web the same thing? Many people believe that the Web is synonymous with the Internet, but that is not the case. The Internet functions as the *transport mechanism*, and the Web (WWW, or W3) is an *application* that *uses* those transport functions. Other applications also run on the Internet, with e-mail being the most widely used.



The Web is a system with universally accepted standards for storing, retrieving, formatting, and displaying information via client/server architecture. The Web handles all types of digital information, including text, hypermedia, graphics, and sound. It uses graphical user interfaces, so it is very easy to use. See Technology Guide 5 for details.

THE EVOLUTION OF COMMERCIAL APPLICATIONS ON THE INTERNET. With the commercialization of the Internet in the early 1990s, we have seen an explosion of commercial applications. These applications evolve through four major phases: *presence*, *e-commerce*, *collaboration*, and *integration*. The major characteristics of each phase are illustrated in Figure 4.1 as they evolve over time.

Specific applications in each phase are demonstrated in Chapter 5 and throughout this book. Another way to look at the applications of the Internet is via the generic categories that they support, as presented next.

INTERNET APPLICATION CATEGORIES. The Internet supports applications in the following major categories:

- **Discovery.** Discovery involves browsing and information retrieval. As shown in the opening case, it provides customers the ability to view information

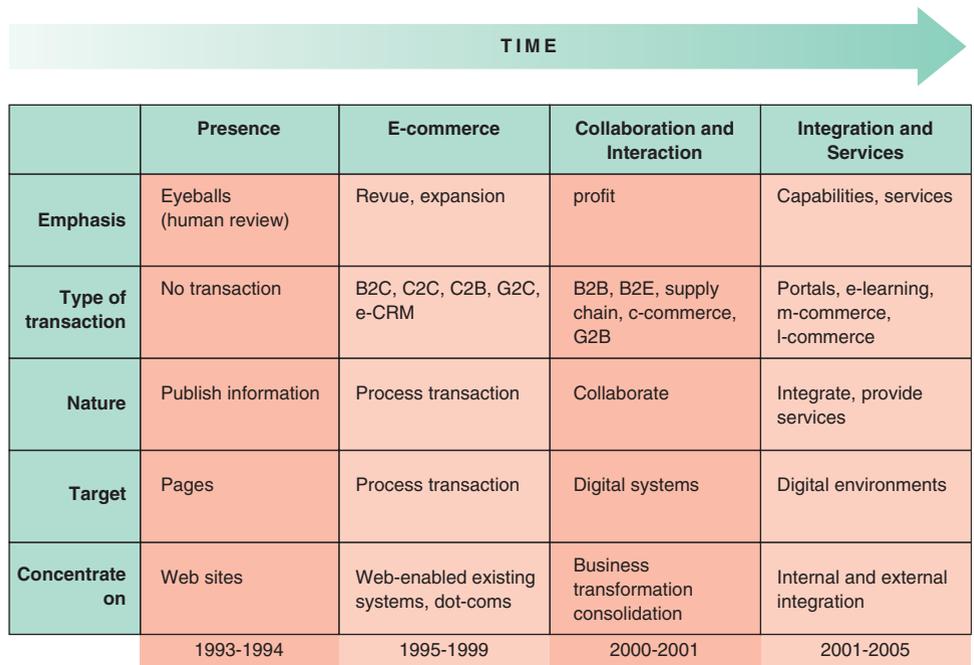


FIGURE 4.1 The evolution of the Internet over time.



in databases, download it, and/or process it. Discovery is facilitated by software agents since the amount of information on the Internet and intranets is growing rapidly. Discovery methods and issues are described in Section 4.2.

- **Communication.** The Internet provides fast and inexpensive communication channels that range from messages posted on online bulletin boards to complex information exchanges among many organizations. It also includes information transfer (among computers and via wireline and wireless) and information processing. E-mail, chat groups, and newsgroups (Internet chat groups focused on specific categories of interest) are examples of major communication media presented in Section 4.3 and in Technology Guide 5.
- **Collaboration.** Due to improved communication, electronic collaboration between individuals and/or groups and collaboration between organizations are increasing rapidly. Several tools can be used, ranging from screen sharing and teleconferencing to group support systems, as we will illustrate in Section 4.4. Collaboration also includes resource-sharing services, which provide access to printers and specialized servers. Several collaboration software products, called groupware and workflow, can be used on the Internet and on other networks.

The Net is also used for education, entertainment, and work. People can access the content of newspapers, magazines, and books. They can download documents, and they can do research. They can correspond with friends and family, play games, listen to music, view movies and other cultural events, and even visit many major museums and galleries worldwide.

The Network Computing Infrastructure: Intranets and Extranets

In addition to the Internet and the Web there are two other major infrastructures of network computing: the intranet and the extranet

THE INTRANET. As discussed in Chapter 2, an **intranet** is a network designed to serve the internal informational needs of a company, using Internet concepts and tools. It is a network confined to an organization for its internal use. It provides easy and inexpensive browsing and search capabilities.

Intranets also support communication and collaboration. They are frequently connected to the Internet, enabling a company to conduct e-commerce activities. (Such activities are facilitated by *extranets*, as described later in this chapter and in Chapter 5.) Using screen sharing and other groupware tools, intranets can be used to facilitate the work of groups. Companies also publish newsletters and deliver news to their employees via their intranets. For extensive information about intranets, see *intranetjournal.com*.

Intranets have the power to change organizational structures and procedures and to help reengineer corporations. Intranets can be implemented using different types of local area network (LAN) technologies including wireless LANs (see Technology Guide 4). *IT at Work 4.1* illustrates how a hospital intranet can be used effectively with a wireless LAN.

Intranets are used in all types of organizations, from businesses to health care providers to government agencies, to educational institutions. Examples





IT At Work 4.1

WIRELESS LANs SPEED HOSPITAL INSURANCE PAYMENTS



The Bridgeton, a holding company that operates four hospitals in New Jersey, uses wireless LANs to process insurance paperwork. The goal is to reduce the number of claims being denied by insurers.

The network environment broadcasts data over a distance of about 120 feet from nursing workstations. Nurses log on to the hospital's intranet using notebook computers and can move with their notebooks from the nursing workstation into patient rooms while maintaining a network connection. When a nurse takes a notebook computer from one nursing station to another, the radio card in the notebook computer goes into a roaming mode similar to a cellular phone. In the course of their work, whether at

the nurses' station or in patient rooms, the nurses collect and record information needed for insurance claims (such as patient treatments and drugs administered).

The company is getting a good return on investment, savings in six-figure dollar amounts each year, for a moderate cost of setting up the network (about \$200 for each notebook computer radio card and \$750 for each of 28 wireless access points).

For Further Exploration: What are the disadvantages of using a wireless LAN?

Source: Compiled from Cope (2000).



of several intranet applications are available in *Online File W4.1* at the book's Web site.

EXTRANETS. An intranet's infrastructure is confined to an organization's boundaries, but not necessarily geographical ones; intranets can also be used to connect offices of the same company in different locations. As discussed in Chapter 2, another type of infrastructure that connects the intranets of *different organizations* is an **extranet**. An extranet is an infrastructure that allows *secure communications* among *business partners* over the Internet (using VPN, see Technology Guide 4). It offers limited accessibility to the intranets of the participating companies, as well as the necessary interorganizational communications, using Internet tools.

The use of extranets is rapidly increasing due to the large savings in communication costs that can materialize. Extranets enable innovative applications of business-to-business (B2B) e-commerce (see Chapter 5). The National Semiconductor Corporation case study at the beginning of this chapter illustrates how NSC's customers could save time and effort in design by using design assistance offered through extranets. Finally, extranets are closely related to improved communications along the supply chain (for details see Technology Guide 4 and in Ling and Yen, 2001).

The Internet, intranets, and extranets can be used in various ways in a corporate environment in order to gain competitive advantage. Examples are provided throughout the book and in *Online File W4.2*. An example of how a hypothetical company, Toys Inc., might use all network computing infrastructures is shown in Figure 4.2.

The *discovery, communication, and collaboration* capabilities available at low cost on the Internet, intranets, and extranets provide for a large number of useful applications. In the next four sections of this chapter, we discuss these capabilities. Many other applications are presented in Chapter 5 and throughout the book.

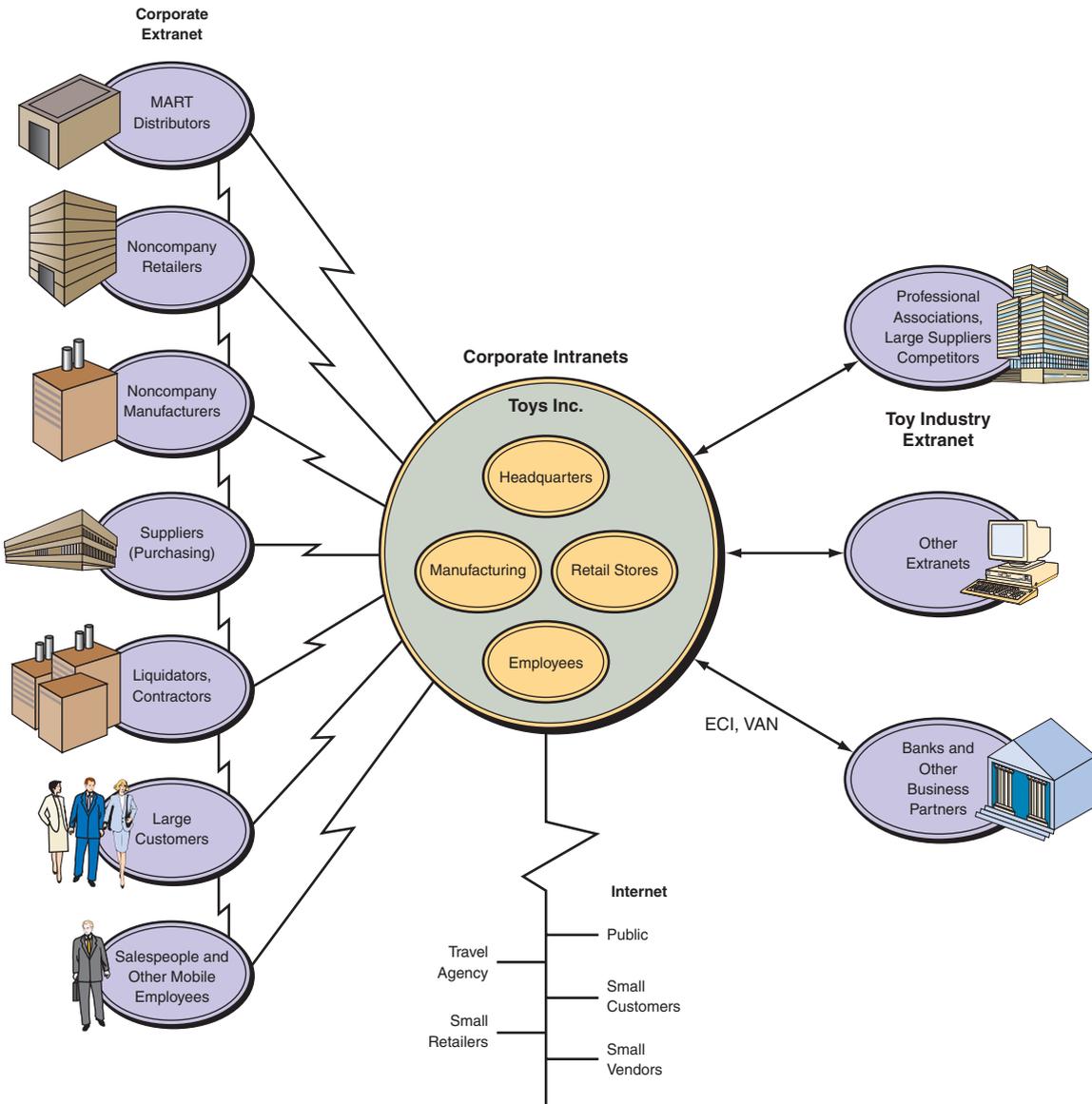


FIGURE 4.2 How a company uses the Internet, intranet, and extranets.

4.2. DISCOVERY

The Internet permits users to access information located in databases all over the world. Although only a small portion of organizational data may be accessible to Internet users, even that limited amount is enormous. Many fascinating resources are accessible. The discovery capability can facilitate education, government services, entertainment, and commerce. Discovery is done by *browsing* and *searching* data sources on the Web. Information can be either *static*, meaning staying basically unchanged, or *dynamic*. Dynamic information, such as

stock prices or news, is changing constantly. The major problem of discovery is the huge amount of information available. The solution is to use different types of search and other software agents.

The Role of Internet Software Agents

A large number of Internet software agents can be used to automate and expedite discovery. **Software agents** are computer programs that carry out a set of routine computer tasks on behalf of the user and in so doing employ some sort of knowledge of the user's goals. We examine some of these agents in this section.

SEARCH ENGINES, DIRECTORIES, SOFTWARE, AND INTELLIGENT AGENTS. The amount of information on the Web is at least doubling every year. This makes navigating through the Web and gaining access to necessary information more and more difficult. *Search engines* and *directories* are two fundamentally different types of search facilities available on the Web. A **search engine** (e.g., Altavista, Google) maintains an index of hundreds of millions of Web pages and uses that index to find pages that match a set of user-specified keywords. Such indexes are created and updated by software robots called **softbots**. A **directory** (e.g., Yahoo, About.com), on the other hand, is a hierarchically organized collection of links to Web pages. Directories are compiled manually, unlike indexes, which are generated by computers.

Search engines and directories often present users with links to thousands or even millions of pages. It is quite difficult to find information of interest from such a large number of links. Therefore we can use additional tools to refine the search. For example, *meta searchers* search several engines at once (e.g., Metacrawler.com). Most of these helpers use software agents, some of which exhibit intelligent behavior and learning and are called **intelligent agents** (Weiss, 1999; Murch and Johnson, 1999). The topic of intelligent agents is discussed more fully in Chapter 12. Here we present only a few examples of Internet-based software agents, which appear under names such as *wizards*, *softbots*, and *knowbots*. Four major types of agents available for help in browsing and searching are Web-browsing-assisting agents, FAQ agents, and indexing agents.

Web-Browsing-Assisting Agents. Some agents can facilitate browsing by offering the user a tour of the Internet. Known as *tour guides*, they work while the user browses. For example, WebWatcher is a personal agent, developed at Carnegie Mellon University, that helps find pages related to the current page, adding hyperlinks to meet the user's search goal and giving advice on the basis of the user's preference.

NetCaptor (*netcaptor.com*) is a custom browser application with a simple-to-navigate Windows interface that makes browsing (only with Internet Explorer) more pleasurable and productive. NetCaptor opens a separate tabbed space for each Web site visited by the user. Users can easily switch between different tabbed spaces. The CaptorGroup feature creates a group of links that are stored together so the user can get single-click access to multiple Web sites. The PopupCaptor feature automatically closes pop-up windows displayed during browsing. NetCaptor also includes a utility, called Flyswat, to turn certain words and phrases into hyperlinks. Clicking on these links opens a window with links to Web sites with relevant information.



For more details on Web-browsing assistants see Tan and Kumar (2002), *botspot.com*, and Lieberman et al. (1999).

Frequently Asked Questions (FAQ) Agents. *FAQ agents* guide people to the answers to frequently asked questions. When searching for information, people tend to ask the same or similar questions. In response, newsgroups, support staffs, vendors, and others have developed files of those FAQs and an appropriate answer to each. But there is a problem: People use natural language, asking the same questions in several different ways. The FAQ agent (such as FAQfinder developed at the University of Chicago) addresses this problem by indexing a large number of FAQ files. Using the text of a question submitted in natural language, the software agent can locate the appropriate answer. GTE Laboratories developed an FAQ agent that accepts natural-language questions from users of Usenet News Groups and answers them by matching question-answer pairs. A solution to natural language may be provided by a semantic Web. (See Chapter 12 and Berners-Lee et al., 2001.)

AskJeeves (*askjeeves.com*), another popular FAQ assistant, makes it easy to find answers on the Internet to questions asked in plain English. The system responds with one or more closely related questions to which the answers are available. Parts of such questions may contain drop-down menus for selecting from different options. After the user selects the question that is closest to the original question, the system presents a reply page containing different sources that can provide answers. Due to the limited number of FAQs and the semistructured nature of the questions, the reliability of FAQ agents is very high.

Search Engines and Intelligent Indexing Agents. Another type of discovery agent on the Internet traverses the Web and performs tasks such as information retrieval and discovery, validating links, and generating statistics. Such agents are called *Web robots*, *spiders*, and *wanderers*.

Indexing agents can carry out a massive autonomous search of the Web on behalf of a user or, more commonly, of a *search engine* like Google, HotBot, or Altavista. First, they scan millions of documents and store an index of words found in document titles, key words, and texts. The user can then query the search engine to find documents containing certain key words.

Special indexing agents are being developed for knowledge sharing and knowledge acquisition in large databases and documents. **Metasearch engines** integrate the findings of the various search engines to answer queries posted by the users. (Examples include *MetaFind*, *QueryServer*, *surfswax*, *Metacrawler*, *Profusion*, *Sherlockhound*, *Search*, *ixquick*, *All-in-One*, *Dogpile*, *Copernic*, and *Web Compass*. See *suite101.com* for details.)

IT at Work 4.2 provides an insight into a specific application of search and indexing technology in education.

Internet-Based Web Mining

The term *data mining* refers to sophisticated analysis techniques for sifting through large amounts of information. Data mining permits new patterns and relationships to be discovered through the use of software that can do much of the mining process (see Chapter 11). Software agents are key tools in discovering previously unknown relationships, especially in complex data structures. *Query-and-reporting tools*, on the other hand, demand a predefined database structure and are most valuable when asking specific questions to confirm hypotheses. For more on Web mining and its varieties, see Chapter 11.



IT At Work 4.2

CATCHING CASES OF PLAGIARISM AT SCHOOLS



The Internet provides abundant information to students who may be tempted to download material and submit it as their own work. Some companies are offering Internet-based antiplagiarism technology to identify cases of plagiarism (e.g., *turnitin* from *plagiarism.org*).

Here's how the process used to find cases of plagiarism works: Instructors register their classes at *turnitin.com*, and request their students to upload term papers or manuscripts into databases designed for specific courses. Each manuscript is converted into an abstract representation using a proprietary technology, and it is then checked against a database of other manuscripts collected from different universities and classes and from all over the Internet. The cases of gross pla-

giarism are flagged, and an originality report, accessible only to the instructor, is generated for each paper.

To try to stay ahead of desperate students, the manuscript collection databases are constantly updated through a series of automated Web robots that scout the Internet for rogue term-paper mills.

For Further Exploration: Do you support using antiplagiarism technology to catch cases of cheating at school? Elaborate on your reasons. Can you think of any other means of finding cases of plagiarism?

Sources: Compiled from *plagiarism.org*, and *turnitin.com*, site accessed April 17, 2003.

Other Discovery Aids

Hundreds of other search engines and discovery aids are available (e.g., see Carroll, 2003). Here are some examples of useful ones:

- **Webopedia.com.** This is a directory of technology-related terms, which are arranged alphabetically. If you know the term for which you want a definition, you can go to it directly. In addition to a definition you will find relevant Internet resources with links. If you do not know the exact term you are looking for, you can use some key word to find it.
- **What Is? (whatis.com).** This knowledge exploration tool provides information about IT, especially about the Internet and computers. It contains over 4,000 individual encyclopedic definitions/topics and a number of "Fast Reference" pages. The topics contain about 12,000 hyperlinked cross-references between definitions/topics and to other sites for further information.
- **eBizSearch (gunther.smeal.psu.edu).** This engine searches the Web as well as academic and commercial articles for various aspects of e-business.
- **Elibrary (ask.library.com).** This site searches for books, articles, maps, pictures, and so on that you can have for a seven-day free trial. After that, you must pay for the files. Abstracts are free.
- **Howstuffworks.com.** You can learn about thousands of products, things, concepts, etc. at this educational and entertaining site. It combines a search engine and a menu system.
- **Findarticles.com.** This search engine specializes in finding articles, usually from trade magazines, on topics of your choice. Like library search engines, it is limited to certain magazines.

Toolbars

To get the most out of search engines, you may use add-on toolbars and special software. Some are attached to the popular search engines, others are independent. Most are free. Examples are: Google Toolbar (*toolbar.google.com*), Copernic Agent Basic (*copernic.com*), KartOO (*kartoo.com*), Yahoo Companion (*companion.yahoo.com*), and Grokker (*groxis.com*).



A CLOSER LOOK

4.1 AUTOMATIC TRANSLATION OF WEB PAGES

Automatic translation of Web pages is an application offered by many vendors. Not all automatic translations are equally good, so some evaluation of these products is needed. According to Sullivan (2001), the best way to assess machine translation is to use the following three criteria: (1) intelligibility—how well a reader can get the gist of a translated document, (2) accuracy—how many errors occur during a translation, and (3) speed—how many words per second are translated. Because the quality of automatic translation has not always been as good as human translation, many experts advocate use of the computer as a pro-

ductivity booster, with human translation as a double-check. However, as time passes, automatic translation is becoming better (see Sullivan, 2001).

Some major translation products are: WorldPoint Passport (worldpoint.com), Babel Fish Translation (world.altavista.com), AutoTranslate (offered in Netscape browser), “BETA” (google.com/language-tools), and products and services available at trados.com and translationzone.com. For details on these and other translators, see *Online File W4.3* at the book’s Web site.



Discovery of Material in Foreign Languages

There is a huge amount of information on the Internet in languages that you may not know. Some of this is vendors’ information intended for global reach. Asking human translators for help is expensive and slow. What really is needed is an *automatic translation* of Web pages. Such translation is available, to and from all major languages, and its quality is improving with time. We distinguish between real-time translation, which is offered by browsers (e.g., Netscape), and delayed translation, which is offered by many others. For details and examples of both types, see *A Closer Look 4.1*.

Information and Corporate Portals

With the growing use of intranets and the Internet, many organizations encounter information overload at a number of different levels. Information is scattered across numerous documents, e-mail messages, and databases at different locations and systems. Finding relevant and accurate information is often time-consuming and may require access to multiple systems.

As a consequence, organizations lose a lot of productive employee time. One solution to this problem is to use portals. A **portal** is a Web-based personalized gateway to information and knowledge in network computing. It attempts to address information overload through an intranet-based environment to search and access relevant information from disparate IT systems and the Internet, using advanced search and indexing techniques. A portal is the one screen from which we do all our work on the Web. In general, portals are referred to as information portals.

INFORMATION PORTALS. An **information portal** is a single point of access through a Web browser to critical business information located inside and outside of an organization, and it can be personalized for each user. One way to distinguish among portals is to look at their content, which can vary from narrow to broad, and their community or audience, which can also vary. We distinguish seven types of portals, described below.

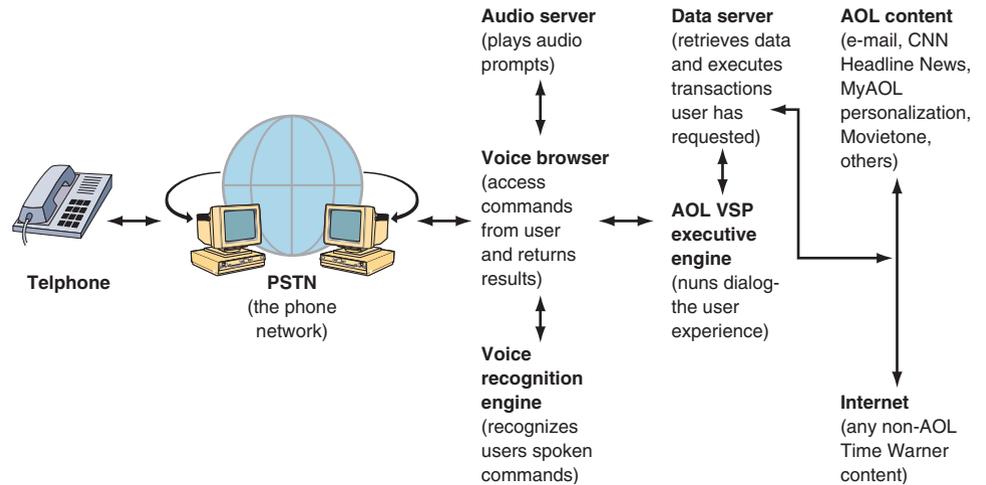


FIGURE 4.3 AOLbyphone.

1. **Commercial (public) portals** offer content for diverse communities and are the most popular portals on the Internet. Although they offer customization of the user interface, they are still intended for broad audiences and offer fairly routine content, some in real time (e.g., a stock ticker and news on a few preselected items). Examples are *yahoo.com*, *lycos.com*, and *msn.com*.
2. **Publishing portals** are intended for communities with specific interests. These portals involve relatively little customization of content, but they provide extensive online search and some interactive capabilities. Examples are *techweb.com* and *zdnet.com*.
3. **Personal portals** target specific filtered information for individuals. They offer relatively narrow content but are typically much more personalized, effectively having an audience of one.
4. **Affinity portals** support communities such as hobby groups or a political party (Tedeschi, 2000). They offer a single point of entry to an entire community of affiliated interests.
5. **Mobile portals** are portals accessible from mobile devices. Although most of the other portals mentioned here are PC-based, increasing numbers of portals are accessible via mobile devices. One example is i-mode from DoCoMo in Japan.
6. **Voice portals** are Web portals with audio interfaces, which enables them to be accessed by a standard or cell phone. AOLbyPhone is an example of a service that allows you to retrieve e-mail, news, and other content by voice. (See Figure 4.3.) Companies such as *tellme.com* and *i3mobile.com* offer the software for such services. Voice portals use both speech recognition and text-to-speech technologies. The 511 system described in Chapter 1 is an example of an e-government voice portal.
7. **Corporate portals** coordinate rich content within relatively narrow corporate and partners' communities. Kounadis (2000) defines a corporate portal as a personalized, single point of access through a Web browser to critical business information located inside and outside of an organization. They are also known as *enterprise portals* or *enterprise information portals*.



A CLOSER LOOK

4.2 TYPES OF CORPORATE PORTALS

The following types of portals can be found in organizations.

A PORTAL FOR SUPPLIERS. Using corporate portals, suppliers can manage their own inventories online. They can view what they sold to the portal owner and for how much. They can see the inventory levels of products at the portal owner's organization, and they can send material and supplies when they see that a reorder level is reached. Suppliers can also collaborate with corporate buyers and other staff via the portal.

A PORTAL FOR CUSTOMERS. Customers can use a *customer-facing portal* for viewing products and services and placing orders, which they can later self-track. They can view their own accounts and see what is going on there in almost real time. Thus, customers personalize their views of the corporate portal. They can configure products (services), place orders, and pay for and arrange delivery and warranty. They can see their outstanding invoices as well.

A PORTAL FOR EMPLOYEES. Such portals are used for training, dissemination of news and information, and workplace discussion groups. They also are used for self-service activities, mainly in the human resources area (e.g., change your address, fill in an expense report, register for classes, get reimbursed for tuition). Employees' portals are sometimes bundled with supervisors' portals (see next item).

SUPERVISORS' PORTALS. These portals, sometimes called *workforce portals*, enable managers and supervisors to control the entire workforce management process—from budgeting to scheduling workforce.

OTHER TYPES. Several other types of corporate portals also exist: *business intelligence portals* (Imhoff, 2001, Ferguson, 2001, and Online Minicase W4.3), *intranet portals* (Ferguson, 2001), and *knowledge portals* (Kesner, 2003).



CORPORATE PORTALS. In contrast with publishing and commercial portals such as Yahoo, which are gateways to general information on the Internet, corporate portals provide single-point access to *specific* enterprise information and applications available on the Internet, intranets, and extranets.

Corporate portals offer employees, business partners, and customers an organized focal point for their interactions with the firm any time and from anywhere. Through the portal, these people can have structured and personalized access to information across large, multiple, and disparate enterprise information systems, as well as the Internet. Many large organizations have already implemented corporate portals to cut costs, free up time for busy executives and managers, and improve profitability. (See ROI white papers and reports at *plumtree.com*.) In addition, corporate portals offer customers and employees self-service opportunities (see CRM in Chapter 7), which reduces company's cost. (See discussion and examples at *Peoplesoft.com*.) *A Closer Look 4.2* describes several types of corporate portals.

Online File W4.4 takes a look at the corporate portals of some well-known companies. Also, look at Online Minicase W4.3, which tells about a business intelligence portal at Amway.

Figure 4.4 depicts a corporate portal framework based on Aneja et al. (2000) and Kounadis (2000). This framework illustrates the features and capabilities required to support various organizational activities using internal and external information sources.



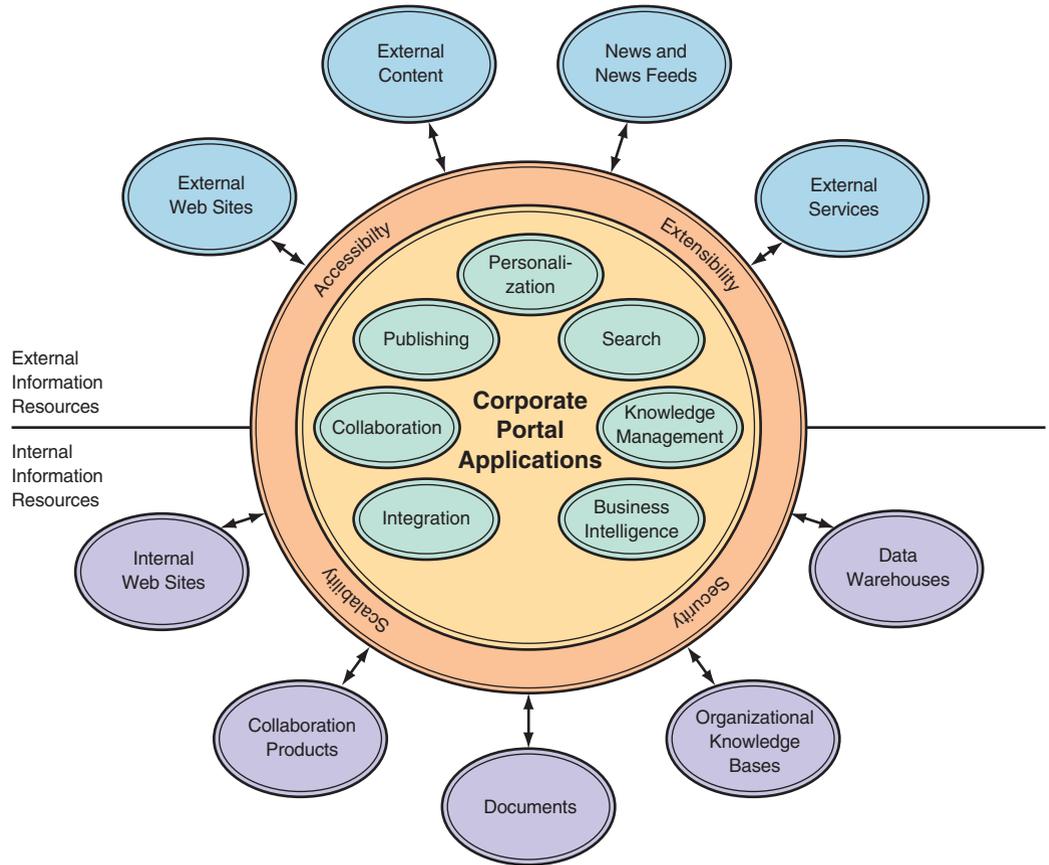


FIGURE 4.4
A corporate portal framework. (Sources: Compiled from A. Aneja et al., “Corporate Portal Framework for Transforming Content Chaos on Intranets,” *Intel Technology Journal*, Q1, 2000, and from T. Kounadis, “How to Pick the Best Portal,” *e-Business Advisor*, August 2000.)

APPLICATIONS OF CORPORATE PORTALS. According to a survey by the Delphi Group, over 55 percent of its 800 respondents had begun corporate portal projects, with about 42 percent of them conducting the projects at the enterprisewide level (cited in Stackpole, 1999). The number of corporate portals can only have increased since that study was conducted. The top portal applications cited in the study, in decreasing order of importance, were: knowledge bases and learning tools; business process support; customer-facing sales, marketing, and service; collaboration and project support; access to data from disparate corporate systems; internal company information, policies, and procedures; best practices and lessons learned; human resources and benefits; directories and bulletin boards; identification of subject matter experts; and news and Internet access.

The Delphi Group also found that poor organization of information and lack of navigation and retrieval tools contributed to over 50 percent of the problems for corporate portal users. (For further details see delphigroup.com/pubs/corporate-portal-excerpt.htm.) For this reason it is advisable for organizations to develop a corporate portal strategy, as discussed in *Online File W4.5*.

INTEGRATION OF PORTALS. Many organizations are creating several corporate portals. While in some cases these portals are completely independent of each other, in other cases they are interrelated. For example, they may share content, and they may draw from the same applications and databases.



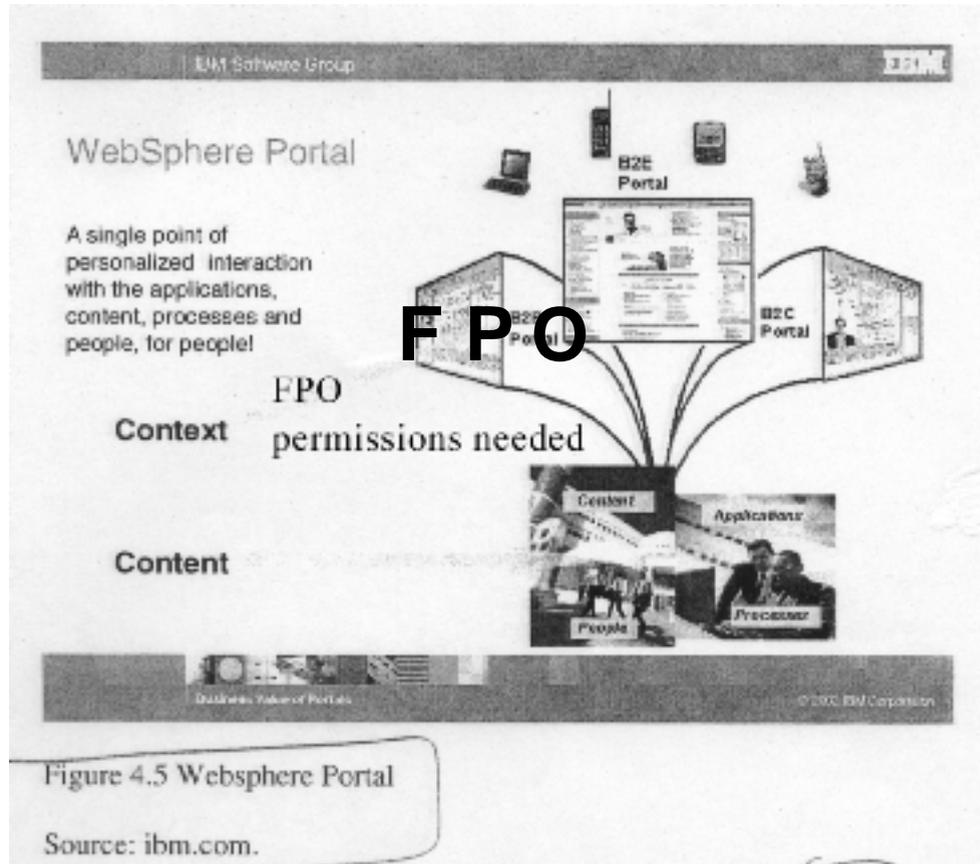


FIGURE 4.5 Websphere portal.

Tool-building software, such as WebSphere Portal (from IBM), allows companies to create multiple portals as one unit. Figure 4.5 shows three different portals used by a single company—a portal for business partners (B2B), a portal for employees (B2E), and a portal for customers (B2C). If portals are built one at a time over a long period, and possibly with different tools, it is wise to keep in mind that it may be beneficial to integrate them (Ojala, 2002).

INDUSTRYWIDE COMMUNICATION NETWORKS (PORTALS). In addition to single-company portals, there are also portals for entire industries. Thanks to the Internet, entire industries can now create communication networks (portals). An example is *chaindrugstore.net*, which links retailers and product manufacturers, and provides product and industry news and recall and promotional information. The site was created in 2001 by the National Association of Chain Drug Stores. The objective is to facilitate the rapid exchange of needed information. The site has an offshoot for independent pharmacies (called *CommunityDrugStore.net*). The service, according to Brookman (2003), reaches more than 130 retailers representing 32,000 stores. The service is free to the retailers; suppliers pay annual fees, in exchange for being able to use the portal to communicate information to retailers (e.g., to advertise special deals, to notify retailers about price changes). The portal also provides industry news,

and it can be personalized for individual retailers. Retailers also use it as a productivity tool. For example, the site has “Call Me” and “Send Me” buttons, so retailers can click and receive product information in seconds. Although some people fear that the site will reduce the effectiveness of face-to-face meetings, the participants are more than happy with the communication and collaboration support. The membership renewal rate has been 100 percent, and more members have joined. For details see Brookman (2003).

4.3 COMMUNICATION

Communication is an interpersonal process of sending and receiving symbols with messages attached to them. Through communication, people exchange and share information as well as influence and understand each other. Most managers spend as much as 90 percent of their time communicating. Managers serve as “nerve centers” in the information-processing networks called organizations, where they collect, distribute, and process information continuously. Since poor communication can mean poor management, managers must communicate effectively among themselves and with others, both inside and outside of organizations. Information technologies have come to play a major role in providing communication support for organizations.

Factors Determining the Uses of Information Technologies for Communication

Several factors determine the IT technologies that could be used to provide communication support to a specific organization or group of users. The major ones are the following:

- **Participants.** The number of people sending and receiving information can range from two to many thousands.
- **Nature of sources and destinations.** Sources and destinations of information can include people, databases, sensors, and so on.
- **Media.** Communication can involve one or several IT-supported media, such as text, voice, graphics, radio, pictures, and animation. Using different media for communicating can increase the effectiveness of a message, expedite learning, and enhance problem solving. Working with multiple media may, however, reduce the efficiency and effectiveness of the system (its speed, capacity, quality) and may significantly increase its cost.
- **Place (location).** The sender(s) and receiver(s) can be in the same room, in different rooms at the same location, or at different locations.
- **Time.** Messages can be sent at a certain time and received almost simultaneously. Such **synchronous (real-time) communication** is provided by telephones, instant messaging online, teleconferencing, and face-to-face meetings. **Asynchronous communication**, on the other hand, refers to communication in which the receiver gets an answer sometime after a request was sent. E-mail and bulletin boards are examples.

A TIME/PLACE FRAMEWORK. The last two factors in the preceding list—place and time—were used by DeSanctis and Gallupe (1987) to create a framework for classifying IT communication and collaboration support technologies. According to this framework, IT communication is divided into four cells, as shown in



		TIME	
		Same	Different
PLACE	Same	A decision room GDSS (Ch. 12) Management cockpit (Ch. 12) Whiteboard	Videoconferencing Instant messenger Screen sharing Whiteboard Chat room Internet telephony
	Different	Multishift control center E-mail Workflow	E-mail Bulletin board Web-based call center Workflow GDSS Autoresponder (Ch. 7)

FIGURE 4.6 A framework for IT communication support.

Figure 4.6, with a representative technology in each cell. The time/place cells are as follows:

1. **Same-time/same-place.** In this setting, participants meet face-to-face in one place and at the same time. An example is communication in a meeting room, which can be electronically supported by group systems (see *group systems.com* and Chapter 12).
2. **Same-time/different-place.** This setting refers to a meeting whose participants are in different places but communicate at the same time. A telephone conference call, desktop videoconferencing, chat rooms, and instant messaging are examples of such situations.
3. **Different-time/same-place.** This setting can materialize when people work in shifts. The first shift leaves electronic or voice messages for the second shift.
4. **Different-time/different-place.** In this setting, participants are in different places, and they send and/or receive messages (for example, via the Internet) at different times.

Businesses require that messages be transmitted as fast as they are needed, that the intended receiver properly interprets them, and that the cost of doing this be reasonable. Communication systems that meet these conditions have several characteristics. They allow two-way communication: Messages flow in different directions, sometimes almost simultaneously, and messages reach people regardless of where they are located. Efficient systems also allow people to access various sources of information (such as databases). IT helps to meet these requirements through the electronic transfer of information using tools such as e-mail.

The Internet has become a major supporter of interactive communications. People are using a variety of Internet technologies—Internet phones, smart cell phones, Internet videoconferencing, Internet radio, whiteboards, chat rooms, and more—for communication. In Section 4.5 we will discuss some of the IT tools cited in connection with Figure 4.5. E-mail, including instant and universal messaging services, is discussed in *Online File W4.6* at the book's Web site. Other Internet-based communication tools and technologies are described in Technology Guide 4.



Web-Based Call Centers

Effective personalized customer contact is becoming an important aspect of customer support through the Web. Such service is provided through *Web-based call*

centers (also known as *customer care centers*). Enabling Web collaboration and simultaneous voice/Web contact can differentiate a company from its competitors. There are at least four categories of capabilities employed by Web-based call centers—e-mail, interactive text chat, callbacks, and simultaneous voice and Web sessions. (For discussion of how companies might decide among the possible choices for Web-based call centers, see Drury, 1999.) WebsiteAlive (*websitealive.com*), a Web-based call center support product, delivers live customer-service capabilities for any online company. Further details and examples are provided in Chapter 7.

Electronic Chat Rooms

Electronic chat refers to an arrangement whereby participants exchange messages in real time. The software industry estimates that millions of chat rooms exist on the Internet. A **chat room** is a virtual meeting place where groups of regulars come to gab. Chat programs allow you to send messages to people who are connected to the same channel of communication *at the same time*. It is like a global conference call system. Anyone can join in the online conversation. Messages are displayed on your screen as they arrive, even if you are in the middle of typing a message.



The chat rooms can be used to build a community, to promote a commercial, political, or environmental cause, to support people with medical problems, or to let hobbyists share their interest. And since many customer-supplier relationships have to be sustained without face-to-face meetings, online communities are increasingly being used to serve business interests, including advertising (see *Parachat.com* and Technology Guide 5). Chat capabilities can be added to a business site for free by letting software chat vendors host your session on their site. You simply put a chat link on your site and the chat vendor does the rest, including the advertising that pays for the session.

Two major types of chat programs exist: (1) Web-based chat programs, which allow you to send messages to Net users using a Web browser and visiting a Webchat site (e.g., *chat.yahoo.com*), and (2) an e-mail-based (text only) program called *Internet Relay Chat (IRC)*. A business can use IRC to interact with customers, provide online experts' answers to questions, and so on.

Voice Communication



The most natural mode of communication is voice. When people need to communicate with each other from a distance, they use the telephone more frequently than any other communication device. Voice communication can now be done on the Internet using a microphone and a sound card (see *protocols.com/VOIP*). You can even talk long distance on the Internet without paying the normal long distance telephone charges. This is known as **Internet telephony (voice-over IP)**, and it is described in Technology Guide 5. Voice communication enables workers, from forklift drivers to disabled employees to military pilots, to have portable, safe, and effective access to computer technology from their work areas. In addition, voice communication is faster than typing (about two and half times faster), and fewer errors in voice data entry are made compared to keyboard data entry.

You can get freeware (free software) for Internet telephony from *roispeed.com*. Also, some browsers provide you with the capability. To connect from computers to regular telephones try, for example, *dialpad.com*, which offers low-cost long-distance calls through the Internet to regular telephones in U.S. cities from anywhere in the world. For more information see *tellenet.com/it*.



Voice and data can work together to create useful applications. **Voice mail**, a well-known computerized system for storing, forwarding, and routing telephone messages, is one such application. For some other applications of voice technologies, see *Online File W4.7* at the book's Web site. More advanced applications of voice technology such as natural language speech recognition and voice synthesis are described in Chapter 12.

Weblogging (Blogging)

The Internet offers an opportunity for individuals to do personal publishing using a technology known as **Weblogging**, or **blogging**. A **blog** is a personal Web site, open to the public, in which the owner expresses his or her feelings or opinions. People can write stories, tell news, and provide links to other articles and Web sites. At some blogs you can reach fascinating items that you might otherwise have overlooked. At others, you can rapidly get up to speed on an issue of special interest. Blogs are growing rapidly, estimated by BBC News (February 2003) to be close to 500,000.

Blogs became very popular after the terrorist attacks of September 11, 2001, and during the 2003 Iraqi war. People were looking for as many sources of information as possible and for personal connections. Blogs are comforting for people in times of stress. They are a place at which people feel their ideas get noticed, and they can result in two-way communication and collaboration and group discussion.

Building blogs is becoming easier and easier. Programs downloadable from *blogger.com*, *pitav.com*, and others are very user friendly. "Bloggers" (the people who create and maintain blogs) are handed a fresh space on their Web site to write in each day. They can easily edit, add entries, and broadcast whatever they want by simply clicking on the send key.

Blogs are criticized for their tendency to coalesce into self-referential cliques. Bloggers are blamed for their mutual backslapping, endlessly praising and linking to one another's sites. However, bloggers are creating their own communities and have developed a rich terminology. (For a bloggers dictionary, see *marketingterms.com/dictionary/blog* and *samizdata.net/blog/glossary*.) Blogs have just begun to be used for commercial purposes. For example, Weidlich (2003) reports that some company executives use blogs for informal talk to customers. For further discussion on blogs, see Phillips (2002).

4.4 COLLABORATION

One of the abiding features of a modern organization is that people collaborate to perform work. **Collaboration** refers to mutual efforts by two or more individuals who perform activities in order to accomplish certain tasks. The individuals may represent themselves or organizations, or they may be members of a team or a group. Group members work together on tasks ranging from designing products and documents, to teaching each other, to executing complementary subtasks. Also, people work with customers, suppliers, and other business partners in an effort to improve productivity and competitiveness. Finally, group members participate in decision making. In all of the above cases they need to collaborate. Collaboration can be supported electronically by several technologies as described later in this chapter.

The Nature of Group Work

Group work is increasing in importance. Indeed, it is a cornerstone in some business process restructuring (BPR) projects and in e-commerce. Also, group work is needed in virtual corporations as well as in multinational organizations. The use of group work is also increasing due to the support provided by IT, especially the support provided to groups whose members are in different locations.

The term **workgroup** refers to two or more individuals who act together to perform some task. The group can be permanent or temporary. It can be in one location (face-to-face meetings) or in several. If group members are in different locations we say we have a **virtual group (team)**, and they conduct *virtual meetings* (they “meet” electronically). Members can meet concurrently or at different times. The group can be a committee, a review panel, a task force, an executive board, a team, or a department. Groups conduct their work by using different approaches or processes.

CONVENTIONAL APPROACH TO GROUP WORK. For years, people have recognized the benefits of collaborative work. Typical benefits that relate to decision making in groups are listed in Table 4.1. But despite the many benefits of group interaction, groups are not always successful. The reason is that the process of collaborative work is frequently plagued by dysfunctions, as listed in Table 4.2.

To reconcile these differences, researchers have worked for many years to improve the work of groups. If the causes of group dysfunctions could be lessened or eliminated, the benefits of group work would be greatly enhanced. Several approaches have been developed to attempt to solve the problems inherent in group work. Two representative methods are the *nominal group technique* and the *Delphi method* (see *Online File W4.8* for explanations of those two methods).

The limited success of the above approaches to group work and the availability of IT tools and the Internet has created an opportunity for supporting groups electronically, which is part of virtual collaboration. We describe the general support in this section. The support that is intended to facilitate decision making is described in Chapter 12.



TABLE 4.1 Benefits of Working in a Group

- Groups are better than individuals at understanding problems.
- People are accountable for decisions in which they participate.
- Groups are better than individuals at catching errors.
- A group has more information (knowledge) than any one member and, as a result, more alternatives are generated for problem solving.
- Synergy can be produced, so the effectiveness and/or quality of group work can be greater than the sum of what is produced by independent individuals.
- Working in a group may stimulate the participants and the process.
- Group members have their egos embedded in the decision they make, so they will be committed to its implementation.

TABLE 4.2 Dysfunctions of Group Process

- Social pressures to conform (“groupthink”) may eliminate superior ideas.
- Group process can be time-consuming, slow, and costly.
- Work done in a group may lack appropriate coordination.
- Some members may dominate the agenda.
- Some group members (“free riders”) may rely on others to do most of their work.
- The group may compromise on solutions of poor quality.
- The group may be unable to complete a task.
- Unproductive time is spent socializing, getting ready, waiting for people, or repeating what has already been said.
- Members may be afraid to speak up.



Virtual Collaboration

Virtual collaboration (or *e-collaboration*) refers to the use of digital technologies that enable organizations or individuals to collaboratively plan, design, develop, manage, and research products, services, and innovative IT and EC applications. Although e-collaboration can involve noncommerce applications, the term usually refers to **collaborative commerce**—collaboration among business partners. An example would be a company that it is collaborating electronically with a vendor that designs a product or a part for the company (see Minicase 1, about General Motors). Collaborative commerce implies communication, information sharing, and collaborative planning done electronically through tools such as groupware and specially designed EC collaboration tools. For details see Turban (2004) and Poirier (2001).

Numerous studies (e.g., *line56.com*, 2002) suggest that collaboration is a set of relationships with significant improvements in organizations' performance. Major benefits cited are cost reduction, increased revenue, and improved customer retention. These benefits are the results of fewer stockouts, less exception-processing, reduced inventory throughout the supply chain, lower material costs, increased sales volume, and increased competitive advantage. According to a survey conducted by Deloitte Consulting and reported in *Manageradvisor.com* (2002), 70 percent of the companies conducting collaborative commerce are showing higher profitability than those who do not. Of those companies surveyed, 75 percent consider online collaboration, especially linking business processes, to be a top executive priority. These figures, gathered in 2002, are more than 20 percent higher than responses from 2000. Finally, 85 percent of all companies plan to have advanced collaborative commerce initiatives by 2005. Some of the major strategic benefits reported are an increase in process flexibility, faster delivery speed, and improved customer service.

C-commerce activities are usually conducted between and among supply chain partners. For example, Webcor Builders is using a communication hub to facilitate collaboration, as described in *IT at Work 4.3*.

The Webcor case shows how one company becomes a *nucleus firm*, or a hub, for collaboration. Such arrangement can be expanded to include all business partners, as shown in Figure 4.7. This concept is the basis for many-to-many e-marketplaces (see Chapter 5), in which a third-party company is the nucleus firm, creating a place not only for collaboration but also for trade.

There are several other varieties of virtual collaboration, ranging from joint design efforts to forecasting. Collaboration can be done both between and within organizations. The following are some types and examples of virtual collaboration.

COLLABORATIVE NETWORKS. Traditionally, collaboration took place among supply chain members, frequently those that were close to each other (e.g., a manufacturer and its distributor, or a distributor and a retailer). Even if more partners are involved, the focus has been on the optimization of information and product flow between existing nodes in the traditional supply chain.

The traditional collaboration resulted in a vertically integrated supply chain. However, as discussed in earlier chapters, IT and Web technologies can *fundamentally change* the shape of the supply chain, as well as the number of players within it and their individual roles and collaboration patterns. The new supply chain can be a hub, as in the Webcor case, or even a network. A comparison between the traditional supply chain collaboration and the collaborative



IT At Work 4.3 WEBCOR GOES ONLINE WITH ITS PARTNERS



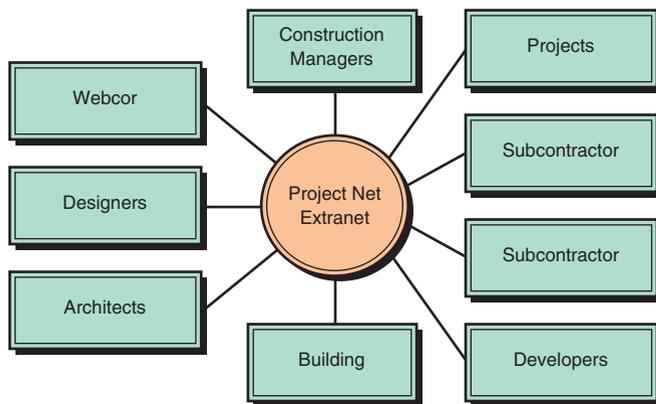
Webcor Builders (*webcor.com*) builds apartment buildings, hotels, and office parks, with revenues of about \$500 million a year. For years the company suffered from poor communication with its partners (architects, designers, building owners, subcontractors) and struggled with too much paperwork. Reams of documents were sent back and forth via “snail mail.” In a very competitive industry, inefficiencies can be costly. So, Webcor decided to introduce c-commerce into its operations. Webcor’s goal was to turn its computer-aided design (CAD) drawings, memos, and other information into shared digital information. The nearby figure shows the connections among Webcor’s partners via its extranet.

To enable online collaboration, Webcor is using an application service provider (ASP) that hosts Webcor’s projects using ProjectNet software on a secured extranet. The software is complex, so there was a problem getting everyone to accept ProjectNet, and some user training was necessary. However, Webcor found itself in a strong enough position to be able to say that in the near future, it would not partner with anyone who would not use ProjectNet.

With everyone on the ProjectNet system, Webcor’s business partners can post, send, or edit complex CAD drawings, digital photos, memos, status reports, and project histories. ProjectNet provides a central meeting place where users can both download and transmit information to all parties, all with a PC. Everyone involved in a project is more accountable, because there is a digital trail, and partners now get instant access to new building drawings.

One of the major benefits of ProjectNet is that employees now spend more time managing their work and less time on administrative paperwork. Several clerical workers were laid off, and the saved cost of their salaries is covering the software rental fees.

For Further Exploration: What are the benefits of this c-commerce project to Webcor? What are the benefits of this project to Webcor’s partners? To its clients?



Webcor Builders Go Online.

Sources: Compiled from Webcor.com press releases at *webcor.com* (2000–2002), and from DiCarlo (1999).

network is shown in Figure 4.8. Notice that the traditional chain (part a, for the food industry) is basically linear. The collaborative network (part b) shows that partners at any point in the network can interact with each other, bypassing traditional partners. Interaction may occur among several manufacturers and/or distributors, as well as with new players such as software agents that act as aggregators, B2B e-marketplaces, or logistics providers.

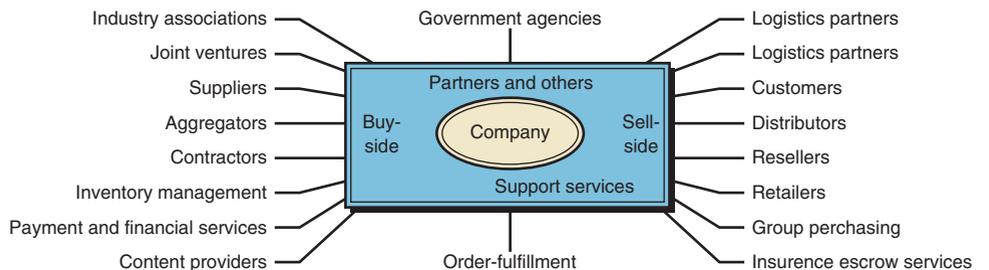
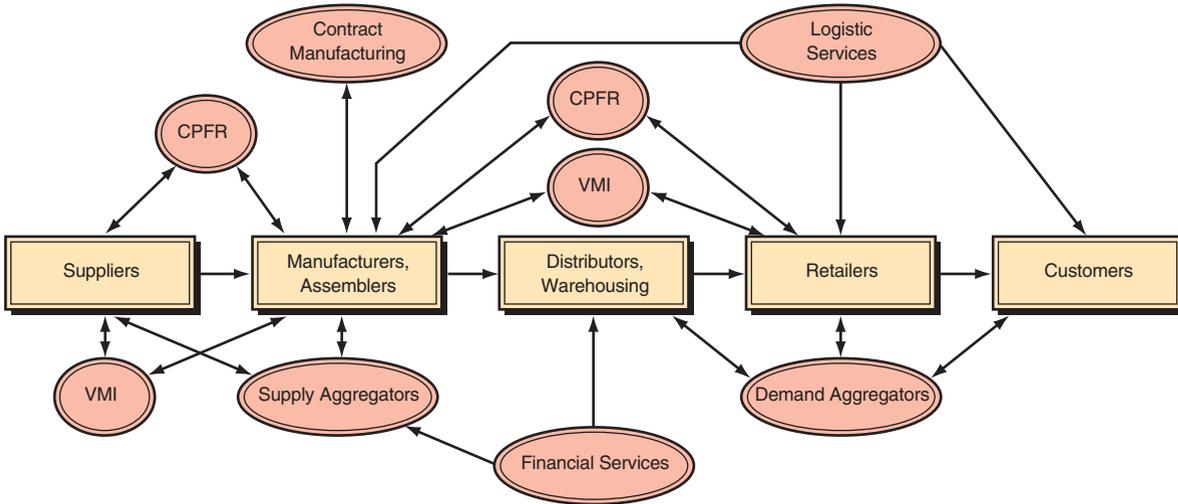
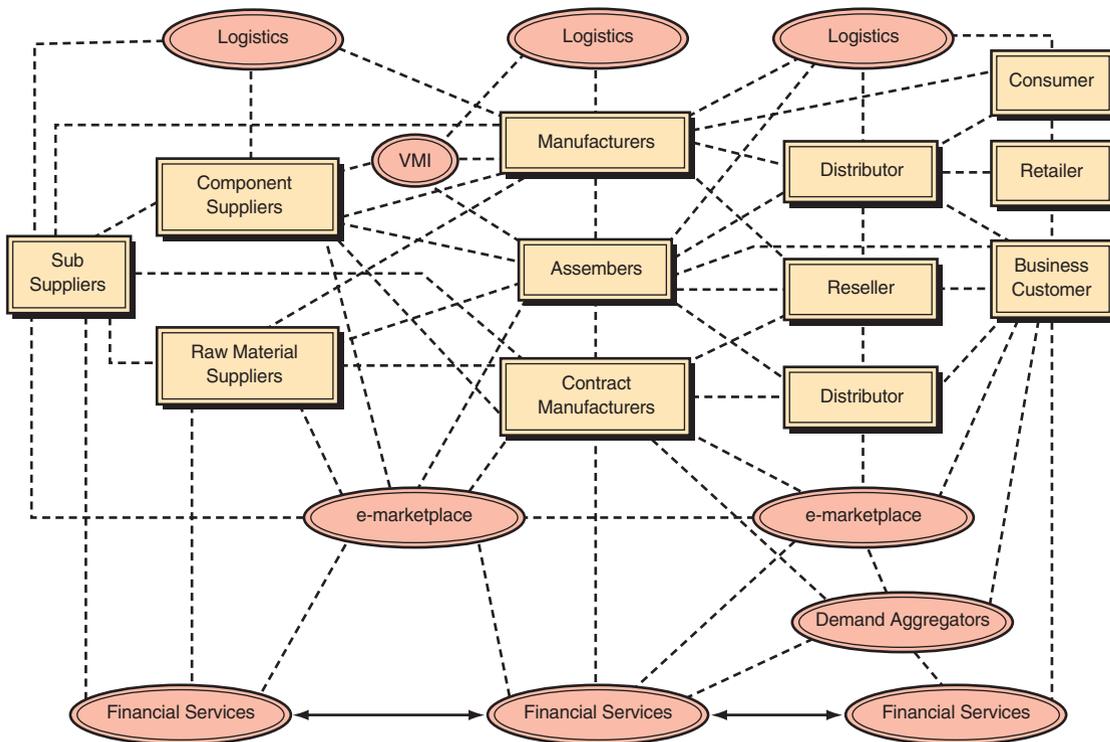


FIGURE 4.7
E-Collaboration for Commerce.



Part A Traditional collaboration, including CPFR. Collaborator agents and efforts are shown as ovals.



Part B Supply chains are evolving into collaborative networks. Ovals designate agents and services.

FIGURE 4.8 Comparing traditional supply chain collaboration and collaborative networks. (Sources: Part A based on Walton and Princi, 2000, p. 193, Fig. 1.8. Part B based on Poiriev, 2001, p. 9–8, Fig. 1.)

The collaborative network can take different shapes depending on the industry, the product (or service), the volume of flow, and more. Examples of collaborative networks are provided by Poirer (2001) and by Walton and Princi (2000).

REPRESENTATIVE EXAMPLES OF VIRTUAL-COLLABORATION. Leading businesses are moving quickly to realize the benefits of e-collaboration. For example, the real estate franchiser RE/MAX uses an e-collaboration platform to improve communications and collaboration among its nationwide network of independently owned real estate franchises, sales associates, and suppliers. Similarly, Marriott International, the world's largest hospitality company, started with an online brochure and then developed a c-commerce system that links corporations, franchisees, partners, and suppliers, as well as customers, around the world. In addition, as described in *Online File W4.9*, Nygard of Canada has developed a collaborative system along its entire supply chain.

There are many examples of e-collaboration. Here we present some additional representative ones. For more see Schram (2001), and Davison and De Vreede (2001).

Information Sharing Between Retailers and Their Suppliers: P&G and Wal-Mart. One of the most notable examples of information sharing is between Procter & Gamble (P&G) and Wal-Mart. Wal-Mart provides P&G access to sales information on every item Wal-Mart buys from P&G. The information is collected by P&G on a daily basis from every Wal-Mart store, and P&G uses the information to manage the inventory replenishment for Wal-Mart. By monitoring the inventory level of each P&G item in every Wal-Mart store, P&G knows when the inventories fall below the threshold that triggers a shipment. All this is done electronically; the benefit for P&G is that they can sell to a good customer, and the benefit to Wal-Mart is adequate inventory on its shelves. P&G has similar agreements with other major retailers.

Retailer–Supplier Collaboration: Target Corporation. Target Corporation (*targetcorp.com*) is a large retail conglomerate (owner of Target Stores, Marshall Field, Mervyn's, and Target.direct.com). It needs to conduct EC activities with about 20,000 suppliers. In 1998, then operating under the name Dayton-Hudson Corporation, the company established an extranet-based system for those suppliers that were not connected to its VAN-based EDI. The extranet enabled the company not only to reach many more partners, but also to use many applications not available on the traditional EDI. The system enabled the company to streamline its communications and collaboration with suppliers. It also allowed the company's business customers to create personalized Web pages that were accessible via either the Internet or GE's private VAN.

Reduction of Product Development Time: Caterpillar, Inc. Caterpillar, Inc. (*caterpillar.com*) is a multinational heavy-machinery manufacturer. In the traditional mode of operation, cycle time along the supply chain was long because the process involved paper-document transfers among managers, salespeople, and technical staff. To solve the problem, Caterpillar connected its engineering and manufacturing divisions with its active suppliers, distributors, overseas factories, and customers through an extranet-based global collaboration system. By means of the collaboration system, a request for a customized tractor component, for example, can be transmitted from a customer to a Caterpillar dealer and on to designers and suppliers, all in a very short time. Customers also can use the extranet to retrieve and modify detailed order information while the





vehicle is still on the assembly line. Remote collaboration capabilities between the customer and product developers have decreased cycle time delays caused by rework time. Suppliers are also connected to the system, so they can deliver materials or parts directly to Caterpillar's repair shops or directly to the customer if appropriate. The system also is used for expediting maintenance and repairs.

For comprehensive coverage of collaborative virtual design environments, see Ragusa and Bochenek (2001). See also Minicase 1 at the end of this chapter.

Barriers to E-Collaboration and C-Commerce

Despite the many potential benefits, e-collaboration and c-commerce are moving ahead fairly slowly. Reasons cited in various studies include technical reasons involving integration, standards, and networks; security and privacy concerns over who has access to and control of information stored in a partner's database; internal resistance to information sharing and to new approaches; and lack of internal skills to conduct collaborative commerce (Schram, 2001). A big stumbling block to the adoption of c-commerce is the lack of defined and universally agreed-on standards. New approaches such as the use of XML and its variants and the use of Web Services could lessen significantly the problem of standards. (See Bradley, 2002, and *cpfr.com* for discussion of the CPFR—collaboration, planning, forecasting, and replenishing—initiative.)

Sometimes collaboration is an organizational culture shock—people simply resist sharing. One reason is the lack of trust, especially in ad-hoc relationships. According to Gibson-Paul (2003) companies such as Boeing and Salding are grappling with the trust factor. Some techniques she suggested include starting small (e.g., synchronizing one type of sales data), picking up projects that are likely to provide a quick return on investment for both sides, meeting face-to-face at the beginning of a collaboration; and showing the benefits to all parties. Despite initial lack of trust, if potential collaborators judge the benefits of collaboration to be sufficient, and about equal among collaborators, they will be more eager to join in.

Finally, global collaboration involves all of these potential barriers, and more. For further discussion, see Davison and de Vreede (2001) and Carmel (1999).

4.5 COLLABORATION-ENABLING TOOLS: FROM WORKFLOW TO GROUPWARE



Workflow Technologies

As mentioned earlier, corporate portals facilitate e-collaboration. Also available for this purpose are a large number of tools and methodologies, whose types and features are listed in *Online File W4.10*. In this section we present workflow technologies, groupware, and other collaboration-enabling tools.

Workflow is the movement of information as it flows through the sequence of steps that make up an organization's work procedures. **Workflow management** is the automation of workflows, so that documents, information, or tasks are passed from one participant to another in a way that is governed by the organizations rules or procedures. Workflow management involves all of the steps in a business process from start to finish, including all exception conditions.

The key to workflow management is the tracking of process-related information and the status of each activity of the business process, which is done by workflow systems (see van der Aalst, 2002). **Workflow systems** are business process automation tools that place system controls in the hands of user

departments. They employ a set of software programs that automate almost any information-processing task. The major workflow activities to be managed are job routing and monitoring, document imaging, document management, supply chain optimization, and control of work. These activities are done by workflow applications.

TYPES OF WORKFLOW APPLICATIONS. Workflow applications fall into three major categories—collaborative, production, and administrative workflow.

- **Collaborative workflow.** *Collaborative workflow* products address project-oriented and collaborative types of processes. They are administered centrally, yet they are capable of being accessed and used by workers from different departments and even from different physical locations. The goal of collaborative workflow tools is to empower knowledge workers. Some leading vendors of collaborative workflow applications are Lotus, JetForm, FileNet, and Action Technologies.
- **Production workflow.** *Production workflow* tools address mission-critical, transaction-oriented, high volume processes. They are often deployed only in a single department or to a certain set of users within a department. Often, these applications include document imaging, and storage and retrieval capabilities. They also can include the use of intelligent forms, database access, and ad-hoc capabilities. The leading vendors of production workflow systems are FileNet, Staffware, IBM(MQ3), and Eastman WorkFlow. An example of production workflow that is mixed with collaboration workflow is presented in *IT at Work 4.4*.
- **Administrative workflow.** *Administrative workflow* can be considered a cross between the previous two types of workflow. The flow is predefined (such as the steps required to approve an expense report), but can be changed, if needed. The goal of administrative workflow applications is to reduce clerical costs in systems with a low volume of complex transactions. The major vendors are Staffware, InTempo, and Metro.

There are multiple benefits of workflow management systems. For example, they improve control of business processes, with far less management intervention, and far less chance for delays or misplaced work than other systems. They also improve the quality of services, by quicker response, with the best person available. They lower costs, both of staff training (since the work can be guided through complex procedures) and of management in general, because managers can have a far wider span of control while also being able to concentrate on nurturing the employees and handling special cases rather than routine reporting and distribution issues. Finally, workflow management systems also improve user satisfaction. Users typically have greater confidence that they are doing the best they can and the satisfaction of completing that work with fewer conflicting requirements.

(For more information on workflow management, see Fischer, 2002, and Basu and Kumar, 2002. Also, visit wfmc.com, aim.org, waria.com, and omg.org.)

Since workflow management systems support more than one individual, they are considered by some to be a subset of groupware, our next topic.

Groupware **Groupware** refers to software products that support groups of people who share a common task or goal and who collaborate on its accomplishment. These



IT At Work 4.4

USING A WORKFLOW SYSTEM TO MANAGE CURRENCY FLOWS AT A GERMAN BANK



Dresdner Bank, in Germany, has automated the way it handles the trading of currency orders. Whether they originate from within a single operation or across its trading rooms worldwide, the bank routes these orders using a workflow system called Limit Order Application (LORA). This workflow system, built on top of Microsoft Exchange, replaced previous telephone and fax-based processes.

One of the main problems that Dresdner Bank sought to solve with the system was the allocation and uptake of orders between different trading rooms around the world. Being able to route orders would allow more efficient trading across the different time-zones—for instance, making it easier for traders to execute a Frankfurt order in New York after close of business in Germany.

Three types of bank staff—traders, controllers, and administrators—use this system, which works as follows: First, when an order is received, it is placed into an electronic folder by the controller. All order folders are held in a “public” file and can be viewed by the relevant staff. Next, when a trader accepts an order, he or she is responsible for that order from that moment on. Although the order can still be canceled or reversed at this stage, the details of price and order quantity cannot be changed. The status of the order is displayed, and any order is locked when accessed, to prevent anyone from altering it. (Even small changes in the details of an order could result in huge profits or losses for the bank or its clients.) Finally, when the order is executed, or if it is canceled or reversed or it expires, then it is sent to a subfolder to be archived.

The bank dropped an initial plan of implementing global common folders that could be accessed by any of its 1,000 traders, in any location. It did so because of resistance from the traders, who did not like the idea of relinquishing local control and allowing other traders to process or execute their orders. Instead, the bank has implemented a system of local folders that reside within the branch of origin; these can be read by, but cannot be processed by, traders elsewhere.

With LORA, users can respond more quickly and accurately to customer queries, because they are able to access and view on the computer screen the precise status of orders. There is also improved control, with responsibility for any order always assigned to a specific staff member. The user interface was carefully designed to meet stringent requirements with respect to efficiency and ease of use.

LORA was built mainly using Visual Basic, with provisions to extend the system to allow reuse of existing components. The system was implemented in about six months, first to support the bank’s 500 dealers in Frankfurt. By 2003 it was implemented in all of the bank’s other branches.

For Further Exploration: Identify the parties in this case that need to collaborate with each other. How does the system facilitate collaboration? How does the workflow system differ from typical transaction-oriented application systems in this bank?

Sources: Compiled from microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=13324 (accessed January 4, 2003), and from Dresdner-bank.com (accessed March 2003).

products provide a way for groups to share resources and opinions. Groupware implies the use of networks to connect people, even if the people are in the same room. Many groupware products are available on the Internet or an intranet, enhancing the collaboration of a large number of people worldwide. There are many different approaches and technologies for the support of groups on the Internet.

Groupware products come either as a standalone product supporting one task (such as e-mail), or as an integrated kit that includes several tools. In general, groupware technology products are fairly inexpensive and can be easily incorporated into existing information systems. The Internet, intranets, extranets, and private communication lines provide the infrastructure needed for the hardware and software of groupware. The software products are mostly Web-based, which is the trend today. In this section we will describe some of the most common groupware products.

ELECTRONIC MEETING SYSTEMS. An important area of virtual collaboration is electronic meetings. For decades, people have attempted to improve face-to-face meetings. Initially, people attempted to better organize group meetings by using a facilitator and established procedures (known as *group dynamics*). More recently, there have been numerous attempts to improve meetings by using information technologies. The advancement of Web-based systems opens the door for electronically supported **virtual meetings**, those whose members are in different locations, frequently in different countries.

The events of September 11, 2001, and the economic slowdown of 2001–2003 made virtual meetings more popular, as corporate travel waned. It is also hard for companies to ignore reported cost savings, such as the \$4 million a month that IBM reported it saved just from cutting travel expenses to meetings (Callaghan, 2002). In addition, improvements in supporting technology, reductions in the price of technology, and the acceptance of virtual meetings as a respected way of doing business are fueling their growth (see Vinas, 2002).

Virtual meetings can be supported by a variety of tools, as will be shown in the remainder of this section. The support provided to decision making is presented in Chapter 12.

ELECTRONIC TELECONFERENCING. **Teleconferencing** is the use of electronic communication that allows two or more people at different locations to have a simultaneous conference. There are several types of teleconferencing. The oldest and simplest is a telephone conference call, where several people talk to each other from three or more locations. The biggest disadvantage is that it does not allow for face-to-face communication. Also, participants in one location cannot see graphs, charts, and pictures at other locations. One solution is *video teleconferencing*, in which participants can see each other as well as the documents.

Video Teleconferencing. In a **video teleconference** (or *videoconference*), participants in one location can see participants at other locations. Dynamic pictures of the participants can appear on a large screen or on a desktop computer. Originally, video teleconferencing was the transmission of live, compressed TV sessions between two or more points. Video teleconferencing today, however, is a digital technology capable of linking various types of computers across networks. Once conferences are digitized and transmitted over networks, they become a computer application.

With videoconferencing, participants can share data, voice, pictures, graphics, and animation. Data can also be sent along with voice and video. Such **data conferencing** makes it possible to work on documents together and to exchange computer files during videoconferences. This allows several geographically dispersed groups to work on the same project and to communicate by video simultaneously.

Video teleconferencing offers various benefits. We've already mentioned three of them—providing the opportunity for face-to-face communication for individuals in different locations, supporting several types of media during conferencing, and lower travel time and costs. Other benefits of video teleconferencing are shown in *Online File W4.11* at the book's Web site.

Web Conferencing. **Web conferencing** is conducted on the Internet for as few as two and as many as thousands of people. Web conferencing is done *solely* on the Web. (Videoconferencing is usually done on regular telephone lines, although it may also be done on the Web.) Like video teleconferencing, Web conferencing allows users to simultaneously view something, such as a sales





presentation in Microsoft PowerPoint or a product drawing, on their computer screens; interaction takes place via messaging or a simultaneous phone teleconference. However, Web conferencing is much cheaper than videoconferencing because it runs on the Internet.

The latest technological innovations permit both business-to-business and business-to-consumer applications of Web conferencing. For example, banks in Alaska use *video kiosks* in sparsely populated areas instead of building branches that will be underutilized. The video kiosks operate on the banks' intranet and provide videoconferencing equipment for eye-to-eye interactions. Some examples of other uses are: to educate staff members about a new product line or technology; to amplify a meeting with investors; or to walk a prospective client through an introductory presentation.

Web conferencing is becoming very popular. Almost all Web conferencing products provide whiteboarding (see discussion below) and polling features, and allow you to give presentations and demos and to share applications. Popular Web conferencing products are: Centra EMeeting, Genesys Meeting Center, PlaceWare, and WebEx Meeting Center.

RTC TOOLS. The Internet, intranets, and extranets offer tremendous potential for real-time and synchronous interaction of people working in groups. *Real-time collaboration (RTC)* tools help companies bridge time and space to make decisions and to collaborate on projects. RTC tools support synchronous communication of graphical and text-based information. These tools are being used in distance training, product demonstrations, customer support, and sales applications. RTC tools can be either purchased as standalone tools or used on a subscription basis. Some examples follow:

Interactive Whiteboards. Computer-based **whiteboards** work like the "physical world" whiteboards with markers and erasers, except with one big difference: Instead of one person standing in front of a meeting room drawing on the whiteboard, all participants can join in. Throughout a meeting, each user can view and draw on a single document "pasted" onto the electronic whiteboard on a computer screen. Digital whiteboarding sessions can also be saved for later reference or other use. Some whiteboarding products let users insert graphics files that can be annotated by the group.

Take, for example, an advertisement that needs to be cleared by a senior manager. The proposed ad would be scanned into a PC, and both parties would see it on their screens. If the senior manager does not like something, he or she can highlight what needs to be changed, using a stylus pen. The two parties can also share applications. For example, if party A works with Excel, party B does not have to have Excel in order to work with it in the whiteboarding tool.

Besides being used for supporting people working on the same task, whiteboards are also used for training and learning. See *Online File W4.12* for discussion of two whiteboarding products that can be used for training and learning.

Screen Sharing. In collaborative work, members are frequently in different locations. Using **screen sharing** software, group members can work on the same document, which is shown on the PC screen of each participant. For example, two authors can work on a single manuscript. One may suggest a correction and execute it so the other author can see the change. Collaborators can work together on the same spreadsheet or on the resulting graphics. Changes can be done by using the keyboard or by touching the screen. This capability



can expedite the design of products, the preparation of reports and bids, and the resolution of conflicts. A special screen sharing capability is offered by Groove Inc. (*groove.net*). Its product synchronizes people, computers, and information to enable the joint creation and/or editing of documents on your PC.

Instant Video. With the spread of **instant messaging** and Internet telephony has come the idea to link people via both voice and audio. Called *instant video*, the idea is for a kind of video chat room. It allows you to chat in real time, seeing the person you are communicating with. A simple way to do it is to add video cameras to the participants' computers. A more sophisticated approach that produces pictures of better quality is to integrate existing online videoconferencing service with instant messaging software, creating a service that offers the online equivalent of a videophone.

INTEGRATION AND GROUPWARE SUITES. Because groupware technologies are computer-based, it makes sense to integrate them with other computer-based or computer-controlled technologies. A *software suite* is created when several products are integrated into one system. Integrating several technologies can save time and money for users. For example, PictureTel Corporation (*picturetel.com*), in an alliance with software developer Lotus, developed an integrated desktop video teleconferencing product that uses Lotus Notes. Using this integrated system, publisher Reader's Digest has built several applications combined with videoconferencing capabilities. A seamless integration is provided in groupware suites. Lotus Notes/Domino is one example of popular *groupware suites*. For discussion of others, see *Online File W4.13*.



Lotus Notes/Domino. The **Lotus Notes/Domino** suite includes a document management system, a distributed client/server database, and a basis for intranet and e-commerce systems, as well as a communication support tool. It enhances real-time communications with asynchronous electronic connections (e.g., electronic mail and other forms of messaging).

Thanks to electronic networks, e-mail, and exchange or update data at any time and from any place, group members using Lotus Notes/Domino might store all their official memos, formal reports, and informal conversations related to particular projects in a shared, online database. Then, as individual members need to check on the contents, they can access the shared database to find the information they need.

Lotus Notes provides online collaboration capabilities, workgroup e-mail, distributed databases, bulletin whiteboards, text editing, (electronic) document management, workflow capabilities, instant virtual meetings, application sharing, instant messaging, consensus building, voting, ranking, and various application development tools. All these capabilities are integrated into one environment with a graphic menu-based user interface. By the end of 2002, there were over 60 million Notes users worldwide (*lotus.com*, 2002). For even more capabilities of Lotus Notes/Domino, see Internet Exercise 3 at the end of the chapter.

Implementation Issues of Virtual Collaboration

Throughout this chapter we have discussed issues of online collaboration of one sort or another. Here we mention a few implementation issues that must be addressed when planning online collaboration. First, to connect you and your business partners, you need an effective collaborative environment. Such an environment is provided by groupware suites such as Lotus Notes/Domino. Another issue is the need to connect collaborative tools with file management



products on the intranet. Two such products are e/pop servers and clients (*wiredred.com*) and eRoom's server (*documentum.com*).

In addition, throughout the book, we have documented the general trend toward moving e-commerce applications onto the Web. To change the read-only Web to a truly collaborative environment, one-needs *protocols*, rules that determine how two computers communicate with one another over a network. The protocols make possible the integration of different applications and standardize communication. One such protocol, which is relatively new, is WebDAV (Web Distributed Authoring and Versioning protocol). For details see *webdav.org*.

Finally, we should point out that online collaboration is not a panacea for all occasions or in all situations. Many times, a face-to-face meeting is a must. Human workers do sometimes need the facial cues and the physical closeness that no computer system can currently provide. (A technology called *pervasive computing* attempts to remove some of these limitations, e.g., by interpreting facial cues. For more, see Chapter 6.)

4.6 E-LEARNING, DISTANCE LEARNING, AND TELECOMMUTING

Web-based systems enable many applications related to discovery, communication, and collaboration. Several important applications are presented in this section—e-learning, distance learning, and telecommuting.

E-Learning versus Distance Learning

There can be some confusion between e-learning and distance learning since they overlap each other. Therefore we begin with brief definitions.

E-learning refers to learning supported by the Web. It can be done inside classrooms, as was demonstrated in the Dartmouth College case in Chapter 1. It can be done as a support to conventional teaching, such as when students work on the Web at home or in the classroom. It also can be done in *virtual classrooms*, in which the entire coursework is done online and classes do not meet face-to-face, and then it is a part of distance learning.

Distance learning (DL) refers to situations where teachers and students do not meet face-to-face. It can be done in different ways. The oldest mode was correspondence, where all communication was done by mail. As early as the 1920s the radio was added to support DL. Then came voice cassettes, videotapes, and TV for delivering lectures. Students communicated with professors by “snail mail,” telephone, and faxes. A breakthrough occurred when the CD-ROM was introduced, since they are media rich and enabled self-testing and feedback. Finally the Web provided a multimedia interactive environment for self-study. (For an overview of DL see Matthews, 1999, and Bunker, 1999.)

Therefore, e-learning is only one channel of distance learning. At the same time, some parts of e-learning are done in the face-to-face mode, and not from a distance. What is common to the two is some of the delivery tools as well as some pedagogical issues. In both cases, Web-enabled systems make knowledge accessible to those who need it, when they need it, any time, anywhere. E-learning and DL can be useful both as an environment for facilitating learning at schools and as an environment for efficient and effective corporate training.

Liaw and Huang (2002) describe how Web technologies can facilitate learning. For an overview and research issues related to e-learning, see Piccoli et al. (2001); this resource also provides a comparison of e-learning with traditional

classroom teaching. Our discussion here concentrates on e-learning, which in its broader scope is known as *e-education* (see Albalooshi, 2003).

The Benefits of E-Learning

In theory, there are many benefits to e-learning: Self-paced and self-initiated learning has been shown to increase content retention (Urdu and Weggen, 2002). Online materials offer the opportunity to deliver very current content, of high quality (created by content experts), and consistent (presented the same way every time). Students in e-learning situations have the flexibility of learning from any place, at any time, and at their own pace. Finally, some learners in both educational and corporate settings appreciate what they perceive as the risk-free environment offered by e-learning, in which they feel more free to express themselves than in a face-to-face learning setting. In corporate training centers, learning time generally is shorter, and more people can be trained due to the faster training time. As a result, training costs can be reduced by 50 to 70 percent (Urdu and Weggen, 2002), and savings can be made on facility space as well.

E-learning provides a new set of tools that can add value to traditional learning modes. It does not usually replace the classroom setting, but enhances it, taking advantage of new content and delivery technologies. The better the match of content and delivery vehicle to an individual's learning style, the greater the content retention, and the better the learning results. Advanced e-learning support environments, such as Blackboard and WebCT, add value to traditional learning in higher education. See *A Closer Look 4.3* for descriptions of these e-learning tools, with which you may already be familiar from personal experience. Several other e-learning courseware tools are discussed in *Online File W4.14*.



A CLOSER LOOK

4.3 BLACKBOARD AND WEBCT

There is a good chance that you will use the Blackboard Inc. or WebCT frameworks when taking a class or using this text. These competing products provide the Internet infrastructure software for e-learning in schools, serving one of the fastest-growing industry segments in the world. Eduventures.com, a leading independent e-learning industry analyst, projected that the higher-education e-learning market will grow from \$4 billion in 2001 to \$11 billion by 2005 (*eduventures.com*, 2001).

The publisher places a book's content, teaching notes, quizzes, etc. on Blackboard or WebCT in a standardized format. Instructors can access modules and transfer them into their own specific Blackboard or WebCT sites, which can be accessed by their students.

Blackboard Inc. offers a complete suite of enterprise software products and services that power a total "e-education infrastructure" for schools, colleges, universities,

and other education providers. Of special interest are the discussion rooms that can be for everyone or for a restricted group.

WebCT provides a similar set of tools, but with a different vision and strategy. It uses advanced pedagogical tools to help institutions of higher education make distance-learning courses possible. Such courses enable schools to expand campus boundaries, attract and retain students and faculty, and continually improve course and degree program quality.

Textbook publishers are embracing these tools by making their major textbooks Blackboard and/or WebCT enabled. Thus, your professor can easily incorporate this book's content into the software that is used by thousands of universities worldwide.

Sources: Compiled from *webct.com* and *blackboard.com* (spring 2003).



Virtual Universities

Some drawbacks do exist that offset the benefits of e-learning. Issues cited as possible drawbacks of e-learning are discussed in *Online File W4.15* at the book's Web site. Suggestions on how to overcome such drawbacks and prevent e-learning failures are provided by Weaver (2002) and by Hricko (2003).

The concept of **virtual universities**—online universities from which students take classes from home or an off-site location via the Internet—is expanding rapidly. Hundreds of thousands of students in dozens of countries, from Great Britain to Israel to Thailand, are studying in such institutions. A large number of existing universities, including Stanford University and other top-tier institutions, offer online education of some form. Some universities, such as University of Phoenix (*phoenix.com*), California Virtual Campus (*cvc.edu*), and the University of Maryland (*umuc.edu/distance*), offer thousands of courses and dozens of degrees to students worldwide, all online. Other universities offer limited online courses and degrees but use innovative teaching methods and multimedia support in the traditional classroom.

The virtual university concept allows universities to offer classes worldwide. Moreover, we may soon see integrated degrees, where students can customize a degree that will best fit their needs by taking courses at different universities. Several all-virtual schools include *eschool-world.com*, *walden.com*, and *trainingzone.co.uk*.

For information about specific e-learning programs, see *Petersons.com*, *ECollege.com*, *icdl.open.ac.uk*, and *usdla.org*. For experiences in moving courses and partial courses to e-learning environments, see Berger (1999), Boisvert (2000), Dollar (2000), and Schell (2000). Hofmann (2002) describes the role of the Internet in distance learning in higher education, surveying implementation issues in terms of technology, course content, and pedagogy.

Online Corporate Training

Like educational institutions, a large number of business organizations are using e-learning on a large scale (e.g., see Kapp, 2002). Web-based learning technologies allow organizations to keep their employees up-to-date, and training via the Web can run 24 hours per day, every day (“24/7”). Online corporate training also offers striking cost advantages: Conventional classroom training costs (in 2000) were about \$75 an hour, with full-week programs costing \$3,000 to \$5,000 (ENTmag.com, 2000). Computer-based training costs about half that amount, without travel costs or class-size restrictions. IBM estimates a savings of \$500,000 for every 1,000 hours of training not done in the traditional classroom (Reeder, 2002).

Corporate training is often done via the intranet and corporate portals. However, in large corporations with multiple sites, and for studies from home, the Internet is used to access the online material. Some companies, like Barclays Bank, COX Industries, and Qantas Airways, offer online training in learning centers that they call “universities.” For discussion of strategies for implementing corporate e-learning, see Delahoussaye and Zemke (2001). Vendors of online training and educational materials can be found at *digitalthink.com*, *fifinance.com*, *click2learn.com*, *deitel.com*, and *smartplanet.com*.

E-learning is radically changing education and corporate training, and the socioeconomic and technological changes should be examined as the learning behaviors and expectations of learners change. There is a sharply growing demand for flexible and adaptive learning environments that are independent of time and

geography (Meso and Liegle, 2000). For an overview of and guidelines for e-learning, see Piskurich (2003), Hartley (2002), and Cone and Robinson (2001).

Virtual Work and Telecommuting

Virtual (distributed) work environments refer to geographically distributed work teams, global project teams, interorganizational teams, and nontraditional work environments such as virtual organizations, satellite work centers, and telecommuting. The use of such distributed work environments in organizations is increasing rapidly. Many of the participants in such environments are mobile workers. The popularity of these environments is growing in direct relationship to the IT support for them. Wireless and wearable devices are one example, and the groupware tools described earlier are another.

Due to the large number of people participating in virtual work, organizations are faced with problems of how to implement virtual work environments and how to use the IT support (see Belanger et al., 2002). In Chapter 12 we will deal with one aspect of virtual work, the support to group decision making. The topic of supporting mobile employees is covered throughout the book. Here we deal with one such virtual work environment—telecommuting.

TELECOMMUTING. **Telecommuting**, or **teleworking**, refers to an arrangement whereby employees can work at home, at the customer's premises, in special work places, or while traveling, usually using a computer linked to their place of employment. Regular and overnight mail, special messengers, and fax typically have been used to support telecommuting, but they are relatively slow and expensive, and the Internet is gradually replacing them. Almost all groupware technologies can be used to support telecommuting.

The first telecommuters were typists and bookkeepers who simply used their homes as an office. Today, a growing number of professionals do a significant portion of their work at home or on the road (see Hartley, 2001). (See *Online File W4.16.*) Telecommuting, which is used by many corporations in large cities, is also appealing to small entrepreneurs. Many people work at home for their own businesses, using the Internet as a supportive tool (e.g., see Cobe and Parlapiano, 2001).

Telecommuting can be used on a temporary basis. For example, during the 1996 Summer Olympics, Atlanta employers anticipated that the 750,000 additional cars of spectators would create a traffic nightmare. So, many Atlanta companies set up temporary data transmission network lines and told employees to work at home. Vendors cooperated: Symantec and U.S. Robotics offered companies free software to provide remote access to corporate networks. The Olympics offered many employees and companies their first taste of telecommuting.

Impact on Individuals and Organizations. Telecommuting has a number of potential advantages for employees, employers, and society. For example, the opportunity to work at home helps single parents with young children or other homebound people assume more responsible managerial positions in organizations. For more advantages of telecommuting, see *Online File W4.17* at the book's Web site.

However, telecommuting also has some potential disadvantages. The major disadvantages for the *employees* are increased feelings of isolation, loss of fringe benefits, lower pay (in some cases), no workplace visibility, with in turn the potential of slower promotions, and lack of socialization. The major





disadvantages to *employers* are difficulties in supervising work (for how to overcome it, see Fisher and Fisher, 2000), potential data security problems, training costs, and the high cost of equipping and maintaining telecommuters' homes.

Companies and employees evidently have decided that the advantages of telecommuting outweigh the disadvantages: The use of telecommuting is on the increase. Some experts predict that in 10 to 15 years, 50 percent of all work will be done at home, on the road, or at the customer's site. For a detailed list of advantages and disadvantages of telecommuting, see Nilles (1998). Major reasons for failure of telecommuting programs and possible preventive measures are presented in *Online File W4.18* at the book's Web site. For a complete discussion of the impacts of telecommuting see Pinsonneault and Boisvert (in Johnson, 2001).

One important advantage of telecommuting—perhaps its key impact—is productivity.

Telecommuting and Productivity. Why would productivity go up if people work at home? Strangely enough, reduced absenteeism has been cited by many organizations as a reason for increased productivity. Paul Ruper, Associate Director of New Ways to Work, claims absenteeism can be reduced by telecommuting because telecommuting eliminates “sort-of” illnesses. He refers to those mornings when an employee wakes up and feels just “sort of blah.” The trip to work and a whole day at the office are not likely to make the worker feel any better, so he or she stays home. A telecommuter in the same situation is likely to try to get some work done, though perhaps in a bathrobe.

Telecommuting also forces managers to manage by results instead of by overseeing. Telecommuting forces both employees and managers to ask some serious questions about the real purpose of a job. For more on teleworking, see Shin et al. (2000).

Even though many employees are attracted to telecommuting, it is not for everybody and should not be mandatory. Some employees need to work with others, and for those employees telecommuting may not be an option. Also, not all jobs can be done while telecommuting, and not all managers can participate. The American Telecommuting Association (ATA) provides information, developments, ideas, and lists of equipment required for supporting teleworkers (knowledgetree.com/ata.html). Khalifa and Davison (2000), based on a survey of over 100 telecommuters in North America, identify key factors that contribute to the decision to telecommute. (For more studies of telecommuting outcomes, see Guimaraes and Dallow, 1999; Higa et al., 2000; and Watad and DiSanzo, 2000. For a comprehensive analysis, see Belanger et al., 2001.)

4.7 SOME ETHICAL AND INTEGRATION ISSUES

Of the many issues involved in implementing network computing environments, ethics and integration issues are discussed here.

Ethics on the Net

Several ethical, legal, and security issues have been raised as a result of the use of electronic networks in general and the Internet in particular. For example:

- Does an employer have the right to look at your e-mail without your permission?



- Is someone's desire to download pornographic images from a newsgroup protected by freedom of speech and privacy laws?
- Should someone post critical comments about a product, service, or person to a newsgroup?
- Should an Internet access provider be held liable for the content of the traffic on the network?

Whenever there are no specific answers to such questions and their legal dimensions are vague, ethics become an important factor. Here we discuss some representative ethical issues.

PRIVACY AND ETHICS IN E-MAIL. The increased use of e-mail raises the question of privacy. While letters are sealed, e-mail material is open (unless encrypted). Many organizations are monitoring e-mail, which they have the *legal* right to do in most states; this raises questions of invasion of privacy (see discussion in Chapter 16). Other issues include the use of e-mail at work for personal purposes and for sending and receiving material that is not related to work. (For privacy protection tips surrounding e-mail, see *PC World*, February 1997.)

RIGHT TO FREE SPEECH. The dissemination of information such as pornographic and racist material via e-mail, newsgroups, electronic bulletin boards, and public networks may offend some people. But dissemination of such information in the United States is believed to be a right protected by the U.S. Constitution. At the time of this writing, the degree of freedom in the online world, and who should be liable for transmissions that are illegal, is still very much in debate. Legislation has been proposed that would require providers to create filters allowing adults to keep children from accessing inappropriate material. In fact, the commercial online providers have largely done so. The Internet, however, remains entirely accessible for anyone with a direct connection.

COPYRIGHT. The material you access on the Internet may be marked as being in the public domain; in that case it can be used by anyone for any purpose. Some material is marked as "copyrighted," which indicates that you need permission for anything other than a "fair use." *Fair use* refers to use for educational and not-for-profit activities. If you make a profit from use of copyrighted material, you should pay the copyright owner some fee or royalties.

Much of the material on the Internet is not marked as either in the public domain or copyrighted. Therefore, at least from an ethical point of view, it should be considered copyrighted. This includes software: You cannot legally copy any licensed software. However, *freeware* on the Internet can be downloaded and distributed. *Shareware* can be downloaded for review, but you are expected to pay for it if you decide you want to use it.

THE PRIVACY OF PATIENTS' INFORMATION. In the United States, several specialized online healthcare networks exist, such as Telemed, a network that tracks tuberculosis patients in order to prescribe the most suitable drugs. These systems could be abused. How do patients know they are getting qualified advice? What if personal medical records fall into the wrong hands? The growth



of computerized networks makes medical confidentiality harder to preserve. The problem is how to strike a balance between the benefits of health information systems and their potential ethical problems.

INTERNET MANNERS. It is easy to offend people or tread on their toes when you cannot see their faces or you do not know who they are. Two well-known behaviors on the Internet are spamming and flaming. **Spamming** refers to indiscriminate distribution of messages, without consideration for their appropriateness. Spamming is a major problem online. Spamming is frequently answered by **flaming**, which refers to sending angry messages. The Internet can become a war zone between spammers and flammers. Both sides may be equally guilty of ruining newsgroups. Flammers are known for their attacks on inexperienced visitors to newsgroups as well as on those who make spelling errors. A *spam shield* can stop spamming (for examples see *siegesoft.com*, *spamcop.com*, and *stopspam.org*). For more discussion of spamming, see Chapter 16.

There are certain general “rules,” called *netiquette* (network etiquette), governing Internet manners. One of these “rules,” for example, is to think carefully before sending a message; keep in mind that you are making your reputation internationally through the messages you send out. Another useful rule of Internet manners is to apply the Golden Rule: Do unto others in cyberspace as you would do unto them face to face, which is, of course, as you would want them to do unto you. A list of various netiquette rules is shown in *Online File W4.19* at the book’s Web site.

Likewise, it is far easier to take offense online because online interaction excludes the nuances of body language, rhythm, mood, and context. E-mail users developed an expressive language that can be used to overcome this problem. A sample is shown in *Online File W4.20*.

UNSOLICITED ADVERTISING. An extension of spamming is the use of junk mail which may clog providers’ systems and which frequently annoys people. Similarly, the use of pop-ups (see Chapter 5) irritates many people.

MONITORING EMPLOYEES’ USE OF THE INTERNET. Some companies use special software that monitors time spent on the Internet by each employee (and by site address). The objective is to eliminate abuse of access during working hours and the accessing of “indecent” sites. Other companies simply disconnect sites they do not want their employees to visit. Some people believe that such monitoring is either unethical or an infringement of their freedom of speech. Is freedom of speech an absolute right, or does it also involve associated responsibilities?

MONITORING STUDENTS’ USE OF THE INTERNET. In Chapter 1 we introduced the issue of using a university’s network for nonstudy use (e.g., for P2P file sharing). This usage may result in insufficient bandwidth in many universities. Some universities monitor students’ activities on the Internet. Some students question whether it is ethical for universities to do so.

Integration Issues

When people discover, communicate, and collaborate by just using the Internet or other open systems, there are no problems of doing so. But in many cases, network computing involves other types of networks, such as value-added



networks (VANs), as well as legacy and other specialized systems, such as computer-aided-design (CAD) or wireless systems. In such a case, users may encounter problems in connecting such systems, a problem known as *integration*. The problem of integration was ranked by a group of chief information officers (CIOs) surveyed in 2001, 2002, and 2003 as their number-one technology problem.

On the Web we distinguish three communication modes:

- **People-to-people.** This was the earliest mode of network communication, when people used e-mail and newsgroups. They also discovered information on bulletin boards and communicated there.
- **People-to-machine.** This was the next step, when people conducted discovery on the Web, searching and finding information.
- **People and machine-to-machine.** This mode occurs when applications need to “talk” to applications, either in complete automation or in automation but including people. An example is buying online with a credit card. When you provide your credit card number to a merchant (say to Amazon.com), the authorization process is done automatically, by several applications residing on several servers, all in a few seconds.

The integration issue can be complicated since information systems involve not only networks, applications, and people, but also hardware, software devices, and support services of multiple organizations. We discussed the integration problem briefly in Chapter 2 and here. Many possible solutions to the integration problem have been developed over the years. They will be discussed in Chapters 5, 7, 8, and 14. One of the newest and most promising approaches to this problem is Web services, as discussed in Chapter 2 and again in more detail in Chapters 7, 8, and 14. An example of how Expedia is using Web services was provided in Chapter 3.

MANAGERIAL ISSUES

1. **Security of communication.** Communication via networks raises the issue of the integrity, confidentiality, and security of the data being transferred. The protection of data in networks across the globe is not simple (see Chapter 15).
2. **Installing digital dashboards.** Many companies are installing “digital dashboards,” which are a sort of one-way portal that is continuously updated with online displays. The dashboard is available to employees in visible places around the company and is also accessible from PCs, PDAs, etc. Large companies, such as General Electric, believe that the cost of the dashboards can be justified by the better discovery and communication they promote within the company.
3. **Control of employee time and activities.** To control the time that employees might waste “surfing the Net” during working hours, some companies limit the information that employees have access to or use special monitoring software. Providing guidelines for employee use of the Internet is a simple but fairly effective approach.



4. **How many portals?** A major issue for some companies is how many portals to have. Should there be separate portals for customers, suppliers, employees, for example? Regardless of the answer, it is a good idea to integrate the separate portals. If you build a separate portal, make sure it can be easily connected to the others (see the tips at “Experts offer key tips. . . ,” 2002).
5. **Organizational impacts.** Technology-supported communication may have major organizational impacts. For example, intranets and groupware force people to cooperate and share information. Therefore, their use can lead to significant changes in both organizational culture and the execution of business process reengineering. Further impacts may be felt in corporate structure and the redistribution of organizational power.
6. **Telecommuting.** Telecommuting is a compelling venture, but management needs to be careful. Not all jobs are suitable for telecommuting, and allowing only some employees to telecommute may create jealousy. Likewise, not all employees are suitable telecommuters; some need the energy and social contact found in an office setting.
7. **Cost-benefit justification.** The technologies described in this chapter do not come free, and many of the benefits are intangible. However, the price of many networking technologies is decreasing.
8. **Controlling access to and managing the content of the material on an intranet.** This is becoming a major problem due to the ease of placing material on an intranet and the huge volume of information. Flohr (1997) suggests tools and procedures to manage the situation.



ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; additional cases, tables, and figures; updates; exercises; links; and demos and activities can be found on the book’s Web site.

KEY TERMS

Affinity portals (p. ●●●)	Information portal (p. ●●●)	Softbot (p. ●●●)
Asynchronous communication (p. ●●●)	Information superhighway (p. ●●●)	Software agents (p. ●●●)
Blog (p. ●●●)	Instant messaging (p. ●●●)	Spamming (p. ●●●)
Bloggging (Web logging) (p. ●●●)	Intelligent agents (p. ●●●)	Synchronous (real-time) communication (p. ●●●)
Chat room (p. ●●●)	Internet (p. ●●●)	Teleconferencing (p. ●●●)
Collaborative commerce (p. ●●●)	Internet2 (p. ●●●)	Telecommuting (teleworking) (p. ●●●)
Collaboration (p. ●●●)	Internet telephony (voice-over IP) (p. ●●●)	Video teleconference (p. ●●●)
Commercial (public) portals (p. ●●●)	Intranet (p. ●●●)	Virtual collaboration (p. ●●●)
Corporate portals (p. ●●●)	Lotus Notes/Domino (p. ●●●)	Virtual meetings (p. ●●●)
Data conferencing (p. ●●●)	Metasearch engines (p. ●●●)	Virtual universities (p. ●●●)
Directories (p. ●●●)	Mobile portals (p. ●●●)	Virtual work (distributed work) (p. ●●●)
Distance learning (DL) (p. ●●●)	Personal portals (p. ●●●)	Virtual group (team) (p. ●●●)
E-learning (p. ●●●)	Portal (p. ●●●)	Voice mail (p. ●●●)
Extranet (p. ●●●)	Publishing portals (p. ●●●)	Voice portals (p. ●●●)
Flaming (p. ●●●)	Screen sharing (p. ●●●)	
Groupware (p. ●●●)	Search engine (p. ●●●)	

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|---|----------------------------|--------------------------------------|
| Web conferencing (<i>p.</i> ●●●) | Workgroup (<i>p.</i> ●●●) | Workflow management (<i>p.</i> ●●●) |
| Whiteboard (electronic) (<i>p.</i> ●●●) | Workflow (<i>p.</i> ●●●) | Workflow systems (<i>p.</i> ●●●) |
| World Wide Web (the Web) (<i>p.</i> ●●●) | | |

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

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| <ul style="list-style-type: none"> 1 The Internet and the Web will enable us to integrate voice, text, and other interactive media and bring them into every home, school, and business. 1 The Internet is a network of many networks. 2 Intranets are an implementation and deployment of Web-based network services within a company. 2 Intranets and extranets have the power to change organizational structures and procedures. 3 There are four ways of supporting communication in meetings: same-time/same-place, same-time/-different-place, different-time/same-place, and different-time/different-place. 3 Electronic mail allows quick communication across the globe at minimal cost. 4 Electronic meeting systems, computer-supported cooperative work, groupware, and other names designate various types of computer support to groups. | <ul style="list-style-type: none"> 4 Video teleconferencing utilizes several technologies that allow people to communicate and view each other as well as view and transfer documents. 4 Voice technologies can be used to increase productivity and usability of communication. 5 Lotus Notes/Domino is a major integrated software that supports the work of dispersed individuals and groups. 6 Software agents help to carry out mundane tasks on the Internet such as searching, browsing, and sorting e-mail. 7 Distance learning and telecommuting are supported by network computing. 8 Ethical behavior on the Internet is critical in order to conduct business in a professional way. You need to know what is right and wrong. |
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QUESTIONS FOR REVIEW

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| <ul style="list-style-type: none"> 1. List the major advantages of the Internet. 2. Define an intranet. 3. Define discovery, communication, and collaboration. 4. Describe corporate portals and their benefits. 5. Distinguish corporate portals from information (Internet) portals. 6. What are some major benefits and limitations of working in groups? 7. Describe the time/place framework. 8. Define software agents applications and list their Internet applications. 9. Describe differences and relationships between intranets and extranets. 10. Define groupware. | <ul style="list-style-type: none"> 11. Describe the major capabilities of real-time collaboration tools. 12. List the major capabilities of teleconferencing. 13. Define workflow systems. 14. Describe software agents. 15. List the major Internet-based agents. 16. Define Internet and Internet2. 17. Define voice technology and list its major business uses. 18. Describe and distinguish between DL and e-learning. 19. Define telecommuting and describe its benefits. 20. Define flaming and contrast it with spamming. 21. Define netiquette. |
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QUESTIONS FOR DISCUSSION

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| <ul style="list-style-type: none"> 1. Identify some commercial tools that allow users to conduct browsing, communication, and collaboration simultaneously. | <ul style="list-style-type: none"> 2. Describe how agents can help people find specific information quickly. |
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3. Explain the advantages of electronic mail over regular mail.
4. Explain the advantages of using Web-based e-mail over server-based e-mail.
5. Discuss the role of Web-based call centers and their contribution to competitive advantage.
6. Explain why the topic of group work and its support is getting increased attention.
7. It is said that collaboration tools can change organizational culture. Explain how.
8. How can computers support a team whose members work at different times?
9. Based on what you know about Lotus Notes, can it support different-time/different-place work situations?
10. Relate telecommuting to networks.
11. Distinguish between flaming and spamming. How are they related? How is flaming related to netiquette?

EXERCISES

1. From your own experience or from the vendor's information, list the major capabilities of Lotus Notes/Domino. Do the same for Microsoft Exchange. Compare and contrast the products. Explain how the products can be used to support knowledge workers and managers.
2. Visit picturetel.com and sites of other companies that manufacture conferencing products for the Internet. Prepare a report. Why are conferencing products considered part of video commerce?
3. Marketel is a fast-growing (hypothetical) telemarketing company whose headquarters are in Colorado, but the majority of its business is in California. The company has eight divisions, including one in Chicago. (The company has just started penetrating the Midwest market.) Recently the company was approached by two large telephone companies, one in Los Angeles and one in Denver, for discussions regarding a potential merger.

Nancy Miranda, the corporate CEO who was involved in the preliminary discussions, notified all division managers on the progress of the discussions. Both she and John Miner, the chief financial officer, felt that an immediate merger would be extremely beneficial. However, the vice presidents for marketing and operations thought the company should continue to be independent for at least two to three years. "We can get a much better deal if we first increase our market share," commented Sharon Gonzales, the vice president for marketing.

Nancy called each of the division managers and found that five of them were for the merger proposal and three objected to it. Furthermore, she found that the division managers from the West Coast strongly opposed discussions with the Colorado company, and the other managers were strongly against discussions with the Los Angeles company. Memos, telephone calls, and meetings of two or three people at a time

resulted in frustration. It became apparent that a meeting of all concerned individuals was needed. Nancy wanted to have the meeting as soon as possible in spite of the busy travel schedules of most division managers. She also wanted the meeting to be as short as possible. Nancy called Bob Kraut, the chief information officer, and asked for suggestions about how to conduct a conference electronically. The options he outlined are as follows.

- (1) Use the corporate intranet. Collect opinions from all division managers and vice presidents, then disseminate them to all parties, get feedback, and repeat the process until a solution is achieved.
 - (2) Fly all division managers to corporate headquarters and have face-to-face meetings there until a solution is achieved.
 - (3) Use the Web for a meeting.
 - (4) Fly all division managers to corporate headquarters. Rent a decision room (a facility designed for electronic meetings) and a facilitator from the local university for \$2,000 per day and conduct the meetings there.
 - (5) Conduct a videoconference. Unfortunately, appropriate facilities exist only at the headquarters and in two divisions. The other division managers can be flown to the nearest division that has equipment. Alternatively, videoconferencing facilities can be rented in all cities.
 - (6) Use a telephone conference call.
- Answer the following questions:
- a. Which of these options would you recommend to management and why?
 - b. Is there a technology not listed that might do a better job?
 - c. Is it possible to use more than one alternative in this case? If yes, which technologies would you combine, and how would you use them?

GROUP ASSIGNMENTS

1. You are a member of a team working for a multinational finance corporation. Your team's project is to prepare a complex financing proposal for a client within one week. Two of the team members are in Singapore, one is in Seoul, South Korea, one is in London, and one is in Los Angeles. You cannot get the team members together in one place. Your team does not have all the required expertise, but other corporate employees may have it. There are 8,000 employees worldwide; many of them travel. You do not know exactly who are the experts in your company.

Your company has never prepared such a proposal, but you know that certain parts of the proposal can be adapted from previous proposals. These proposals are filed electronically in various corporate databases, but you are not sure exactly where. (The company has over 80 databases, worldwide.) Finally, you will need a lot of external information, and you will need to communicate with your client in China, with investment groups in Japan and New York, and with your corporate headquarters in London.

If the client accepts your proposal, your company will make more than \$5 million in profit. If the contract goes to a competitor, you may lose your job.

Your company has all the latest information and communication technologies.

- a. Prepare a list of tasks and activities that your team will need to go through in order to accomplish the mission.
- b. Describe what information technologies you would use to support the above tasks. Be specific, explaining

how each technology can facilitate the execution of each task.

2. The world of the Internet is growing very fast, and it keeps changing. The task for the group is to report on the latest developments on the Internet's uses. Members of the group will prepare a report to include the following:
 - a. New business applications on the Internet.
 - b. New books about the Internet.
 - c. Information about new software products related to the Internet.
 - d. New managerial and technological issues related to the Internet.
 - e. Also, send an e-mail message about a topic of concern to you to the White House and include the reply in your report.
3. Assign each group member to an integrated group support tool kit (Lotus Notes, Exceloncorp.com, GroupWise, etc.). Have each member visit the Web site of the commercial developer and obtain information about this product. As a group, prepare a comparative table of the major similarities and differences among the kits.
4. Assign each team to a college collaborative tool such as Blackboard, WebCT, etc. Establish common evaluative criteria. Have each team evaluate the capabilities and limitations of its tool, and convince each team that its product is superior.
5. Have each team download a free copy of Groove from *groove.net*. Install the software on the members' PCs and arrange collaborative sessions. What can the free software do for you? What are its limitations?

INTERNET EXERCISES

1. Your friend wishes to pursue graduate studies in accounting in the United States. She is especially interested in two universities: the University of Illinois and the University of Southern California. Use the Internet to find information that will help her choose between the two universities. Such information should include, *but not be limited to*, the following:
 - a. The types of degree programs in accounting offered by the two universities.
 - b. The admission procedures and school calendar.
 - c. Coursework and dissertation requirements of the programs under consideration.
 - d. The costs of tuition and other expenses associated with the programs.
2. You plan to take a three-week vacation in Hawaii this December, visiting the big island of Hawaii. Using

the Internet, find information that will help you plan the trip. Such information includes, *but is not limited to*, the following:

- a. Geographical location and weather conditions in December.
- b. Major tourist attractions and recreational facilities.
- c. Travel arrangements (airlines, approximate fares).
- d. Car rental; local tours.
- e. Alternatives for accommodation (within a moderate budget) and food.
- f. Estimated cost of the vacation (travel, lodging, food, recreation, shopping, etc.).
- g. State regulations regarding the entrance of your dog that you plan to take with you.
- h. Shopping (try to find an electronic mall).





3. Enter *lotus.com* and identify the various tools it provides for collaboration. Mark the capabilities that are not cited in this chapter.
4. Visit *cdt.org*. Find what technologies are available to track users' activities on the Internet.
5. You are assigned the task of buying desktop teleconferencing equipment for your company. Using the Internet:
 - a. Identify three major vendors.
 - b. Visit their Web sites and find information about their products and capabilities.
 - c. Compare the least expensive products of two vendors.
 - d. Find a newsgroup that has an interest in video teleconferencing. Post new questions regarding the products selected. (For example, what are the users' experiences with the products?)
 - e. Prepare a report of your findings.
6. Both Microsoft Explorer and Netscape Navigator have the capability for Internet telephony; all you need is a sound card, microphone, and speakers on your PC. (If you do not have these browsers, access the VocalTec Web site at *vocaltec.com/*, and download and install its fully functional Internet long-distance telephone software.) Get a friend in another city to do the same.

Contact each other via the Internet using your computer as a telephone. What are the advantages and disadvantages of using the Internet for telephone service? Compare your experience to that of making a standard telephone call.
7. Visit *albion.com/netiquette/netiquiz.html* and take the on-line quiz about netiquette.
8. Visit *talarian.com* and examine its Smartsockets product. Read the Southwest Airlines case and prepare a list of the advantages of the system.
9. Visit *microsoft.com* and *slipstick.com* and find information about their digital dashboards. Examine their capabilities and compare them to information portals.
10. Enter *intranets.com*. Is this site a portal or an advertising company? Why are the services provided of interest to real estate companies?
11. Enter *hpe-learning.com*. Find what programs they have and how they conduct training. Write a report.
12. Enter *setiathome.ssl.Berkeley.edu* and download the free software. Join the efforts to analyze radiotelescope data. Comment about this collaborative effort. Explain why it uses P2P technology.
13. Enter *PCSVision.com*. Describe its services.



Minicase 1

How General Motors Is Collaborating Online

The Problem

Designing a car is a complex and lengthy task. Take, for example, General Motors (GM). Each model created needs to go through a frontal crash test. So the company builds prototypes that cost about one million dollars for each car and test how they react to a frontal crash. GM crashes these cars, makes improvements, makes new prototypes and crashes them again. There are other tests and more crashes. Even as late as the 1990s, GM crashed as many as 70 cars for each new model.

The information regarding a new design and its various tests, collected in these crashes and other tests, has to be shared among close to 20,000 designers and engineers in hundreds of divisions and departments at 14 GM design labs, some of which are located in different countries. In addition, communication and collaboration is needed with design engineers of the more than 1,000 key suppliers. All of these necessary communications slowed the design process and increased its cost. It took over four years to get a new model to the market.

The Solution

GM, like its competitors, has been transforming itself to an e-business. This gradual transformation has been going on since the mid-1990s, when Internet bandwidth increased sufficiently to allow Web collaboration. The first task was to examine over 7,000 existing legacy IT systems, reducing them to about 3,000, and making them Web-enabled. The EC system is centered on a computer-aided design (CAD) program from EDS (a large IT company, subsidiary of GM). This system, known as Unigraphics, allows 3-D design documents to be *shared online* by both the internal and external designers and engineers, all of whom are hooked up with the EDS software. In addition, collaborative and Web-conferencing software tools, including Microsoft's NetMeeting and EDS's eVis, were added to enhance

teamwork. These tools have radically changed the vehicle-review process.

To see how GM now collaborates with a supplier, take as an example a needed cost reduction of a new seat frame made by Johnson Control. GM electronically sends its specifications for the seat to the vendor's product data system. Johnson Control's collaboration systems (eMatrix) is integrated with EDS's Unigraphics. This integration allows joint searching, designing, tooling, and testing of the seat frame in real time, expediting the process and cutting costs by more than 10 percent.

Another area of collaboration is that of crashing cars. Here designers need close collaboration with the test engineers. Using simulation, mathematical modeling, and a Web-based review process, GM is able now to electronically "crash" cars rather than to do it physically.

The Results

Now it takes less than 18 months to bring a new car to market, compared to 4 or more years before, and at a much lower design cost. For example, 60 cars are now "crashed" electronically, and only 10 are crashed physically. The shorter cycle time enables more new car models, providing GM with a competitive edge. All this has translated into profit. Despite the economic slowdown, GM's revenues increased more than 6 percent in 2002, while its earnings in the second quarter of 2002 doubled that of 2001.

Questions for Minicase 1

1. Why did it take GM over four years to design a new car?
2. Who collaborated with whom to reduce the time-to-market?
3. How has IT helped to cut the time-to-market?

Sources: Compiled from Sullivan (2002), press releases at *gm.com*, and from *amrresearch.com* as reported by Sullivan (October 2002).



Minicase 2

Cisco Systems Pioneers E-Learning

The Problem

Cisco Systems is one of the fastest-growing high-tech companies in the world, selling devices that connect computers and networks to the Internet and other networks. Cisco's products are continuously being upgraded or replaced; so extensive training of employees and customers is needed. Cisco has recognized that its employees, business partners, and independent students seeking professional certification all require training on a continuous basis. Traditional classroom training was flawed by its inability to scale rapidly enough. Cisco offered in-house classes for each course, 6 to 10 times a year, in many locations, but the rapid growth in the number of students, coupled with the fast pace of technological change, made the training both expensive and ineffective.

The Solution

Cisco believes that *e-learning* is a revolutionary way to empower its workforce and partners with the skills and knowledge needed to turn technological change to an advantage. Therefore, Cisco implemented e-learning programs that allow students to learn new software, hardware, and procedures. Cisco believes that once people experience e-learning, they will recognize that it is the fastest, easiest way to get the information they need to be

successful. The company created the Delta Force—made up of the CEO, the IT unit, and the Internet Learning Solution Group to implement e-learning. The first project was to build two learning portals, one for 40 partner companies that sell Cisco products, and one for 4,000 systems engineers who implement the products after the sale.

To encourage its employees to use e-learning, Cisco:

- Makes e-learning “nonthreatening” by using an anonymous testing and scoring process that focuses on helping people improve rather than penalizing those who fail
- Gives those who fail the tests precision learning targets (remedial work, modules, exercises, or written materials) to help them pass and remove the fear associated with testing
- Enables managers to track, manage, and ensure employee development, competency change, and, ultimately, performance change
- Offers additional incentives and rewards such as stock grants, promotions, and bonuses to employees who pursue specialization and certification through e-learning
- Adds e-learning as a strategic top-down metric for Cisco executives, who are measured on their deployment of IT in their departments



Virtual Company Assignment

Network Computing in The Wireless Café

With 24/7 operations, The Wireless Café has three shifts of workers. This adds complexity to both the physical operation of the restaurant (there's no downtime for cleaning and maintenance) as well as communications across the shifts. (How would you hold a staff meeting with everybody in attendance?) Barbara and Jeremy have noticed some missed communications and misunderstandings among the three shift managers, and so they are looking

for ways to improve round-the-clock information flows. Your task is to identify ways network computing can facilitate better staff communications.

1. Based on your experiences in restaurants, and by looking at The Wireless Café's organizational chart, consider the different kinds of interpersonal and transactional communications that occur during and across shifts.

- Makes e-learning a mandatory part of employees' jobs
- Offers easy access to e-learning tools via the Web

Cisco also wants to serve as a model of e-learning for its customers, hoping to convince them to use e-learning programs.

Cisco operates E-Learning Centers for Excellence that offer training at Cisco's centers as well as at customers' sites via intranets and the Internet. Some of the training requires the use of partnering vendors. Cisco offers a variety of training programs supported by e-learning. For example, in 2001, Cisco converted a popular 4 1/2-day, instructor-led training (ILT) course on Cisco's signature IOS (interorganizational information system) technologies into an e-learning program that blends both live and self-paced components. The goal was to teach seasoned systems engineers how to sell, install, configure, and maintain those key IOS technologies, and to do so in a way that would train more people than the 25 employees the ILT course could hold.

The Results

On the IOS course alone, Cisco calculated its return on investment as follows:

- It cost \$12,400 in labor to develop the blended course.
- The course saved each system engineer one productivity day and 20 percent of the travel and lodging cost of a one-week training course in San Jose. Estimating \$750 for travel and lodging and \$450 for

the productivity day, the savings totaled \$1,200 per engineer.

- Seventeen system engineers attended the course the first time it was offered, for a total savings of \$20,400. Cisco therefore recovered the development costs in the first offering—and saved \$8,000 over and above the development costs. Since March 2001, the IOS Learning Services team has presented two classes of 40 engineers per month. At that rate, Cisco saves \$1,152,000 net for just this one course every 12 months.

In 2003, there were over 10,000 corporate salespeople, 150,000 employees of business partners, and 200,000 independent students, all taking courses at Cisco learning centers, many using the e-learning courses. By 2003, Cisco had developed over 100 e-learning courses and was planning to develop many more soon. According to Galagan (2002), e-learning became a major force in Cisco's economic recovery, which started in 2002.

Questions for Minicase 2

1. What were the drivers of e-learning at Cisco?
2. How can e-learning empower employees and partners?
3. What, in your opinion, made this project a success?
4. Can a small company use such e-training? Why or why not?

Sources: Compiled from miscellaneous news items at *Cisco.com* (2001–2003), Galagan (2002), and Delahoussaye and Zemke (2001).

- a. List three business-related transactions and the kind of communication they require.
 - b. For each of these transactions, identify data items that should be captured.
 - c. What kinds of networked solutions discussed in the chapter might be useful in facilitating communications?
2. The Wireless Café has created a rudimentary employee portal at <http://kainani.hpu.edu/dsamson/TheWirelessCafe>. Review what is there now, and describe other kinds of information you think would be useful for the employees of The Wireless Café.
 3. Jeremy is concerned that the implementation of new networked communications applications will cost more than the benefits provided. Identify some tangible and intangible costs and benefits that would help Jeremy evaluate the financial impact of implementing new networked communications applications. Use these costs and benefits to give Jeremy a set of criteria to evaluate different discovery, communication, and collaboration applications.



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PART II
The Web Revolution



- 4. Network Computing: Discovery, Communication, and Collaboration
- ▶ 5. E-Business and E-Commerce
- 6. Mobile, Wireless, and Pervasive Computing

CHAPTER

5

E-Business and E-Commerce

Hi-Life Corporation

5.1

Overview of E-Business and E-Commerce

5.2

EC Mechanisms: Electronic Auctions and Bartering

5.3

Business-to-Consumer Applications

5.4

Market Research and Online Advertising

5.5

B2B Applications

5.6

Intrabusiness and B2E

5.7

E-Government and Consumer-to-Consumer EC

5.8

E-Commerce Support Services

5.9

Legal and Ethical Issues in E-Business

5.10

Failures and Strategies for Success

Minicases: (1) Freemarkets.com / (2) Restaurants.com

Appendix 5.1 EDI and Extranets

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Describe electronic commerce, its scope, benefits, limitations, and types.
- 2 Understand auctions and bartering.
- 3 Describe the major applications of business-to-consumer commerce, including service industries.
- 4 Discuss the importance and activities of B2C market research and online advertising.
- 5 Describe business-to-business applications.
- 6 Describe emerging EC applications such as intrabusiness and B2E commerce.
- 7 Describe e-government activities and consumer-to-consumer e-commerce.
- 8 Describe the e-commerce support services, specifically payments and logistics.
- 9 Discuss some ethical and legal EC issues.
- 10 Describe EC failures and strategies for success.



E-COMMERCE PROVIDES DECISION SUPPORT TO HI-LIFE CORPORATION

➡ THE PROBLEM

Hi-Life Corporation owns and operates 720 convenience retail stores in Taiwan, where the company sells over 3,000 different products. A major problem is keeping a proper level of inventory of each product in each store. Overstocking is expensive due to storage costs and tying up money to buy and maintain the inventory. Understocking reduces sales and could result in unhappy customers who may go to a competitor.

To calculate the appropriate level of inventory, it is necessary to know exactly how many units of each product are in stock at specific times. This is known as *stock count*. Periodic stock count is needed since the actual amount in stock frequently differs from the theoretical one (inventory = previous inventory – sales + arrivals). The difference is due to “shrinkage” (e.g., theft, misplaced items, spoilage, etc.). Until 2002, stock count at Hi-Life was done manually. Using data collection sheets, where the products’ names were preprinted, employees counted the quantity of each product and recorded it on the data collection sheets. Then, the data were painstakingly keyed into each store’s PC. The process took over 21 person hours, in each store, each week. This process was expensive and frequently was delayed, causing problems along the entire supply chain due to delays in count and errors. Suppliers, employees, and customers were unhappy.

➡ THE SOLUTION

The first phase of improvement was introduced in spring 2002. Management introduced a pocket PC (a handheld device) from Hewlett-Packard that runs on Microsoft Windows (Chinese version). The pocket PC, called Jornada, enables employees to enter the inventory tallies directly on the forms on the screen by hand, using Chinese characters for additional notes. Jornada has a synchronized cradle called Activesync. Once the pocket PC is placed in its cradle, inventory information can be relayed instantly to Hi-Life’s headquarters.

In the second phase of improvement, in 2003, a compact bar code scanner was added on in the pocket PC’s expansion slot. Employees now can scan the products’ bar codes and then enter the quantity found on the shelf. This new feature expedites data entry and minimizes errors in product identification. The up-to-the second information enables headquarters to compute appropriate inventory levels, shipment schedules, and purchasing strategies, using decision support system formulas, all in minutes. The stores use the Internet (with a secured VPN) to upload data to the intranet at headquarters.

➡ THE RESULTS

The results have been astonishing. Inventory taking has been reduced to less than four hours per store. Errors are down by more than 90 percent, order placing is simple and quick, and administrative paperwork has been eliminated. Furthermore, quicker and more precise inventory counts have resulted in lower inventory levels and in shorter response times for changes in demand. Actually, the entire product-management process became more efficient, including purchasing,

stocking, selling, shelf-price audit and price checks, re-ticketing, discontinuance, and customer inquiries.

The employees like the new electronic commerce-based system too. It is very user friendly, both to learn and to operate, and the battery provides at least 24 hours of power, so charging can be done after hours. Finally, Hi-Life's employees now have more time to plan, manage, and chat with customers. More important, faster and better decisions are enabled at headquarters, contributing to greater competitiveness and profitability for Hi-Life.

Sources: Compiled from *hp.com/jornada jornada*, and from *microsoft.com/asia/mobile* (May 2002).



LESSONS LEARNED FROM THIS CASE

The output of an information system is only as good as the inputted data. When data are inaccurate and/or delayed, the decisions that use the data are not the best, as in Hi-Life's old system, which resulted in high inventories and low customer satisfaction. The solution described in this case was provided by an electronic-commerce system that expedited and improved the flow of information to the corporate headquarters. Electronic commerce (EC), which is the subject of this chapter, describes the process of buying, selling, transmitting, or exchanging products, services, and information via computerized networks, primarily by the Internet (see Turban et al., 2004). This case illustrates an intrabusiness application, involving employees, and it is referred to business-to-employees (B2E) e-commerce. There are several other types of EC, and they all are the subject of this chapter. We also provide here an overview of the EC field and comment on its relationship to other information systems.

5.1 OVERVIEW OF E-BUSINESS AND E-COMMERCE

Definitions and Concepts

Electronic commerce (EC, or e-commerce) describes the process of buying, selling, transferring, or exchanging products, services, and/or information via computer networks, including the Internet. Some people view the term *commerce* as describing only transactions conducted between business partners. When this definition of commerce is used, some people find the term electronic commerce to be fairly narrow. Thus, many use the term e-business instead. **E-business** refers to a broader definition of EC, not just the buying and selling of goods and services, but also servicing customers, collaborating with business partners, conducting e-learning, and conducting electronic transactions within an organization. Others view e-business as the "other than buying and selling" activities on the Internet, such as collaboration and intrabusiness activities.

In this book we use the broadest meaning of electronic commerce, which is basically equivalent to e-business. The two terms will be used *interchangeably* throughout the chapter and the remainder of the text.

PURE VERSUS PARTIAL EC. Electronic commerce can take several forms depending on the *degree of digitization* (the transformation from physical to digital) involved. The degree of digitization can relate to: (1) the *product* (service) sold, (2) the *process*, or (3) the *delivery agent* (or intermediary). Choi et al.

(1997) created a framework that explains the possible configurations of these three dimensions. A product can be physical or digital, the process can be physical or digital, and the delivery agent can be physical or digital. In traditional commerce all three dimensions are physical, and in *pure EC* all dimensions are digital. All other combinations include a mix of digital and physical dimensions. If there is at least one digital dimension, we consider the situation electronic commerce but only *partial EC*. For example, buying a shirt at Wal-Mart Online, or a book from Amazon.com is *partial EC*, because the merchandise is physically delivered by FedEx. However, buying an e-book from Amazon.com or a software product from Buy.com is *pure EC*, because the product, its delivery, payment, and transfer agent are all done online.

EC ORGANIZATIONS. Pure physical organizations (corporations) are referred to as **brick-and-mortar** (or old-economy) **organizations**, whereas companies that are engaged only in EC are considered **virtual** (or pure-play) **organizations**. **Click-and-mortar** (or click-and-brick) **organizations** are those that conduct some e-commerce activities, yet their primary business is done in the physical world. Gradually, many brick-and-mortar companies are changing to click-and-mortar ones (e.g., Wal-Mart Online).

INTERNET VERSUS NON-INTERNET EC. Most e-commerce is done over the Internet. But EC can also be conducted on private networks, such as *value-added networks* (VANs, networks that add communication services to existing common carriers), on local area networks (LANs), or even on a single computerized machine. For example, buying food from a vending machine and paying with a smart card or a cell phone can be viewed as EC activity

Types of E-Commerce Transactions

E-commerce transactions can be done between various other parties, as follows:

- **Business-to-business (B2B):** In B2B transactions, both the sellers and the buyers are business organizations. The vast majority of EC volume is of this type.
- **Collaborative commerce (c-commerce):** In c-commerce, business partners collaborate electronically. Such collaboration frequently occurs between and among business partners along the supply chain (see Chapters 4 and 8).
- **Business-to-consumers (B2C):** In B2C, the sellers are organizations, and the buyers are individuals.
- **Consumers-to-businesses (C2B):** In C2B, consumers make known a particular need for a product or service, and suppliers compete to provide the product or service to consumers. An example is Priceline.com, where the customer names a product and the desired price, and Priceline tries to find a supplier to fulfill the stated need.
- **Consumer-to-consumer (C2C):** In C2C, an individual sells products or services to other individuals. (You also will see the term C2C used as “customer-to-customer.” The terms interchangeable, and both will be used in this book to describe individuals sells products and services to each other.)
- **Intrabusiness (intraorganizational) commerce:** In this case an organization uses EC internally to improve its operations. A special case of this is known as **B2E (business to its employees) EC**, which was illustrated in the opening case.

- **Government-to-citizens (G2C) and to others:** In this case the government provides services to its citizens via EC technologies. Governments can do business with other governments as well as with businesses (G2B).
- **Mobile commerce (m-commerce):** When e-commerce is done in a wireless environment, such as using cell phones to access the Internet, we call it m-commerce.

EC Business Models Each of the above types of EC is executed in one or more **business models**, the method by which a company generates revenue to sustain itself. For example, in B2B one can sell from catalogs, or in auctions. The major business models of EC are summarized in Table 5.1. (Note that this is an expanded version

TABLE 5.1 E-Commerce Business Models

EC Model	Description
Online direct marketing	Manufacturers or retailers sell directly to customers. Very efficient for digital products and services. Can allow for customization.
Electronic tendering systems	Businesses conduct online tendering, requesting quotes from suppliers. Use B2B <i>reverse auctions</i> mechanism.
Name-your-own-price	Customers decides how much they are willing to pay. An intermediary (e.g., Priceline.com) tries to match a provider.
Find-the-best-price	Customers specify a need. An intermediary (e.g., Hotwire.com) compares providers and shows the lowest price. Customer must accept the offer in a short time or may lose the deal.
Affiliate marketing	Vendors ask partners to place logos (or banners) on partner's site. If customers click, come to vendors, and buy, vendors pay commission to partners.
Viral marketing	Spread your brand on the Net by word-of-mouth. Receivers will send your information to their friends. (Be on the watch for viruses.)
Group purchasing (e-co-ops)	Aggregating the demands of small buyers to get a large volume. Then conduct tendering, or negotiate a low price.
Online auctions	Placing auctions of various types on the Internet. Very popular in C2C, but getting grounds in other types of EC.
Product customization	Using the Internet to self-configure products or services, price them, and then fulfill them quickly (build-to-order).
Electronic marketplaces and exchanges	Create virtual marketplaces (private or public) where transactions can be conducted in an efficient way (more information to buyers and sellers, less transaction cost).
Value-chain integrators	Aggregate information and package it for customers, vendors, or others in the supply chain.
Value-chain service providers	Provide specialized services in supply-chain operations such as providing logistics or payment services.
Information brokers	Provide services related to EC information such as trust, content, matching buyers and sellers, evaluating vendors and products.
Bartering online	Exchanging surplus products and/or services with the process administered completely online by an intermediary. Company receives "points" for its contribution, and the points can be used to purchase other needed items.
Deep discounters	Gain market share via deep discounts (e.g., Half.com). For customers who consider only price in their purchasing decisions.
Membership	Only members can use the services provided, including access to certain information, conducting trades, etc. (e.g., Egreetings.com).
Supply-chain improvers	Restructure supply chains to hubs, or other configuration. Increase collaboration, reduce delays, and smooth supply-chain flows.

of the list of five representative models introduced in A Closer Look 1.●, page ●●●.) For details see Turban et al., 2004.

Brief History and Scope of EC

E-commerce applications began in the early 1970s with such innovations as electronic transfer of funds. However, the applications were limited to large corporations and a few daring small businesses. Then came electronic data interchange (EDI), which automated routine transaction processing and extended EC to all industries. (See Appendix 5.1.)

Since the commercialization of the Internet and the introduction of the Web in the early 1990s, EC applications have expanded rapidly. By 2000 there was a major shakeout in EC activities when hundreds of dot-com companies went out of business. The shakeout lasted about three years. Since 2003, EC continues its steady progress. Today, most medium and large organizations and many small ones are practicing some EC.

THE SCOPE OF EC. The field of e-commerce is broad, and we use Figure 5.1 to describe it. As can be seen in the figure, there are many of EC applications (top of the figure), some of which were illustrated in the opening case about Hi-Life Corp; others will be shown throughout the book. (Also see Huff et al., 2001, and Farhoomand and Lovelock, 2001.)

To execute these applications, companies need the right information, infrastructure, and support services. Figure 5.1 shows that the EC applications are supported by infrastructure and by five support areas (shown as supporting pillars):

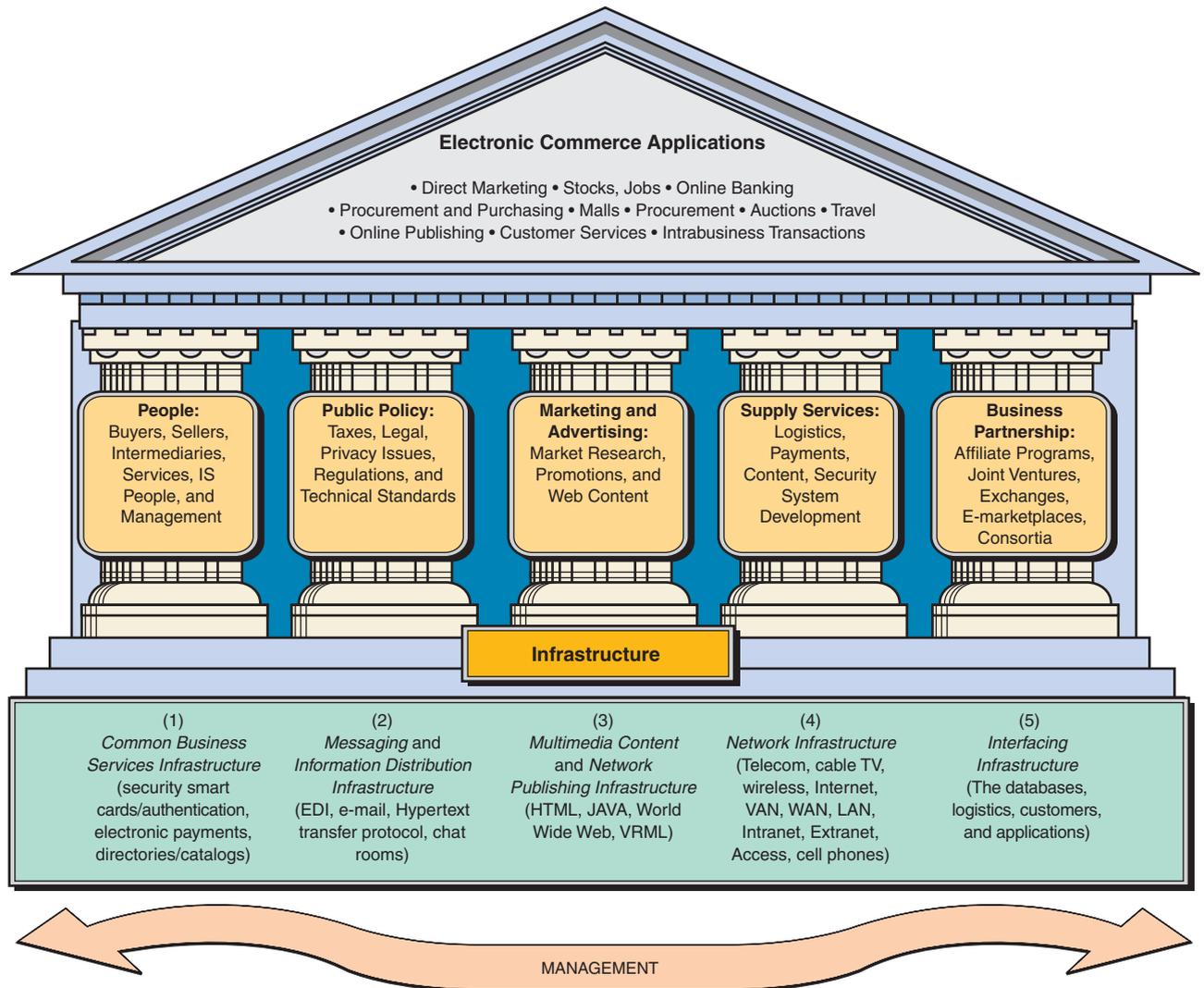
- **People:** Sellers, buyers, intermediaries, information systems specialists and other employees, and any other participants.
- **Public policy:** Legal and other policy and regulating issues, such as privacy protection and taxation, that are determined by the government.
- **Marketing and advertising:** Like any other business, EC usually requires the support of marketing and advertising. This is especially important in B2C online transactions where the buyers and sellers usually do not know each other.
- **Support services:** Many services are needed to support EC. These range from payments to order delivery and content creation.
- **Business partnerships:** Joint ventures, e-marketplaces, and business partnerships of various sorts are common in EC. These occur frequently throughout the supply chain (i.e., the interactions between a company and its suppliers, customers, and other partners).

The supporting infrastructure includes hardware, software, and networks, ranging from browsers to multimedia.

All of these EC components require good management practices. This means that companies need to plan, organize, motivate, devise strategy, and reengineer processes as needed.

Benefits and Limitations/Failures of E-Commerce

Few innovations in human history encompass as many benefits to organizations, individuals, and society as does e-commerce. These benefits have just begun to materialize, but they will increase significantly as EC expands. The major benefits are summarized in Table 5.2.



A framework for electronic commerce

FIGURE 5.1 A framework for e-commerce.

Counterbalancing its many benefits, EC has some limitations, both technological and nontechnological, which have slowed its growth and acceptance. Those limitations and inhibitors are listed in Table 5.3. Some have been contributing factors in the failures of many EC projects and dot-com companies in recent years. As time passes, the limitations, especially the technical ones, will lessen or be overcome. In addition, appropriate planning can minimize the negative impact of some of them.

Despite its limitations and failures, e-commerce has made very rapid progress. Also, various B2B activities, e-auctions, e-government, e-learning, and some B2C activities are ballooning. As experience accumulates and technology improves, the ratio of EC benefits to cost will increase, resulting in an even greater rate of EC adoption.

TABLE 5.2 Benefits of E-Commerce**To Organizations**

- Expands a company's marketplace to national and international markets. With minimal capital outlay, a company can quickly locate more customers, the best suppliers, and the most suitable business partners worldwide.
- Enables companies to procure material and services from other companies, rapidly and at less cost.
- Shortens or even eliminates marketing distribution channels, making products cheaper and vendors' profits higher.
- Decreases (by as much as 90 percent) the cost of creating, processing, distributing, storing, and retrieving information by digitizing the process.
- Allows lower inventories by facilitating "pull"-type supply chain management (see Appendix 3A). This allows product customization and reduces inventory costs.
- Lowers telecommunications costs because the Internet is much cheaper than value-added networks (VANs).
- Helps some small businesses compete against large companies.
- Enables a very specialized niche market.

To Customers

- Frequently provides less expensive products and services by allowing consumers to conduct quick online searches and comparisons.
- Gives consumers more choices in selecting products and vendors.
- Enables customers to shop or make other transactions 24 hours a day, from almost any location.
- Delivers relevant and detailed information in seconds.
- Enables consumers to get customized products, from PCs to cars, at competitive prices.
- Makes it possible for people to work and study at home.
- Makes possible electronic auctions that benefit buyers and sellers (see Section 5.9).
- Allows consumers to interact in electronic communities and to exchange ideas and compare experiences.

To Society

- Enables individuals to work at home and to do less traveling, resulting in less road traffic and lower air pollution.
- Allows some merchandise to be sold at lower prices, thereby increasing people's standard of living.
- Enables people in developing countries and rural areas to enjoy products and services that are otherwise not available. This includes opportunities to learn professions and earn college degrees, or to receive better medical care.
- Facilitates delivery of public services, such as government entitlements, reducing the cost of distribution and chance of fraud, and increasing the quality of social services, police work, health care, and education.

TABLE 5.3 Limitations of E-Commerce**Technological Limitations**

- Lack of universally accepted standards for quality, security, and reliability.
- Insufficient telecommunications bandwidth.
- Still-evolving software development tools.
- Difficulties in integrating the Internet and EC applications and software with some existing (especially legacy) applications and databases.
- Need for special Web servers in addition to the network servers.
- Expensive and/or inconvenient Internet accessibility for many would-be users.

Nontechnological Limitations

- Unresolved legal issues (see Section 5.9).
- Lack of national and international government regulations and industry standards.
- Lack of mature methodologies for measuring benefits of and justifying EC.
- Many sellers and buyers waiting for EC to stabilize before they take part.
- Customer resistance to changing from a real to a virtual store. People do not yet sufficiently trust paperless, faceless transactions.
- Perception that EC is expensive and unsecured.
- An insufficient number (critical mass) of sellers and buyers exists for profitable EC operations.

5.2 E-COMMERCE MECHANISMS: AUCTIONS AND BARTERING

The major mechanism for buying and selling on the Internet is the electronic catalog. However, in order to better understand how e-commerce works, let's first look at two common mechanisms used in its implementation: electronic auctions and bartering online.

Electronic Auctions (E-Auctions)

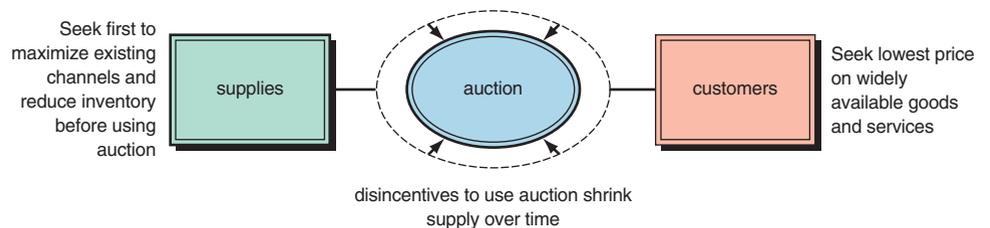
An **auction** is a market mechanism by which sellers place offers and buyers make sequential bids. The primary characteristic of auctions, whether off-line or online, is that prices are determined dynamically by competitive bidding. Auctions have been an established method of commerce for generations, and they are well-suited to deal with products and services for which conventional marketing channels are ineffective or inefficient. Auctions can expedite the disposal of items that need liquidation or a quick sale (for an example, see Minicase 1).

The Internet provides an efficient infrastructure for executing auctions at lower administrative cost and with many more involved sellers and buyers (see Kambil and Van-Heck, 2002). Individual consumers and corporations alike can participate in this rapidly growing form of e-commerce. There are several types of auctions, each with its motives and procedures. Auctions are divided here into two major types: *forward* auctions and *reverse* auctions.

FORWARD AUCTIONS. **Forward auctions** are auctions that *sellers* use as a selling channel to many potential buyers. Usually, items are placed at sites for auction, and buyers will bid continuously for the items. The highest bidder wins the items. Sellers and buyers can be individuals or businesses. The popular auction site eBay.com is a forward auction.

According to Gallagher (2002) there are two types of forward e-auctions. One is for *liquidations*, the other one is to *increase marketing efficiency*, as defined and shown in Figure 5.2.

Liquidation Auctions:



Market Efficiency Auctions:

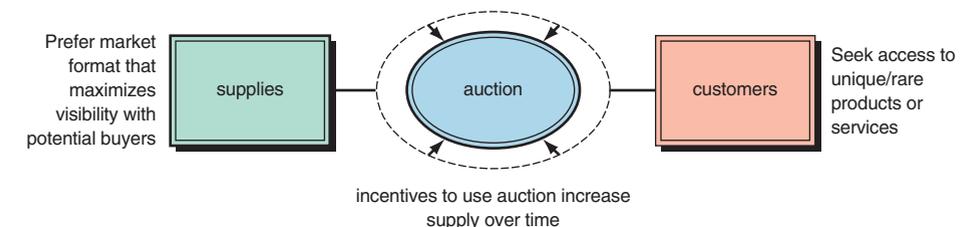


FIGURE 5.2 Types of forward auctions.
(Source: Gallagher (2002), Fig. 3, p. 91.)



IT At Work 5.1

e-BAY—THE WORLD'S LARGEST AUCTION SITE

eBay (*ebay.com*) is the world's largest auction site, and one of the most profitable e-businesses. The successful online auction house has its roots in a 50-years old novelty item—Pez candy dispensers. Pamela Kerr, an avid collector of Pez dispensers, came up with the idea of trading them over the Internet. When she expressed this idea to her boyfriend (now her husband), Pierre Omidyar, he was instantly struck with the soon-to-be-famous e-business auction concept.

In 1995, the Omidyars created a company called AuctionWeb. Later renamed eBay, the company has since become the premier online auction house, with millions of unique auctions in progress and over 500,000 new items added each day. eBay is now much more than an auction house, as we will see. But its initial success was in electronic auctions. The business model of eBay was to provide an electronic infrastructure for conducting mostly C2C auctions, although it caters to small businesses as well.

Technology replaces the traditional auctioneer as the intermediary between buyers and sellers.

On eBay, people can buy and sell just about anything. The company collects a submission fee upfront, plus a commission as a percentage of the sale amount. The submission fee is based on the amount of exposure you want your item to receive. For example, a higher fee is required if you would like to be among the “featured auctions” in your specific product category, and an even higher fee if you want your item to be listed on the eBay home page under Featured Items.

The auction process begins when the seller fills in the registration information and posts a description of the item for sale. The seller must specify a minimum opening bid. Sellers might set the opening bid lower than the *reserve price*, a minimum acceptable bid price, to generate bidding activity. If a successful bid is made, the seller and the buyer negotiate the payment method, shipping details, warranty,

REVERSE AUCTIONS. In **reverse auctions**, there is one buyer, usually an organization, that wants to buy a product or a service. Suppliers are invited to submit bids. Online bidding is much faster than conventional bidding, and it usually attracts many more bidders. The reverse auction is the most common auction model for large purchases (in terms of either quantities or price). Governments and large corporations frequently mandate this approach, which may provide considerable savings.



Auctions are used in B2C, B2B, C2B, e-government, and C2C commerce, and they are becoming popular in many countries. Their benefits for sellers, buyers, and auctioneers are listed in Online File W5.1 at the book's Web site. Electronic auctions started in the 1980s on private networks, but their use was limited. The Internet opens many new opportunities for e-auctions. As we have discussed, auctions can be conducted from the seller's site, the buyer's site, or from a third-party site. For example, as described in *IT At Work 5.1*, eBay, the most known third-party site, offers hundreds of thousands of different items in several types of auctions. Over 300 other major companies, including Amazon.com and Dellauction.com, offer online auctions as well.

Bartering Related to auctions is **electronic bartering**, the exchange of goods or services *without a monetary transaction*. In addition to the individual-to-individual bartering ads that appear in some newsgroups, bulletin boards, and chat rooms, there are several intermediaries that arrange for corporate e-bartering (e.g., *barterbrokers.com*). These intermediaries try to match online partners to a barter.

and other particulars. eBay serves as a liaison between the parties; it is the interface through which sellers and buyers can conduct business. eBay does not maintain a costly physical inventory or deal with shipping, handling or other services that businesses such as Amazon and other retailers must provide.

After a few years of successful operations and tens of million of loyal users, eBay started to do e-tailing, mostly in fixed prices. By 2003, eBay operated several specialty sites, such as eBay Motors, and made wireless trading possible. eBay also operates a business exchange in which small- and medium-sized enterprises can buy and sell new and used merchandise, in B2B or B2C modes. In addition, *half.com*, the famous discount e-tailer, is now part of eBay and so is PayPal.com, the P2P payment company.

eBay operates globally, permitting international trades to take place. Country-specific sites are located in over 25 countries. Buyers from more than 160 other countries also participate. eBay also operates a business exchange in which small- and medium-sized enterprises can buy and sell new and used merchandise, in B2B or B2C modes. Finally, eBay operates locally: It has over 60 local sites in the

United States that enable users to easily find items located near them, to browse through items of local interest, and to meet face-to-face to conclude transactions. As of fall 2002, eBay had close to 50 million registered users, and according to company financial statements, eBay transacted over \$14.87 billion in sales in 2002.

The impact of eBay on e-business has been profound. Its founders took a limited-access off-line business model— auctions—and, by using the Internet, brought it to the desktops of consumers worldwide. This business model consistently generates a profit and promotes a sense of community—a near addiction that keeps traders coming back. As a matter of fact, the only place where people are doing more online business than off-line business (and considerably more, at that) is auctions. For comparison, e-tailing is less than 2 percent of the total retailing.

For Further Exploration: Is bigger always in better in auctions? Does eBay's 2003 change of business model, from auctions to e-tailing, make sense? Why are wireless auctions promoted?

Sources: Compiled from press releases at *eBay.com* (2001–2003), and from Cohen (2001) and Deitel et al. (2001).

5.3 BUSINESS-TO-CONSUMER APPLICATIONS

Forrester Research Institute, the Gartner Group, and others predict that online B2C will be in the range of \$300 to \$800 billion in the year 2004, up from \$515 million in 1996 (see *cyberatlas.com* and *emarketer.com*). For 2004 the total of B2C and B2B is estimated to be in the range of \$3.5 billion to \$8 billion (depending on the estimator and their definitions of what they measure). Here we will look at some of the major categories of B2C applications.

Electronic Retailing: Storefronts and Malls

For generations home shopping from catalogs has flourished, and television shopping channels have been attracting millions of shoppers for more than two decades. However, these methods have drawbacks: Both methods can be expensive; paper catalogs are sometimes not up-to-date; many people are troubled by the waste of paper used in catalogs that just get tossed out; and television shopping is limited to what is shown on the screen at any given time. Shopping online offers an alternative to catalog and television shopping that appeals to many consumers.

Like any mail-order shopping experience, e-commerce enables you to buy from home, and to do so 24 hours a day, 7 days a week. However, EC overcomes some of the limitations of the other forms of home shopping. It offers a wide variety of products and services, including the most unique items, often at lower prices. Furthermore, within seconds, shoppers can get very detailed information on products, and can easily search for and compare competitors' products and prices. Finally, using the Internet, buyers can find hundreds of thousands of sellers. **Electronic retailing** (*e-tailing*) is the direct sale of products



through electronic storefronts or electronic malls, usually designed around an electronic catalog format and/or auctions.

Both goods and services are sold online. Goods that are bought most often online are computers and computer-related items, office supplies, books and magazines, CDs, cassettes, movies and videos, clothing and shoes, toys, and food. Services that are bought most often online include entertainment, travel services, stocks and bonds trading, electronic banking, insurance, and job matching. (Services will be presented as a separate topic later in this section.) Directories and hyperlinks from other Web sites and intelligent search agents help buyers find the best stores and products to match their needs. Two shopping locations online are electronic storefronts and electronic malls.

ELECTRONIC STOREFRONTS. Hundreds of thousands of solo storefronts can be found on the Internet, each with its own Internet name and EC portal. Called **electronic storefronts**, they may be an *extension* of physical stores such as Home Depot, The Sharper Image, or Wal-Mart. Or, they may be new businesses started by entrepreneurs who saw a niche on the Web, such as Amazon.com, CDNow, Uvine.com, Restaurant.com (see Minicase 2), and Alloy.com. Besides being used by retailers, such as Officedepot.com, storefronts also are used by manufacturers, such as Dell.com. Retailers' and manufacturers' storefronts may sell to individuals and/or to organizations. There are two types of storefronts, general and specialized. The *specialized* store sells one or a few products (e.g., flowers, wines, or dog toys). The *general* storefronts sell many products.

ELECTRONIC MALLS. An **electronic mall**, also known as a cybermall or e-mall, is a collection of individual shops under one Internet address. The basic idea of an electronic mall is the same as that of a regular shopping mall—to provide a one-stop shopping place that offers many products and services. Representative cybermalls are Downtown Anywhere (*da.awa.com*), Cactus Hill HandCrafters Mall (*cactushill.com*), America's Choice Mall (*mall.choicemall.com*), and Shopping 2000 (*shopping2000.com*). A unique e-mall is *2bsure.com*, which specializes in services (financial, legal, etc.) but also sells computers and other electronic products, as well as provides price comparisons.

Two types of malls exist. First, there are *referral malls*, such as *hawaii.com*. You cannot buy in such a mall, but instead you are transferred to a participating storefront. In the second, more traditional type of mall, such as at *store.yahoo.com*, you can actually make a purchase. At this type of mall, you might shop from a variety of stores, but are able to make only one purchase transaction at the end; an electronic shopping cart enables you to gather items from various vendors and pay for them all together in once transaction. (The mall organizer, such as Yahoo, takes a commission from the sellers for this service.)

Each cybermall may include thousands of vendors. For example, *shopping.yahoo.com* and *eshop.msn.com* include tens of thousands of products from thousands of vendors.

As is true for vendors that locate in a physical shopping mall, a vendor that locates in an e-mall gives up a certain amount of independence. Its success depends on the popularity of the mall, as well as on its own marketing efforts. On the other hand, malls generate streams of prospective customers who otherwise might never have stopped by the store.

E-Tailing: The Essentials

The concept of retailing and e-tailing implies sales of goods and/or services to individual customers. However, the distinction between B2C and B2B e-commerce is

not always clear cut. For example, Amazon.com sells books mostly to individuals (B2C), but it also sells to corporations (B2B). Amazon.com's rival, Barnes & Noble Online (*bn.com*), has a special division that caters only to business customers. Walmart.com sells to both individuals and businesses (via Sam's Club). Dell.com sells its computers to both consumers and businesses, as does Staples.com, and some insurance sites sell both to individuals and corporations.

There are several models of B2C (see Turban et al., 2004). One of the most interesting properties of these models is the ability to offer customized products at a reasonable price and fairly fast (as done by Dell Computer). Many sites (e.g., *nike.com* and *lego.com*) offer product self-configuration from their B2C portals. (For more on build-to-order and its impact on e-commerce, see Appendix 3.1.) The most well known B2C site is Amazon.com, whose story is presented in *IT At Work* 5.2.

Issues in E-Tailing

The following are the major issues faced by e-tailers that may be handled and supported by IT tools:

- **Resolving channel conflict.** If a seller is a click-and-mortar company, such as Levi's or GM, it may face a conflict with its regular distributors when it sells directly online. Known as **channel conflict**, this situation can alienate the regular distributors. Channel conflict has forced some companies (e.g., Lego.com) to limit their B2C efforts; others (e.g., some automotive companies) have decided not to sell direct online. An alternative approach is to try to collaborate in some way with the existing distributors whose services may be restructured. For example, an auto company could allow customers to configure a car online, but require that the car be picked up from a dealer, where customers would arrange financing, warranties, and service. IT tools can facilitate resolution of channel conflict, for example by using a group DSS (Chapter 12).
- **Resolving conflicts within click-and-mortar organizations.** When an established company decides to sell direct online, on a large scale, it may create a conflict within its existing operations. Conflicts may arise in areas such as pricing of products and services, allocation of resources (e.g., advertising budget) and logistics services provided by the offline activities to the online activities (e.g., handling of returns of items bought online). As a result of these conflicts, some companies have completely separated the "clicks" (the online portion of the organization) from the "mortars" or "bricks" (the traditional brick-and-mortar part of the organization). Such separation may increase expenses and reduce the synergy between the two. The decisions about how to organize the online and off-line operations and whether or not to separate them, can be facilitated by IT tools. In addition, group DSS can be used to resolve conflicts.
- **Organizing order fulfillment and logistics.** E-tailers face a difficult problem of how to ship very small quantities to a large number of buyers. This can be a difficult undertaking, especially when returned items need to be handled. IT-supported decision models can help with scheduling, routing, shipments, inventory management and other logistics-related decisions.
- **Determining viability and risk of online e-tailers.** Many pure online e-tailers folded in 2000–2002 (see Kaplan, 2002), the result of problems with customer acquisition, order fulfillment, and demand forecasting. Online competition, especially in commodity-type products such as CDs, toys, books, or groceries, became very fierce, due to the ease of entry to the marketplace. So a problem most young e-tailers face is to determine how long to operate while



IT At Work 5.2

AMAZON.COM: THE KING OF E-TAILING



Entrepreneur Jeff Bezos, envisioning the huge potential for retail sales over the Internet, selected books as the most logical product for e-tailing. In July 1995, Bezos started Amazon.com, an e-tailing pioneer, offering books via an electronic catalog from its Web site. Key features offered by the Amazon.com “superstore” were broad selection; low prices; easy searching and ordering; useful product information and personalization; secure payment systems; and efficient order fulfillment. Early on, recognizing the importance of order fulfillment, Amazon.com invested hundreds of millions of dollars in building physical warehouses designed for shipping small packages to hundreds of thousands of customers. Over the years since its founding, Amazon.com has continually enhanced its business models and electronic store by expanding product selection, improving the customer’s experience, and adding services and alliances. For example, the company now offers specialty stores, such as its professional and technical store. It has expanded its editorial content through partnerships with experts in certain fields. It has increased product selection with the addition of millions of used and out-of-print titles. It also is expanding its offerings beyond books. For example, in June 2002 it became an authorized dealer of Sony Corp. for selling Sony products online.

In 1997, Amazon started an extensive affiliates program. By 2002, the company had more than 500,000 partners that refer customers to Amazon.com. Amazon pays a 3 to 5 percent commission on any resulting sale. Amazon.com has undertaken alliances with major “trusted partners” that provide knowledgeable entry into new markets, such as cars, health and beauty aids, toys, and even wireless phone service providers. In yet another extension of its services, in September 2001 Amazon signed an agreement with Borders Group Inc., providing Amazon’s users with the option of picking up books, CDs, etc. at Borders’ physical bookstores. Amazon.com also is becoming a Web fulfillment contractor for national chains such as Target and Circuit City.

Amazon.com is recognized as an online leader in creating sales through customer intimacy and customer relationship management (CRM), which are cultivated by informative marketing front-ends and one-to-one advertising. In addition, sales are supported by highly automated, efficient back-end systems. When a customer makes a return visit to Amazon.com, a cookie file identifies the user and says, for example, “Welcome back, Sarah

Shopper,” and then proceeds to recommend new books from the same genre of previous customer purchases. The company tracks customer purchase histories and sends purchase recommendations via e-mail to cultivate repeat buyers. These efforts usually result in satisfactory shopping experiences and encourage customers to return. The site has an efficient search engine and other shopping aids.

Customers can personalize their accounts and manage orders online with the patented “One-Click” order feature. This personalized service includes an *electronic wallet*, which enable shoppers to place an order in a secure manner without the need to enter their address, credit card number, etc., each time they shop. One-Click also allows customers to view their order status and make changes on orders that have not entered yet the shipping process.

Annual sales for Amazon.com have trended upward, from \$15.7 million in 1996 to \$600 million in 1998 to about \$4 billion by 2002. With over 17 million book, music, and DVD/video titles (including over 1 million Japanese-language titles), Amazon.com has sold products to some 20 million customers. According to Retail Forward’s study, *Top E-Retail 2001* (*emarketer.com*, August 1, 2002), Amazon was the number 1 e-tailer in 2001, generating \$3.12 billion. This level of sales represented 22 percent of the total online sales for all 50 companies in the study. According to Bayers (2002), Amazon is becoming very successful in reducing its costs and increasing its profitability.

In January 2002, Amazon.com declared its first ever profit—for the 2001 fourth quarter—and followed that by a profitable first quarter of 2002. Yet the company’s financial success is by no means assured: The company sustained operating losses in the second and third quarters of 2002, though those losses were smaller than losses in the same quarters in preceding years. In the fourth quarter of 2002, the company again made a profit. Like all businesses, and especially all e-tailing businesses, Amazon.com will continue to walk the fine line of profitability for the foreseeable future.

For Further Exploration: What are the critical success factors of Amazon? What advantages does it have over other e-tailers (e.g., Wal-Mart online or *toysrus.com*)? What disadvantages? What is the purpose of the alliances Amazon.com has made?

Sources: Compiled from Bayers (2002), Daisey (2002), and *New York Times* (2002).

you're still losing money and how to finance the losses. In deciding on new EC initiatives, or on an entire dot-com company, a risk analysis is needed. A DSS modeling can be helpful in such cases (see Westland, 2002).

- **Identifying appropriate revenue models.** Many dot-com companies were selling goods at or below cost, with the objective of attracting many customers and advertisers to their sites. One early dot-com model was to generate enough revenue from advertising to keep the business afloat until the customer base reached critical mass. This model did not work. Too many dot-com companies were competing for too few advertising dollars, which went mainly to a small number of well-known sites such as AOL and Yahoo. In addition, there was a "chicken-and-egg" problem: Sites could not get advertisers to come if they did not have enough visitors. To succeed in EC, it is necessary to identify appropriate revenue models. For further discussion of revenue models, see Turban et al., 2004.

Service Industries Online

Selling books, toys, computers, and most other products on the Internet may reduce vendors' selling costs by 20 to 40 percent. Further reduction is difficult to achieve because the products must be delivered physically. Only a few products (such as software or music) can be digitized to be delivered online for additional savings. On the other hand, delivery of *services*, such as buying an airline ticket or buying stocks or insurance online, can be done 100 percent electronically, with considerable cost reduction potential. Therefore, delivering services online is growing very rapidly, with millions of new customers added annually. Indeed, in many ways e-commerce is now simply a part of traditional commerce, and like the addition of credit card payment capabilities a generation ago, many people expect companies to offer some form of e-commerce.

We've take a quick look here at the leading online service industries: banking, trading of securities (stocks, bonds), job matching, travel services, and real estate.

CYBERBANKING. **Electronic banking**, also known as **cyberbanking** and *online banking*, includes various banking activities conducted from home, a business, or on the road instead of at a physical bank location. Electronic banking has capabilities ranging from paying bills to applying for a loan. It saves time and is convenient for customers. For banks, it offers an inexpensive alternative to branch banking (for example, about 2 cents cost per transaction versus \$1.07 at a physical branch) and a chance to enlist remote customers. Many banks now offer online banking, and some use EC as a major competitive strategy (see Athitakis, 2003).

Electronic banking offers several of the benefits of EC listed in Section 5.1, such as expanding the customer base and saving the cost of paper transactions. In addition to regular banks with added online services, we are seeing the emergence of **virtual banks**, dedicated solely to Internet transactions, such as *netbank.com*.

International and Multiple-Currency Banking. International banking and the ability to handle trading in multiple currencies are critical for international trade. Although some international retail purchasing can be done by giving a credit card number, other transactions may require cross-border banking support. For example, Hong Kong and Shanghai Bank (*hsbc.com.hk*) has developed a special system (called Hexagon) to provide electronic banking in 60 countries. Using

this system, the bank has leveraged its reputation and infrastructure in the developing economies of Asia, to rapidly become a major international bank without developing an extensive new branch network (Peffer and Tunnainen, 1998). Transfers of electronic funds and electronic letters of credit are other important services in international banking. An example of support for EC global trade is provided by TradeCard (*tradecard.com*), which is done in conjunction with MasterCard. Banks and companies such as Oanda also provide currency conversion of over 160 currencies. International foreign-currency traders can be assisted by many other online services (see *financialsupermarket.com* and *foreign-trade.com*).

ONLINE SECURITIES TRADING. It is estimated that by the year 2004, about 35 million people in the United States will be using computers to trade stocks, bonds, and other financial instruments (eMarketer, 2003). In Korea, more than half of stock traders are using the Internet for that purpose. Why? Because it makes a lot of dollars and “sense”: An online trade typically costs the trader between \$3 and \$15, compared to an average fee of \$100 from a full-service broker and \$25 from a discount broker. There is no waiting on busy telephone lines. Furthermore, the chance of making mistakes is small because online trading does away with oral communication with a securities broker in a frequently very noisy physical environment. Orders can be placed from anywhere, any time, even from your cell phone. Investors can find on the Web a considerable amount of information regarding investing in a specific company or in a mutual fund. (e.g., *money.cnn.com*, *bloomberg.com*).

How does online trading work? Let’s say you have an account with Charles Schwab. You access Schwab’s Web site (*schwab.com*) from your PC or your Internet-enabled mobile device, enter your account number and password to access your personalized Web page, and then click on “stock trading.” Using a menu, you enter the details of your order (buy or sell, margin or cash, price limit, market order, etc.). The computer tells you the current “ask” and “bid” prices, much as a broker would do on the telephone, and you can approve or reject the transaction. Some well-known companies offer only online trading are E*Trade, Ameritrade, and Suretrade.

However, both online banking and securities trading require tight security. Otherwise, your money may be at risk. Here is what happened in Korea on August 23, 2002: According to news items (*Korean Times*, August 24, 2002), an unknown criminal managed to get an account number and a password of a large investor in Korea (Hyundai Investment). Sitting in an Internet café, the criminal placed an order with the company that managed the investment, Daewoo Securities, to buy five million shares of Delta Information Communication. Within 90 seconds 2.7 million shares were sold by 100 sellers, at a much higher than normal price. When the fake order was discovered and the news broke out, the price of the shares spiraled down. Daewoo Securities ended with 2.7 million unwanted shares. Some analysts have suggested that one or more sellers hired the hacker so they could sell at a high price. Whatever the motive, Daewoo lost a huge amount of money. Most online bank stock and traders use only ID numbers and passwords. This may not be secured enough. See Chapter 15 on how to improve the online security.

THE ONLINE JOB MARKET. The Internet offers a perfect environment for job seekers and for companies searching for hard-to-find employees. The online job

market is especially effective for technology-oriented jobs. However, there are thousands of companies and government agencies that advertise available positions of all types of jobs, accept resumes, and take applications via the Internet. The online job market is used by:

- **Job seekers.** Job seekers can reply to employment ads online. Or they can take the initiative and place resumes on their own home pages or on others' Web sites, send messages to members of newsgroups asking for referrals, and use recruiting firms such as Career Mosaic (*careermosaic.com*), Job Center (*jobcenter.com*), and Monster Board (*monster.com*). For entry-level jobs and internships for newly minted graduates, job seekers can use *jobdirect.com*. Need help writing your resume? Try *resume-link.com* or *jobweb.com*. Finally, if you want to know if you are underpaid or how much you can get if you relocate to another city, consult *wageweb.com*.
- **Job offerers.** Many organizations advertise openings on their Web site. Others use sites ranging from Yahoo! to bulletin boards of recruiting firms. In many countries governments must advertise openings on the Internet.
- **Recruiting firms.** Hundreds of job-placement brokers and related services are active on the Web. They use their own Web pages to post available job descriptions and advertise their services in electronic malls and in others' Web sites. Recruiters use newsgroups, online forums, bulletin boards, and chat rooms. Job-finding brokers help candidates write their resumes and get the most exposure. Matching of candidates and jobs is done by companies such as Peopleclick.com.

Due to the large number of job market resources available on the Internet, it is too expensive and time-consuming to evaluate them manually. Resumix (*resumix.com*) can help (see Chapter 7 for details).

TRAVEL SERVICES. The Internet is an ideal place to plan, explore, and economically arrange almost any trip. Potential savings are available through special sales, comparisons, use of auctions, and the elimination of travel agents. Examples of comprehensive travel online services are Expedia.com, Travelocity.com, and Orbitz.com. Services are also provided online by all major airline vacation services, large conventional travel agencies, car rental agencies, hotels (e.g., *hotels.com*), and tour companies. Online travel services allow you to purchase airline tickets, reserve hotel rooms, and rent cars. Most sites also support an itinerary-based interface, including a fare-tracker feature that sends you e-mail messages about low-cost flights to your favorite destinations or from your home city. Finally, Priceline.com allows you to set a price you are willing to pay for an airline ticket or hotel accommodations and Priceline then attempts to find a vendor that will match your price. A similar service offered by Hotwire.com tries to find the lowest available price for you.

REAL ESTATE. Real estate transactions are an ideal area for e-commerce, for the following reasons. First, you can view many properties on the screen, saving time for you and the broker. Second, you can sort and organize properties according to your preferences and decision criteria, and can preview the exterior and interior designs of the properties, shortening the search process. Finally, you can find detailed information about the properties and frequently get even more detail than brokers will provide.

In some locations brokers allow the use of real estate databases only from their offices, but considerable information is now available on the Internet. For example, Realtor.com allows you to search a database of over 1.2 million homes across the United States. The database is composed of local “multiple listings” of all available properties and properties just sold, in hundreds of locations. Those who are looking for an apartment can try Apartments.com.

In another real estate application, homebuilders use three-dimensional floor plans for potential home buyers on their Web sites. They use “virtual models” that enable buyers to “walk through” mockups of homes.

5.4 MARKET RESEARCH AND ONLINE ADVERTISING

We now turn our attention in another direction—market research and online advertising. To successfully conduct electronic commerce, especially B2C, it is important to find out who are the actual and potential customers and what motivates them to buy. Several research institutions collect Internet-usage statistics (e.g., *acnielsen.com*, *emarketer.com*), and they also look at factors that inhibit shopping. Merchants can then prepare their marketing and advertising strategies based on this information.

Finding out what specific groups of consumers (such as teenagers or residents of certain geographical zones) want is done via **segmentation**, dividing customers into specific segments, like age or gender. However, even if we know what groups of consumers in general want, each individual consumer is very likely to want something different. Some like classical music while others like jazz. Some like brand names, while price is more important to many others. Learning about customers is extremely important for any successful business, especially in cyberspace. Such learning is facilitated by *market research*.

A MODEL OF CONSUMER BEHAVIOR ONLINE. For decades, market researchers have tried to understand consumer behavior, and they have summarized their findings in various models of consumer behavior. The purpose of a consumer behavior model is to help vendors understand how a consumer makes a purchasing decision. If the process is understood, a vendor may try to influence the buyer’s decision, for example, by advertising or special promotions.

Figure 5.3 shows the basics of these consumer behavior models, adjusted to fit the EC environment. The EC model is composed of the following parts:

- *Independent (or uncontrollable) variables*, which are shown at the top of Figure 5.3. They can be categorized as personal characteristics and environmental characteristics.
- *Vendors’ controlled variables* (intervening or moderating variables), which are divided into market stimuli (on the left) and EC systems at the bottom.
- The *decision-making process*, shown in the center of the figure, is influenced by the independent and intervening variable. This process ends with the buyers’ decisions (shown on the right), resulting from the decision making process.
- The *dependent variables* that describe the decisions made.

Figure 5.3 identifies some of the variables in each category. In this chapter, we deal briefly with only some of the variables. Discussions of other variables can be found in Internet-marketing books, such as Strauss et al. (2003) and Sterne (2001, 2002) and in Online File W5.2.



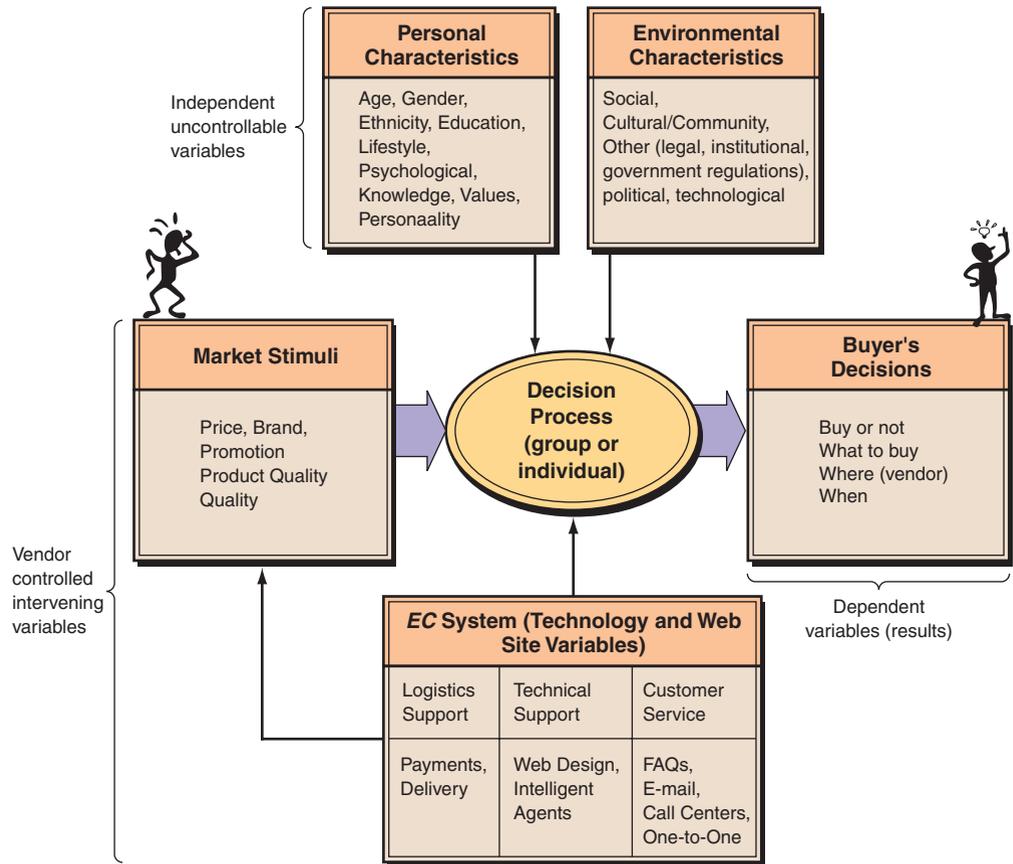


FIGURE 5.3
E-commerce consumer
behavior model.

Before we discuss some of the model's variables, let's examine who the EC consumers are. Online consumers can be divided into two types: *individual consumers*, who get much of the media attention, and *organizational buyers*, who do most of the actual shopping in cyberspace. Organizational buyers include governments, private corporations, resellers, and public organizations. Purchases by organizational buyers are generally used to create products (services) by adding value to raw material or components. Also, organizational buyers such as retailers and resellers may purchase products for resale without any further modifications.

The above model is simplified. In reality it can be more complicated, especially when new products or procedures need to be purchased. For example, for online buying, a customer may go through the following five adoption stages: awareness, interest, evaluation, trial, and adoption. (For details see McDaniel and Gates, 2001, and Solomon, 2002.) Understanding the structure of the model in Figure 5.3, or any more complicated one, is necessary, but in order to really make use of such models, we need to learn about the decision making process itself, as discussed next.

The Consumer Decision-Making Process

Let's return to the central part of Figure 5.3, where consumers are shown making purchasing decisions. Several models have been developed in an effort to describe the details of the decision-making process that leads up to and

culminates in a purchase. These models provide a framework for learning about the process in order to predict, improve, or influence consumer decisions. Here we introduce two relevant purchasing-decision models.

A GENERIC PURCHASING-DECISION MODEL. A general purchasing-decision model consists of five major phases. In each phase we can distinguish several activities and, in some of them, one or more decisions. The five phases are: (1) need identification, (2) information search, (3) evaluation of alternatives, (4) purchase and delivery, and (5) after-purchase evaluation. Although these phases offer a general guide to the consumer decision-making process, do not assume that all consumers' decision making will necessarily proceed in this order. In fact, some consumers may proceed to a point and then revert back to a previous phase, or skip a phase. For details, see Strauss et al. (2003) and Online File W5.2.

A CUSTOMER DECISION MODEL IN WEB PURCHASING. The above purchasing-decision model was used by O'Keefe and McEachern (1998) to build a framework for a Web-purchasing model, called the *Consumer Decision Support System (CDSS)*. According to their framework, shown in Table 5.4, each of the phases of the purchasing model can be supported by both CDSS facilities and Internet/Web facilities. The CDSS facilities support the specific decisions in the process. Generic EC technologies provide the necessary mechanisms, and they enhance communication and collaboration. Specific implementation of this framework is demonstrated throughout the text.

TABLE 5.4 Purchase Decision-Making Process and Support System

Decision Process Steps	Consumer Decision Support System Support Facilities	Generic Internet and Web Support Facilities
Need recognition ↓	Agents and event notification	Banner advertising on order Web sites URL on physical material Discussions in newsgroups
Information search (what, from whom?) ↓	Virtual catalogs Structured interaction and question/answer sessions Links to (and guidance on) external sources	Web directories and classifiers Internal search on Web site External search engines Focused directories and information brokers
Evaluation, negotiation, selection ↓	FAQs and other summaries Samples and trials Provisions of evaluative models Pointers to (and information) existing customers	Discussion in newsgroups Cross-site comparisons Generic models
Purchase, payment, and delivery ↓	Product or service ordering Arrangement of delivery	Electronic cash and virtual banking Logistics providers and package tracking
After-purchase service and evaluation	Customer support via e-mail and newsgroups E-mail communication	Discussion in newsgroups

Source: Modified from O'Keefe, R. M., and T. McEachern, "Web-Based Customer Decision Support System." *Communications of the ACM*, March 1998 ACM, Inc. Used with permission.

How Market Research Finds What Customers Want

There are basically two ways to find out what customers want. The first is to ask them, and the second is to infer what they want by observing what they do in cyberspace.

ASKING CUSTOMERS WHAT THEY WANT. The Internet provides easy, fast, and relatively inexpensive ways for vendors to find out what customers want by interacting directly with them. The simplest way is to ask potential customers to fill in electronic questionnaires. To do so, vendors may need to provide some inducements. For example, in order to play a free electronic game or participate in a sweepstakes, you are asked to fill in an online form and answer some questions about yourself (e.g., see *bizrate.com*). Marketers not only learn what you want from the direct answers, but also try to infer from your preferences of music, for example, what type of books, clothes, or movies you may be likely to prefer.

In some cases, asking customers what they want may not be feasible. Also, customers may refuse to answer questionnaires, or they may provide false information (as is done in about 40 percent of the cases, according to studies done at Georgia Tech University). Also, questionnaires can be lengthy and costly to administer. Therefore, a different approach may be needed—observing what customers do in cyberspace.

TRACKING CUSTOMER ACTIVITIES ON THE WEB. Today it is possible to learn about customers by observing their *behavior* on the Internet. Many companies offer site-tracking services, based on cookies, Web bugs, or spyware programs. For example, Nettracker (from *sane.com*) collects data from client/server logs and provides periodic reports that include demographic data such as where customers come from or how many customers have gone straight from the home page to ordering.

The Web is an incredibly rich source of business intelligence, and many enterprises are scrambling to build data warehouses that capture the knowledge contained in the *clickstream data* (data recovered from customers' "clicks" as they move around online) obtained from their Web sites. By analyzing the user behavior patterns contained in these clickstream data warehouses (see Sweiger et al., 2002), savvy businesses can expand their markets, improve customer relationships, reduce costs, streamline operations, strengthen their Web sites, and plot their business strategies.

Using Software Agents to Enhance B2C and Market Research

As discussed in Chapter 12, software agents are computer programs that conduct routine tasks, search and retrieve information, support decision making, and act as domain experts. These agents sense the environment and act autonomously without human intervention. This results in a significant savings of users' time. There are various types of agents, that can be used in EC ranging from *software agents*, which are those with no intelligence, to *learning agents* that exhibit some intelligent behavior.

Agents are used to support many tasks in EC. But first, it will be beneficial to distinguish between search engines and the more intelligent type of agents. As discussed in Chapter 4, a *search engine* is a computer program that can automatically contact other network resources on the Internet, search for specific information or key words, and report the results. Unlike search engines, an **intelligent agent** uses expert, or knowledge-based, capabilities to do more than just "search

and match.” For example, it can monitor movements on a Web site to check whether a customer seems lost or ventures into areas that may not fit his profile, and the agent can then notify the customer and even provide corrective assistance. Depending on their level of intelligence, agents can do many other things. In this section we will concentrate on intelligent agents for assisting shoppers (see Yuan, 2003). (For other uses of intelligent agents, see Chapter 12.)

BRAND- AND VENDOR-FINDING AGENTS AND PRICE COMPARISONS. Once the consumer has decided what to buy, a type of intelligent agent called a *comparison agent* will help in doing comparisons, usually of prices, from different vendors. A pioneering price-comparison agent was Bargainfinder from Andersen Consulting. This agent was used only in online shopping for CDs. It queried the price of a specific CD from a number of online vendors and returned the list of vendors and prices. Today much more sophisticated agents, such as Mysimon.com, Pricescan.com and Dealttime.com, make comparisons. Some of these look at multiple criteria, not just price, and even let you prioritize the criteria. Then, the agent makes a recommendation based on your stated preferences.

SEARCH AGENTS. Search agents, another type of intelligent agents, can help customers determine what to buy to satisfy a specific need (e.g., Likemind.com, Gifts.com). This is achieved by looking for specific product information and critically evaluating it. The search agent helps consumers decide what product best fits their profile and requirements (e.g., see *salesmountain.com*).

COLLABORATIVE FILTERING AGENTS. Once a company knows a consumer’s preferences (e.g., what music they like), it would be useful if the company could predict, without asking, what other products or services this consumer might enjoy. One way to do this is through use of **collaborative filtering agents**, which use customer data to *infer* customer interest in other products or services. There are several methods and formulas, all using software agents, to execute collaborative filtering. Some collaborative filtering agents based predictions on statistical formulas derived from behavioral sciences (see sins.berkeley.edu/resources.collab/ for details). Some based their predictions on what is known about other customers with similar profiles. (For details of the different methods and formulas, see Ridell et al., 2002.) One of the pioneering filtering agents was Firefly (now embedded in Microsoft’s Passport System).

OTHER AGENTS. Many other software agents can aid buyers and sellers in e-commerce. Examples are: *UPS.com* for optimizing deliveries, *e-Falcon.com* for fraud detection, and *webassured.com* for increasing trust levels. Other agents are described throughout the book.

The information collected by market research is used for customer relationship management (CRM), described in Chapter 7, and for advertising, the topics we discuss next.

Advertising Online

Advertisement is an attempt to disseminate information in order to influence a buyer–seller transaction. Traditional advertising on TV or newspapers is impersonal, one-way mass communication. Direct-response marketing (telemarketing) contacts individuals by means of direct mail or by telephone calls and requires them to respond in order to make a purchase. The direct-response

approach personalizes advertising and marketing, but it can be expensive, slow, and ineffective (and from the consumer's point of view, annoying).

Internet advertising redefines the advertising process, making it media-rich, dynamic, and interactive. It improves on traditional forms of advertising in a number of ways: Internet ads can be updated any time at minimal cost, and therefore can always be timely. Internet ads can reach very large number of potential buyers all over the world and they are sometimes cheaper in comparison to print (newspaper and magazine), radio, or television ads. Ads in these other media are expensive because they are determined by space occupied (print ads), by how many days (times) they are run, and on the number of local and national stations and print media that run them. Internet ads can be interactive and targeted to specific interest groups and/or to individuals. Finally, the use of the Internet itself is growing very rapidly, and it makes sense to move advertisement to the Internet, where the number of viewers is growing.

Nevertheless, the Internet as an advertising medium does have some shortcomings, most of which relate to the difficulty in measuring the effectiveness and justifying the ads. For example, it is difficult to measure the actual results of placing a banner ad, or an e-mail and the audience is still relatively small (compared to television, for example). For a comparison of advertising media, see Online File W5.3.



ADVERTISING METHODS. The most common advertising methods online are banners, pop-ups, and e-mails. The essentials of these and some other methods are briefly presented next.

Banners. **Banners** are, simply, electronic billboards, and banner advertising is the most commonly used form of advertising on the Internet. Typically, a banner contains a short text or graphical message to promote a product or a vendor. It may even contain video clips and sound. When customers click on a banner, they are transferred to the advertiser's home page. Advertisers go to great lengths to design banners that catch consumers' attention.

There are two types of banners: **Keyword banners** appear when a predetermined word is queried from a search engine. It is effective for companies who want to narrow their target to consumers interested in particular topics. **Random banners** appear randomly and might be used to introduce new products to the widest possible audience, or for brand recognition.

A major advantage of using banners is the ability to customize them to the target audience. Keyword banners can be customized to a market segment or even to an individual user. If the computer system knows who you are or what your profile is, you may be sent a banner that is supposed to match your interests. However, one of the major drawbacks of using banners is that limited information is allowed due to its small size. Hence advertisers need to think of creative but short messages to attract viewers. Another drawback is that banners, which were a novelty in late 1990s and so were noticed by viewers, are ignored by many viewers today. A new generation of banner-like ads are the pop-ups.

Pop-Up, Pop-Under, and Similar Ads. One of the most annoying phenomena in Web surfing is the increased use of pop-up, pop-under, and similar ads. These ads are contained in a new browser window that is automatically launched when one enters or exits a site, or by other triggers such as a delay during Internet surfing. A **pop-up ad** appears in front of the current browser window. A **pop-under ad** appears underneath the active window, and when



users close the active window, they see the ad. Pop-ups and pop-unders are sometime difficult to close. These methods are controversial: Many users strongly object to these ads, which they consider intrusive.

For further discussion, see Martin and Ryan, 2002, and Online File W5.4.

E-Mail Advertising. E-mail is emerging as an Internet advertising and marketing channel that affords cost-effective implementation and a better and quicker response rate than other advertising channels (such as print ads). Marketers develop or purchase a list of e-mail addresses, place them in a customer database, and then send advertisements via e-mail. A list of e-mail addresses can be a very powerful tool because the marketer can target a group of people, or even individuals. For example, Restaurant.com (see Minicase 2) use e-mail to send restaurant coupons to millions of customers. However, as with pop ups, there is a potential for misuse of e-mail advertising, and some consumers are receiving a flood of unsolicited mail (see the section on unsolicited advertising, below).

Electronic Catalogs and Brochures. Printed catalogs have been an advertising medium for a long time. Recently electronic catalogs have been gaining popularity. The merchant's objective in using online catalogs is to advertise and promote products and services. From the customer's perspective, online catalogs offer a source of information that can be searched quickly with the help of special search engines. Also, comparisons involving catalog products can be made very effectively.

Sometimes merchants find it useful to provide a *customized catalog* to a regular customer. Such a catalog is assembled specifically for the particular buyer, usually a company but sometimes even an individual who buys frequently or in large quantities.

Other Forms of Internet Advertising. Online advertising can be done in several other forms, including posting advertising in chat rooms (newsgroups) and in classified ads (see *classifieds 2000.com*). Advertising on Internet radio is just beginning, and soon advertising on Internet television will commence. Of special interest is advertising to members of Internet communities. Community sites (such as *geocities.com*) are gathering places for people of similar interests and are therefore a logical place to promote products related to those interests. Another interesting method is wireless ads, which we will describe in Chapter 6.

SOME ADVERTISING ISSUES AND APPROACHES. There are many issues related to the implementation of Internet advertising: how to design ads for the Internet, where and when to advertise, and how to integrate online and off-line ads. Most of such decisions require the input of marketing and advertising experts. Here, we present the following illustrative issues.

Unsolicited Advertising: Spamming and More. A major issue related to pop ups and e-mail advertising is *spamming*, the practice of indiscriminate distribution of electronic ads without permission of the receiver. E-mail spamming, also known as *unsolicited commercial e-mail* or *UCE*, has been part of the Internet for years. Unfortunately, the situation is getting worse with time. The drivers of spamming and some of potential solutions are described in Online File W5.5.

Permission Marketing. Permission marketing is one answer to e-mail spamming. **Permission marketing** asks consumers to give their permission to voluntarily accept advertising and e-mail. Typically, consumers are asked to complete a form that asks what they are interested in and requests permission to send related marketing information. Sometimes consumers are offered incentives



to receive advertising; at the least, marketers try to send information in an entertaining, educational, or other interesting manner.

Permission marketing is the basis of many Internet marketing strategies. For example, millions of users receive e-mails periodically from airlines such as American and Southwest. Users of this marketing service can ask for notification of low fares from their home town or to their favorite destinations. Users can easily unsubscribe at any time. Permission marketing is also extremely important for market research (e.g., see *mediamatrix.com*).

In one particularly interesting form of permission marketing, companies such as Clickdough.com, Getpaid4.com, and CashSurfers.com built customer lists of millions of people who are happy to receive advertising messages whenever they are on the Web. These customers are paid \$0.25 to \$0.50 an hour to view messages while they do their normal surfing. They may also be paid \$0.10 an hour for the surfing time of any friends they refer to the above sites.

Viral Marketing. **Viral marketing** refers to online word-of-mouth marketing. The main idea in viral marketing is to have people forward messages to friends, asking them, for example, to “check this out.” A marketer can distribute a small game program, for example, which comes embedded with a sponsor’s e-mail, that is easy to forward. By releasing a few thousand copies, vendors hope to reach many more thousands. Word-of-mouth marketing has been used for generations, but its speed and reach are multiplied many-fold by the Internet. Viral marketing is one of the new models being used to build brand awareness at a minimal cost (e.g., see *alladvantage.com*). It has long been a favorite strategy of online advertisers pushing youth-oriented products.

Unfortunately, though, several e-mail hoaxes have spread via viral marketing. Also, a more serious danger of viral marketing is that a destructive computer virus can be added to an innocent advertisement, game, or message. However, when used properly, viral marketing can be both effective and efficient.

Interactive Advertising and Marketing. Conventional advertising is passive, targeted to mass audiences, and for that reason it may be ineffective. Therefore, all advertisers, whether online or not, attempt to customize their ads to special groups and, if possible, even to individuals. A good salesperson is trained to interact with sales prospects, asking questions about the features they are looking for and handling possible objections as they come up. Online advertising comes closer to supporting this one-to-one selling process than more traditional advertising media possibly can.

Ideally, in interactive marketing, advertisers present customized, one-on-one ads. The term *interactive* points to the ability to address an individual, to gather and remember that person’s responses, and to serve that customer based on his or her previous, unique responses. When the Internet is combined with databases marketing, interactive marketing becomes a very effective and affordable competitive strategy.

Online Promotions: Attracting Visitors to a Site. A Web site without visitors has little value. The following are two examples of ways to attract visitors to a Web site.

- **Making the top list of a search engine.** Web sites submit their URLs to search engines. The search engine’s intelligent program (called a *spider*) crawls through the submitted site, indexing all related content and links. Some lists generated by search engines includes hundreds or thousands of items. Users

that view the results submitted by a search engine typically start by clicking on the first 10 or so items, and soon get tired. So, for best exposure, advertisers like to make the top 10 of the list. How to do it? If it understands how a search engine's program ranks its findings, a company can get to the top of a search engine's list merely by adding, removing, or changing a few sentences on its Web pages. However, this is not easy, as everyone wants to do it, so there are sometimes several thousand entries competing to be in the top 10. It is easier to pay the search engine to put a banner at the top of the lists (e.g., usually on the right-hand side of the screen at *google.com*'s results).

- **Online events, promotions, and attractions.** People generally like the idea of something funny or something free, or both. Contests, quizzes, coupons, and free samples are an integral part of e-commerce as much as, or even more than, they are in off-line commerce. Running promotions on the Internet is similar to running offline promotions. These mechanisms are designed to attract visitors and to keep their attention. For innovative ideas for promotions and attractions used by companies online, see Sterne, 2001 and Strauss et al., 2003.

5.5 B2B APPLICATIONS

In *business to business (B2B) applications*, the buyers, sellers, and transactions involve only organizations. Business-to-business comprises about 85 percent of EC volume. It covers a broad spectrum of applications that enable an enterprise to form electronic relationships with its distributors, resellers, suppliers, customers, and other partners. By using B2B, organizations can restructure their supply chains and partner relationship (e.g., see Warkentin, 2001).

There are several business models for B2B applications. The major ones are sell-side marketplaces, buy-side marketplaces, and electronic exchanges.

Sell-Side Marketplaces

In the **sell-side marketplace** model, organizations attempt to sell their products or services to other organizations electronically, from their own private e-marketplace and/or from a third-party site. This model is similar to the B2C model in which the buyer is expected to come to the seller's site, view catalogs, and place an order. In the B2B sell-side marketplace, however, the buyer is an organization.

The key mechanisms in the sell-side model are: (1) electronic catalogs that can be customized for each large buyer and (2) forward auctions. Sellers such as Dell Computer (*dellauction.com*) use this method extensively. In addition to auctions from their Web sites, organizations can use third-party auction sites, such as eBay, to liquidate items. Companies such as Freemarkets.com are helping organizations to auction obsolete and old assets and inventories (see Minicase 1).

The sell-side model is used by thousands of companies and is especially powerful for companies with superb reputations. Examples are major computer companies such as Cisco, IBM, and Intel. The seller in this model can be either a manufacturer, a distributor (e.g., *bigboxx.com* and *avnet.com*), or a retailer. In this model, EC is used to increase sales, reduce selling and advertising expenditures, increase delivery speed, and reduce administrative costs. This model is especially suitable to customization. For example, customers can configure their orders online at *cisco.com*, *dell.com*, and others. This results in fewer misunderstandings about what customers want and in much faster order fulfillment.

Buy-Side Marketplaces

The **buy-side marketplace** is a model in which organizations attempt to buy needed products or services from other organizations electronically, usually from their own private e-marketplace. A major method of buying goods and services in the buy-side model is a reverse auction. Here, a company that wants to buy items places a *request for quotation (RFQ)* on its Web site, or in a third-party bidding marketplace. Once RFQs are posted, sellers (usually preapproved suppliers) submit bids electronically. Such auctions attract large pools of willing sellers, who can be either a manufacturer, a distributor, or a retailer. The bids are routed via the buyer's intranet to the engineering and finance departments for evaluation. Clarifications are made via e-mail, and the winner is notified electronically.

The buy-side model uses EC technology to streamline the purchasing process in order to reduce the cost of items purchased, the administrative cost of procurement, and the purchasing cycle time. General Electric, for example, has calculated that it saves 10 to 15 percent on the cost of the items placed for bid and up to 85 percent on the administrative cost of procurement (Turban et al., 2004); in addition, cycle time is reduced by about 50 percent. Procurements using a third-party buy-side marketplace model are especially popular for medium and small organizations.

E-PROCUREMENT. Purchasing by using electronic support is referred to as **e-procurement**. In addition to *reverse auctions* just discussed, e-procurement uses other mechanism. Two popular ones are group purchasing and desktop purchasing.

Group purchasing. In **group purchasing**, the requirements of many buyers are aggregated so that they total to a large volume, and may merit more seller attention. Once buyers' orders are aggregated, they can be placed on a reverse auction, and a volume discount can be negotiated. The orders of small buyers usually are aggregated by a third-party vendor, such as Consarta.com and Shop2gether.com. Group purchasing is especially popular in the health care industry (see *all-health.com*).

Desktop purchasing. In this variation of e-procurement, known as **desktop purchasing**, suppliers' catalogs are aggregated into an internal master catalog on the buyer's server, so that the company's purchasing agents (or even end users) can shop more conveniently. Desktop purchasing is most suitable for *maintenance, replacement, and operations (MRO) indirect items*, such as office supplies. (The term *indirect* refers to the fact that these items are not inputs to manufacturing.) In the desktop purchasing model, a company has many suppliers, but the quantities purchased from each are relatively small. This model is most appropriate for large companies (such as Schlumberger, as described in *IT at Work* 5.3) and for government entities.

Electronic Exchanges

E-marketplaces in which there are many sellers and many buyers are called **public exchanges** (in short, **exchanges**). They are open to all, and frequently are owned and operated by a third party. According to Kaplan and Sawhney, 2000, there are basically four types of exchanges:

1. **Vertical distributors for direct materials.** These are B2B marketplaces where *direct materials* (materials that are inputs to manufacturing) are traded in an environment of long-term relationship, known as *systematic sourcing*.



IT At Work 5.3

E-PROCUREMENT AT SCHLUMBERGER



Schlumberger is an \$8.5 billion company with 60,000 employees in 100 countries. That makes it the world's largest oil-service company. In 2000 the company installed a Web-based automated procurement system in Oilfield Services, its largest division. With this system, employees can buy office supplies and equipment as well as computers direct from their desktops.

The system replaced a number of older systems, including automated and paper-based ones. The single desktop system streamlined and sped up the purchasing operation, reducing costs, as well as the number of people involved in the process. The system also enables the company to consolidate purchases for volume discounts from vendors.

The system has two parts:

1. The internal portion uses CommerceOne's BuySite procurement software and runs on the company's intranet. Using it is like shopping at an online store: Once the employee selects the item, the system generates the requisition, routes it electronically to the proper people for approval, and turns it into a purchase order.
2. CommerceOne's MarketSite transmits the purchase orders to the suppliers. This B2B Internet marketplace connects Schlumberger with hundreds of suppliers with a single, low-cost, many-to-many system.

Negotiation of prices is accomplished with individual vendors. For example, Office Depot's entire catalog is

posted on the MarketSite, but the Schlumberger employees see only the subset of previously negotiated products and prices. (In the future, the company plans to negotiate prices in real time through auctions and other bidding systems.)

The benefits of the system are evident in both cost and processes. The cost of goods has been reduced, as have the transaction costs. Employees spend much less time in the ordering process, giving them more time for their true work. The system is also much more cost efficient for the suppliers, who can then pass along savings to customers. By using one system worldwide, Schlumberger saves time for employees who are transferred—they don't spend time learning a new system wherever they go. Procurement effectiveness can be increased because tracing the overall procurement activity is now possible.

Getting the system up and running was implemented in stages and ran at the same time as existing systems. There were no implementation issues for employees (once the system was in place, the old system was disabled), and there were no complaints in regard to the old system being shut down (no one was using the old system anymore).

For Further Exploration: What are the benefits of the e-procurement system to Schlumberger? How does it empower the buyers? Why would real-time price negotiations be beneficial?

Sources: Compiled from Ovans (2000) and *commerceone.com* (1999 and 2003).

Examples are Plasticsnet.com and Papersite.com. Both fixed and negotiated prices are common in this type of exchange

2. **Vertical exchanges for indirect materials.** Here indirect materials in one industry are purchased on an "as-needed" basis (called *spot sourcing*). Buyers and sellers may not even know each other. ChemConnect.com and Isteelasia.com are examples. In such vertical exchanges, prices are continually changing, based on the matching of supply and demand. Auctions are typically used in this kind of B2B marketplace, sometimes done in private trading rooms, which are available in exchanges like ChemConnect.com (see *IT At Work 5.4*).
3. **Horizontal distributors.** These are "many-to-many" e-marketplaces for indirect (MRO) materials, such as office supplies, used by any industry. Prices are fixed or negotiated in this systematic sourcing-type exchange. Examples are EcEurope.com, Globalsources.com, and Alibaba.com.
4. **Functional exchanges.** Here, needed services such as temporary help or extra space are traded on an "as-needed" basis (spot sourcing). For example,



IT At Work 5.4

CHEMICAL COMPANIES “BOND” AT CHEMCONNECT



Buyers and sellers of chemical and plastics today can meet electronically in a large vertical exchange called ChemConnect (*chemconnect.com*). Using this exchange, global industry leaders such as British Petroleum, Dow Chemical, BASF, Hyundai, Sumitomo, and many more can reduce trading cycle time and cost and can find new markets and trading partners around the globe.

ChemConnect provides a public trading marketplace and an information portal to more than 9,000 members in 150 countries. In 2003, over 60,000 products were traded in this public, third-party-managed e-marketplace.

Chemconnect provides three marketplaces (as of April 21, 2003): a commodity markets platform, a marketplace for sellers, and a marketplace for buyers.

1. The commodity markets platform is a place where pre-qualified producers, customers, consumers, distributors, and others come together in real time to sell and buy chemical-related commodities like natural gas liquids, oxygenates, olefins, and polymers. They can even simultaneously execute multiple deals. Transactions are done through regional trading hubs.
2. The marketplace for sellers has many tools ranging from electronic catalogs to forward auctions. It enables companies to find buyers all over the world. ChemConnect provides all the necessary tools to expedite selling and achieving the best prices. It also allows for negotiations.
3. The marketplace for buyers is a place where thousands of buyers shop for chemical-related indirect materials

(and a few direct materials). The market provides for automated request for proposal (RFP) tools as well as a complete online reverse auction. The sellers' market is connected to the buyers' market, so that sellers can connect to the RFPs posted on the marketplace for buyers. (Note that RFP and RFQ are interchangeable terms; RFP is used more in government bidding.)

For the three marketplaces, ChemConnect provides logistics and payment options as well as connectivity solutions (such as integration connection with ERPs). Also, market information is provided as well as a network of industry experts and contact with third-party service providers and other business partners.

In all of its trading mechanisms, up-to-the-minute market information is available and can be translated to 30 different languages. Members pay transaction fees only for successfully completed transactions. Business partners provide several support services, such as financial services for the market members. The marketplaces work with certain rules and guidelines that ensure an unbiased approach to the trades. There is full disclosure of all legal requirements, payments, trading rules, etc. (Click on “Legal info and privacy issues” at the ChemConnect Web site.) ChemConnect is growing rapidly, adding members and trading volume.

For Further Exploration: What are the advantages of the ChemConnect exchange? Why there are there three trading places? Why does the exchange provide information portal services?

Source: Compiled from *chemconnect.com* (accessed April 11, 2003).

Employease.com can find temporary labor using employers in its Employease Network. Prices are dynamic, and they vary depending on supply and demand.

All four types of exchanges offer diversified support services, ranging from payments to logistics. Vertical exchanges are frequently owned and managed by a group of big players in an industry (referred to as a *consortium*). For example, Marriott and Hyatt own a procurement consortium for the hotel industry, and Chevron Texaco owns an energy e-marketplace. The vertical e-marketplaces offer services particularly suited to the particular e-community they serve.

Since B2B activities involve many companies, specialized network infrastructure is needed. Such infrastructure works either as an Internet/EDI or as extranets (see Appendix 5.1 to this chapter). A related EC activity, usually done between and among organizations, is collaborative commerce (see Chapters 4 and 8).



5.6 INTRABUSINESS AND BUSINESS-TO-EMPLOYEES

E-commerce can be done not only between business partners, but also within organizations. Such activity is referred to as *intra-business* EC or in short, **intra-business**. Intra-business can be done between a business and its employees (B2E); among units within the business (usually done as c-commerce); and among employees in the same business.

Business to Its Employees (B2E) Commerce

Companies are finding many ways to do business electronically with their own employees. They disseminate information to employees over the intranet, for example. They also allow employees to manage their fringe benefits and take training classes electronically. In addition, employees can buy discounted insurance, travel packages, and tickets to events on the corporate intranet, and they can electronically order supplies and material needed for their work. Also, many companies have electronic corporate stores that sell a company's products to its employees, usually at a discount. Of the many types of employees that benefit from B2E we have chosen to focus on sales people in the field. Note that in the literature on B2E commerce, B2E includes all things employees need for work, not just for communication, compensation, and benefits; so productivity software, such as sales force automation, is considered part of B2E.

SALES FORCE AUTOMATION. *Sales force automation (SFA)* is a technique of using software to automate the business tasks of sales, including order processing, contact management, information sharing, inventory monitoring and control, order tracking, customer management, sales forecast analysis, and employee performance evaluation. Of special interest in the context of B2E e-commerce is the support provided to employees when they are in the field. Recently, SFA become interrelated with CRM, since the salespeople constitute the contact point with customers. IT can empower salespeople and other customer-facing employees to make quick decisions, when they are in the customer's office. Advancement in wireless technologies is creating opportunities for providing salespeople with new capabilities, such as shown in the case of PAVECA Corp. in *IT At Work 5.5*. Many other companies, ranging from Maybelline (see Mini-case in Chapter 2) to Kodak, have equipped their salesforces with similar mobile devices.

E-Commerce Between and Among Units Within the Business

Large corporations frequently consist of independent units, or *strategic business units (SBUs)*, which "sell" or "buy" materials, products, and services from each other. Transactions of this type can be easily automated and performed over the intranet. An SBU can be considered as either a seller or a buyer. An example would be company-owned dealerships, which buy goods from the main company. This type of EC helps in improving the internal supply chain operations.

E-Commerce Between and Among Corporate Employees

Many large organizations allow employees to post classified ads on the company intranet, through which employees can buy and sell products and services from each other. This service is especially popular in universities, where it has been conducted since even before the commercialization of the Internet. The Internet is used for other collaboration as well.



IT At Work 5.5

PAVECA OF VENEZUELA USES WIRELESS IN SALES FORCE AUTOMATION



PAVECA, Venezuela's largest paper goods manufacturer and exporter manufactures toilet paper, paper towels, tissues, and other paper products. The company enjoys a significant amount of market share, and seeking to maintain that, it chose to use some e-commerce technologies to cut operational costs and improve customer service at the same time.

PAVECA implemented a wireless systems that allows its sales reps to use their wireless PDAs to connect to the Internet while they are in the field. Via the Internet connection, the salespeople can log directly into the company intranet to get all the information they need in real time. Orders can then be entered into the system in real time.

The system revolves around two pieces of software from iWork Software (*iworksoftware.com*): an automatic data collection system, and a workflow integration solution. The combination allows sales people to automatically register sales transactions into the ERP system (Chapter 8) as they occur. Each salesperson has a PDA that connects them directly to the company's ERP system in real time. When an order is entered into the PDA, it goes into the ERP system and follows a pre-defined automated workflow. The savings produced by the new system as compared to the

ERP/manual system were dramatic. For example, order processing time was reduced by 90 percent, order approval time by 86 percent, shipment time by 50 percent, and the time between orders taken and order posting was reduced from three days to 20 seconds. The faster order processing time not only led to faster order approval but also increased the number of daily shipments out of their warehouse.

While the main goal was to improve workflow, there's another potential benefit here: better customer service. Because of the direct links and integration, customers can get their orders faster, and there's less chance of errors occurring. Customers are happier and more loyal, and so indirectly, the company's profit increases because customers are more likely to place additional orders in the future. Finally, the transmitted data enter directly into the corporate DSS models, enabling quick decisions in response to the field reports filed by the salespeople.

For Further Exploration: What are the benefits of PAVECA's new system? What segments of the supply chain are supported? What are the advantages of using wireless systems?

Sources: Compiled from Paperloop Inc., 2002.

5.7 E-GOVERNMENT AND CONSUMER-TO-CONSUMER EC

E-Government As e-commerce matures and its tools and applications improve, greater attention is being given to its use to improve the business of public institutions and governments (country, state, county, city, etc). **E-government** is the use of Internet technology in general and e-commerce in particular to deliver information and public services to citizens, business partners and suppliers, and those working in the public sector. It is also an efficient way of conducting business transactions with citizens and businesses and within the governments themselves.

E-government offers a number of potential benefits: It improves the efficiency and effectiveness of the functions of government, including the delivery of public services. It enables governments to be more transparent to citizens and businesses by giving access to more of the information generated by government. E-government also offers greater opportunities for citizens to provide feedback to government agencies and to participate in democratic institutions and processes. As a result, e-government may facilitate fundamental changes in the relationships between citizens and governments.

E-government applications can be divided into three major categories: *government-to-citizens (G2C)*, *government-to-business (G2B)*, and *government-to-government (G2G)*. In the first category, government agencies are increasingly using the



IT At Work 5.6

E-GOVERNMENT IN WESTERN AUSTRALIA



The focus of the Western Australian (WA) government agency Contract and Management Services (CAMS) is to develop online contract management solutions for the public sector. CAMS Online allows government agencies to search existing contracts to discover how to access the contracts that are in common use by different government agencies (for example, lightbulbs or paper towels bought by various government units). It also enables suppliers wanting to sell to the government to view the current tenders (bids) on the Western Australia Government Contracting Information Bulletin Board, and download tender documents from that site.

CAMS Online also provides government departments and agencies with unbiased expert advice on e-commerce, Internet, and communication services, and how-to's on building a bridge between the technological needs of the public sector and the expertise of the private sector. The center also offers various types of support for government procurement activities.

WA's e-commerce activities include electronic markets for government buying. The *WA Government Electronic Market* provides online supplier catalogs, electronic purchase orders, and electronic invoicing, EFT, and check and credit card payments. The Victoria government and the new South

Wales government in Western Australia spent over \$500 million (U.S.) on e-procurement systems under the Government Electronic Market System (*ecc.online.wa.gov.au/news*, 19, September 2002).

Government-to-government e-commerce functions include *DataLink*, which enables the transfer of data using a secure and controlled environment. *DataLink* is an ideal solution for government agencies needing to exchange large volumes of operational information. Another G2G function is a videoconferencing service that offers two-way video and audio links, enabling government employees to meet together electronically from up to eight sites at any one time.

In addition to G2B functions, the G2G Web site also offers online training to citizens. A service called *Westlink* delivers adult training and educational programs to remote areas and schools, including rural and regional communities.

For Further Exploration: How is contract management facilitated by e-commerce tools? Describe the WA online training program? Why would government want to take on a role in promoting e-learning?

Source: business.wa.gov.au, February, 2001, *ecc.online.wa.gov.au/news* (June–November 2002).

Internet to provide various services to citizens. An example is **electronic benefits transfer (EBT)**, in which governments (usually state or national) transfer benefits, such as Social Security and pension benefits, directly to recipients' bank accounts or to smart cards. Governments also are using the Internet to sell to or buy from businesses. For example, electronic tendering systems using reverse auctions are becoming mandatory, in order to ensure the best price for government procurement of goods and services. Chen (2003) presents several specific e-government initiatives. For an example of one initiative in Australia, see *IT At Work 5.6*.

IMPLEMENTING E-GOVERNMENT. Like any other organization, government entities want to move into the digital era, becoming click-and-mortar organizations. However, the transformation from traditional delivery of government services to full implementation of online government services may be a lengthy process. The business consulting firm Deloitte and Touche conducted a study (see Wong, 2000) that identified six stages in the transformation to e-government:

Stage 1: Information publishing/dissemination.

Stage 2: "Official" two-way transactions, with one department at a time.

Stage 3: Multipurpose portals.

Stage 4: Portal personalization.

Stage 5: Clustering of common services.

Stage 6: Full integration and enterprise transformation.

The speed at which a government moves from stage 1 to stage 6 varies, but usually the transformation is very slow. Deloitte and Touche found that in 2000, most governments were still in stage 1 (Wong, 2000). The implementation issues that are involved in the transformation to e-government depend on which of the six stages of development a government is in, on the plan for moving to higher stages, and on the available funding. In addition, governments are concerned about maintaining the security and privacy of citizens' data, so time and effort must be spent to ensure that security. According to *emarketer.com* (October 2, 2002), the number of U.S. government Web sites with *security policies* increased from 5 percent in 2000 to 34 percent in 2002; the percentage of those with *privacy policies* increased from 7 percent in 2000 to 43 percent in 2002.

In general, implementation of G2B is easier than implementation of G2C. In some countries, such as Hong Kong, G2B implementation is outsourced to a private company that pays all of the start-up expenses in exchange for collecting future transaction fees. As G2B services have the potential for rapid cost savings, they can be a good way to begin an e-government EC initiative.

Customer-to-Customer E-Commerce

Customer-to-customer (C2C) e-commerce refers to e-commerce in which both the buyer and the seller are individuals (not businesses). C2C is conducted in several ways on the Internet, where the best-known C2C activities are auctions.

C2C AUCTIONS. Regardless where people are, in dozens of countries, selling and buying on auction sites is exploding. Most auctions are conducted by intermediaries, like eBay.com. Consumers can select general sites such as *eBay.com* or *auctionanything.com*, and they can use specialized sites such as *buyit.com* or *bid2bid.com*. In addition, many individuals are conducting their own auctions. For example, *greatshop.com* provides software to create C2C reverse auction communities online.

CLASSIFIED ADS. People sell to other people every day through classified ads in newspapers and magazines. Internet-based classified ads have one big advantage over these more traditional types of classified ads: They offer a national, rather than a local, audience. This wider audience greatly increases the supply of goods and services available and the number of potential buyers. For example, *infospace.com/info.cls2k* contains a list of 3 million job openings and about 500,000 cars, compared with the much, much smaller numbers you might find locally. Another example is *recycler.com*. Often, placing an ad on one Web site brings it automatically into the classified sections of numerous partners. This increases ad exposure, at no cost. In addition, Internet-based classifieds often can be edited or changed easily, and in many cases they display photos of the product offered for sale.



Like their counterparts in printed media, classified ad Web sites accept no responsibility for the content of any advertisement. Advertisers are identified by e-mail address. A password is used to authenticate the advertiser for future changes in an ad. Most classified ads are provided for free.

The major categories of classified ads are similar to those found in the newspaper: vehicles, real estate, employment, general merchandise, collectibles, computers, pets, tickets, and travel. Classified ads are available through most Internet service providers (AOL, MSN, etc.), at some portals (Yahoo, etc.), and from Internet directories, online newspapers, and more. To help narrow the search for a particular item on several sites, shoppers can use search engines. Once users find an ad and get the details, they can e-mail or call the other party for additional information or to make a purchase. Classified sites generate revenue from affiliate sites.

PERSONAL SERVICES. Numerous personal services are available on the Internet (lawyers, handy helpers, tax preparers, investment clubs, dating services). Some are in the classified ads, but others are listed in specialized Web sites and directories. Some are for free, some for a fee. *Be very careful before you purchase any personal services.* Fraud or crime could be involved. For example, a lawyer online may not be an expert in the area they profess, or may not deliver the service at all.

SUPPORT SERVICES TO C2C. When individuals buy products or services from individuals, they usually buy from strangers. The issues of ensuring quality, receiving payments, and preventing fraud are critical to the success of C2C. One service that helps C2C is payments by companies such as Paypal.com (see Section 5.8). Another one is *escrow services*, intermediaries that take the buyer's money and the purchased goods, and only after making sure that the seller delivers what was agreed upon, deliver the goods to the buyer and the money to the seller (for a fee).

5.8 E-COMMERCE SUPPORT SERVICES

The implementation of EC may require several support services. B2B and B2C applications require payments and order fulfillment. Portals require content, etc. Figure 5.4 portrays the collection of the major EC services. They include: e-infrastructure (mostly technology consultants, system developers and integrators, hosting, security, and networks), e-process (mainly payments and logistics), e-markets (mostly marketing and advertising) e-communities (different audiences and business partners), e-services (CRM, PRM, and directory services), and e-content (supplied by content providers). All of these services support the EC applications in the center of the figure, and all of the services need to be managed.

Here we will discuss only two of the above topics—payments and order fulfillment. For details on the other services, see Turban et al., 2004.

Electronic Payments

Payments are an integral part of doing business, whether in the traditional way or online. Unfortunately, in most cases traditional payment systems are not effective for EC, especially for B2B.

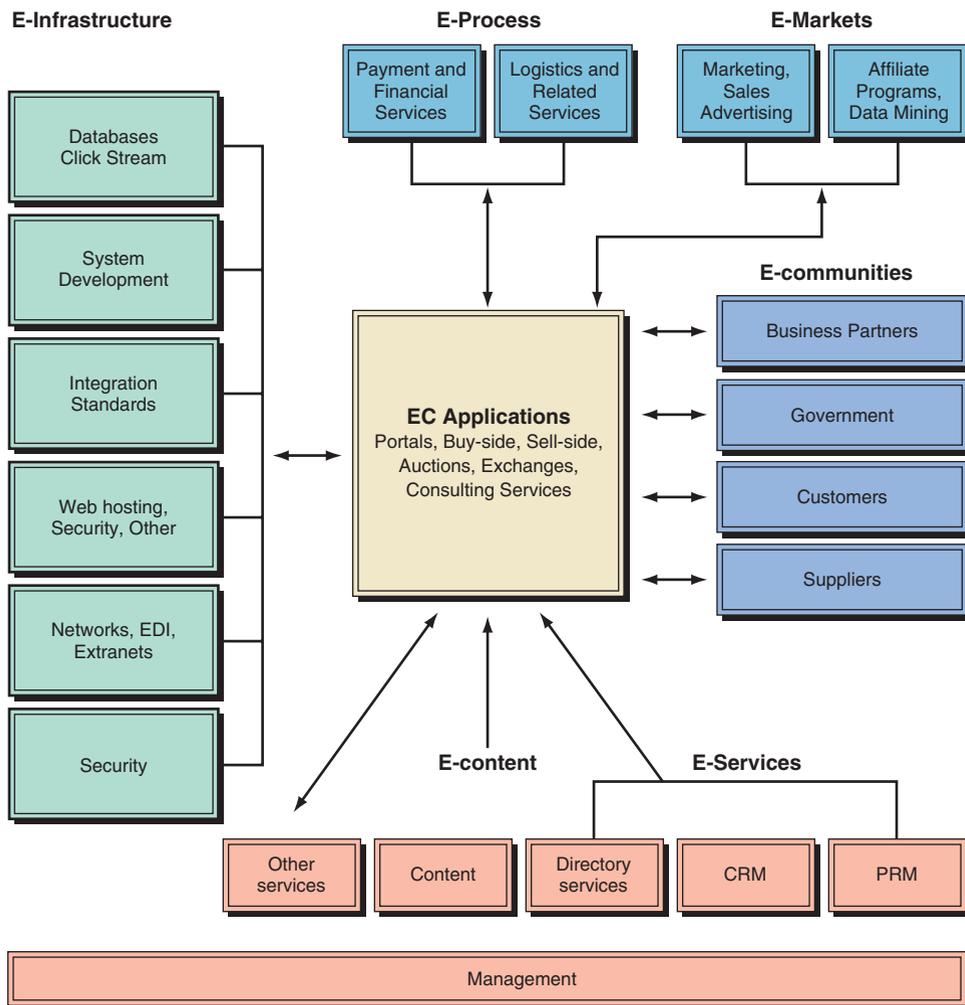


FIGURE 5.4 E-Commerce Services. (Sources: Modified from Choi, 1997, p.18.)

LIMITATIONS OF TRADITIONAL PAYMENT INSTRUMENTS. Non-electronic payments methods such as using cash, writing a check, sending a money order, or giving your credit card number over the telephone, have several limitations in EC. First, cash cannot be used because there is no face-to-face contact. Second, if payment is sent by mail, it takes time for it to be received. Even if a credit card number is provided by phone or fax, it takes time to process it. Nor is it convenient to have to switch from the computer to the phone to complete a transaction, especially if the same telephone line is used. Also, not everyone accepts credit cards or checks, and some buyers do not have credit cards or checking accounts. Finally, contrary to what many people believe, it may be less secure for the buyer to use the telephone or mail to arrange or send payment, especially from another country, than to complete a secured transaction on a computer.

Another issue is that many EC transactions are valued at only a few dollars or even cents. The cost of processing such **micropayments** needs to be very low; you would not want to pay \$5 to process a purchase valued at only a few dollars. The cost of making micropayments off-line is just too high.

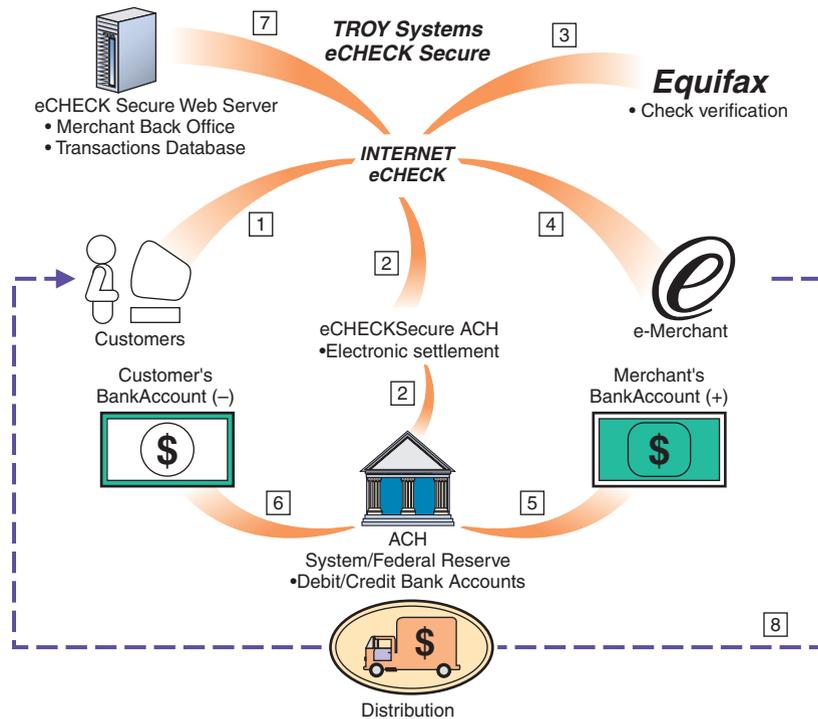


FIGURE 5.5 eSecure Check

For all of these reasons, a better way is needed to pay for goods and services in cyberspace. This better way is *electronic payment systems*.

ELECTRONIC PAYMENT SYSTEMS. As in the traditional marketplace, so too in cyberspace, diversity of payment methods allows customers to choose how they wish to pay. The following instruments are acceptable means of electronic payment: electronic checks, electronic credit cards, purchasing cards, electronic cash, stored-value cards, smart cards, and person-to-person payments. In addition we discuss electronic bill presentment and/or payment, both online and from ATMs. Here we will look at each of these payment mechanisms. In Chapter 15 and in Online File W5.6 we consider how to make them secure.

Electronic checks. **Electronic checks (e-checks)** are similar to regular checks. They are used mostly in B2B (see Reda, 2002). Here is how they work: First, the customer establishes a checking account with a bank. Next, the customer contacts a seller, buys a product or a service, and e-mails an encrypted electronic check to the seller. The seller deposits the check in a bank account, and funds are transferred from the buyer's account and into the seller's account.

Like regular checks, e-checks carry a signature (in digital form) that can be verified (see *echeck.net*). Properly signed and endorsed e-checks are exchanged between financial institutions through electronic clearinghouses (see Echo, 2002, and *echo.org* for details). For the process of how e-checks work as done by eCheck Secure (*echecksecure.com*), see Figure 5.5.

Electronic credit cards. *Electronic credit cards* make it possible to charge online payments to one's credit card account. It is easy and simple for a buyer to e-mail his or her credit card number to the seller. The risk here is that if the



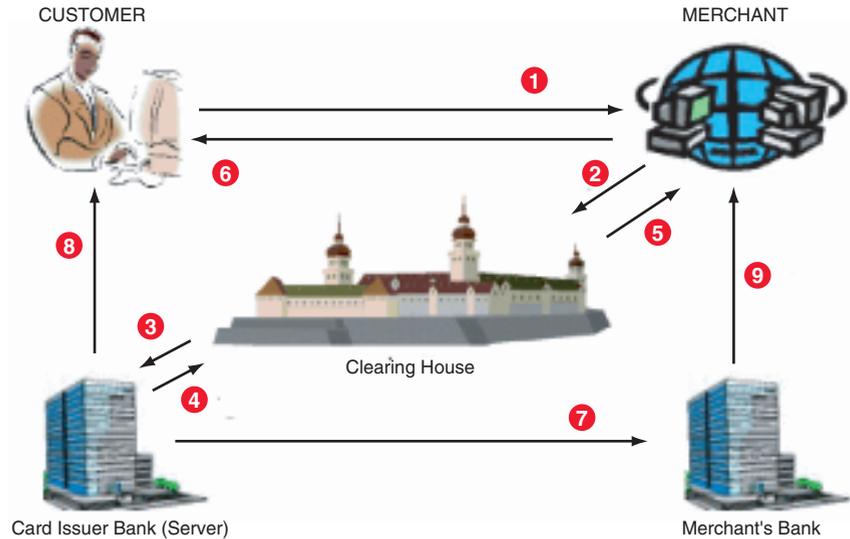


FIGURE 5.6 How e-Credit Cards Work

1 Customer places order (encrypting credit card number). 2 Merchant's server contacts clearing house's server for authorization, 3 clearing house checks balance with card issuer, 4 get an answer and debit to customer 5, Merchant gets credit notice 6 customer notified (yes, or no) 7 money is transferred to Merchant's bank, 8 customer gets debit notice in monthly statement 9 Merchant get a credit line in monthly statement.



card number is not encrypted, then hackers will be able to read it and may use it illegally. Sender authentication is also difficult. (New technologies will solve this problem in 2 to 3 years, however.) Therefore, for security, only encrypted credit cards should be used. (Credit card details can be encrypted by using the SSL protocol in the buyer's computer, which is available in standard browsers. This process is described in Online File W5.6.)

Here is how electronic credit cards works: When you buy a book from Amazon, your credit card information and purchase amount are encrypted in your browser. So the information is safe while "travelling" on the Internet. Furthermore, when this information arrives at Amazon, it is not opened but is transferred automatically (in encrypted form) to a clearinghouse, where the information is decrypted for verification and for money transfer from the payer's account to the payee's bank account. The process is illustrated in Figure 5.6. Electronic credit cards are used mainly in B2C and in shopping by SMEs (small to medium enterprises).

Purchasing Cards. The B2B equivalent of electronic credit cards is *purchasing cards*. In some countries companies pay other companies primarily by means of purchasing cards, rather than by traditional checks. Unlike credit cards, where credit is provided for 30 to 60 days (for free) before payment is made to the merchant, payments made with purchasing cards are settled within a week.

Purchasing cards typically are used for unplanned B2B purchases, and corporations generally limit the amount per purchase (usually \$1,000 to \$2,000). Purchasing cards can be used on the Internet much like regular credit cards. They expedite the process of unplanned purchases, usually as part of *desktop purchasing* described earlier. (For details see Segev and Gebauer, 2001).

Electronic Cash. Cash is the most prevalent consumer payment instrument. Traditional brick-and-mortar merchants prefer cash since they do not have to pay commissions to credit card companies, and they can put the money to use

as soon as it is received. Also, some buyers pay with cash because they do not have checks or credit cards, or because they want to preserve their anonymity. It is logical, therefore, that EC sellers and some buyers may prefer electronic cash. **Electronic cash (e-cash)** appears in three major forms: stored-value cards, smart cards, and person-to-person payments.

Stored-Value Money Cards. A typical e-payment card is known as a **stored-value money card**. It is the one that you use to pay for photocopies in your library, for transportation, or for telephone calls. It allows a fixed amount of prepaid money to be stored on it. Each time you use the card, the amount is reduced. One successful example is used by the New York Metropolitan Transportation Authority (MTA), described in Chapter 1. Similar cards are used in many cities around the world. Some of these cards are reloadable, and some are discarded when the money is depleted. The transportation card Octopus in Hong Kong is used in trains, buses, and shopping in stores and from vending machines (for details see Poon and Chan, 2001).

Cards with stored-value money can be also purchased for Internet use. To use such cards, you enter a third-party Web site and provide an ID number and a password, much as you do when you use a prepaid phone card. The money can be used only in participating stores online.

Smart Cards. Although some people refer to stored-value money cards as smart cards, they are not really the same. True **smart cards** contain a microprocessor (chip), which enables them to store a considerable amount of information (more than 100 times that of a stored-value card) and conduct processing. Such cards are frequently *multipurpose*; they can be used as a credit card, debit card, or stored-value card. In addition, when used in department store chains (as a *loyalty card*), they may contain the purchasing information of shoppers.

Advanced smart cards have the ability to transfer funds, pay bills, buy from vending machines, or pay for services such as those offered on television or PCs (see Shelter and Procaccino, 2002). Money values can be loaded onto advanced smart cards at ATMs, kiosks, or from your PC. For example, the VISA Cash Card allows you to buy goods or services at participating gas stations, fast-food outlets, pay phones, discount stores, post offices, convenience stores, coffee shops, and even movie theaters. Smart cards are ideal for micropayments.

Smart cards can also be used to transfer benefits from companies to their employees, as when retirees get their pension payments, and from governments that pay citizens various entitlements. The money is transferred electronically to a smart card at an ATM, kiosk, or PC.

Person-to-Person Payments. **Person-to-person payments** are one of the newest and fastest-growing payment schemes. They enable the transfer of funds between two individuals, or between an individual and a business, for a variety of purposes like repaying money borrowed from a friend, sending money to students at college, paying for an item purchased at an online auction, or sending a gift to a family member.

One of the first companies to offer this service was PayPal (*paypal.com*). PayPal (now an eBay company) claimed (on its Web site, accessed January 6, 2003) to have had about 20 million customer accounts in 2003, handling more than 35 percent of all transactions of eBay and funneling \$8.5 billion in payments through its servers annually. Other companies offer similar services;

Citibank c2it (*c2it.com*), AOL QuickCash, One's Bank eMoneyMail, Yahoo Pay-Direct, and WebCertificate (*webcertificate.com*) are all PayPal competitors.

Virtually all of these person-to-person payment services work in a similar way. Assume you want to send money to someone over the Internet. First, you select a service and open up an account. Basically, this entails creating a user name, selecting a password, giving your e-mail address, and providing the service with a credit card or bank account number. Next, you add funds from your credit card or bank account to your account. Once the account has been funded you're ready to send money. You access PayPal (for example) with your user name and password. Now you specify the e-mail address of the person to receive the money, along with the dollar amount that you want to send. An e-mail is sent to the payee's e-mail address. The e-mail will contain a link back to the service's Web site. When the recipient clicks on the link, he or she will be taken to the service. The recipient will be asked to set up an account to which the money that was sent will be credited. The recipient can then credit the money from this account to either his or her credit card or bank account. The payer pays a small amount (around \$1) per transaction.

Electronic Bill Presentment and Payments. An increasing number of people prefer to pay online their recurring monthly bills, such as telephone, utilities, credit cards, and cable TV. The recipients of such payments are even more enthusiastic about such service than the payers, since online payments enable them to reduce processing costs significantly. The following are the major existing payments systems in common use: automatic payment of mortgages; automatic transfer of funds to pay monthly utility bills; paying bills from online banking account; merchant-to-customer direct billing; and use of an intermediary to aggregate bills into one payable Web site.

Paying Bills at ATMs. In some countries (e.g., Hong Kong, Singapore) customers can pay bills at regular ATMs. The bills are sent by regular mail or can be viewed online. When you receive the bills, you go to an ATM, slide in your bank card, enter a password and go to "bill payments" on the menu. All you need to do is insert the account number of the biller and the amount you want to pay; that amount will be charged to your bank card and sent to the biller. You get a printed receipt on the spot. In addition to utilities you can pay for purchases of products and services (e.g., for airline tickets). Merchants love it and many give a discount to those who use the service, since they do not have to pay 3 percent to Visa or MasterCard.

SECURITY IN ELECTRONIC PAYMENTS. Two main issues need to be considered under the topic of payment security: what is required in order to make EC payments safe, and the methods that can be used to do so.

Security Requirements. Security requirements for conducting EC are the following:

1. **Authentication.** The buyer, the seller, and the paying institutions must be assured of the identity of the parties with whom they are dealing.
2. **Integrity.** It is necessary to ensure that data and information transmitted in EC, such as orders, reply to queries, and payment authorization, are not accidentally or maliciously altered or destroyed during transmission.

3. **Nonrepudiation.** Merchants need protection against the customer's unjustified denial of placing an order. On the other hand, customers need protection against merchants' unjustified denial of payments made. (Such denials, of both types, are called *repudiation*.)
4. **Privacy.** Many customers want their identity to be secured. They want to make sure others do not know what they buy. Some prefer complete anonymity, as is possible with cash payments.
5. **Safety.** Customers want to be sure that it is safe to provide a credit card number on the Internet. They also want protection against fraud by sellers or by criminals posing as sellers.

Security Protection. Several methods and mechanisms can be used to fulfill the above requirements. One of the primary mechanisms is encryption, which is often part of the most useful security schemes. For a coverage of security protection see Online Text Section W5.6 and Chapter 15. Other representative methods are discussed below.

E-Wallets. **E-wallets** (or **digital wallets**) are mechanisms that provide security measures to EC purchasing. The wallet stores the financial information of the buyer, including credit card number, shipping information, and more. Thus, sensitive information does not need to travel on the Net, and the buyer and seller save time. E-wallets can contain digital certificates (see Online Text Section W5.6), e-loyalty information, etc. As soon as you place an order, say at Amazon.com, your e-wallet at Amazon is opened, and Amazon can process your order.

The problem is that you need an e-wallet with each merchant. One solution is to have a wallet installed on your computer (e.g., MasterCard Wallet). In that case, though, you cannot purchase from another computer, nor is it a totally secured system. Another solution is a *universal* e-wallet such as Microsoft's Passport (Rosenbaum, 2002) and the Liberty Alliance (Costa, 2002). Universal systems are becoming popular since they provide a *digital identity* as well. For a description of how Microsoft's Passport works, see Rosenbaum, 2002. At our Web site, in Online File W5.7, you can see how Liberty Alliance works.



Virtual Credit Cards. *Virtual credit cards* are a service that allow you to shop with an ID number and a password instead of with a credit card number. They are used primarily by people who do not trust browser encryption sufficiently to use their credit card number on the Internet. The virtual credit card gives an extra layer of security. The bank that supports your traditional credit card, for example, can provide you with a transaction number valid for use online for a short period. For example, if you want to make a \$200 purchase, you would contact your credit card company to charge that amount to your regular credit card account, and would be given transaction number that is good for charges up to \$200. This transaction number is encrypted for security, but even in the worst possible case (that some unauthorized entity obtained the transaction number), your loss be limited, in this case to \$200. For another example of virtual credit cards, see *americanexpress.com*.

Payment Using Fingerprints. An increasing number of supermarkets allow their regular customers to pay by merely using their fingerprint for identification. A computer template of your fingerprint is kept in the store's computer system. Each time you shop, your fingerprint is matched with the template at

the payment counter. You approve the amount which is then charged either to your credit card or bank account. See Alga (2000) for details.

Order Fulfillment We now turn our attention to another important EC support service—order fulfillment. Any time a company sells direct to customers it is involved in various order fulfillment activities. It must: quickly find the products to be shipped, and pack them; arrange for the packages to be delivered speedily to the customer's door; collect the money from every customer, either in advance, by COD, or by individual bill; and handle the return of unwanted or defective products.

It is very difficult to accomplish these activities both effectively and efficiently in B2C, since a company may need to ship small packages to many customers, and do it quickly. For this reason, both online companies and click-and-mortar companies have difficulties in their B2C supply chain. Here, we provide only a brief overview; a more detailed discussion is provided in Turban et al. (2004) and in Bayles (2001).

Order fulfillment refers not only to providing customers with what they ordered and doing it on time, but also to providing all related customer service. For example, the customer must receive assembly and operation instructions to a new appliance. (A nice example is available at *livemanuals.com*.) In addition, if the customer is not happy with a product, an exchange or return must be arranged (see *fedex.com* for how returns are handled via FedEx). Order fulfillment is basically a part of a company's back-office operations.

During the last few years, e-tailers have faced continuous problems in order fulfillment, especially during the holiday season. The problems resulted in inability to deliver on time, delivery of wrong items, high delivery costs, and the need to heavily compensate unhappy customers. Several factors can be responsible for delays in deliveries. They range from inability to forecast demand accurately to ineffective supply chains. Some such problems exist also in off-line businesses. One factor that is typical of EC, though, is that it is based on the concept of "pull" operations, which begin with an order, frequently a customized one. This is in contrast with traditional retailing that begins with a production to inventory, which is then "pushed" to customers (see Appendix 3.1A on Build-to-Order). In the pull case it is more difficult to forecast demand, due to unique demands of customized orders and lack of sufficient years of experience.

For many e-tailers, taking orders over the Internet could well be the easy part of B2C e-commerce. Fulfillment to customers' doors is the sticky part. Fulfillment is less complicated in B2B where several effective methods are in use (see Bayles, 2001). For more on order fulfillment and IT-supported solutions, see Chapter 8.

5.9 LEGAL AND ETHICAL ISSUES IN E-BUSINESS

Ethical standards and their incorporation into law frequently trail technological innovation. E-commerce is taking new forms and enabling new business practices that may bring numerous risks—particularly for individual consumers—along with their advantages. Before we present some specific issues, we discuss the topic of market practices and consumer/seller protections.

Market Practices and Consumer and Seller Protection

When buyers and sellers do not know each other and cannot even see each other (they may even be in different countries), there is a chance that dishonest people will commit fraud and other crimes over the Internet. During the first few years of EC, the public witnessed many of these, ranging from the creation of a virtual bank that disappeared along with the investors' deposits, to manipulation of stock prices on the Internet. Unfortunately, fraudulent activities on the Internet are increasing.

FRAUD ON THE INTERNET. Internet fraud and its sophistication have grown as much as, and even faster than, the Internet itself. In most of these stock-fraud cases, stock promoters falsely spread positive rumors about the prospects of the companies they touted. In other cases the information provided might have been true, but the promoters did not disclose that they were paid to talk up the companies. Stock promoters specifically target small investors who are lured by the promise of fast profits.

Stocks are only one of many areas where swindlers are active. Auctions are especially conducive for fraud, by both sellers and buyers. Other areas of potential fraud include selling bogus investments and phantom business opportunities. Financial criminals now have access to far more people, mainly due to the availability of electronic mail. The U.S. Federal Trade Commission (*ftc.gov*) regularly publishes examples of twelve scams most likely to arrive via e-mail or be found on the Web.

There are several ways buyers can be protected against EC fraud. Representative methods are described next.

BUYER PROTECTION. Buyer protection is critical to the success of any commerce where buyers do not see the sellers, and this is especially true for e-commerce. Some tips for safe electronic shopping are shown in Table 5.5. In short, do not forget that you have shopper's rights. Consult your local or state consumer protection agency for general information on your consumer rights.

TABLE 5.5 Tips for Safe Electronic Shopping

- Look for reliable brand names at sites like Wal-Mart Online, Disney Online, and Amazon.com. Before purchasing, make sure that the site is authentic by entering the site directly and not from an unverified link.
- Search any unfamiliar selling site for the company's address and phone and fax numbers. Call up and quiz the employees about the sellers.
- Check out the vendor with the local Chamber of Commerce or Better Business Bureau (*bbbonline.org*). Look for seals of authenticity such as TRUSTe.
- Investigate how secure the seller's site is by examining the security procedures and by reading the posted privacy notice.
- Examine the money-back guarantees, warranties, and service agreements.
- Compare prices to those in regular stores. Too-low prices are too good to be true, and some "catch" is probably involved.
- Ask friends what they know. Find testimonials and endorsements in community sites and well-known bulletin boards.
- Find out what your rights are in case of a dispute.
- Consult the National Fraud Information Center (*fraud.org*).
- Check *consumerworld.org* for a listing of useful resources.

SELLER PROTECTION. Sellers, too, may need protections. They must be protected against consumers who refuse to pay or who pay with bad checks, and from buyers' claims that the merchandise did not arrive. They also have the right to protect against the use of their name by others, as well as to protect the use of their unique words and phrases, slogans, and Web address (trademark protection). Another seller protection applies particularly to electronic media: Sellers have legal recourse against customers who download without permission copyrighted software and/or knowledge and use it or sell it to others.

Ethical Issues



Many of the ethical and global issues related to IT apply also to e-commerce. These are discussed in Appendix 1.1, in Chapter 16, and in the Ethics Primer at our Web site. Here we touch on issues particularly related to e-commerce.

PRIVACY. Most electronic payment systems know who the buyers are; therefore, it may be necessary to protect the buyers' identities. Another privacy issue may involve tracking of Internet user activities by intelligent agents and "cookies" (a string of characters stored on the user's hard drive to record the history of the user's visits to particular Web sites). A privacy issue related to employees also involves tracking: Many companies monitor employees' e-mail and have installed software that performs in-house monitoring of Web activities. Yet many employees don't want to feel like they are under the watchful eye of "Big Brother," even while at work.

WEB TRACKING. By using tracking software, companies can track individuals' movements on the Internet. Programs such as "cookies" raise a batch of privacy concerns. The tracking history is stored on your PC's hard drive, and any time you revisit a certain Web site, the computer knows it (see NetTracker at *sane.com*). Programs such as Cookie Cutter, Cookie Crusher, and Spam Butcher are designed to allow users to have some control over cookies. (For further discussion see Chapter 16 and Alwang, 2001).

DISINTERMEDIATION. The use of EC may result in the elimination of some of a company's employees as well as brokers and agents. This result is called **disintermediation**—that is, eliminating the intermediary. The manner in which these unneeded workers, especially employees, are treated may raise ethical issues, such as how to handle the displacement.

Legal Issues Specific to E-Commerce

Many legal issues are related to e-commerce (Cheeseman, 2001, Doll et al., 2003, and Isenberg, 2002). Representative examples are discussed below.

DOMAIN NAMES. Internet addresses are known as **domain names**. Domain names appear in levels. A top-level name is *wiley.com* or *stanford.edu*. A second-level name will be *wiley.com/turban* or *ibm.com.hk* (for IBM in Hong Kong). Top-level domain names are assigned by central nonprofit organizations that check for conflicts and possible infringement of trademarks. Obviously, companies who sell goods and services over the Internet want customers to be able to find them easily, so it is best when the URL matches the company's name.

Problems arise when several companies that have similar names compete over a domain name. For example, if you want to book reservations at a Holiday Inn hotel and you go to *holidayinn.com*, you get the Web site for a hotel at Niagara

Falls, New York; to get to the hotel chain's Web site, you have to go to *holiday-inn.com*. Several cases of disputed names are already in court. An international arbitration organization is available as an alternative to the courts. The problem of domain names was alleviated somewhat in 2001 after several upper-level names were added to "com" (such as "info" and "coop").

Cybersquatting. **Cybersquatting** refers to the practice of registering domain names in order to sell them later at a higher price. For example, the original owner of *tom.com* received about \$8 million for the name. The case of *tom.com* was ethical and legal. But in other cases, cybersquatting can be either illegal or at least unethical (e.g., see Stead and Gilbert, 2001). Companies such as Christian Dior, Nike, Deutsche Bank, and even Microsoft have had to fight or pay to get the domain name that corresponds to their company's name. The Anticybersquatting Consumer Protection Act (1999) lets trademark owners in the United States sue for statutory damages.

DISINTERMEDIATION AND REINTERMEDIATION. One of the most interesting EC issues is that of *intermediation*. Intermediaries provide two types of services: (1) matching and providing information and (2) value-added services such as consulting. As seen in the Rosenbluth case (at the beginning of Chapter 3), the first type of services (matching and providing information) can be fully automated, and therefore, these services are likely to be assumed by e-marketplaces and portals that provide free services. The second type of services (value-added services) requires expertise, and these can be only partially automated. Rosenbluth decided to charge only for the second type of service. Intermediaries who provide only (or mainly) the first type of service may be eliminated, a phenomena called **disintermediation**. On the other hand, brokers who provide the second type of service or who manage electronic intermediation, also known as *infomediation*, are not only surviving, but may actually prosper, as Rosenbluth did. This phenomenon is called **reintermediation**.

The Web offers new opportunities for reintermediation. First, brokers are especially valuable when the number of participants is enormous, as with the stock market or when complex information products are exchanged. Second, many brokering services require information processing; electronic versions of these services can offer more sophisticated features at a lower cost than is possible with human labor. Finally, for delicate negotiations, a computer mediator may be more predictable, and hence more trustworthy, than a human. For example, suppose a mediator's role is to inform a buyer and a seller whether a deal can be made, without revealing either side's initial price to the other, since such a revelation would influence subsequent price negotiations. An independent auditor can verify that a software-based mediator will reveal only the information it is supposed to; a human mediator's fairness is less easily verified. The subject of reintermediation and intermediation is further discussed in Chapters 7 and 16.

TAXES AND OTHER FEES. Federal, state, and local authorities are scrambling to figure out how to get a piece of the revenue created electronically. The problem is particularly complex for interstate and international commerce. For example, some claim that even the state in which a *server* is located deserves to receive some sales tax from an e-commerce transaction. Others say that the state in which the *seller* is located deserves the entire sales tax (or value-added tax, VAT, in some countries).

In addition to sales tax, there is a question about where (and in some case, whether) electronic sellers should pay business license tax, franchise fees, gross-receipts tax, excise tax, privilege tax, and utility tax. Furthermore, how should tax collection be controlled? Legislative efforts to impose taxes on e-commerce are opposed by an organization named the Internet Freedom Fighters. Their efforts have been successful so far: At the time this edition was written, there was a ban on taxing business done on the Internet in the United States and many other countries (sales tax only), which could remain valid until fall 2006.

COPYRIGHT. Intellectual property, in its various forms, is protected by copyright laws and cannot be used freely. Copyright issues and protection of intellectual property are discussed in Chapter 16.

5.10 FAILURES AND STRATEGIES FOR SUCCESS

In the concluding section of this chapter we pay attention to failures of EC and to successes.

E-Commerce Failures



In this and other chapters of the book we presented dozens of examples that illustrate the success of the new economy and EC. Yet, failures of EC initiatives are fairly common. Furthermore, during 2000–2002, large numbers of dot-com companies failed. In this section we will look at some examples of failures and their causes. We will also look into some success factors that can be used to prevent failure.

PRE-INTERNET FAILURES. Failures of e-commerce systems should not seem surprising, since we have known about failures of EDI systems for more than 10 years. A typical example involved the attempt of the U. S. Food and Drug Administration (FDA) to install an online collaboration systems to reduce drug-review time (Williams et al., 1997). It was basically an electronic submission system and then an intranet-based internal distribution and review system. The system failed for various reasons. We present them in list form below; many of these reasons are typical of the reasons for EC failures in general, so we have highlighted the key words, for your future reference.

- *No standards* were established for submitted documents.
- There was *resistance to change* to the new system, and the FDA did not force reviewers to work electronically.
- The system was merely an electronic version of existing documents. *No business process reengineering (BPR)* was undertaken in planning (or improving) the new system.
- The FDA *lacked technical expertise* in interorganizational information systems and in collaborative commerce.
- *No training* or even information was provided to the FDA's end users.
- There were *learning curve difficulties*, and no time was allowed to learn different document systems.
- Clients (the pharmaceutical companies) *were not encouraged* to make electronic submissions.
- There was *no IS planning*. The FDA knew that a business process design study was needed, but it did not do it.



However, the FDA learned from its mistakes. An improved EDI-based system was installed in 1998/1999—after a BPR was done, training was completed, and standards were provided. The system became a full success in 1999.

INTERNET-RELATED EC FAILURES. Failures of e-commerce initiatives started as early as 1996. Early on, pioneering organizations saw the potential for EC, but expertise and EC business models were just developing. However, the major wave of failures started in 2000, as secondary funding that was needed by Internet-based EC began to dry up. Here are some examples (again, with key words highlighted).

- PointCast, a pioneer in personalized Web-casting, folded in 1998 due to an *incorrect business model*. Similarly, Dr. Koop, a medical portal, was unable to raise the needed advertising money, so the company folded. The diagnosis: death due to *incorrect business model*.
- An Internet mall, operated by Open Market, was closed in 1996 due to *an insufficient number of buyers*.
- Several toy companies—Red Rocket (a Viacom Company), *eparties.com*, and *babybucks.com*—failed due to *too much competition, low prices*, and lack of cash. Even E-toys, a virtual toy retailer that affected the entire toy industry, folded in 2001 due to its inability to generate profits and the need for additional funding for expanding its logistics infrastructure. It was sold to *kbkids.com*.
- Garden.com closed its doors in December 2000 due to *lack of cash*. Suppliers of venture capital were unwilling to give the company any more money to “burn.”
- Living.com, the online furniture store, closed in 2000. The *customer acquisition cost* was too high.
- PaperX.com, an online paper exchange in the U.K., folded due to *lack of second-round funding* (funding subsequent to a firm’s original funding but before it goes to the stock market with a stock offering).
- Webvan, an online grocery and same-day delivery company, invested over \$1 billion in infrastructure of warehouses and logistics. But its *income was insufficient* to convince investors to fund it further. It collapsed in 2002. Kozmo, another same-day delivery company in New York, Boston, and other large cities was unable to show sufficient profit and collapsed in 2001.
- In late 2000 Chemdex.com, the “granddaddy” of the third-party exchanges, closed down. Ventro.com, its parent company, said that the *revenue growth* was too slow and that a *new business model* was needed. Because of the difficulty in obtaining enough buyers and sellers fast enough (before the cash disappears), some predicted that as many as 90 percent of all 1998–2001 exchanges would collapse (Ulph, Favier, and O’Connell, 2001). And indeed, during 2001–2003 large numbers of exchanges folded or changed their business models.

Even Amazon.com, considered by many as one of the most successful e-commerce sites, did not reach profitability until the end of 2001.

The major lessons of the Internet-based EC failures were summarized by Useem (2000) in his “12 truths” and by Agrawal et al. (2001). The major reasons for failure are incorrect revenue model, lack of strategy and contingency planning, inability to attract enough customers, lack of funding, channel conflict with distributors, too much online competition in standard (commodity) products (e.g., CDs, toys), poor order fulfillment infrastructure, and lack of qualified management.

To learn more about EC failures, visit *whytheyfailed.com* and *techdirt.com*. Also, see Kaplan (2002).

FAILED EC INITIATIVES. Whereas failing companies, especially publicly listed ones, are well advertised, failing EC initiatives within companies, especially within private companies, are less known. However, news about some failed EC initiatives has reached the media and been well advertised. For example, Levi Strauss stopped online direct sales of its apparel (jeans and its popular Dockers brand) on its Web site (*livestrauss.com*) after its major distributors and retailers put pressure on the company not to compete with their brick-and-mortar outlets (*channel conflict*). Another EC initiative that failed was a joint venture between Intel and SAP, two world-class companies, which was designed to develop low-cost solutions for SMEs. It collapsed in August 2000. Large companies such as Citicorp, Disney, and Merrill Lynch also closed EC initiatives after losing millions of dollars in them.

Success Stories and Lessons Learned

There are hundreds of EC success stories, primarily in specialty and niche markets (see Athitakis, 2003). One example is Puritan.com, a successful vitamin and natural health care product store. Another one is Campusfood.com, which serves take-out food to college students. Monster.com is doing very well, and so is Southwest Airlines Online (*iflyswa.com*). Alloy.com is a successful shopping and entertainment portal for young adults.

Here are some of the reasons for EC success and some suggestions from EC experts on how to succeed:

- Thousands of brick-and mortar companies are slowly adding online channels with great success. Examples are Uniglobe.com, Staples.com, Homedepot.com, Clearcommerce.com, 1-800-FLOWERS (*800flowers.com*), and Southwest Airlines (*iflyswa.com*).
- As of late 2000, more companies were pursuing mergers and acquisitions (e.g., Ivillage.com with Women.com, though each maintains its separate Web site). Mergers seem to be a growing trend (see Bodow, 2000).
- Peter Drucker, the management guru, provides the following advice: “Analyze the opportunities, go out to look, keep it focused, start small (one thing at a time), and aim at market leadership” (quoted in Daly, 2000).
- A group of Asian CEOs recommend the following factors that are critical for success: select robust business models, understand the dot-com future, foster e-innovation, carefully evaluate a spin-off strategy, co-brand, employ ex-dot-com staffers, and focus on the e-generation as your market (e.g., *alloy.com* and *bolt.com*) (Phillips, 2000).
- Consultant PricewaterhouseCoopers (*pwglobal.com*) suggests avoiding technology malfunctions (e.g., inability to handle a surge of orders quickly enough), which erode consumer trust.
- Many experts (e.g., The National Institute for Standards and Technology, NIST) recommend contingency planning and preparing for disasters (as reported by Buchholz, 2002).
- Agrawal et al. (2001) suggest that companies should match a value proposition with customer segmentation, control extensions of product lines and business models, and avoid expensive technology.



- Huff et al. (1999) suggest the following critical success factors for e-commerce: add value, focus on a niche and then extend that niche, maintain flexibility, get the technology right, manage critical perceptions, provide excellent customer service, create effective connectedness, and understand Internet culture.

Conclusion Analyzing successful companies, researchers have suggested that if they do careful planning to reach profitability quickly, many click-and-mortar companies are likely to succeed. Joint ventures and partnerships are very valuable, and planning for satisfactory infrastructure and logistics to meet high demand is needed. In short, do not forget that e-business has a “business” side!

Finally, let’s not forget that history repeats itself. When the automobile was invented, there were 240 startup companies between 1904 and 1908. In 1910 there was a shakeout, and today there are only three U.S. automakers. However, the auto industry has grown by hundredfolds. The same is happening in EC: Despite the 2000–2003 failures, the total volume of EC activities continued to grow exponentially. For example, *emarketer.com* reported on May 19, 2003, that B2C revenues in 2002 reached \$76 billion, a 48 percent increase over 2001. The estimate for 2003 is \$96 billion—more than a 30 percent increase over 2002 (reported by Biz Report, 2003).



MANAGERIAL ISSUES

1. **Managing resistance to change.** Electronic commerce can result in a fundamental change in how business is done, and resistance to change from employees, vendors, and customers may develop. Education, training, and publicity over an extended time period offer possible solutions to the problem.
2. **Integration of e-commerce into the business environment.** E-commerce needs to be integrated with the rest of the business. Integration issues involve planning, competition for corporate resources with other projects, and interfacing EC with databases, existing IT applications, and infrastructure.
3. **Lack of qualified personnel and outsourcing.** Very few people have expertise in e-commerce. There are many implementation issues that require expertise, such as when to offer special promotions on the Internet, how to integrate an e-market with the information systems of buyers and sellers, and what kind of customer incentives are appropriate under what circumstances. For this reason, it may be worthwhile to outsource some e-commerce activities. Yet, as shown in Chapter 13, outsourcing decisions are not simple.
4. **Alliances.** It is not a bad idea to join an alliance or consortium of companies to explore e-commerce. Alliances can be created at any time. Some EC companies (e.g., Amazon.com) have thousands of alliances. The problem is which alliance to join, or what kind of alliance to form and with whom.
5. **Implementation plan.** Because of the complexity and multifaceted nature of EC, it makes sense to prepare an implementation plan. Such a plan should include goals, budgets, timetables, and contingency plans. It should address the many legal, financial, technological, organizational, and ethical issues that can surface during implementation.
6. **Choosing the company’s strategy toward e-commerce.** Generally speaking there are three major options: (1) *Lead*: Conduct large-scale innovative e-commerce activities. (2) *Watch and wait*: Do nothing, but carefully watch



what is going on in the field in order to determine when EC is mature enough to enter it. (3) *Experiment*: Start some e-commerce experimental projects (learn by doing). Each of these options has its advantages and risks.

7. **Privacy**. In electronic payment systems, it may be necessary to protect the identity of buyers. Other privacy issues may involve tracking of Internet user activities by intelligent agents and cookies, and in-house monitoring of employees' Web activities.
8. **Justifying e-commerce by conducting a cost-benefit analysis is very difficult**. Many intangible benefits and lack of experience may produce grossly inaccurate estimates of costs and benefits. Nevertheless, a feasibility study must be done, and estimates of costs and benefits must be made. For example, see the proposal for assessing EDI investment presented by Hoogewelgen and Wagenaar (1996).
9. **Order fulfillment**. Taking orders in EC may be easier than fulfilling them. To learn about the problems and solutions related to order fulfillment, see Chapter 8.
10. **Managing the impacts**. The impacts of e-commerce on organizational structure, people, marketing procedures, and profitability may be dramatic. Therefore, establishing a committee or organizational unit to develop strategy and to manage e-commerce is necessary.



ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; additional resources such as cases, tables, and figures; updates; additional exercises; links; and demos and activities can be found on the book's Web site.

KEY TERMS

Banners (p. ●●●)	E-business (p. ●●●)	Electronic retailing (e-tailing) (p. ●●●)
Brick-and-mortar organizations (p. ●●●)	E-government (p. ●●●)	Electronic storefronts (p. ●●●)
Business-to-business (B2B) (p. ●●●)	E-learning (p. ●●●)	Forward auction (p. ●●●)
Business-to-consumer (B2C) (p. ●●●)	E-tailer (p. ●●●)	Group purchasing (p. ●●●)
Business-to-employees (B2E) (p. ●●●)	E-procurement (p. ●●●)	Internet communities (p. ●●●)
Business models (p. ●●●)	E-wallets (digital wallets) (p. ●●●)	Intelligent (software) agents (p. ●●●)
Buy-side marketplace (p. ●●●)	Electronic auctions (p. ●●●)	Intrabusiness EC (p. ●●●)
Channel conflict (p. ●●●)	Electronic banking (cyberbanking) (p. ●●●)	Keyword banner (p. ●●●)
Click-and-mortar organizations (p. ●●●)	Electronic bartering (p. ●●●)	Micropayments (p. ●●●)
Collaborative commerce (c-commerce) (p. ●●●)	Electronic benefits transfer (EBT) (p. ●●●)	Mobile commerce (p. ●●●)
Collaborative filtering agents (p. ●●●)	Electronic cash (e-cash) (p. ●●●)	Order fulfillment (p. ●●●)
Consumer-to-business (C2B) (p. ●●●)	Electronic checks (e-checks) (p. ●●●)	Permission marketing (p. ●●●)
Consumer-to-consumer (C2C) (p. ●●●)	Electronic commerce (EC) (p. ●●●)	Person-to-person payments (p. ●●●)
Cybersquatting (p. ●●●)	Electronic exchange (Exchange) (p. ●●●)	Pop-under ad (p. ●●●)
Desktop purchasing (p. ●●●)	Electronic funds transfer (EFT) (p. ●●●)	Pop-up ad (p. ●●●)
Disintermediation (p. ●●●)	Electronic mall (p. ●●●)	Private exchange (p. ●●●)
Domain names (p. ●●●)	Electronic marketplace (p. ●●●)	Public exchange (p. ●●●)
		Random banner (p. ●●●)
		Reintermediation (p. ●●●)



Reverse auction (p. ●●●)

Segmentation (p. ●●●)

Sell-side marketplace (p. ●●●)

Smart cards (p. ●●●)

Stored-value money
cards (p. ●●●)

Viral marketing (p. ●●●)

Virtual banks (p. ●●●)

Virtual organization (p. ●●●)

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 E-commerce can be conducted on the Web, by e-mail, and on other networks. It is divided into the following major types: business-to-consumer, consumer-to-consumer, business-to-business, e-government, collaborative commerce, and intrabusiness. In each type you can find several business models.
- 1 E-commerce offers many benefits to organizations, consumers, and society, but it also has limitations (technological and nontechnological). The current technological limitations are expected to lessen with time.
- 2 A major mechanism in EC is auctions. The Internet provides an infrastructure for executing auctions at lower cost, and with many more involved sellers and buyers, including both individual consumers and corporations. Two major types exist: one for selling, which is the traditional process of selling to the highest bidder (forward auctions), and one is for buying, using a tendering system of buying at the lowest bid (reverse auctions).
- 2 A minor mechanism is online bartering, in which companies arrange for *exchange* of physical items and/or services.
- 3 The major application areas of B2C commerce are in direct retailing, banking, securities trading, job markets, travel, and real estate. Several issues slow the growth of B2C, notably channel conflict, order fulfillment, and customer acquisition. B2C e-tailing can be pure (such as Amazon.com), or part of a click-and-mortar organization.
- 3 Direct marketing is done via solo storefronts or in malls. It can be done via electronic catalogs, or by using electronic auctions. Understanding consumer behavior is critical to e-commerce. Finding out what customers want can be determined by asking them, in questionnaires, or by observing what they do online. Other forms of market research can be conducted on the Internet by using intelligent agents.
- 4 Like any commerce, EC requires advertising support, much of which can be done online by methods such as banner ads, pop-ups, and customized ads. Permission marketing, interactive and viral marketing, electronic catalogs, making it to the top of search-engine listings, and online promotions offer ways for vendors to reach more customers.
- 5 The major B2B applications are selling from catalogs and by forward auctions, buying in reverse auctions and in group and desktop purchasing, and trading in exchanges.
- 5 Most organizations employ B2B collaborative commerce, usually along the supply chain.
- 6 EC activities can be conducted inside organizations. Three types are recognized: between a business and its employees, between units of the business, and among employees of the same organizations. Many method and tools exist in conducting the above.
- 7 E-government commerce can take place between government and citizens, between businesses and governments, or among government units. It makes government operations more effective and efficient.
- 7 EC can also be done between consumers (C2C), but should be undertaken with caution. Auction is the most popular C2C mechanism.
- 8 Traditional, nonelectronic payment systems are insufficient or inferior for doing business on the Internet. Therefore, electronic payment systems are used. Electronic payments can be made by e-checks, e-credit cards, e-cash, stored-value and smart cards, electronic bill presentment and payment, and e-wallets.
- 8 Order fulfillment is especially difficult in B2C, making B2C expensive at times (solutions are provided in Chapter 8).
- 9 Protection of customers, sellers, and intellectual property is a major concern, but so are the value of contracts, domain names, and how to handle legal issues in a multicountry environment.
- 9 There is increasing fraud and unethical behavior on the Internet, including invasion of privacy by sellers and misuse of domain names. Both sellers and buyers need to be protected.
- 10 Periods of innovations produce both many successes and many failures. There have been many of both in e-commerce.
- 10 Major reasons for failure are insufficient cash flow, too much competition, conflicts with existing system systems, wrong revenue models, and lack of planning. Despite the failures, overall EC volume is growing exponentially.

QUESTIONS FOR REVIEW

1. Define e-commerce and distinguish it from e-business.
2. List the major types of EC (by transaction)
3. Distinguish between business-to-consumer, business-to-business, and intrabusiness EC.
4. List major technological and nontechnological limitations of EC (three each).
5. Describe electronic storefronts and malls.
6. List the benefits of cyberbanking.
7. Describe electronic securities trading.
8. Describe the online job market.
9. Explain how electronic auctions work.
10. Describe the EC consumer behavior model.
11. Describe EC market research and its tools.
12. Describe the major support areas of intelligent agents in EC.
13. Describe online advertising, its methods, and benefits.
14. Describe pop-up ads and the issues surrounding them.
15. Briefly describe the sell-side marketplace.
16. Describe the various methods of e-procurement.
17. Describe how forward and reverse auctions are used in B2B commerce.
18. Describe the role of exchanges in B2B.
19. Describe c-commerce and its benefits.
20. Describe e-government and its benefits.
21. Describe e-bartering.
22. Describe some C2C activities.
23. Describe intrabusiness and B2E commerce.
24. List the various electronic payment mechanisms.
25. List the security requirements for EC.
26. Describe the issues in EC order fulfillment.
27. Describe some areas of potential fraud on the Internet.
28. Describe buyer protection in EC.
29. List some ethical issues in EC.
30. List the major legal issues of EC.
31. List five reasons for EC failures.
32. List five suggestions for EC success.

DISCUSSION QUESTIONS

1. Discuss the major limitations of e-commerce. Which of them are likely to disappear? Why?
2. Why is the electronic job market popular, especially among the high-tech professions?
3. Distinguish between business-to-business forward auctions and buyers' bids for RFQs.
4. Discuss the benefits to sellers and buyers of a B2B exchange.
5. What are the major benefits of e-government?
6. Why are online auctions popular?
7. Discuss the reasons for EC failures.
8. Discuss the various ways to pay online in B2C. Which one you prefer and why?
9. Why is order fulfillment in B2C considered difficult?
10. Distinguish between smart cards and value-added cards. Discuss the advantages of each.
11. Discuss the online consumer behavior model and explain why it is needed.
12. Discuss the reasons for having multiple EC business models.

EXERCISES

1. Assume you're interested in buying a car. You can find information about cars at *autos.msn.com*. Go to *autoweb.com* or *autobytel.com* for information about financing and insurance. Decide what car you want to buy. Configure your car by going to the car manufacturer's Web site. Finally, try to find the car from *autobytel.com*. What information is most supportive of your decision making process? Write a report about your experience.
2. Consider the opening case about Hi-Life.
 - a. How was the corporate decision making improved?
 - b. Summarize the benefits to the customers, suppliers, store management, and employees.
 - c. The data collected at Activesys can be uploaded to a PC and transmitted to the corporate intranet via the internet. It is suggested that transmission be done using a wireless system. Comment on the proposal.
3. Compare the various electronic payment methods. Specifically, collect information from the vendor cited in the chapter, and find more with *google.com*. Be sure you pay attention to security level, speed, cost, and convenience.



GROUP ASSIGNMENTS

1. Have each team study a major bank with extensive EC strategy. For example, Wells Fargo Bank is well on its way to being a cyberbank. Hundreds of brick-and-mortar branch offices are being closed. In Spring 2003 the bank served more than a 1.2 million cyberaccounts (see wellsfargo.com). Other banks to look at are Citicorp, Netbank, and HSBC (Hong Kong). Each team should attempt to convince the class that its e-bank is the best.
2. Assign each team to one industry. Each team will find five real-world applications of the major business-to-business models listed in the chapter. (Try success stories of vendors and EC-related magazines.) Examine the problems they solve or the opportunities they exploit.
3. Have teams investigate how B2B payments are made in global trade. Consider instruments such as electronic letters of credit and e-checks. Visit tradecard.com and examine their services to SMEs. Also, investigate what Visa and MasterCard are offering. Finally, check Citicorp and some German and Japanese banks.

INTERNET EXERCISES

1. Access etrade.com and register for the Internet stock simulation game. You will be bankrolled with \$100,000 in a trading account every month. Play the game and relate your experiences to IT.
2. Use the Internet to plan a trip to Paris.
 - a. Find the lowest airfare.
 - b. Examine a few hotels by class.
 - c. Get suggestions of what to see.



Minicase 1 FreeMarkets.com

FreeMarkets (freemarkets.com) is a leader in creating B2B online auctions for buyers of industrial parts, raw materials, commodities, and services around the globe. The company has created auctions for goods and services in hundreds of industrial product categories. FreeMarkets auctions more than \$5 billion worth of purchase orders a year and saves buyers an estimated 2 to 25 percent of total expenses (administrative and items).

FreeMarkets operates two types of marketplaces. First, the company helps customers purchase goods and services through its B2B global marketplace where reverse auctions usually take place. Second, FreeMarkets helps companies improve their asset-recovery results by getting timely market prices for surplus assets through the FreeMarkets AssetExchange, employing a *forward auction* process, as well as other selling models.

FreeMarkets Onsite Auctions include (1) asset disposal recovery and (2) sourcing (e-procurement) functions. These functions provide the following:

- **Asset disposal analysis.** Market makers work with sellers to determine the best strategy to meet asset-recovery goals.
- **Detailed sales offering.** The company collects and consolidates asset information into a printed or online sales offering for buyers.

- **Targeted market outreach.** FreeMarkets conducts targeted advertising to a global database of 500,000 buyers and suppliers.
- **Event coordination.** The company prepares the site, provides qualified personnel, and enforces auction rules.
- **Sales implementation.** FreeMarkets summarizes auction results and assists in closing sales.

Asset-Recovery Success Stories

FreeMarkets helped the following companies make asset recoveries.:

New Line Cinema (newline.com) had unique memorabilia that they had stored for years. In 2001 they decided to auction these via Freemarket's auction marketplace (AssetExchange). The release of a movie sequel titled *Austin Powers: The Spy Who Shagged Me* provided an opportunity for New Line to experiment with the asset-recovery auction. Items from the original production were put off for auction; these items included a 1965 Corvette driven by Felicity Shagwell (sold in the auction for \$121,000) and one of Austin's suits (sold for \$7,500). In addition to freeing storage space and generating income, the auction provided publicity for the sequel through the newspaper and television coverage is received. An additional benefit was that the auction was

- d. Find out about local currency, and convert \$1,000 to that currency with an online currency converter.
 - e. Compile travel tips.
 - f. Prepare a report.
3. Access *realtor.com*. Prepare a list of services available on this site. Then prepare a list of advantages derived by the users and advantages to realtors. Are there any disadvantages? To whom?
 4. Enter *alibaba.com*. Identify the site capabilities. Look at the site's private trading room. Write a report. How can such a site help a person who is making a purchasing?
 5. Try to find a unique gift on the Internet for a friend. Several sites help you do it. (You might try *shopping.com* and *amazon.com*, for example.) Describe your experience with such a site.
 6. Enter *campusfood.com*. Explore the site. Why is the site so successful? Could you start a competing one? Why or why not?
 7. Enter *dell.com*, go to "desktops" and configure a system. Register to "my cart" (no obligation). What calculators are used there? What are the advantages of this process as compared to buying a computer in a physical store? What are the disadvantages?
 8. Enter *bizrate.com* and complete one of the questionnaires that entitles you to participate in their rewards and receive information. What data they collect? Why?
 9. Enter *nike.com* and configure a pair of shoes; then go to *jaguar.com* and configure a car; and finally go to Lands' End and configure some clothing for yourself. Summarize your experiences.
 10. Enter *checkfree.com* and find their services. Prepare a report.
 11. Enter *authorizenet.com* and find *echeck.net*; view the payment diagram. Compare this process to the one described in Figure 5.6. Comment on the relationships.

linked to the company's online store. If you were unable to afford the 1965 Corvette, you instead could have purchased a new T-shirt or a poster of the new movie. Finally, the auction created a dedicated community of users. The auction was a great success, and since then New Line Cinema has conducted similar auctions on a regular basis.

Another success story for FreeMarkets' auctions was American Power Conversion Corp. (*apcc.com*), which needed a channel for end-of-life (old models) and refurbished power-protection products. These were difficult to sell in the regular distribution channels. Before using auctions, the company used special liquidation sales, which were not very successful. FreeMarkets deployed the auction site (using its standard technology, but customizing the applications). It also helped the company determine the auction strategies (such as starting-bid price and auction running length), which were facilitated by DSS modeling. The site became an immediate success. The company is considering selling regular products there, but only merchandise for which there would be no conflict with the company regular distributors.

E-Procurement (Sourcing) Success Story

Besides providing companies with successful efforts in asset recovery, FreeMarkets has also helped companies conduct reverse auctions either from their own sites (with necessary expertise provided by FreeMarkets) or from FreeMarkets' site. Singapore Technologies Engineering (STE), a large integrated global engineering group specializing in the fields

of aerospace, electronics, land systems and marine, had the following goals when it decided to use e-procurement (sourcing) with the help of FreeMarkets: to minimize the cost of products they need to buy, such as board parts; to identify a new global supply base for their multi-sourcing strategy; to ensure maximized efficiency in the procurement process; to find new, quality suppliers for reliability and support; and to consolidate existing suppliers. These are typical goals of business purchasers.

FreeMarkets started by training STE's corporate buyers and other staff. Then it designed an improved process that replicated the traditional negotiations with suppliers. Finally, it took a test item and prepared a RFQ, placing it for bid in the FreeMarkets Web site. FreeMarkets uses a five-step tendering process that starts with the RFQ and ends with supplier management (which includes suppliers verification and training). STE saved 35 percent on the cost of printed circuit board assemblies.

Questions for Minicase 1

1. What makes FreeMarket different from eBay?
2. Why do you think FreeMarkets concentrates on asset recovery and on e-procurement?
3. Why is the RFQ mechanism popular?
4. In 2003 the company shifted attention to global supply management. What does the company mean by that?

Sources: Compiled from *freemarkets.com*, see success stories (site accessed December 15, 2002 and March 28, 2003).



Minicase 2

Marketing Dining Certificates Online

Restaurants.com was founded in 1999 as an all-purpose dining portal with menus, video tours online, and a reservation feature. Like other dot-coms, the company was losing money. Not too many restaurants were willing to pay the fees in order to put their Web page on the *restaurants.com* site. The company was ready to pull the plug when its owner learned that CitySpree, which was selling dining certificates (coupons) online, was for sale in a bankruptcy auction. Realizing that Restaurants.com might have a better model for selling dining certificates online than did CitySpree, the owner purchased CitySpree. This enabled him to change the company from “just another dining portal” to a gift-certificate seller.

Here is how the new business model works: Restaurants are invited to place, for free, dining certificates at *restaurants.com*, together with information about the restaurant, menu, parking availability, and more. The dining certificate traditionally had been found in newspapers or newspaper inserts. Placing them online is free to the restaurants’ owners; some use the online coupons to replace the paper coupons, and others supplement the paper coupons with the online version. Restaurants.com *sells* these certificates online, and collects all the fees for itself. The restaurants get broad visibility, since Restaurants.com advertises on Orbitz, Yahoo, and MSN; it even auctions certificates at eBay.

The certificates offer 30–50 percent off the menu price, so they are appealing to buyers. By using a search engine, you can find a restaurant with a cuisine of your choice, and you can look for certificates when you need them. Although you pay \$5–\$15 to purchase a certificate, you get usually a better discount than is offered in the newspapers. You pay with your credit card, print the certificate, and are ready to dine. Customers are encouraged to register as members, free of charge. Then they can get e-mails with promotions, news, etc. In their personalized account, customers can view past purchases as well. Customers also

can purchase gift certificates to be given to others. And bargains can be found: For example, a \$50 off regular price certificate to New York City’s Manhattan Grille was auctioned for only \$16.

The business model worked. By going to eBay, the world largest virtual mall, Restaurants.com found an audience of millions of online shoppers. By e-mailing coupons to customers it saves the single largest cost of most conventional coupon marketers—printing and postage. Finally, the model works best in difficult economic times, when price-conscious consumers are looking for great deals. The financial results are striking: Revenues doubled during the first five months of operation (late 2001). The company has been profitable since the third quarter of 2002. And by June 2003, the company was selling over 80,000 certificates a month, grossing over \$5 million in 2002, and expecting about \$10 million in 2003.

Question for Minicase 2

1. Visit *restaurants.com*. Find an Italian restaurant in your neighborhood and examine the information provided. Assuming you like Italian food, is the gift certificate a good deal?
2. Review the “lessons from failures” described in Section 5.10 and relate them to this case.
3. Why was it necessary to purchase CitySpree? (Speculate.)
4. What motivates restaurants to participate in the new business model when they refused to do so in the old one?
5. Given that anyone can start a competing business, how can Restaurants.com protect its position? What are some of its competitive advantages?

Sources: Compiled from Athitakis (2003) and *restaurants.com* (June 1, 2003).





Virtual Company Assignment

E-Commerce in the Diner

As the head hostess for The Wireless Café, Barbara has noticed more customers using wireless devices at their tables, sending e-mails and messages, looking up information during business lunches, as well as talking on the phone. She has shared this observation with you and asked you to identify ways The Wireless Café can attract more customers through e-commerce. After reading Chapter 5, you are now aware that e-commerce is more than just business-to-customer relationships, so you ask her if you can broaden the scope of your analysis. Barbara agrees.

1. Identify the category, participants, and benefits of e-commerce for the following activities:
 - a. Ordering food supplies.
 - b. Financial reporting (city, state, federal)
 - c. Employee benefits management
 - d. Customer reservations and communication
 - e. Job postings and applications
2. Inventory management is more than just ordering food supplies. It includes table-setting items (dishes, glassware, cutlery, napkins), and cleaning and office supplies in addition to ingredients for the daily menu offerings. How would Internet-based EDI benefit The Wireless Café in managing these inventories? Can you find any products and services on the Internet that would help The Wireless Café do this?
3. Identify for Barbara some lessons learned in implementing successful ecommerce projects and how they can help ensure TH The Wireless Café's success.

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APPENDIX 5.1

EDI AND EXTRANETS

E-commerce transactions must be executable worldwide without any delays or mistakes. Infrastructure may be of many types (see Online File W5.8 and Technology Guides 4 and 5). But, their detailed description is outside the scope of this book. Here we deal with only two infrastructures: EDI and extranets.



Electronic Data Interchange (EDI)

As discussed briefly in Chapter 2, **EDI** is the electronic movement of specially formatted standard business documents, such as orders, bills, and confirmations sent between business partners. Figure 5A.1 shows the order-delivery cycle with and without EDI. Many companies use EDI to foster relationships with their suppliers and/or customers. The major advantages of

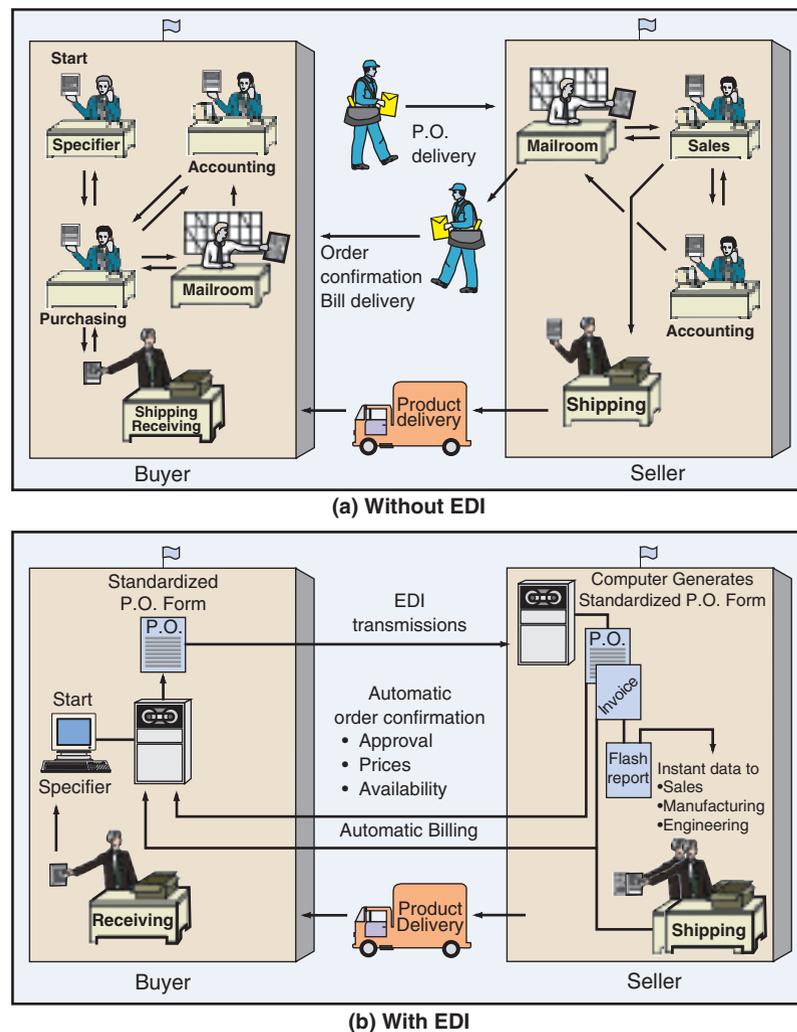


FIGURE 5A.1 Order Delivery Cycle with and Without EDI



EDI are summarized in Online File W5.9 at the book's Web site.

Like e-mail, EDI allows sending and receiving of messages between computers connected by a communication link. However, EDI has the following special characteristics:

- **Business transactions messages.** EDI is used primarily to electronically transfer *repetitive* business transactions. These include various transactions essential in EC: purchase orders, invoices, approvals of credit, shipping notices, confirmations, and so on.
- **Data formatting standards.** Since EDI messages are repetitive, it is sensible to use some formatting (coding) standards. Standards can shorten the length of the messages and eliminate data entry errors, since data entry occurs only once. In the United States and Canada, data are formatted according to the ANSI X.12 standard. An international standard developed by the United Nations is called EDIFACT.
- **EDI translators.** An *EDI translator* converts data into standard EDI format code. An example of such formatting for a shipping company is shown in Figure 5A.2.
- **Private lines versus the Internet.** In the past, EDI ran on expensive value-added networks. These networks provided a high level of security and capacity. However, because of cost, their implementation was confined mainly to large trading partners. There were also some problems of compatibility. As a result, large companies doing business with thousands of other companies

were unable to place most of them on the EDI. For example, Boeing Commercial Airplane Group, which sells aircraft parts, was using EDI with only 30 out of 500 customers. With the emergence of Internet-based EDI (EDI/Internet), this situation is rapidly changing, as shown in a story about Hewlett-Packard in Online File W5.10 at our Web site.



Note that Internet-based EDI does not have the same capabilities as VAN-based EDI. Therefore, at least in the short run, it is viewed as supplementary to the VAN, permitting more companies to use EDI. Also, Internet EDI may be cheaper, but it still requires coordination and integration with the company's back-end processing systems. In cases of high use of EDI, such as in financial services, the traditional EDI must be used. But in many cases where low volume of transactions is involved, EDI/Internet is becoming the chosen solution.

HOW DOES EDI WORK? *A Closer Look 5A.1* illustrates how EDI works. Information flows from the hospital's information systems into an EDI station that includes a PC and an EDI translator. From there the information moves, using a modem if necessary, to a VAN. The VAN transfers the formatted information to a vendor(s) where an EDI translator converts it to a desired format.

INTERNET-BASED EDI. There are a number of reasons for firms to create EDI ability over the Internet: The Internet is a publicly accessible network with few geographical constraints. The Internet's global

	Sample Invoice	Formatted Into X12 Standard
Ship To:	The Corner Store 601 First Street Crossroads, MI 48106	N1*ST*THE CORNER STORE/NL N3*601 FIRST STREET/NL N4*CROSSROADS*MI*48106/NL
Charge To:	Acme Distributing Company P.O. Box 33327 Anytown, NJ 44509	N1*BT*ACME DISTRIBUTING CO/NL N3*P.O. BOX 33327/NL N4*ANYTOWN*NJ*44509/NL
Terms of Sale:	2% 10 days from invoice date	ITD*01*3*2**10/NL

FIGURE 5A.2 Translating Data to EDI Code



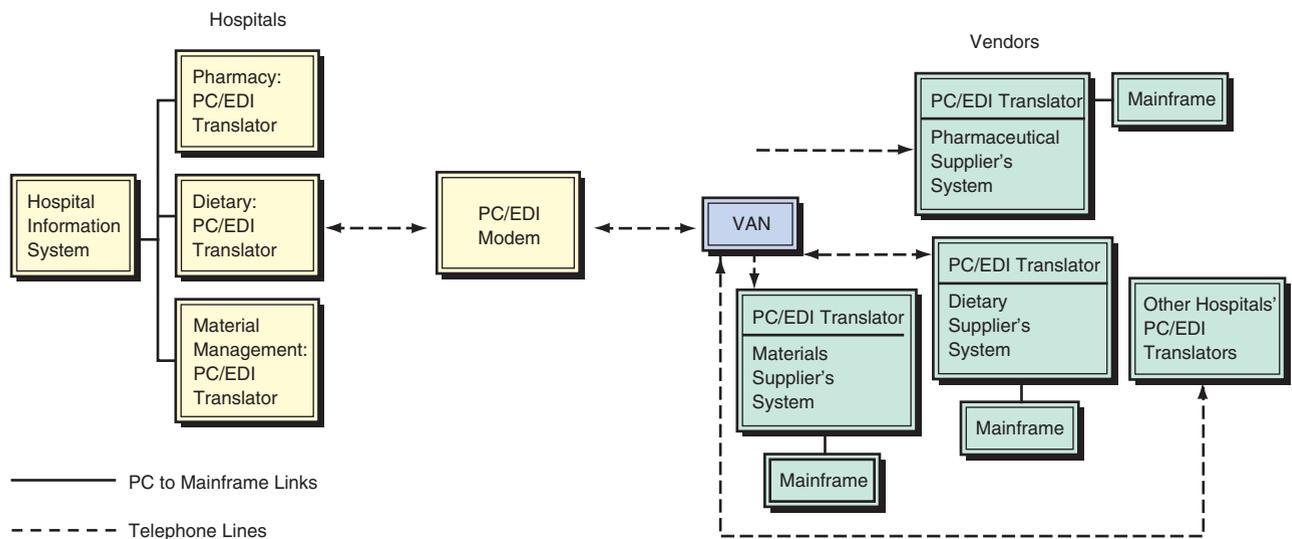
A CLOSER LOOK

5A.1 HOW EDI CUTS COSTS OF ORDERING SUPPLIES

An average hospital generates about 15,000 purchase orders each year, at a processing cost of about \$70 per order. The Health Industry Business Communication Council estimates that EDI can reduce this cost to \$4 per order—potential yearly savings of \$840,000 per hospital. The required investment ranges between \$8,000 and \$15,000, which includes purchase of a PC with an EDI translator, a modem, and a link to the mainframe-

based information system. The hospital can have two or three ordering points. These are connected to a value-added network (VAN), which connects the hospital to its suppliers (see figure below). The system also can connect to other hospitals, or to centralized joint purchasing agencies.

Source: Based on G. Nussbaum (1992).



network connections offer the potential to reach the widest possible number of trading partners of any viable alternative currently available. In addition, the Internet's largest attribute—large-scale connectivity (without the need to have any special networking architecture)—is a seedbed for growth of a vast range of business applications. Internet-based EDI can complement or replace current EDI applications. Internet tools such as browsers and search engines are very user-friendly; most users today know how to use them, so new training is minimized. Using the Internet to exchange EDI transactions is consistent with the growing interest of businesses in delivering an ever-increasing variety of products and services electronically, particularly through the Web. Finally, a “bottom-line” reason to move to Internet-based

EDI is cost: Using the Internet can cut EDI communication costs by over 50 percent. For implementation of EDI in Singapore (Tradenet) see Online File W5.11 at our Web site.



Extranets

The major network structure used in e-marketplaces and exchanges is an extranet, or “extended intranet.” As discussed in Chapters 2, an **extranet** is a network that links business partners to one another over the Internet by tying together their corporate intranets. It connects with both the Internet and individual companies' intranets. An extranet adds value to the Internet by increasing its security and expanding the available bandwidth.

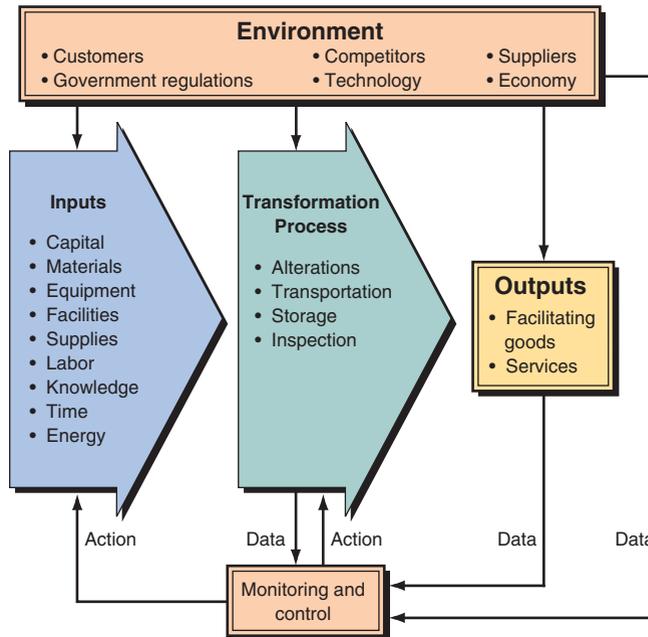


FIGURE 5A.3 The Extranet Framework

The use of an extranet as a B2B infrastructure is growing rapidly. In contrast with electronic data interchange (EDI), which mostly supports *transaction processing* between two business partners, an extranet can be used for collaboration, discovery of information, trading support, and other activities. Also, EDI is mostly used to support company-centric transactions (where relationships are fairly permanent), whereas extranets are used also in exchanges (where relationships may be of a “one-deal-only” nature).

The main goal of extranets is to foster collaboration between organizations. Extranets may be used, for example, to allow inventory databases to be searched by business partners, or to transmit information on the status of an order. An extranet typically is open to selected suppliers, customers, and other business partners, who access it on a private wide-area network, or usually over the Internet with a virtual private network (VPN) for increased security and functionality.

Extranets allow the use of capabilities of both the Internet and intranets among business partners. External partners and telecommuting employees can use the extranet to place orders, access data, check status of shipments, and send e-mail. The Internet-based extranet is far more economical than the creation and maintenance of proprietary networks. Extranets support all types of the B2B models described earlier, but

especially many-to-many exchanges. Buy-side and sell-side e-marketplaces are supported frequently by EDI/Internet. Extranets are especially useful in supporting *collaborative commerce* (*c-commerce*).

An extranet uses the TCP/IP protocol to link intranets in different locations (as shown in Exhibit 5A.3). Extranet transmissions are usually conducted over the Internet, which offers little privacy or transmission security. Therefore, it is necessary to add security features. This is done by creating tunnels of secured data flows, using cryptography and authorization algorithms, to provide secure transport of private communications. An Internet with tunneling technology is known as a **virtual private network (VPN)** (see Technology Guide 4 for details).

Extranets provide secured connectivity between a corporation’s intranets and the intranets of its business partners, materials suppliers, financial services, government, and customers. Access to an extranet is usually limited by agreements of the collaborating parties, is strictly controlled, and is available only to authorized personnel. The protected environment of an extranet allows partners to collaborate and share information and to perform these activities securely.

Because an extranet allows connectivity between businesses through the Internet, it is an open and flexible platform suitable for supply chain activities. To further increase security, many companies replicate

the portions of their databases that they are willing to share with their business partners and separate them physically from their regular intranets.

According to Szuprowicz (1998), the benefits of extranets fall into five categories:

1. **Enhanced communications.** The extranet enables improved internal communications; improved business partnership channels; effective marketing, sales, and customer support; and facilitated collaborative activities support.
2. **Productivity enhancements.** The extranet enables just-in-time information delivery, reduction of information overload, productive collaboration between work groups, and training on demand.
3. **Business enhancements.** The extranet enables faster time to market, potential for simultaneous engineering and collaboration, lower design and production costs, improved client relationships, and creation of new business opportunities.
4. **Cost reduction.** The extranet results in fewer errors, improved comparison shopping, reduced travel and meeting time and cost, reduced administrative

and operational costs, and elimination of paper-publishing costs.

5. **Information delivery.** The extranet enables low-cost publishing, leveraging of legacy systems, standard delivery systems, ease of maintenance and implementation, and elimination of paper-based publishing and mailing costs.

Rihao-Ling and Yen (2001) reported additional advantages of extranets, such as ready access to information, ease of use, freedom of choice, moderate setup cost, simplified workflow, lower training cost, and better group dynamics. They also listed a few disadvantages, such as difficulty in justifying the investment (measuring benefits and costs), high user expectations, and drain on resources.

While the extranet provides the communication line between intranets, it is still necessary to connect applications. For example, Brunswick Corp. connects all of its boat-brand manufacturing with an extranet called Compass, using IBM's WebSphere and Web services to provide the connectivity (see Chen, 2003, for details).

KEY TERMS

Electronic data interchange (EDI) (p. ●●●)

Extranet (p. ●●●)

Virtual private network (VPN) (p. ●●●)

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PART II
The Web Revolution



4. Network Computing: Discovery, Communication, and Collaboration
5. E-Business and E-Commerce
- ▶ 6. Mobile, Wireless, and Pervasive Computing

CHAPTER

6

Mobile, Wireless, and Pervasive Computing

NextBus

6.1

Mobile Computing and Commerce:
Overview, Benefits, and Drivers

6.2

Mobile Computing Infrastructure

6.3

M-Commerce Applications in
Financial Services

6.4

Mobile Shopping, Advertising,
and Content-Providing

6.5

Mobile Intrabusiness and
Enterprise Applications

6.6

Mobile B2B and Supply Chain
Applications

6.7

Mobile Consumer and Personal
Service Applications

6.8

Location-Based Commerce

6.9

Pervasive Computing

6.10

Inhibitors and Barriers of Mobile
Computing and M-Commerce

Minicases: (1) Hertz / (2) Washington Township
Fire Department

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Discuss the characteristics and attributes of mobile computing and m-commerce.
- 2 Describe the drivers of mobile computing.
- 3 Understand the technologies that support mobile computing.
- 4 Describe wireless standards and transmission networks.
- 5 Discuss m-commerce applications in financial and other services, advertising, and providing of content.
- 6 Describe the applications of m-commerce within organizations.
- 7 Understand B2B and supply chain applications of m-commerce.
- 8 Describe consumer and personal applications of m-commerce.
- 9 Describe some non-Internet m-commerce applications.
- 10 Describe location-based commerce (l-commerce).
- 11 Discuss the key characteristics and current uses of pervasive computing.
- 12 Describe the major inhibitors and barriers of mobile computing and m-commerce.



NEXTBUS: A SUPERB CUSTOMER SERVICE

THE PROBLEM

Buses in certain parts of San Francisco have difficulty keeping up with the posted schedule, especially in rush hours. Generally, buses are scheduled to arrive every 20 minutes, but at times, passengers may have to wait 30 to 40 minutes. The schedules become meaningless, and passengers are unhappy because they waste time.

THE SOLUTION

San Francisco bus riders carrying an Internet-enabled wireless device, such as a cell phone or PDA, can quickly find out when a bus is likely to arrive at a particular bus stop. The system tracks public transportation buses in *real time*. Knowing where each bus is and factoring in traffic patterns and weather reports, NextBus (nextbus.com) dynamically calculates the estimated arrival time of the bus to each bus stop on the route. The arrival times are also displayed on the Internet and on a public screen at each bus stop.

The NextBus system has been used successfully in several other cities around the United States, in Finland, and in several other countries. Figure 6.1 shows how the NextBus system works. The core of the NextBus system is a GPS satellite that

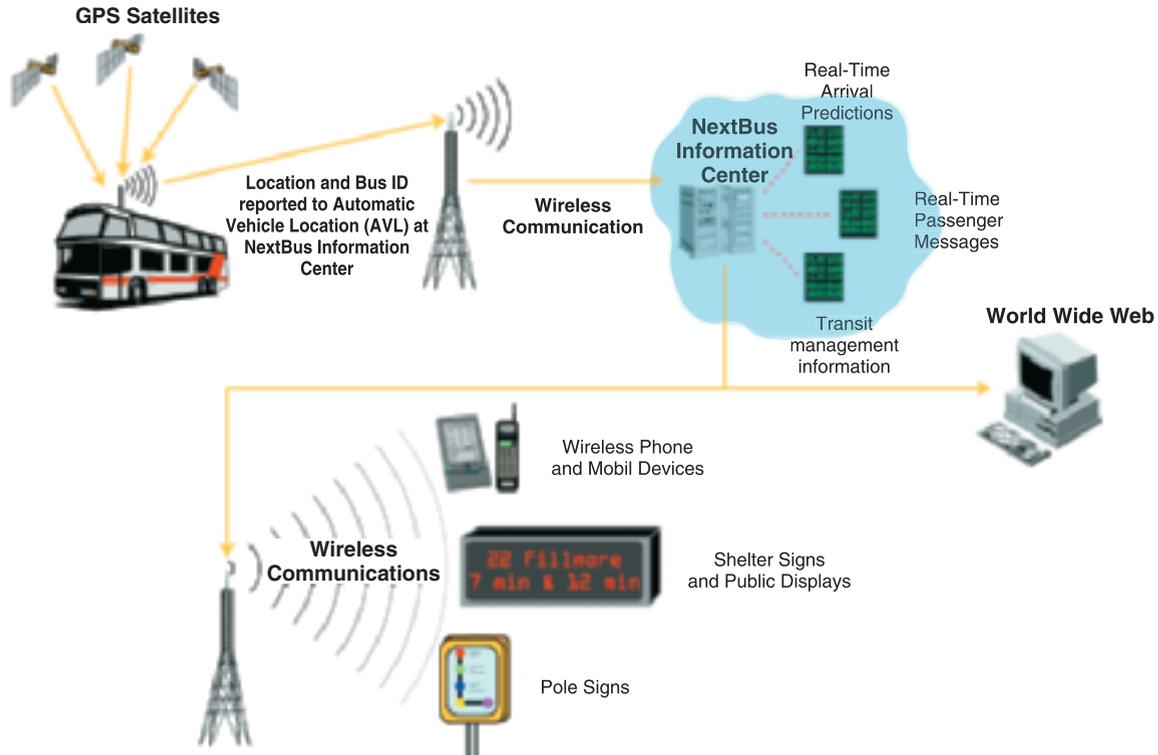


FIGURE 6.1 NextBus operational model. (Source: NextBus.com/corporate/works/index.htm, 2002. Used with permission of NextBus Information Systems.)



can tell the NextBus information center where a bus is at any given time. Based on a bus's location, the scheduled arrival time at each stop can be calculated. Users can access the information from their cell phones or PCs, anytime, anywhere. NextBus schedules are also posted in real time on shelter signs and public displays.

Currently, NextBus is an ad-free customer service, but in the near future advertising may be added. As the system knows exactly where you are when you request information and how much time you have until your next bus, it may send you to the nearest Starbucks for a cup of coffee, giving you an electronic discount coupon for a cup of coffee as you wait.



THE RESULTS

Passengers in San Francisco are happy with the NextBus system; worries about missing the bus are diminished. A similar system is used in rural areas in Finland, where buses are infrequent and winters are very cold, passengers can stay in a warm coffeehouse not far from the bus stop rather than waiting in the cold for a bus that may be an hour late. Also, using the system, a bus company can do better scheduling, arrange for extra buses when needed, and improve its operations.

Sources: Compiled from ITS America 2001; Murphy, 1999; and *nextbus.com*, accessed 2003.



LESSONS LEARNED FROM THIS CASE

This opening vignette is an example of location-based e-commerce, which is an application of *mobile commerce*, in which EC services are provided to customers wherever they are located at the time they need them. This capability, which is not available in regular EC, may change many things in our lives. The vignette also exemplifies *pervasive computing*, in which services are seamlessly blended into the environment without the user being aware of the technology behind the scenes. This application is also a part of *mobile computing*, a computing paradigm designed for workers who travel outside the boundaries of their organizations or for travellers of any kind.

Mobile computing and commerce are spreading rapidly, replacing or supplementing wired computing. Mobile computing involves mostly wireless infrastructure. Mobile computing may reshape the entire IT field (see Intel, 2002; Sadeh, 2002; and Menneckeand Strader, 2003). The technologies, applications, and limitations of mobile computing and mobile commerce are the main focus of this chapter. Later in the chapter, we will look briefly at futuristic applications of *pervasive computing*.

6.1 MOBILE COMPUTING AND COMMERCE: OVERVIEW, BENEFITS, AND DRIVERS

The Mobile Computing Landscape

In the traditional computing environment it was necessary to come to the computer to do some work on it. All computers were connected to each other, to networks, servers, etc. via wires. This situation limited the use of computers and created hardship for people and workers on the move. In particular, salespeople, repair people, service employees, law enforcement agents, and utility workers, can be more effective if they can use information technology while at their jobs

in the field or in transit. There are also mobile vacationers, people on holiday who wish to be connected with home or office.

The first solution was to make computers small enough so they can be easily carried about. First, the laptop computer was invented, and later on smaller and smaller computers, such as the PDAs and other handhelds, appeared. These carryable computers are called **mobile devices**. They have become lighter with time and more powerful as far as processing speed and storage. At the end of the day, mobile workers could download (or upload) information from or to a regular desktop computer in a process known as *synchronization*. To speed up the “sync,” special connecting cradles (docking stations) were created (see Minicase 2 at the end of this chapter and the Maybelline Minicase in Chapter 2).

These devices provided the first application of **mobile computing**, a computing paradigm designed for workers who travel outside the boundaries of their organizations or for any other people traveling outside their homes. Salespeople were able to make proposals at customers’ offices; a traveler could read and answer all of the day’s e-mails while on a plane. One could work with the mobile device as long as the battery was working.

For example, Millstone Coffee equipped its 300 drivers with handheld devices and mobile applications for use while they are on the road selling roasted coffee beans to 13,000 stores in the United States. Using the devices the drivers can track inventory, generate invoices, and capture detailed sales and marketing data at each store. The system does not use wireless; instead, the drivers synchronize (“sync”) their handhelds with the company’s main system at the end of the day, a process that takes only 2 minutes. This strategy has proven to be cheaper for Millstone than going wireless, at least with the 2002 technology (see Cohen, 2002).

The second solution to the need for mobile computing was to replace wires with *wireless communication media*. Wireless systems have been in use in radio, TV and telephones for a long time. So it was natural to adopt them to the computing environment (for more, see *Wired*, 2003).

The third solution was a combination of the first two, namely to use mobile devices in a wireless environment. Referred to as **wireless mobile computing**, this combination enables a real-time connection between a mobile device and other computing environments, such as the Internet or an intranet. This innovation is creating a revolution in the manner in which people use computers. It is spreading at work and at home. It is also used in education, health care, entertainment, and much more. The new computing model is basically leading to *ubiquity*—meaning that computing is available anywhere, at any time. (Note: Since many mobile applications now go wireless, the term *mobile computing* today is often used generally to describe wireless mobile computing.)

Due to some current technical limitations, we cannot (yet) do with mobile computing all the things that we do with regular computing. However, as time passes we can do more and more. On the other hand, we can do things in mobile computing that we cannot do in the regular computing environment. A major boost to mobile computing was provided in 2003 by Intel with its Centrino chip. This chip, which will be a standard feature in most laptops by 2005 (Estrada, 2002), includes three important capabilities: (1) a connection device to a wireless local area network, (2) low usage of electricity, enabling users to do more work on a single battery charge, and (3) a high level of security. The Centrino is expected to make mobile computing the common computing environment.



A second driving development of mobile computing is the introduction of the third- and fourth-wireless generation environments known as 3G and 4G. We will describe these later on.

Mobile Commerce

While the impact of mobile computing on our lives will be very significant, a similar impact is already occurring in the way we conduct business. This impact is described as **mobile commerce** (also known as *m-commerce* and *m-business*), which is basically any e-commerce or e-business done in a wireless environment, especially via the Internet. Like regular EC applications, m-commerce can be done via the Internet, private communication lines, smart cards, or other infrastructures (e.g., see Sadeh, 2002; Mennecke and Strader, 2003; and Kalakota and Robinson, 2001).

M-commerce is not merely a variation on existing Internet services; it is a natural extension of e-business. Mobile devices create an opportunity to deliver new services to existing customers and to attract new ones. Varshney and Vetter (2001) classified the applications of m-commerce into 12 categories, as shown in Table 6.1. (A classification by industry is provided at *mobile.commerce.net*. Also see *mobiforum.org*.)

Many of these applications, as well as some additional ones, will be discussed in this chapter. According to Sarshar (2003), as much as \$1.8 trillion in consumer transactions could be made from mobile devices by the year 2005. The Yankee Group forecasted that mobile transactions will exceed \$15 billion in the U.S. alone (TechLive, 2001).

Mobile Computing Basic Terminology

Let's build a foundation for further discussion by defining some common mobile computing terms:

- **Global positioning system (GPS)**. A satellite-based tracking system that enables the determination of a GPS device's location. (See Section 6.8 for more on GPS.)

TABLE 6.1 Classes of M-Commerce Applications

Class of Applications	Examples
1. Mobile financial applications (B2C, B2B)	Banking, brokerage, and payments by mobile users
2. Mobile advertising (B2C)	Sending user-specific and location-sensitive advertising to users
3. Mobile inventory management (B2C, B2B)	Location tracking of goods, boxes, troops, and people
4. Proactive service management (B2C, B2B)	Transmitting information related to distributing components to vendors
5. Product locating and shopping (B2C, B2B)	Locating/ordering certain items from a mobile device
6. Wireless reengineering (B2C, B2B)	Improvement of business services
7. Mobile auction or reverse auction (B2C)	Services for customers to buy or sell certain items
8. Mobile entertainment services (B2C)	Video-on-demand and other services to a mobile user
9. Mobile office (B2C)	Working from traffic jams, airports, and conferences
10. Mobile distance education (B2C)	Taking a class using streaming audio and video
11. Wireless data center (B2C, B2B)	Downloading information by mobile users/vendors
12. Mobile music/music-on-demand (B2C)	Downloading and playing music using a mobile device

Source: Varshney and Vetter (2000, pp. 107–109).

- **Personal digital assistant (PDA).** A small portable computer, such as the family of Palm handhelds and the Pocket PC devices from companies like HP.
- **Short Message Service (SMS).** A technology, in existence since 1991, that allows for the sending of short text messages (up to 160 characters in 2003) on certain cell phones. Data are borne by the radio resources reserved in cellular networks for locating mobile devices and connecting calls. SMS messages can be sent or received concurrently, even during a voice or data call. Used by hundreds of millions of users, SMS is known as the e-mail of m-commerce.
- **Enhanced Messaging Service (EMS).** An extension of SMS that is capable of simple animation, tiny pictures, and short melodies.
- **Multimedia Messaging Service (MMS).** The next generation of wireless messaging, this technology will be able to deliver rich media.
- **Bluetooth.** A chip technology wireless standard designed for temporary, short-range connection (data and voice) among mobile devices and/or other devices (see *bluetooth.com*).
- **Wireless Application Protocol (WAP).** A technology that offers Internet browsing from wireless devices (see Section 6.2).
- **Smartphones.** Internet-enabled cell phones that can support mobile applications. These “phones with a brain” are becoming standard devices. They include WAP microprocessors for Internet access and the capabilities of PDAs as well.
- **Wi-Fi (short for wireless fidelity).** Refers to a standard 802.11b on which most of the wireless local area networks (WLANs) run.
- **WLAN (wireless local area network).** A broad term for all 802.11 standards. Basically, it is a wireless version of the Ethernet networking standard. (For discussion of the Ethernet standard, see Technology Guide 4.)

With these terms in mind, we can now look more deeply at the attributes and drivers of mobile computing.

Attributes and Drivers of Mobile Computing

Generally speaking, many of the EC applications described in Chapter 5 can be done in m-commerce. For example, e-shopping, e-banking, and e-stock trading are gaining popularity in wireless B2C. Auctioning is just beginning to take place on cell phones, and wireless collaborative commerce in B2B is emerging. However, there are several *new* applications that are possible only in the mobile environment. To understand why this is so, let’s examine the major attributes of mobile computing and m-commerce.

SPECIFIC ATTRIBUTES OF MOBILE COMPUTING AND M-COMMERCE. Mobile computing has two major characteristics that differentiate it from other forms of computing: *mobility* and *broad reach*.

- **Mobility.** Mobile computing and m-commerce are based on the fact that users carry a mobile device everywhere they go. Mobility implies portability. Therefore, users can initiate a *real-time* contact with other systems from wherever they happen to be if they can connect to a wireless network.
- **Broad reach.** In mobile computing, people can be reached at any time. Of course, users can block certain hours or certain messages, but when users carry an open mobile device, they can be reached instantly.



These two characteristics break the barriers of geography and time. They create the following five value-added attributes that drive the development of m-commerce: ubiquity, convenience, instant connectivity, personalization, and localization of products and services.

Ubiquity. *Ubiquity* refers to the attribute of being available at *any location at any given time*. A mobile terminal in the form of a smartphone or a PDA offers ubiquity—that is, it can fulfill the need both for real-time information and for communication, independent of the user's location.

Convenience. It is very convenient for users to operate in the wireless environment. All they need is an Internet enabled mobile device such as a smartphone. Using GPRS (General Packet Radio Service, a cell phone standard), it is easier and faster to access the Web without booting up a PC or placing a call via a modem. Also, more and more places are equipped with Wi-Fi, enabling users to get online from portable laptops anytime (as was shown in the Dartmouth College case in Chapter 1). You can even watch an entire movie on a PDA (see *pocketpcfilms.com*).

Instant Connectivity. Mobile devices enable users to connect easily and quickly to the Internet, intranets, other mobile devices, and databases. Thus, wireless devices could become the preferred way to access information.

Personalization. *Personalization* refers to the preparation of customized information for individual consumers. For example, a user who is identified as someone who likes to travel might be sent travel-related information and advertising. Product personalization is still limited on mobile devices. However, the emerging need for conducting transactions electronically, combined with availability of personalized information and transaction feasibility via mobile portals, will move personalization to new levels, leading ultimately to the mobile device becoming a major EC tool. The process of personalization is illustrated in Figure 6.2 and is described by Dogac and Tumer (2002).

Localization of Products and Services. Knowing where the user is physically located at any particular moment is key to offering relevant products and services. E-commerce applications based on localization of products and services are known as *location-based e-commerce* or *l-commerce*. Precise location information is known when a GPS is attached to a user's wireless device. For example, you might use your mobile device to find the nearest ATM or FedEx drop box. In addition, the GPS will tell others where you are. Localization can be general, such as to anyone in a certain location (e.g., all shoppers at a shopping mall). Or, even better, it can be targeted so that users get messages that depend both on where they are and what their preferences are, thus combining localization and personalization. For instance, if it is known that you like Italian food and you are strolling in a mall that has an Italian restaurant, you might receive a SMS that tells you that restaurant's "special of the day" and gives you a 10 percent discount. GPS may be a standard feature in many mobile devices by 2005.

Vendors and telecommunication carriers can *differentiate* themselves in the competitive marketplace by offering new, exciting, and useful services based on these attributes. Such services will help vendors attract and keep customers and increase their revenues.

DRIVERS OF MOBILE COMPUTING AND M-COMMERCE. In addition to the value-added attributes just discussed, the development of mobile computing and m-commerce is driven by the following factors.

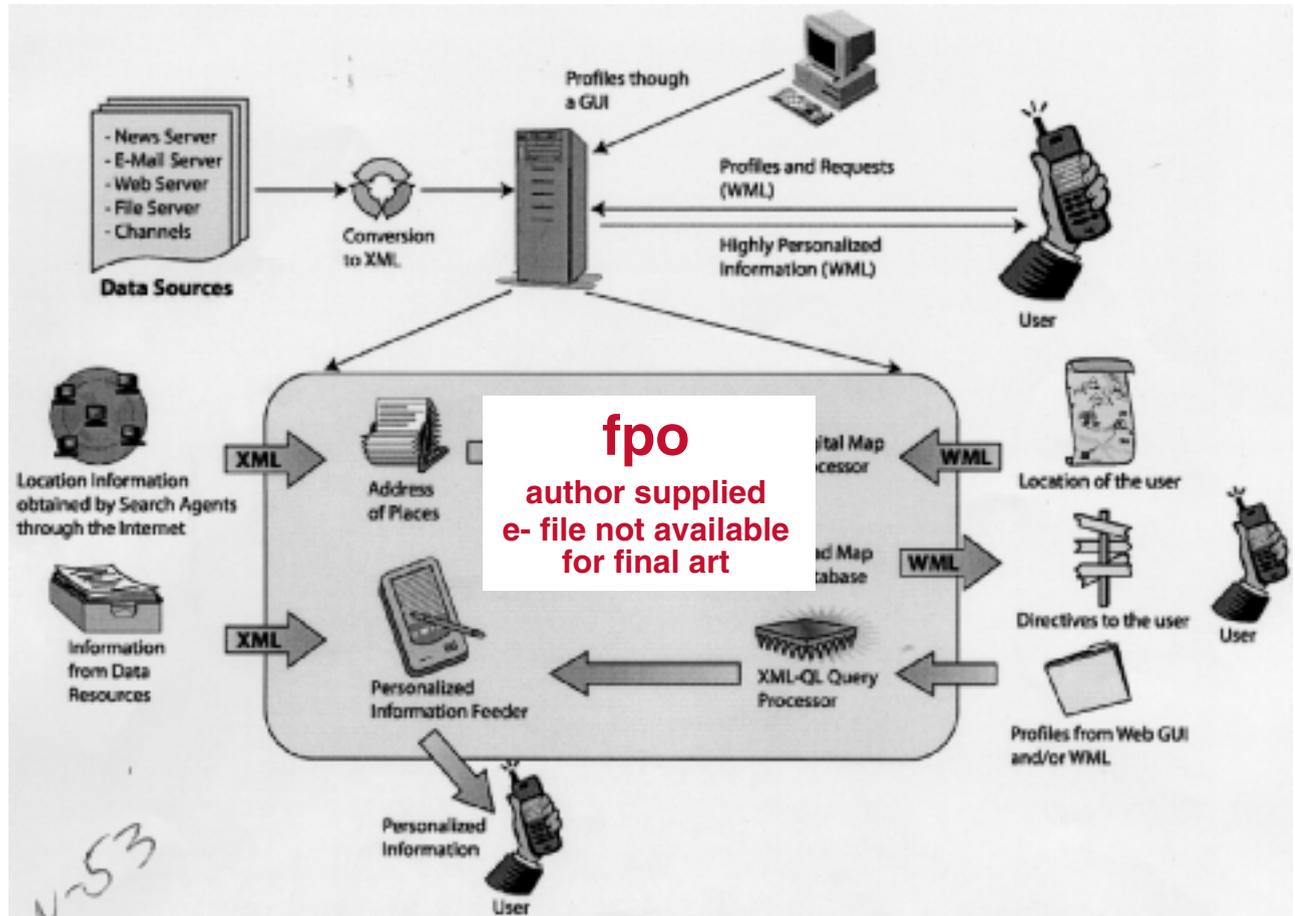


FIGURE 6.2 How a Wireless System Provides Personalized Information (Source: Dogac and Tumer (2002), p. 40.)

Widespread Availability of Mobile Devices. The number of cell phones throughout the world exceeds 1.3 billion (cellular.co.za/stats/stats-main.htm). It is estimated that within a few years, about 70 percent of cell phones will have Internet access. Thus, a potential mass market is available for conducting discovery, communication, collaboration, and m-commerce. Cell phones are spreading quickly in developing countries. In 2002, for example, the number of cell phones in China exceeded 200 million, virtually equally the number of fixed line phones in that country (CellularOnline 2002). This growth enables developing countries to leap-frog to m-commerce.

No Need for a PC. Because the Internet can be accessed via smartphone or other Internet-enabled wireless device, there is no need for a PC to access the Internet. Even though the cost of a PC, such as the Simputer (a “simple computer”), that is used primarily for Internet access can be as low as \$300 (or even less), that amount is still a major expense for the vast majority of people in the world. Furthermore, one needs to learn how to operate a PC, service it, and replace it every few years to keep it up-to-date. Smartphones and other wireless devices obviate the need for a PC.



The Handset Culture. Another driver of m-commerce is the widespread use of cell phones, which is becoming a social phenomenon, especially among the 15-to-25-year-old age group. These users will constitute a major force of online buyers once they begin to make and spend reasonable amounts of money. The use of SMS has been spreading like wildfire in several European and Asian countries. In the Philippines, for example, SMS is a national phenomenon in the youth market. As another example, Japanese send many more messages through mobile phones than do Americans, who prefer the desktop for e-mail.

Vendors' Push. Vendors also are pushing m-commerce. Both mobile communication network operators and manufacturers of mobile devices are advertising the many potential applications of mobile computing and m-commerce so that they can sell new technologies, products, and services to buyers.

Declining Prices and Increased Functionalities. With the passage of time, the price of wireless devices is declining, and the per-minute pricing of mobile services is expected to decline by 50 to 80 percent before 2005. At the same time, functionalities are increasing.

Improvement of Bandwidth. To properly conduct m-commerce, it is necessary to have sufficient bandwidth for transmitting text; however, bandwidth is also required for voice, video, and multimedia. The 3G (third-generation) technology (described in Section 6.2) provides the necessary bandwidth, at a data rate of up to 2 Mbps. This enables information to move 35 times faster than when 56K modems are used. Wi-Fi moves information even faster, at 11 Mbps.

M-Commerce Value Chain and Revenue Models

Like EC, m-commerce is a complex process involving a number of operations and a number of players (customers, merchants, mobile operators, and the like). The key elements in the m-commerce value chain (for delivering m-commerce content and applications to end users) are summarized in Table 6.2. Several types of vendors provide value-added services to m-commerce. These include:

TABLE 6.2 M-Commerce Value Chain

Link	Function	Provider
Transport	Maintenance and operation of the infrastructure supporting data communication between mobile users and application providers	Technology platform vendors
Enabling services	Server hosting, data backup, and system integration	Infrastructure equipment vendors
Transaction support	Mechanisms for assisting with transactions, security, and billing	Application platform vendor
Presentation services	Conversion of content of Internet-based applications to applications suitable for mobile devices	Application developer
Personalization support	Gathering of users' preferences, information, and devices in order to provide individualized applications	Content developer
User applications	General and specialized applications for mobile users	Mobile service provider
Content aggregators	Design and operation of portals that offer categorized information and search facilities	Mobile portal provider

Source: Compiled from Siau et al. (2001).

mobile portals, advertisers, software vendors, content providers, mobile portal, mobile network operator and more (See Sadeh 2002, pg 34 there)

The revenue models of m-commerce are the following: access fees, subscription fees, pay-per-use, advertisement, transaction fees, hosting, payment clearing, and point-of-traffic (Coursaris and Hassanein, 2002).

6.2 MOBILE COMPUTING INFRASTRUCTURE

Mobile computing requires hardware, software, and networks. The major infrastructure components of mobile computing are described in this section.

Mobile Computing Hardware

To conduct m-commerce, one needs devices for data entry and access to the Internet, applications, and other equipment. Several mobile computing devices are used in m-commerce. The major ones are:

- **Cellular (mobile) phones.** All major cell phone manufacturers are making (or plan to make) Internet-enabled phones, also known as *smartphones*. These cell phones are improving with time, adding more features, larger screens, keyboards, and more. Over 35 percent of the new cell phones have color screens (Pilato, 2002), for example. An example of an Internet-enabled cell phone is the Nokia 3510i, which includes Internet access, multimedia messaging (MMS), support for small Java applications (like games), a calculator, schedule, address book, and more. Note that even phones without screen displays (regular or cellular phones) can be used to retrieve voice information from the Web (see *tellme.com* and the discussion of voice portals in Section 6.2).
- **Attachable keyboard.** Transactions can be executed with the regular handset entry keys, but it is fairly time-consuming to do so. An alternative is to use a larger cell phone such as the Nokia 9290 that contains a small-scale keyboard. Yet another solution is to plug an attachable keyboard into the cell phone. (Attachable keyboards are also available for other wireless devices, such as PDAs.)
- **PDAs.** Personal digital assistants (PDAs) with Internet access are now available from several vendors, and their capabilities are increasing. Using special software, users can connect these PDAs to the Internet via a wireless modem. PDAs for *corporate users* include additional capabilities, such as e-mail synchronization and exchange of data and backup files with corporate servers. (Examples of PDAs for corporate users are Jornada from HP, IPAQ from Compaq, Sony NX70V, and MobilePro from NEC.)
- **Interactive pagers.** Some two-way pagers can be used to conduct limited mobile computing and m-commerce activities on the Internet (mainly sending and receiving text messages, such as stock market orders).
- **Screenphones.** A telephone equipped with a color screen, possibly a keyboard, e-mail, and Internet capabilities is referred to as a **screenphone**. Initially, these were *wire-lined*; that is, they were regular phones connected by wires to a network. As of 2000, wireless screenphones became available.
- **E-mail handhelds.** To enhance wireless e-mail capabilities, one can use devices such as the BlackBerry Handheld (*blackberry.net*). This device, which includes a keypad, is an integrated package, so there is no need to dial into an Internet provider for access. A variety of services for data communication



enable users to receive and send messages from anywhere. For example, the law firm of Paul, Hastings, Janofsky, & Walker (with offices in major U.S. cities) has deployed Blackberry handhelds to its 900 lawyers, who can now receive their e-mail in real time and can enter billing information while on the road. Furthermore, they can be alerted whenever they have a voice mail or fax waiting. A third of the company's lawyers have returned their laptops, and the company has saved \$260,000 each year. New applications are coming with each new version of the handhelds (for details see Cohen 2002). A product demo is available at *blackberry.net*.

- **Other devices.** Many other wireless support devices are on the market. For example, the Seiko SmartPad (*siibusinessproducts.com*) allows you to hand-write from a notepad instantly to a cell phone or PDA screen, overcoming the small screen size of these devices. Some new cell phones have built-in cameras; you can take a picture and e-mail it immediately from your mobile location. Finally there is a wireless mouse, which works up to 15 feet, so it can be used for presentations. For an overview of devices see Kridel, 2003.

There is a significant trend toward the *convergence* of PDAs and cell phones. On the one hand, the PDA manufacturers are providing PDAs with cellular or wireless capabilities. On the other hand, the cellular phone manufacturers and systems providers are offering phones with PDA capabilities

In addition to the hardware described above, m-commerce also requires the following infrastructure hardware, most of which the user does not see or know about, but which is essential for wireless connectivity:

- A suitably configured wireline or wireless *WAN modem*, *wireless LAN adapter*, or *wireless MAN* (metro-area network) adapter.
- A *Web server* with wireless support, a WAP gateway, a communications server, and/or a mobile communications server switch (MCSS). Such a Web server provides communications functionality that enables the handheld device to communicate with the Internet or intranet infrastructure (see *mobileinfo.com*).
- An *application* or *database server* with application logic and a business application database.
- A large *enterprise application server*.
- A *GPS locator* that is used to determine the location of the person carrying the mobile computing device. This is the basis for location-based applications, as described in Section 6.8.

Mobile Computing Software

Developing software for wireless devices is challenging because, as of 2002, there is no widely accepted standard for wireless applications. Therefore, software applications need to be customized for each type of device with which the application may communicate. The major software products required for mobile computing are presented in Table 6.3.

Wireless Wide Area Networks (WWANs)

At the core of most mobile computing applications are *mobile networks*. These are of two general types: the *wide area* and the *local area*. The wide area networks for mobile computing are known as **wireless wide area networks (WWAN)**. The breadth of coverage of WWANs directly affects the availability of services (see Intel, 2002). Breadth of coverage depends on the transmission media and the generation of wireless.

TABLE 6.3 Software for Mobile Computing

Software	Description
Microbrowser	A browser with limited bandwidth and memory requirements. Provides wireless access to the Internet
Operating system (OS) for mobile-client	An OS for mobile devices. Examples: PalmOS, Windows 2001NT, Win CE. Specialized OSs: Blackberry and Web browser.
Bluetooth (named for a Viking king)	Chip technology for short-range (30 meters, 2003) communication among wireless devices. Uses digital two-way radio frequency (RF). It is an almost universal standard for wireless Personal Area Network (WPAN) for data and voice. See bluetooth.com .
User interface	Application logic for handheld devices. It is often controlled by the microbrowser.
Legacy application software	Residing on the mainframe, it is a major source of data to wireless systems.
Application middleware	Provides connecting among applications, databases, and Web-based servers.
Wireless middleware	Links wireless networks to application servers.
Wireless Application Protocol (WAP)	A set of communication protocols that enables wireless devices to “talk” to a server on a mobile network, so users can access the Internet. Specially designed for small screen. A competing standard is the J2ME platform that offers better security and graphics (see wapforum.org).
Wireless Markup Language (WML)	An XML-based scripting language for creating content for wireless systems.
Voice XML	An extension of XML designed to accommodate voice.

The global communications and cellular phone companies operate most of the wireless wide area networks. A very simple mobile system is shown in Figure 6.3. At the edge of the system are the mobile handsets. A **mobile handset** consists of two parts—terminal equipment that hosts the applications (e.g., a PDA) and a mobile terminal (e.g., a cell phone) that connects to the mobile network.



TRANSMISSION MEDIA. Several transmission media can be used for wireless transmission. These media differ in both capabilities and cost. The major ones are shown in Online File W6.1.

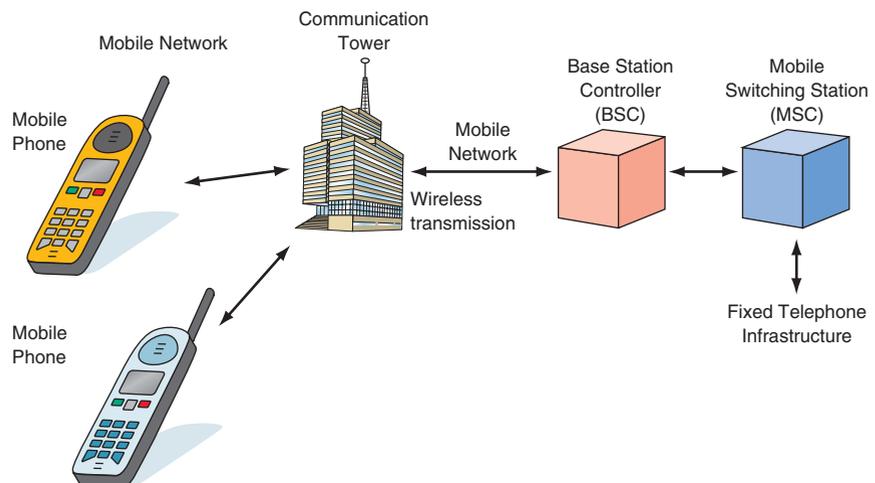


FIGURE 6.3 Mobile System Architecture



COMMUNICATION GENERATIONS OF WIRELESS WIDE AREA NETWORKS. The success of mobile computing depends on the capabilities of the WWAN communication systems. Four generations of communications technology are distinguished:

- **1G.** The first generation of wireless technology. It was an analog-based technology, in effect from 1979 to 1992.
- **2G.** The second generation of digital wireless technology. In existence today, 2G is based on digital radio technology and mainly accommodates text.
- **2.5G.** An interim technology based on GPRS (General Packet Radio Services) and EDGE (Enhanced Data Rates for Global Evaluation) that can accommodate limited graphics.
- **3G.** The third generation of digital wireless technology, which supports rich media such as video clips. It started in 2001 in Japan, and reached Europe in 2002 and the United States in 2003. As of 2003, the number of 3G cell phones in operation was around 150 million (a small percentage of the total number cell phones in use today) (Dunne, 2001).
- **4G.** The expected next generation after 3G. The arrival of 4G, which will provide faster display of multimedia, is expected between 2006 and 2010. Experimental HGs were used in Japan as early as 2003.

For details on transmission media, see Sadeh (2002) and Mennecke and Strader (2003).

SOME NETWORK COMPONENTS. Some mobile handsets, especially in Europe, contain a **subscriber identification module (SIM) card**. This is an extractable storage card that is used not only for identification but also for providing customer location information, transaction processing, secure communications, and the like. A SIM card makes it possible for a handset to work with multiple phone numbers.

The mobile handset communicates with a *base-transceiver station*. There are thousands of these throughout the world. A base-transceiver station is connected to a *base-station controller* that handles the handoff from one transceiver to the next as the customer or user travels from one place to another. The various base-station controllers are connected to *mobile switching centers* that connect the mobile network with the public wired phone network.

COMMUNICATION PROTOCOLS IN WWAN. One of the major problems facing the mobile communication system providers is how to service extremely large numbers of users given limited communication bandwidth. This can be done through multiplexing protocols (see Technology Guide 4). In today's mobile world (2003), there are three main protocols:

- **Frequency Division Multiple Access (FDMA).** Used by 1G systems, this protocol gives each user a different frequency to communicate on.
- **Time Division Multiple Access (TDMA).** Used with some of the more popular 2G systems, this protocol assigns different users different time slots on a given communications channel (e.g., every 1/8 time slot).
- **Code Division Multiple Access (CDMA).** Used with most 2.5G and 3G systems, this protocol separates different users by assigning different codes to the segments of each user's communications.



Wireless Local Area Networks and Wi-Fi

In today's mobile world most of the networks rely on either TDMA or CDMA. The relationships between these two multiplexing methods and the major network standards are detailed in Online File W6.2 along with the evolution of these standards from today's 2G world to tomorrow's 3G and 4G world.

For the past few years, much of the discussion about mobile computing and m-commerce has revolved around WWANs with cellular technologies, especially the 3G one. Slowly but surely, another technology (one that has been around for at least a decade)—wireless local area networks—has been making its way to the forefront as the market factors impeding its growth are being addressed. As the name implies, a **wireless LAN (WLAN)** is like a wired LAN but without the cables. WLANs transmit and receive data over the airwaves.

In a typical configuration, a transmitter with an antenna, called a **wireless access point**, connects to a wired LAN from a fixed location or to satellite dishes that provide an Internet connection. A wireless access point provides service to a number of users within a small geographical perimeter (up to a couple hundred feet), known as a "hot spot" or **hotspot** zone. Several wireless access points are needed to support larger numbers of users across a larger geographical area. End users can access a WLAN with their laptops, desktops, or PDAs by adding a wireless network card. As of 2002 most PC and laptop manufacturers incorporate these cards directly in their PCs. (as an option). For how to connect your PC quickly and securely with no wires, see Stafford and Brandt, 2002.

WLANs provide fast and easy Internet or Intranet broadband access from public *hotspots* like airports, hotels, Internet cafes, and conference centers. WLANs are also being used in universities (recall the Dartmouth case in Chapter 1), offices, and homes, in place of the traditional wired LANs. In this way users are free to roam across the campus, office, or throughout their homes (see *weca.net*).

Most of today's WLANs run on a standard known as **802.11b** that was developed by the IEEE (Institute of Electrical and Electronic Engineers). That standard is also called **Wi-Fi (wireless fidelity)**. WLANs employing this standard have communication speeds of 11 mbps. While most wired networks run at 100 mbps, 11 mbps is actually sufficient for many applications. Two other new standards, 802.11a and 802.11g, support data transmissions at 54 mbps. The 802.11g standard is beginning to show up in commercial products because it is compatible with the 802.11b standard. While PCs can take advantage of 54 mbps, today's (2003) PDAs cannot, because their expansion (network) cards are limited to the 11 mbps speed. As of 2003 there is even hardware and software that supports voice over Wi-Fi (*telephony*).

The major benefits of Wi-Fi are its lower cost and its ability to provide simple Internet access. As a matter of fact it is the greatest facilitator of the *wireless Internet* (see Anderson, 2003). The Wi-Fi market got a boost at the end of 2002 when AT&T, Intel, and IBM, along with two global investment firms, joined forces to create Cometa Networks, Inc. Cometa (*cometa.com*) works with major retail chains, hotels, universities and real estate firms to deploy Wi-Fi hotspots throughout the top 50 U.S. metropolitan areas.

WIRELESS PERSONAL AREA NETWORKS (WPANs). A *wireless personal area network (WPAN)* is a kind of WLAN that people have at their home offices. With



such a network, one can connect PCs, PDAs, mobile phones, and digital music players that detect each other and can interact. Also, one can also add a digital payment system and personal security technologies. The network maintains constant connectivity among devices, which is useful for users in office settings, including those who use wearable devices.

ILLUSTRATIVE APPLICATIONS OF WI-FI. The year 2003 may be a breakthrough year for wireless networking in offices, airports, hotels, and campuses around the United States. Each month brings new examples of businesses that have added Wi-Fi services for their employees or customers. Several examples are presented below. Many more examples of Wi-Fi are included in this chapter and throughout the book.

- Like a number of airports in the United States, the Minneapolis-St. Paul International airport is served by Wi-Fi. The Northstar Crossing concession area, the Northwest Airlines' World Club lounge, the United Airlines' Red Carpet Club, and many of the main terminal concourses provide wireless Internet access to anyone with a laptop or handheld device and a Wi-Fi network card. iPass is hosting the Internet service. The fee is \$7.95 for unlimited daily access.
- Lufthansa offers in-flight Wi-Fi service on its long-haul fleet. The hotspots on the aircrafts are connected to the Internet via satellites. While a news channel is free, there is a charge of \$25 for use during the flight (Bloomberg News, 2003).
- In 2002, T-Mobile installed Wi-Fi networks in approximately 2,000 Starbucks stores in the United States. Starbucks has plans to add Wi-Fi to 70 percent of its 6,000 locations worldwide over the next few years. T-Mobile is also installing Wi-Fi in hundreds of Borders Books & Music Stores. T-Mobile is charging \$30 a month for unlimited access, with walk-in customers paying \$2.99 for the first 15 minutes and 25 cents a minute thereafter.
- McDonald's piloted a program in April 2003 in which it initially offered Wi-Fi wireless access in 10 restaurants in New York City (*mcdwireless.com*). The company has an access point (hotspot) in each of these restaurants. If you buy a "value meal" you get one hour of free access. Alternatively, you can pay \$3 an hour (which is significantly cheaper than the \$12 an hour charged by Kinko's and many others for using regular desktop computers). McDonald's will eventually offer the program in thousands of its restaurants (watch for the window sign on the restaurants, that will combine McDonald's arches with an "at" (B) symbol). With tens of thousand McDonald's restaurants worldwide, this service can greatly help travelers accessing the Internet. Furthermore, if you have an Internet access via AOL or other ISPs, you will get the services free, even without buying the value meal.
- Similarly, Panera Bread Company has added hotspots in many of its restaurants in St. Louis, Missouri, where Panera is headquartered. The addition of hotspots is a marketing tactic aimed at attracting customers.
- Using wireless ticketing system, Universal Studios in Hollywood is shortening the waiting lines for tickets at its front gate. The ticket sellers, armed with Wi-Fi-enabled devices and belt-mounted printers, not only sell tickets but also provide information. For details, see Scanlon (2003).

- CVS Corp., the largest retail pharmacy in the United States, uses Wi-Fi-based devices throughout its 4,100 stores. The handheld computers support a variety of in-store applications, including direct store delivery, price management, inventory control, and receiving. Benefits include faster transfer rates, increasing productivity and performance, reduced cost, and improved customer service. For details see *symbol.com*, 1998.

BARRIERS TO COMMERCIAL WI-FI GROWTH. Two factors are standing in the way of Wi-Fi market growth: cost and security. First, some analysts question why anyone would pay \$30 a month, \$7.95 a day, or any other fee for Wi-Fi access when it is readily available in many locations for free. Because it's relatively inexpensive to set up a wireless access point that is connected to the Internet, a number of businesses offer their customers Wi-Fi access without charging them for the service. In fact, there is an organization, *Freenetworks.org*, aimed at supporting the creation of free community wireless network projects around the globe. In areas like San Francisco, where there is a solid core of high-tech professionals, many "gear heads" have set up their own wireless hotspots that give passersby free Internet connections. This is a part of a new culture known as *war chalking* and *war driving* (see *A Closer Look 6.1*).

One of the primary aims of people engaged in war driving is to highlight the lax security of Wi-Fi hotspots. This is the second barrier to widespread acceptance of Wi-Fi. Using radio waves, Wi-Fi can be interrupted by walls (resulting in poor quality at times), and it is difficult to protect. Wi-Fi does have a built-in security system, known as *Wireless Encryption Protocol (WEP)*, which encrypts the communications between a client machine (laptop or PDA) and a wireless access point. However, WEP provides weak encryption, meaning that it is secured against casual hacking as long as the person setting up the network remembers



A CLOSER LOOK

6.1 WAR CHALKING AND WAR DRIVING

Free Wi-Fi Internet hubs are marked in some places by symbols on sidewalks and walls to indicate nearby wireless access. This practice is called *war chalking*. It was inspired by the practice of hobos during the Great Depression who used chalkmarks to indicate which homes were friendly.

A number of people have also made a hobby or sport out of war driving. *War driving* is the act of locating wireless local area networks while driving around a city or elsewhere (see *wardriving.com*). To war drive, you need a vehicle, a computer or PDA, a wireless card, and some kind of an antenna that can be mounted on top of or positioned inside the car. Because a WLAN may have a range

that extends beyond the building in which it is located, an outside user may be able to intrude into the network, obtain a free Internet connection, and possibly gain access to important data and other resources. The term war driving was coined by computer security consultant Peter Shipley and derives from the term *war dialing*, a technique in which a hacker programs his or her system to call hundreds of phone numbers in search of poorly protected computer dial-ups. The term war dialing in turn came from the movie *WarGames*, which features Matthew Broderick performing the technique.

Source: Compiled from Kellner (2003).



Mobile Computing and M-Commerce Security Issues

to turn on the encryption. Unfortunately, many small businesses owners and homeowners with wireless LANs fail to do just that. For more on WEP, see Online File W6.3.

In 2001 a hacker sent an e-mail message to 13 million users of the i-mode wireless data service in Japan. The message had the potential to take over the recipient's phone, causing it to dial Japan's emergency hotline (1-1-0). NTT Docomo, which provides the i-mode service, rapidly fixed the problem so no damage was done. At the beginning of 2002, researchers in Holland discovered a bug in the operating system used by many Nokia phones that would enable a hacker to exploit the system by sending a malformed SMS message capable of crashing the system. Again, no real damage was done.

Today, most of the Internet-enabled cell phones in operation are incapable of storing applications and, in turn, incapable of propagating a virus, worm, or other rogue program from one phone to another. Most of these cell phones also have their operating systems and other functionalities "burned" right into the hardware. This makes it difficult for a rogue program to permanently alter the operation of a cell phone. However, as the capabilities of cellular phones increase and the functionality of PDAs and cell phones converge, the threat of attack from malicious code will certainly increase.

Just because a mobile device is less susceptible to attack by malicious code does not mean that m-commerce is more secure than e-commerce in the wired world. By their very nature mobile devices and mobile transactions produce some unique security challenges. See Raina and Harsh, 2002, and Online File W6.4.

Because m-commerce transactions eventually end up on a wired Internet, many of the processes, procedures, and technologies used to secure e-commerce transactions can also be applied in mobile environments. Of particular importance is the *public key infrastructure* (see Chapter 5 Online Files). The security approaches that apply directly to mobile devices and networks are presented in Online File W6.5.



Voice Systems for M-Commerce

The most natural mode of human communication is voice. When people need to communicate with each other from a distance, they use the telephone more frequently than any other communication device. Voice communication can now also be done on the computer using a microphone and a sound card. As computers are getting better at recognizing and understanding the human voice, voice systems are improving and the number and types of voice technology applications are growing. (For further discussion of voice recognition, see Kumagai, 2002, and Chapter 12 of this book.)

Voice technologies have various advantages: The most obvious one is portability; users do not have to go to a stationary computer. The hands- and eyes-free operations of voice technologies increase the productivity, safety, and effectiveness of mobile computer users, ranging from forklift drivers to military pilots. Also, for those users in dirty or moving environments, voice terminals operate better than keyboards because they are more rugged. Voice technologies also enable disabled people to tell a computer to perform various tasks. Another advantage is speed; people can communicate about two-and-a-half times faster talking than typing. In most circumstances, speaking also results in fewer data

entry errors than does keyboard data entry, assuming a reliable voice recognition system is used.

Voice and data can work together to create useful applications. For example, operators of PBXs (private branch exchanges, which are basically the command center of intracompany phone systems) are letting callers give simple computer commands using interactive voice response (e.g., spelling the last name of the person one is calling).

VOICE PORTALS. A **voice portal** is a Web site with an audio interface. Voice portals are not really Web sites in the normal sense because they are accessed through a standard or a cell telephone. A certain phone number connects you to a participating Web site where you can request information verbally. The system finds the information, translates it into a computer-generated voice reply, and tells you what you want to know. (See the demo at *3iobile.com*.) Several of these new sites are in operation. An example of this application is the voice-activated 511 traveler information line developed by Tellme.com (see Chapter 1). *Tellme.com* and *bevocal.com* allow callers to request information about weather, local restaurants, current traffic, and other handy information (see Kumagai, 2002).

In addition to retrieving information, some sites provide true interaction. *iPing.com* is a reminder and notification service that allows users to enter information via the Web and receive reminder calls. In addition, *iPing.com* can call a group of people to notify them of a meeting or conference call.

The real value for Internet marketers is that these voice portals can help businesses find new customers. Several of these sites are supported by ads; thus, the customer profile data they have available can deliver targeted advertising very precisely. For instance, a department-store chain with an existing brand image can use short audio commercials on these sites to deliver a message related to the topic of the call.

With the development of technical standards and continuing growth of wireless technologies, the number of m-commerce applications is growing rapidly. Applications are derived from providing wireless access to existing B2C, intrabusiness, and CRM applications and from creating new location-based and SMS-based applications. In Sections 6.3 through 6.8 of this chapter, we will study m-commerce applications in a number of diverse categories.

6.3 MOBILE APPLICATIONS IN FINANCIAL SERVICES

Mobile financial applications include banking, wireless payments and micropayments, wireless wallets, bill payment services, brokerage services, and money transfers. While many of these services are simply a subset of their wire-line counterparts, they have the potential to turn a mobile device into a business tool, replacing banks, ATMs, and credit cards by letting a user conduct financial transactions with a mobile device, any time and from anywhere. In this section we will look at some of the most popular mobile applications in financial services.

Mobile Banking Throughout Europe, the United States, and Asia, an increasing percentage of banks offer mobile access to financial and account information. For instance,



Merita Bank in Sweden pioneered many services (Sadeh, 2002); Citibank has a diversified mobile banking service. Consumers in such banks can use their mobile handsets to access account balances, pay bills, and transfer funds using SMS. The Royal Bank of Scotland uses a new mobile payment service (Lipset, 2002), and Banamex, one of the Mexico's largest banks, is a strong provider of wireless services to customers. Many banks in Japan allow for all banking transactions to be done via cell phone. In the same vein, a study of banks in Germany, Switzerland, and Austria found that over 60 percent offered some form of mobile financial services (Hornberger and Kehlenbeck, 2002).

To date, though, the uptake of mobile banking has been minimal. Yet surveys indicate there is strong latent demand for these offerings; customers seem to be waiting for the technology and transmission speeds to improve. The same picture holds true for other mobile financial applications like mobile brokering, insurance, and stock market trades.

Wireless Electronic Payment Systems

Wireless payment systems transform mobile phones into secure, self-contained purchasing tools capable of instantly authorizing payments over the cellular network. In Italy, for example, DPS-Promatic has designed and installed the first parking meter payable by mobile telephone (DPS-Promatic, 2002). In the United States, Cellbucks offers a mobile payment service to participating sports stadiums that enables fan to purchase food, beverages, and merchandise by cell phone and have it delivered to their seats. Any fan who is a member of the Cellbucks Network can dial a toll-free number provided on a menu of choices, enter his or her pass code and seat location, then select numbered items that correspond to desired menu selections. Once authorized, the purchase is passed on to stadium personnel and is in turn delivered to the fan's seat. An e-mail detailing the transaction is sent to the fan as further confirmation of the order. In Europe and Japan buying tickets to movies and other events are popular (Sadeh, 2002).

Micropayments

If you were in Frankfurt, Germany, and took a taxi ride, you could pay the taxi driver using your cell phone. As discussed in Chapter 5, electronic payments for small-purchase amounts (generally less than \$10) are called *micropayments*. The demand for wireless micropayments systems is fairly high. An A.T. Kearney study (CyberAtlas, 2002) found that more than 40 percent of mobile phone users surveyed would like to use their mobile phone for small cash transactions such as transit fares or vending machines. The desire for such service was highest in Japan (50 percent) and lowest in the United States (38 percent). The percentage of mobile phone users who had actually used their phones for this purpose was only 2 percent, reflecting the fact that very few vendors participate in micropayments systems.

An Israeli firm, TeleVend, Inc. (*televend.com*), has pioneered a secure platform that allows subscribers to make payments using mobile phones of any type on any cellular infrastructure. A customer places a mobile phone call to a number stipulated by the merchant, to authorize a vending device to dispense the service. Connecting to a TeleVend server, the user selects the appropriate transaction option to authorize payment. Billing can be made to the customer's bank or credit card account or to the mobile phone bill.

Micropayment technology has wide-ranging applications, such as making payments to parking garages, restaurants, grocery stores, and public transportation. The success of micropayment applications, however, ultimately depends on

the costs of the transactions. Transaction costs will be small only if there is a large volume of transactions.

Mobile (Wireless) Wallets

An *e-wallet* (see Chapter 5) is a piece of software that stores an online shopper's credit card numbers and other personal information so that the shopper does not have to reenter that information for every online purchase. In the recent past, companies like SNAZ offered **mobile wallet (m-wallet, also known as wireless wallet)** technologies that enabled cardholders to make purchases with a single click from their mobile devices. While most of these companies are now defunct, some cell phone providers have incorporated m-wallets in their offerings. A good example is the Nokia wallet. This application provides users with a secure storage space in their phones for information (such as credit card numbers) to be used in mobile payments. The information can also be used to authenticate transactions by signing them digitally. Microsoft is about to offer its e-wallet, Passport, in a wireless environment.

Wireless Bill Payments

In addition to paying bills through wireline banking, or from ATMs (see Chapter 5), a number of companies are now providing their customers with the option of paying their bills directly from a cell phone (Lipset, 2003). HDFC Bank of India (*hdfcbank.com*), for example, allows customers to pay their utility bills through SMS. An example of how bill payments can be made using a mobile device is shown in Figure 6.4. This service is offered by Nordea, a pioneering provider of wireless banking services in Scandinavia.

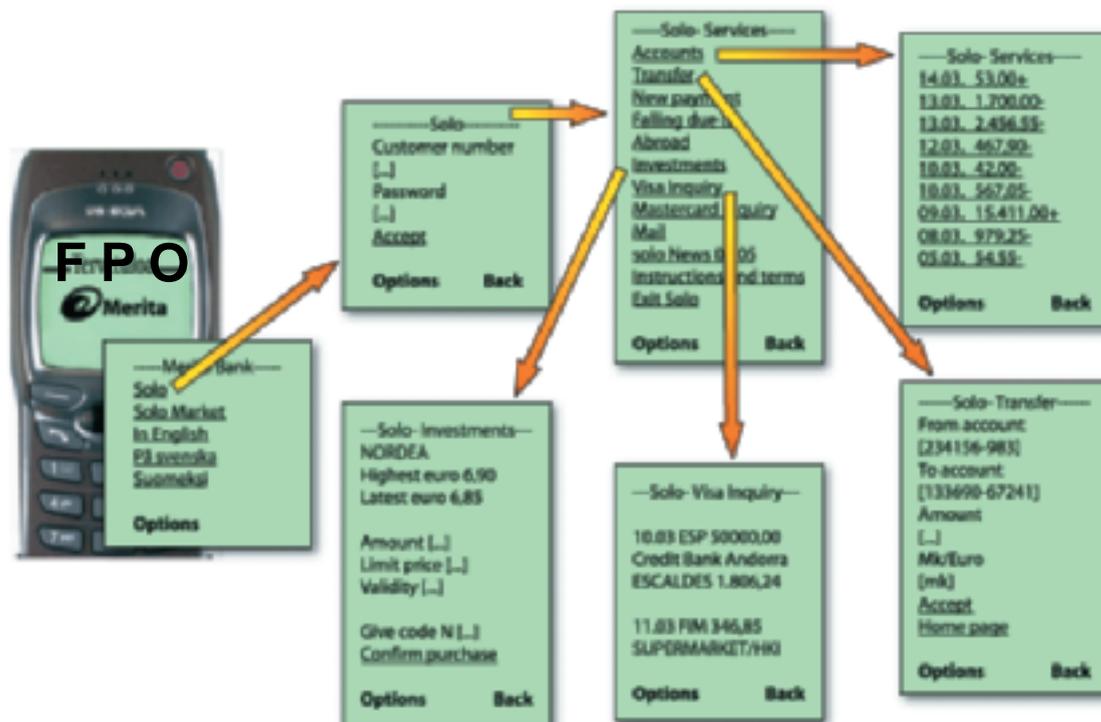


FIGURE 6.4 Nordea's WAP Solo Banking Portal. (Source: Sadeh (2002).)

6.4 MOBILE SHOPPING, ADVERTISING, AND CONTENT-PROVIDING

Like EC, m-commerce B2C applications are concentrated in three major areas—retail shopping, advertising, and providing content for a fee (see Rupp and Smith, 2002).

Shopping from Wireless Devices

An increasing number of online vendors allow customers to shop from wireless devices. For example, customers who use Internet-ready cell phones can shop at certain sites such as *mobile.yahoo.com* or *amazon.com*. Shopping from wireless devices enables customers to perform quick searches, compare prices, use a shopping cart, order, and view the status of their order using their cell phones or wireless PDAs. Wireless shoppers are supported by services similar to those available for wire-line shoppers.

An example of restaurant food shopping from wireless devices is that of a joint venture between Motorola and Food.com. The companies offer restaurant chains an infrastructure that enables consumers to place an order for pick up or delivery virtually any time, anywhere. Donatos Pizzeria was the first chain to implement the system in 2002.

Cell phone users can also participate in online auctions. For example, eBay offers “anywhere wireless” services. Account holders at eBay can access their accounts, browse, search, bid, and rebid on items from any Internet-enabled phone or PDA. The same is true for participants in Amazon.com Auctions.

An example of purchasing movie tickets by wireless device is illustrated in Figure 6.5. Notice that the reservation is made directly with the merchant. Then money is transferred from the customer’s account to the merchant’s account.

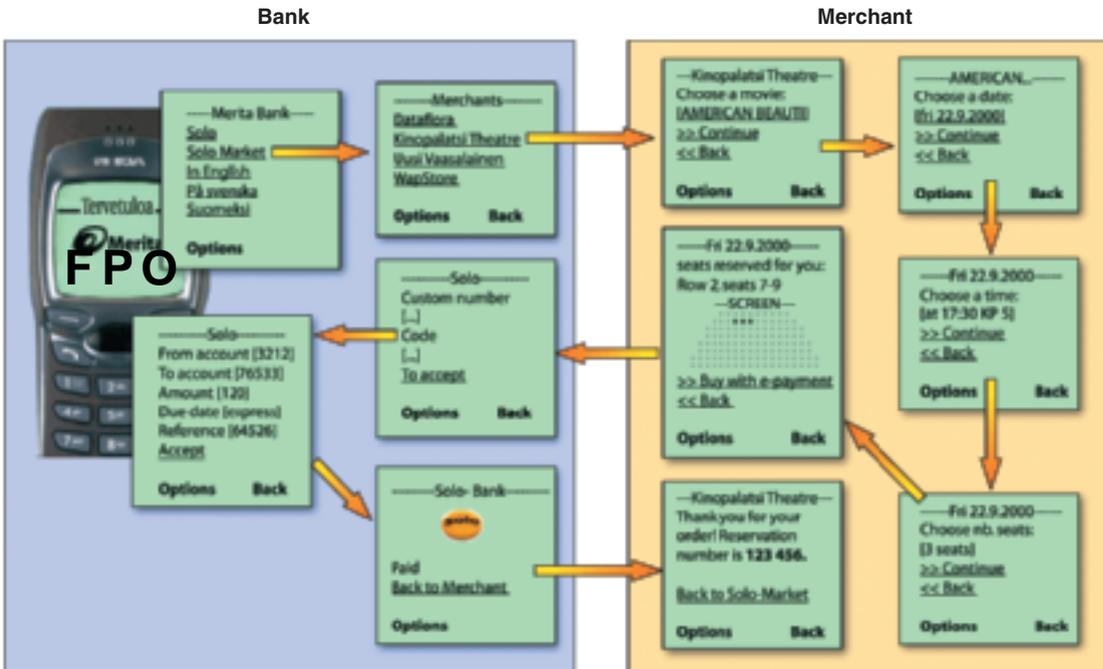


FIGURE 6.5 Purchasing Movie Tickets with WAP Solo. (Source: Sadeh (2002).)



A CLOSER LOOK

6.2 WIRELESS ADVERTISING IN ACTION

The following are a few examples of wireless advertisement in action.

Vindigo.com (*vindigo.com*) has a large database of customers (over 600,000 in early 2003) willing to accept promotional materials on their wireless devices. This is known as *permission marketing*. The users download special software on their PDAs that allows Vindigo.com to deliver timely, accurate information about places to go and things to do in their area. Along with every listing, the company can deliver a customized message to the users at a time and place where it is of most interest to them and they are most likely to act on it.

The company targets ads by city (New York, San Francisco, Los Angeles, etc.) and channel (Eat, Shop, or Play). Vindigo.com tracks which ads a user sees and selects, and even allows a user to request information from an advertiser via e-mail. Vindigo.com determines a user's location through GPS or by asking which neighborhoods they want to be matched with. For example, if you own an Italian restaurant chain, you can use Vindigo.com to send a message to anyone looking for Italian food within a few blocks of one of your locations. You can give them directions to that restaurant

and even offer them the list of specials on the menu and discounts.

MyAvantGo.Com (*avantgo.com*) has over 2,500 content channels and over 7 million registered users (AvantGo, 2002). The content is delivered to PDAs and handsets running Palm or PocketPC operating systems. My Avantgo's offers an m-business channel and direct promotions to deliver advertising from some of the world's top brands including American Airlines, Chevy Trucks, the Golf Channel, CNN, the New York Times, and Yahoo. For details see Stanford (2002).

Hoping to become the king of location-based Web domains, Go2Online (*go2online.com*) helps mobile travelers find everything from lodging (choose *go2hotels*) to Jiffy Lube stations (choose *go2oilchanges*). Partnering with Sprint, Nextel, Verizon, and BellSouth, Go2 makes its services available on every Web-enabled phone, Palm i705, and BlackBerry RIM pager in America. Entering "JiffyLube" or hundreds of other brand names into the Go2 system will bring up the nearest location where a shopper can find that product or service.

Sources: Compiled from the Web sites of Vindigo.com, AvantGo.com, and GO2Online.com.

Targeted Advertising

Knowing the current location of mobile users (using GPS) and their preferences or surfing habits, marketers can send user-specific advertising messages to wireless devices. Advertising can also be location-sensitive, informing a user about shops, malls, and restaurants close to where a potential buyer is. SMS messages and short paging messages can be used to deliver this type of advertising to cell phones and pagers, respectively. Many companies are capitalizing on targeted advertising, as shown in *A Closer Look 6.2*.

As more wireless bandwidth becomes available, content-rich advertising involving audio, pictures, and video clips will be generated for individual users with specific needs, interests, and inclinations. Also, depending on the interests and personality types of individual mobile users, the network provider may consider using "push" or "pull" methods of mobile advertising on a per user basis or to a class of users (market segmentation). The number of ads pushed to an individual customer should be limited, to avoid overwhelming a user with too much information and also to avoid the possibility of congestion over the wireless networks. Wireless network managers may consider ad traffic to be of a lower priority compared with ordering or customer interaction. Finally, since ad pushers need to know a user's current location, a third-party vendor may be used to provide location services. This will require a sharing of revenues with



a location service provider. A futuristic area of advertisement, which is based on GPS tracking, is described in Section 6.8.

GETTING PAID TO LISTEN TO ADVERTISING. Would you be willing to listen to a 10-second ad when you dial your cell phone if you were paid 2 minutes of free long-distance time? As in the wire-line world, some consumers are willing to be paid for exposure to advertising. It depends on which country you are in. In most places where it was offered in the United States, this service was a flop and was discontinued.

In Singapore, though, getting paid to listen to advertising works very well. Within a few months of offering the ads, more than 100,000 people subscribed to the free minutes in exchange for listening to the ads offered by SingTel Mobile (Eklund, 2001). Subscribers to SingTel's service fill out a personal questionnaire when they sign up. This information is fed into the Spotcast database and encrypted to shield subscribers' identities—Spotcast cannot match phone numbers to names, for example. To collect their free minutes—one minute per call, up to 100 minutes a month—subscribers dial a four-digit code, then the phone number of the person they want to talk to. The code prompts SingTel to forward the call to Spotcast and, in an instant Spotcast's software finds the best ad to send to the subscriber based on the subscriber's profile.

THE FUTURE OF WIRELESS ADVERTISING. In 2002, the Yankee Group concluded that the U.S. wireless advertising market would be worth only \$10 million by 2004, substantially below earlier estimates that pegged the market at \$130 million by that year (Yankee Group, 2002). By 2003 almost all wireless advertising initiatives have been merely trials. As the Yankee Group noted, the most promising avenues of success for wireless advertising will incorporate it with other advertising media (e.g., hardcopy advertising that directs consumers to wireless or mobile ads offering incentives) or wireless ads directing users to Web sites or physical locations. According to the Yankee Group, many wireless advertising firms are betting their futures on the wide-scale acceptance of SMS, even in the United States where its usage currently is small.

Mobile Portals

A **mobile portal** is a customer channel, optimized for mobility, that aggregates and provides content and services for mobile users (see Bughin et al., 2001; Sadeh 2002; and Chapter 4 for additional discussion of portals). Examples of best "pure" mobile portals (those whose only business is to be a mobile portal) are Room 33 (*room33.com*) in Europe and *zed.com* from Sonera in Finland. Nordea's Solo banking portal was illustrated in Figure 6.4. The world's most-known mobile portal, with over 40 million members, mostly in Japan, is i-mode from DoCoMo.

The services provided by mobile portals include news, sports, e-mail, entertainment, and travel information, restaurants and event information, leisure-related services (e.g., games, TV and movie listings), community services, and stock trading. A sizeable percentage of the portals also provide downloads and messaging, music-related services, and health, dating, and job information. Mobile portals frequently charge for their services. For example, you may be asked to pay 50 cents to get a weather report over your mobile phone. Alternatively, you may pay a monthly fee for the portal service and get the report free any time you want it. In Japan, for example, i-mode generates revenue mainly from subscription fees.



Increasingly, the field of mobile portals is being dominated by a few big companies (Global Mobile Suppliers Association, 2002). The big players in Europe, for instance, are companies like Vodafone, Orange, O2, and T-Mobile; in the United States big players are Cingular, Verizon, and Sprint PCS. Also, mobile-device manufacturers offer their own portals (e.g., Club Nokia portal, my Palm portal). And, finally, the traditional portals (such as Yahoo, AOL, and MSN) have mobile portals as well.

6.5 MOBILE INTRABUSINESS AND ENTERPRISE APPLICATIONS

Although B2C m-commerce is getting considerable publicity, most of today's applications are used within organizations. According to Estrada, 2002, employees connected to Wi-Fi increase their productivity by up to 22 percent due to better and faster connectivity. This section looks at how mobile devices and technologies can be used *within* organizations.

Support of Mobile Workers

Mobile workers are those working outside the corporate premises. Examples of mobile workers are salespeople in the field, traveling executives, telecommuters, people working in corporate yards and warehouses, and repair or installation employees who work at customers' sites or on utility lines. These mobile workers need the same corporate data available to employees working inside the company's offices. Yet, using wire-line devices, even portable ones, may be inconvenient or impossible when employees are away from their offices.

The solution is a myriad of smaller, simple wireless devices—the smartphones and handheld companions carried by mobile workers and the in-vehicle information systems installed in cars. Many of these wireless devices are wearable.

WEARABLE DEVICES. Employees who work on buildings, electrical poles, or other difficult-to-climb places may be equipped with a special form of mobile wireless computing devices called **wearable devices**. Examples of wearable devices include:

- **Camera.** A camera is mounted on a safety hat. Workers can take digital photos and videos and transmit them instantly to a portable computer nearby. Photo transmission to a wearable device or computer is made possible via Bluetooth technology.
- **Screen.** A computer screen is mounted on a safety hat, in front of the wearer's eyes, displaying information to the worker.
- **Keyboard.** A wrist-mounted keyboard enables typing by the other hand. (Wearable keyboards are an alternative to voice recognition systems, which are also wireless).
- **Touch-panel display.** In addition to the wrist-mounted keyboard, mobile employees can use a flat-panel screen, attached to the hand, which responds to the tap of a finger or stylus.
- **Speech translator.** For those mobile employees who do not have their hands free to use a keyboard, a wearable speech translator is handy (see Smailagic et al., 2001).

For an example of wearable devices used to support mobile employees, see *IT At Work 6.1* and wearable.com.au.



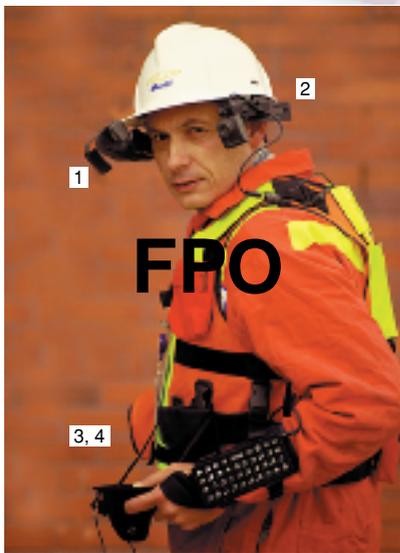
IT At Work 6.1

WEARABLE DEVICES FOR BELL CANADA WORKERS



For years mobile employees, especially those who had to climb trees, electric poles, or tall buildings, were unable to enjoy the new technologies designed to make employees work or feel better. Thus, their productivity and comfort were inferior, especially where computers were involved. That is all beginning to change.

On a cold, damp November day in Toronto, Chris Holm-Laursen, a field technician with Bell Canada (*bell.ca*), is



out and about as usual, but this time with a difference: A small but powerful computer sits in a pocket of his orange mesh vest, a keyboard is attached to the vest's upper-left side, and a flat-panel display screen hangs by his waist. A video camera attached to his safety hat enables him to take pictures without using his hands and send them immediately to the office. A cell phone is

attached as well, connected to the computer. A battery pack to keep everything going sits against his back. (See nearby photo.)

Holm-Laursen and 18 other technicians on this pilot project were equipped like this for 10 weeks during fall

2000. By summer 2003 an increasing number of Bell Canada's employees have been equipped with similar devices. The wearable devices enabled the workers to access work orders and repair manuals wherever they were. These workers are not typical of the group usually most wired up, that is, white-collar workers. The hands-free aspect and the ability to communicate anytime, from anywhere, represent major steps forward for these utility workers. A wide variety of employees—technicians, medical practitioners, aircraft mechanics, and contractors—are using or testing such devices.

So far, only a few companies make and sell wearables for mobile workers. Bell Canada's system was developed by Xybernaut, a U.S. company that in 2002 had more than a thousand of its units in use around the world, some in operation and others in pilot programs (see *xybernaut.com*, 2003). Minneapolis-based ViA is another supplier, most of whose systems are belt-worn (*bell.ca*). Meanwhile, Bell Canada was impressed with the initial results, and is equipping most of its technicians with wearable.

Of course, a practical problem of wearable devices in many countries is the weather: What happens when the temperature is minus 50 degrees or the humidity is 99 percent? Other potential problems also exist: If you are wearing thick gloves, how can you use a keyboard? If it is pouring rain, will the battery short circuit? Various solutions are being developed, such as voice input, tapping on a screen instead of typing, and rainproof electrical systems.

For Further Exploration: What are some other industrial applications of similar wearable devices? How do you think wearable devices could be used in entertainment?

Sources: Compiled from XyberFlash, 2000, and *xybernaut.com*, 2003.

JOB DISPATCH. Mobile devices are becoming an increasingly integral part of groupware and workflow applications. For example, non-voice mobile services can be used to assist in dispatch functions—to assign jobs to mobile employees, along with detailed information about the task. The target areas for mobile delivery and dispatch services include the following: transportation (delivery of food, oil, newspapers, cargo, courier services, tow trucks); taxis (already in use in Korea and Singapore); utilities (gas, electricity, phone, water); field service (computer, office equipment, home repair); health care (visiting nurses, doctors, social services); and security (patrols, alarm installation).

A dispatching application for wireless devices allows improved response with reduced resources, real-time tracking of work orders, increased dispatcher



IT At Work 6.2

U.S. FLEET SERVICES AND WIRELESS NETWORKING



Started in 1997, U.S. Fleet Services URL (*usfleet.com*) has grown to be the leading provider of mobile, onsite fueling in the United States with customers such as FedEx, Home Depot, Coca-Cola, Nabisco, and Office Max. Using trucks that resemble home fuel-delivery vehicles, U.S. Fleet travels to its customers, refueling the customers' vehicles onsite, usually during off-hours. In 1999 U.S. Fleet considered building a wireless network for its drivers, but decided against it. Managers considered the project too hard and too expensive given the expected return on investment. However, toward the end of 2001, they changed their minds.

While a mobile wireless solution was the end goal, the first step in the project actually involved the implementation of an ERP system. This was followed by a Web-based application built on top of the ERP that provided customers with information about their fuel consumption and local gas taxes, enabling them to do better fleet management. Finally, U.S. Fleet equipped its drivers with handheld devices that could communicate with the company's intranet using Wi-Fi.

The handheld device U.S. Fleet selected was the Intermec 710 (*intermec.com*). Besides having a built-in barcode scanner, this device also runs Microsoft's Pocket PC operating system, supports Visual Basic programs, handles CompactFlash cards, and has an integrated wireless radio for short range Wi-Fi communications. The device is fairly lightweight with a drop-resistant case that is sealed to protect against harsh weather conditions.

The way the system works is this: Branch managers enter a delivery route and schedule for each driver into a centralized database via the company's intranet. Each driver starts his or her shift by downloading the route and

schedule over the company's Wi-Fi network into a handheld. When the driver reaches a customer stop, the handheld is used to scan a barcode attached to the customer's truck. This provides the driver with the type of fuel required by the truck. After the truck is fueled, a meter on the delivery truck sends a wireless signal to the handheld. The handheld then syncs with the meter, capturing the type and quantity of fuel delivered. The data are stored on the handheld's CompactFlash memory card. When the driver returns to the home base, the data are unloaded over the Wi-Fi network to the central database. At this point, the data are available for U.S. Fleet and its customers to analyze using business intelligence tools.

Before the handhelds were deployed, drivers would record the data manually. The data were then faxed from the branch offices to headquarters and entered by hand into the system. Not only were there delays but the data were also subject to entry errors at both ends of the line. Now, the company and its customers have accurate data in a timely fashion, which provides the company with faster invoicing and cash flow. On average, the new system has also enabled drivers to service six to seven more stops per shift.

For Further Exploration: What systems did U.S. Fleet put in place before implementing its wireless solution? Why did U.S. Fleet select the device? How does the Intermec 710 handheld device communicate with the company's intranet? What are the major benefits that U.S. Fleet has realized by combining handheld devices with Wi-Fi?

Sources: Compiled from Ludorf, 2002, *intermec.com* 2001, and *usfleet.com* 2003.

efficiency, and a reduction in administrative work. AirIQ (*edispatch.com*), for example, offers an interesting solution. AirIQ's OnLine system combines Internet, wireless, GPS, digital mapping, and intelligent information technologies. The system tracks vital information about a vehicle's direction, speed, and location which is provided by a device housed in each of the vehicles being tracked. Managers can view and access information about the fleet on digital maps, monitor vehicles on the Internet, and maintain top operating condition of their fleet. AirIQ promises savings of about 30 percent in communication costs and increases in workforce efficiency of about 25 percent.

IT At Work 6.2 provides a detailed description of a job-dispatching system being used by U.S. Fleet to benefit both itself and its customers.



SUPPORTING OTHER TYPES OF WORK. Wireless devices may support a wide variety of mobile workers. The applications will surely grow as the technology matures and as workers think up new ways to apply the functions of wireless devices to their jobs. Here are three examples.

1. Tractors equipped with sensors, onboard computers, and a GPS help farmers save time, effort, and money. GPS determines the precise location of the tractor and can direct its automatic steering. Because the rows of planting resulted from GPS-guiding are more exact, the farmers save both on seeds and on fertilizers, due to minimized overlapping and spillage. Farmers can also work longer hours with the satellite-controlled steering, taking advantage of good weather, for example. Another saving is due to instant notification to the service department of any machine that breaks down. For details see Scanlon (2003).
2. Taco Bell provided its mystery shoppers (shoppers who visit restaurants to conduct a survey unknown to the owners) with handheld computers so that they can communicate more quickly with the company's headquarters. The visitors must answer 35 questions, ranging from the speed of service to food quality. Before the devices, information was provided by filling paper forms that were mailed overnight. This information was scanned into computers for processing. The information flow using the handhelds is both faster and more accurate.
3. Like e-mail, MSM can be used to bolster collaboration; because of its reach it has special applications. According to Kontzer (2003), the following are 10 applications of SMS for mobile workers: (1) alerting mobile technicians to system errors, (2) alerting mobile execs to urgent voice messages, (3) confirming with mobile sales personnel that a faxed order was received, (4) informing travelers of delays and changes, (5) enabling contract workers to receive and accept project offers, (6) keeping stock traders up to date on urgent stock activity, (7) reminding data services subscribers about daily updates, (8) alerting doctors to urgent patient situations, (9) enabling mobile sales teams input daily sales figures into corporate database, and (10) sending mobile sales reps reminders of appointments and other schedule details.

Customer Support and CRM

Supporting customers is the essence of customer relationship management (CRM) systems. Mobile access extends the reach of CRM—both inside and outside the company—to both employees and business partners on a 24/7 basis, to any place where recipients are located. According to Eklund, 2002, 12 percent of companies in the United States provided corporate users with mobile access to their CRM systems.

In the large software suites like Siebel's CRM, the two CRM functions that have attracted the most interest are sales force automation and field service. For instance, a sales person might be on a sales call and need to know recent billing history for a particular customer. Or, a field service representative on a service call might need to know current availability of various parts in order to fix a piece of machinery. It is these sorts of situations where mobile access to customer and partner data is invaluable. Two of the more recent offerings in this arena are Salesforce.com's Airforce Wireless Edition and Upshot's Alerts (*upshot.com*) (see Hill, 2002). See *A Closer Look 6.3* for descriptions of the use of mobile applications for customer support.



A CLOSER LOOK

6.3 MOBILE WORKPLACE APPLICATIONS FOR CUSTOMER SUPPORT

The following are two scenarios of wireless applications for mobile employees.

SALES SUPPORT. Linda is a member of the field sales team at Theru Tools (a fictitious company). Each day she drives out to her customers in a van stocked with products. For each sale, she has to note the customer name, the number and type of products sold, and any special discounts made. This record-keeping used to be done manually, and many errors were made, leading to customer complaints and lost sales.

Theru implemented a system using low-cost but powerful handheld wireless devices. Using Mobile Sales (an application for handhelds), accessed via the *mysap.com* Mobile Workplace, Linda and her coworkers in the field now have information at their fingertips, including updates on new products and special promotions. Linda can place orders without delay and get immediate feedback on product availability and delivery times. What's more, the system can prompt Linda as she enters orders, and it also can make plausibility checks on the orders, eliminating many of the errors associated with the manual process. It also checks to see if she is giving the right discounts to the right customer, and immediately triggers the invoicing process or prints out a receipt on the spot.

CUSTOMER SERVICE SUPPORT. Michael works for Euroblast, Inc. (another fictitious company) as a service engineer. It is his job to provide time-critical maintenance and support for the company's customers' electro-mechanical control systems. To do so, he needs to know immediately when a customer's system is faltering, what is malfunctioning, and what type of service contract is in effect.

Michael does not need to carry all of this information in his head, but instead has it in the palm of his hand. With only a few taps of a stylus, Michael accesses the *mysap.com* Mobile Workplace for all the data he requires, including the name and address of the next customer he should visit, equipment specifications, parts inventory data, and so forth.

Once he has completed the job, he can report back on the time and materials he used, and these data can be employed for timely billing and service quality analysis. In addition, his company is able to keep track of his progress and monitor any major fluctuations in activities. As a result, both Michael and his supervisors are better informed and better able to serve their customers.

Source: Compiled from SAP AG Corp. (2000) (advertisement).

Voice portal technology can also be used to provide enhanced customer service or to improve access to data for employees. For example, customers who are away from the office could use a vendor's voice portal to check on the status of deliveries to a job site. Sales people could check on inventory status during a meeting to help close a sale. There are a wide variety of CRM applications for voice portal technology. The challenge is in learning how to create the navigation and other aspects of interaction that makes customers feel comfortable with voice-access technology.

Wireless Intrabusiness Applications

Wireless applications in the non-Internet environment have been around since the early 1990s. Examples include such applications as: wireless networking, used to pick items out of storage in warehouses via PCs mounted on forklifts; delivery-status updates, entered on PCs inside distribution trucks; and collection of data such as competitors' inventories in stores and customer orders, using a handheld (but not networked) device, from which data were transferred to company headquarters each evening. (See the Maybelline minicase in Chapter 2, and the Hi-Life example in Chapter 4.)

Since then, a large number of Internet-based wireless applications have been implemented inside enterprises. Two examples of such intrabusiness applications



are described below. For other examples, see Online File W6.6 at the book's Web site.

1. Employees at companies such as Telecom Italia Mobile (Repubblica IT 2001) get their monthly pay slips as SMS messages sent to their mobile phone. The money itself is transferred electronically to a designated bank account. The method is much cheaper for the company and results in less paperwork than the old method of mailing monthly pay slips.
2. Kemper Insurance Company has piloted an application that lets property adjusters report from the scene of an accident. Kemper attached a wireless digital imaging system to a camera that lets property adjusters take pictures in the field and transmit them to a processing center (Henning, 2002; Nelson, 2000). The cameras are linked to Motorola's StarTac data-enabled cellular phone service, which sends the information to a database. These applications eliminate delays in obtaining information and in film processing that exist with conventional methods.

As just these two examples indicate, a variety of intrabusiness workflow applications are possible. Table 6.4 shows typical intrabusiness workflow applications before and after the introduction of wireless services. Some of these can be delivered on a wireless intranet; some are offered on the Internet. (For details on intrabusiness applications, see *mdsi-advantex.com* and *symbol.com*. The advantages offered by intrabusiness wireless solutions can be seen through an examination of workflow applications at *mdsi-advantex.com*.)

Mobile intrabusiness applications are very popular and are typically easier to implement than interbusiness applications, such as B2B and supply chain, discussed next.

TABLE 6.4 Intrabusiness Workflow Applications

Before Wireless	With Wireless
Work orders are manually assigned by multiple supervisors and dispatchers.	Work orders are automatically assigned and routed within minutes for maximum efficiency.
Field service technicians commute to dispatch center to pick up paper work orders.	Home-based field service technicians receive first work order via mobile terminal and proceed directly to first assignment.
Manual record keeping of time, work completed, and billing information.	Automated productivity tracking, record keeping, and billing updates.
Field service technicians call in for new assignments and often wait because of radio traffic or unavailable dispatcher.	Electronic transmittal of additional work orders with no waiting time.
Complete work orders dropped off at dispatch center at the end of the day for manual entry into the billing or tracking system. Uncompleted orders are manually distributed to available technicians. Overtime charges often result.	Technicians close completed work orders from the mobile terminals as they are completed. At the end of the shift, the technicians sign off and go home.

Source: From the publicly distributed brochure "RALI Mobile" from Smith Advanced Technology, Inc., 2001.

6.6 MOBILE B2B AND SUPPLY CHAIN APPLICATIONS

Mobile computing solutions are also being applied to B2B and supply chain relationships. Such solutions enable organizations to respond faster to supply chain disruptions by proactively adjusting plans or by shifting resources related to critical supply chain events as they occur. With the increased interest in collaborative commerce comes the opportunity to use wireless communication to collaborate along the supply chain. For this to take place, integration is needed.

An integrated messaging system is at the center of B2B communications. By integrating the mobile terminal into the supply chain, it is possible to make mobile reservations of goods, check availability of a particular item in the warehouse, order a particular product from the manufacturing department, or provide security access to obtain confidential financial data from a management information system.

One example of an integrated messaging system is wireless *telemetry*, which combines wireless communications, vehicle monitoring systems, and vehicle location devices. (Telemetry is described further in Section 6.8.) This technology makes possible large-scale automation of data capture, improved billing timeliness and accuracy, less overhead than with the manual alternative, and increased customer satisfaction through service responsiveness. For example, vending machines can be kept replenished and in reliable operation by wirelessly polling inventory and service status continually to avert costly machine downtime.

Mobile devices can also facilitate collaboration among members of the supply chain. There is no longer any need to call a partner company and ask someone to find certain employees who work with your company. Instead, you can contact these employees directly, on their mobile devices.

By enabling sales force employees to type orders straight into the ERP while at a client's site, companies can reduce clerical mistakes and improve supply chain operations. By allowing them to check production schedules and inventory levels, and to access product configuration and *available-to-promise/capacity-to-promise* (ATP/CTP) functionality to obtain real-time delivery quotes, they empower their sales force to make more competitive and realistic offers to customers. Today's ERP systems tie into broader supply chain management solutions that extend visibility across multiple tiers in the supply chain. Mobile supply chain management (mSCM) empowers the workforce to leverage these broader systems through inventory management and ATP/CTP functionality that extend across multiple supply chain partners and take into account logistics considerations.

6.7 MOBILE CONSUMER AND PERSONAL SERVICE APPLICATIONS



A large number of applications exist that support consumers and provide personal services (see Coursaris and Hassanein, 2002, and Sadeh, 2002). As an example, consider the situation of a person going to an international airport. Tasks such as finding the right check-in desk, checking for delayed flights, waiting for lost luggage, and even finding a place to eat or the nearest washroom can be assisted by mobile devices. Online File W6.7 at the book's Web site lists



12 problem areas at airports that can be solved using mobile devices. The capabilities shown in the table are now possible in some places and are expected to be more widely available by 2005.

Other consumer and personal service areas in which wireless devices can be used are described in the following sections. (See also *attws.com*.)

Mobile Games

In the handheld segment of the gaming market, Nintendo has been the long-time leader. In contrast, Nintendo has shown minimal interest in online or mobile games. Here, Sega has capitalized on the popularity of games such as Sonic the Hedgehog to garner 2.5 million Japanese subscribers for its mobile games and entertainment services (Becker, 2002). In Japan, where millions of commuters kill time during long train rides, cell phone games have become a cultural phenomenon.

With more than one billion cell phones in use today (CellularOnline, 2003), the potential audience for mobile games is substantially larger than the market for other platforms, Playstation and Gameboy included. Because of the market potential, Nokia has decided to enter the mobile gaming world, producing not only the phone/console but also the games that will be delivered on memory cards. It seeks to develop and market near-distance multiplayer gaming (over Bluetooth) and wide area gaming (using cellular networks) (Nokia, 2002).

In July of 2001 Ericsson, Motorola, Nokia, and Siemens established the Mobile Games Interoperability Forum (MGIF) (*mgif.org*) to define a range of technical standards that will make it possible to deploy mobile games across multi-game servers, wireless networks, and over different mobile devices. Microsoft is moving into this field as well.

A topic related to games is *mobile entertainment*, discussed in Online File W6.8. Mobile gambling, another related topic, is extremely popular in some countries (e.g., horse racing in Hong Kong and racing and other events in Australia). For more on mobile gambling, see *sportodds.com.au*.)



Hotels Services Go Wireless

A number of hotels now offer their guests in-room, high-speed Internet connection. Some of these same hotels are beginning to offer Wi-Fi Internet access in public areas and meeting rooms. One of these is Marriott, which manages 2,500 hotels worldwide. After a seven-month test, Marriott has partnered with STSN (*stsn.com*), an Internet service provider specializing in hotels, to provide Wi-Fi services in the 400 Marriott hotels that already have in-room broadband Internet access (Reuters, 2002). In the same vein, AT&T has partnered with Wayport Inc. to offer Wi-Fi in 475 hotels throughout the United States. In India the Taj Group is offering Wi-Fi access in its hotels (Taj Hotel, 2002), and Megabeam (a wireless provider in England) is starting to offer the same service in select Holiday Inn and Crowne Plaza hotels in London.

While Wi-Fi provides guests with Internet access, to date it has had minimal impact on other sorts of hotel services (e.g., check-in). However, a small number of hotels are testing use of the Bluetooth technology. Guests are provided with Bluetooth-enabled phones that can communicate with access points located throughout the hotel. This technology can be used for check-in and check-out, for making purchases from hotel vending machines and stores, for tracking loyalty points (see *tesalocks.com*), and for opening room doors in place of keys (Mayor, 2001). In 2001, Classwave signed a deal with Starwood Hotels



Wireless Telemedicine

Starwood Resorts worldwide to enable Bluetooth solutions within Starwood's hotels (Houck, 2001).

For a comparison of traditional and m-commerce hotel services, see Online File W6.9. These capabilities are now available only in some locations, but are expected to be widely available by 2006.

Today there are two different kinds of technology used for *telemedicine* applications: (1) storage of data and transferring of digital images from one location to another, and (2) videoconferencing used for "real-time" consultation between a patient in one location and a medical specialist in another. In most of the real-time consultations, the patient is in a rural area and the specialist is in an urban location.

There are a number of impediments to telemedicine. Some states do not allow physicians to provide medical advice across state lines. The threat of malpractice suits is another issue since there is no "hands-on" interaction between the physician and patient. In addition, from a technical standpoint, many telemedicine projects are hindered by poor telecommunications support. However, those who are looking ahead to the needs of the aging population are seeing opportunities to meet some of those needs in emerging technologies. The new wireless and mobile technologies, especially the forthcoming generation, not only offer the possibility of overcoming the hurdles imposed by remote locations but also open a number of new and novel application opportunities. Examples include the following.

- Typically, physicians write a prescription and you take it to the pharmacy where you wait 15–30 minutes for fulfillment. Instead, some new mobile systems allow physicians to enter the patient prescription onto a palm size device. That information goes by cellular modem (or Wi-Fi) to Med-i-net's (or similar companies') services. There, the information is checked for insurance eligibility and conformity to insurance company regulations. If all checks out, the prescription is transformed electronically to the appropriate pharmacy. For patients that need refills, the system tracks and notifies physicians when it is time to reorder, and the doctor can reissue a prescription with a few clicks.
- At the first warning signs of a heart attack, people are advised to contact emergency facilities as soon as possible. Manufacturers are working on wearable heart monitors linked to cell phones that can automatically contact doctors or family members at the first sign of trouble.
- The Swiss Federal Institute of Technology is designing portable devices that transmit the vital signs of avalanche victims up to 80 meters away (Baard, 2002). Not only does the device provide location information but it also provides information about body orientation that helps reduce injuries as rescuers dig for the victims.
- In-flight medical emergencies occur more frequently than one might think. Alaska Airlines, for example, deals with about 10 medical emergencies per day (Conrad, 2002). Mobile communications are already being used to attend to medical emergencies occurring on planes. MedLink, a service of MedAire in Phoenix, provides around-the-clock access to board-certified emergency physicians. These mobile services can also remotely control medical equipment, like defibrillators, located on board the plane.



- The military is involved in developing mobile telesurgery applications that enable surgeons in one location to remotely control robotic arms for surgery in another location. The technology proven to be particularly useful battle-field situations during the 2003 Iraq War.

Other Mobile-Computing Services for Consumers



Many other mobile computer services exist for consumers, in a variety of service categories. Examples include services providing news, weather, and sports reports; online language translations; information about tourist attractions (hours, prices); and emergency services. Other services for consumers are listed in Online File W6.10 at the book's Web site. Also, see the case studies at *mobileinfo.com*.

Non-Internet Mobile-Computing Applications for Consumers

Non-Internet mobile applications for consumers, mainly those using smart cards, have existed since the early 1990s. Active use of the cards is reported in transportation, where millions of "contactless" cards (also called *proximity cards*) are used to pay bus and subway fares and road tolls. Amplified remote-sensing cards that have an RF (radio frequency) of up to 30 meters are used in several countries for toll collection. *IT At Work 6.3* describes one use of proximity cards for toll collection.



IT At Work 6.3 THE HIGHWAY 91 PROJECT



Route 91 is a major eight-lane, east-west highway near Los Angeles. Traffic is especially heavy during rush hours. California Private Transportation Company (CPT) built six express toll lanes along a 10-mile stretch in the median of the existing Highway 91. The express lane system has only one entrance and one exit, and it is totally operated with EC technologies. The system works as follows.

Only prepaid subscribers can drive on the road. Subscribers receive an automatic vehicle identification (AVI) device that is placed on the rearview mirror of the car. The device, about the size of a thick credit card, includes a microchip, an antenna, and a battery. A large sign over the tollway tells drivers the current fee for cruising the express lanes. In a recent year it varied from \$0.50 in slow traffic hours to \$3.25 during rush hours.

Sensors in the pavement let the tollway computer know that a car has entered; the car does not need to slow or stop. The AVI makes radio contact with a transceiver installed above the lane. The transceiver relays the car's identity through fiber-optic lines to the control center, where a computer calculates the fee for that day's trip. The system accesses the driver's account and the fare is auto-

matically deducted from the driver's prepaid account. A monthly statement is sent to the subscriber's home.

Surveillance cameras record the license numbers of cars without AVIs. These cars can be stopped by police at the exit or fined by mail. Video cameras along the tollway also enable managers to keep tabs on traffic, for example, sending a tow truck to help a stranded car. Also, through knowledge of the traffic volume, pricing decisions can be made. Raising the price as traffic increases ensures that the tollway will not be jammed.

The system saves commuters between 40 and 90 minutes each day, so it is in high demand. An interesting extension of the system is the use of the same AVIs for other purposes. For example, they can be used in paid parking lots. Someday you may be even recognized when you enter the drive-through lane of McDonald's and a voice asks you, "Mr. Smart, do you want your usual meal today?"

For Further Exploration: What is the role of the wireless component of this system? What are the advantages of the system to commuters?

Source: *91expresslanes.com*, 2002.

6.8 LOCATION-BASED COMMERCE

As discussed in Section 6.1, **location-based commerce (l-commerce)** refers to the localization of products and services. Location-based services are attractive to both consumers and businesses alike. From a consumer's or business user's viewpoint, l-commerce offers safety (you can connect to an emergency service with a mobile device and have the service pinpoint your exact location), convenience (you can locate what is near you without having to consult a directory, pay phone, or map), and productivity (you can optimize your travel and time by determining points of interest within close proximity). From a business supplier's point of view, l-commerce offers an opportunity to provide services that meet customers' needs.

The basic l-commerce services revolve around five key areas:

- **Location:** determining the basic position of a person or a thing (e.g., car or boat).
- **Navigation:** plotting a route from one location to another.
- **Tracking:** monitoring the movement of a person or a thing (e.g., a package or vehicle).
- **Mapping:** creating maps of specific geographical locations.
- **Timing:** determining the precise time at a specific location.

L-Commerce Technologies

Providing location-based services requires the following location-based and network technologies:

- **Position Determining Equipment (PDE).** This equipment identifies the location of the mobile device (either through GPS or by locating the nearest base station). The position information is sent to the mobile positioning center.
- **Mobile Positioning Center (MPC).** The MPC is a server that manages the location information sent from the PDE.
- **Location-based technology.** This technology consists of groups of servers that combine the position information with geographic- and location-specific content to provide an l-commerce service. For instance, location-based technology could present a list of addresses of nearby restaurants based on the position of the caller, local street maps, and a directory of businesses.
- **Geographic content.** Geographic contents consists of streets, road maps, addresses, routes, landmarks, land usage, Zip codes, and the like. This information must be delivered in compressed form for fast distribution over wireless networks.
- **Location-specific content.** Location-specific content is used in conjunction with the geographic content to provide the location of particular services. Yellow page directories showing the location of specific business and services exemplify this type of content.

Figure 6.6 shows how these technologies are used in conjunction with one another to deliver location-based services. Underlying these technologies are global positioning and geographical information systems.

GLOBAL POSITIONING SYSTEM (GPS). As indicated at the start of the chapter, a **global positioning system (GPS)** is a wireless system that uses satellites to

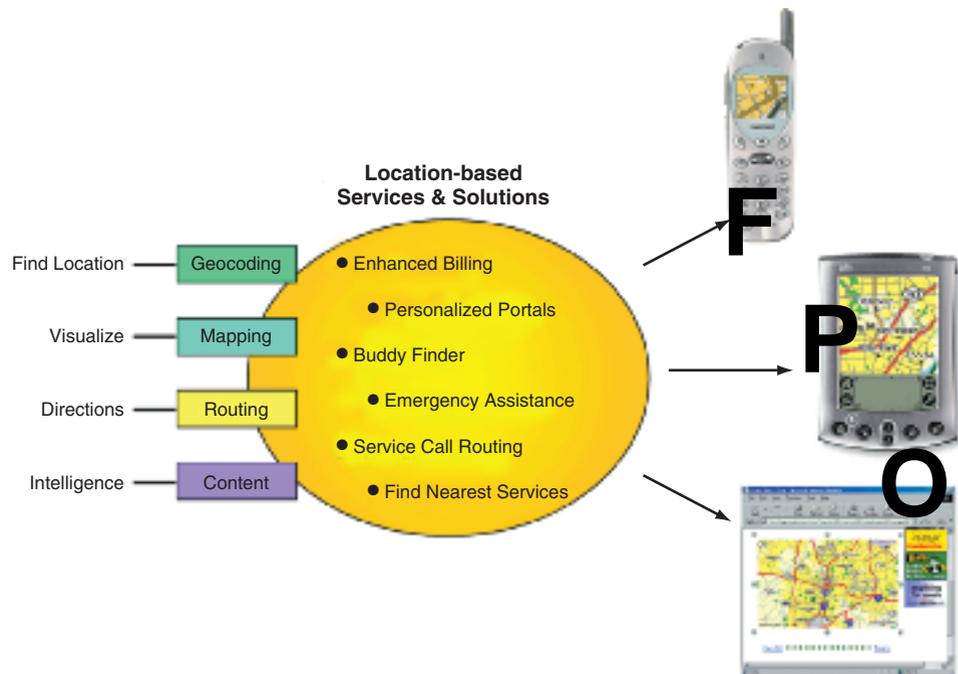


FIGURE 6.6 Location-based Services Involving Maps (Source: Mapinfo.com, 2001.)

enable users to determine their position anywhere on the earth. GPS equipment has been used extensively for navigation by commercial airlines and ships and for locating trucks and buses (as in the opening case study).

GPS is supported by 24 U.S. government satellites that are shared worldwide. Each satellite orbits the earth once every 12 hours on a precise path, at an altitude of 10,900 miles. At any point in time, the exact position of each satellite is known, because the satellite broadcasts its position and a time signal from its onboard atomic clock, which is accurate to one-billionth of a second. Receivers also have accurate clocks that are synchronized with those of the satellites.

GPS handsets can be stand-alone units or can be plugged into or embedded in a mobile device. They calculate the position (location) of the handsets (or send the information to be calculated centrally). Knowing the speed of the satellite signals (186,272 miles per second), engineers can find the location of any receiving station (latitude and longitude) to within 50 feet by *triangulation*, using the distance from a GPS to *three* satellites to make the computation. GPS software then computes the latitude and longitude of the receiver. For an online tutorial on GPS, see trimble.com/gps.

GEOGRAPHICAL INFORMATION SYSTEM (GIS). The location provided by GPS is expressed in terms of latitude and longitude. To make that information useful to businesses and consumers it is necessary in many cases to relate those measures to a certain place or address. This is done by inserting the latitude and longitude onto an electronic map, which is known as a **geographical information system (GIS)**. The GIS data visualization technology integrates GPS data onto digitized map displays. (See Steede-Terry, 2000, for an explanation of how this is done.) Companies such as mapinfo.com provide the GIS core spatial

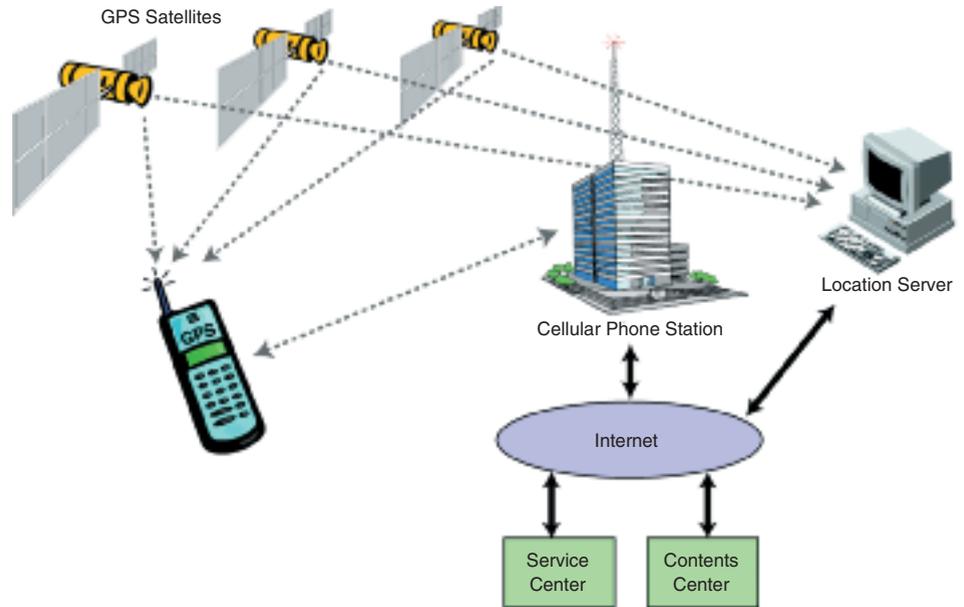


FIGURE 6.7
A Smartphone with GPS
System in L-Commerce

technology, maps, and other data content needed in order to power location-based GIS/GPS services (see Figure 6.7).

An interesting application of GPS/GIS is now available from several car manufacturers (e.g., Toyota, Cadillac) and car rental companies (e.g., Hertz, Avis). Some cars have a navigation system that indicates how far away the driver is from gas stations, restaurants, and other locations of interest. The GPS knows where the car is at any time, so the application can map the route for the driver to a particular destination. Any GPS application can be classified as *telemetry*, a topic discussed further later on.

LOCATION-BASED ADVERTISING. Imagine that you are walking near a Starbucks store, but you do not even know that one is there. Suddenly your cell phone beeps with a message: “Come inside and get a 15 percent discount.” Your wireless device was detected, and similar to the pop-up ads on your PC, advertising was directed your way (Needleman, 2002). You could use permission marketing to shield yourself from location-based advertising; if the system knows that you do not drink coffee, for example, you would not be sent a message from Starbucks.

Another use of wireless devices for advertising is described by Raskin (2003). In this case, a dynamic billboard ad will be personalized specifically for you when your car approaches a certain billboard and the system knows what you likes and preferences are. Your car will be tracked by a GPS, every 20 seconds. A computer scans the areas in which billboards are visible, and by cross-referencing information about your location and your likes, a personalized ad can be placed on the billboard so you will see it as you pass.

Yet another method of location-based advertising involves putting ads on the top of taxicabs. The add will be changed based on the taxi location. For example, a taxi cruising in the theater district in New York City might show an ad for a play or a restaurant in that area; when the cab goes to another



neighborhood, the ad might be for a restaurant or a business in the other area of the city.

E-911 Emergency Cell Phone Calls

If someone dials 911 from a regular wired phone, it is easy for the emergency 911 service to pinpoint the location of the phone. But, what happens if someone places a 911 call from a mobile phone? How can the emergency service locate the caller? A few years ago, the U.S. Federal Communication Commission (FCC) issued a directive to wireless carriers, requiring that they establish services to handle **wireless 911 (e-911)** calls. To give you an idea of the magnitude of this requirement, more than 156,000 wireless 911 calls are made every day, representing more than half the 911 calls made daily in the United States (Sarkar, 2003).

The e-911 directive is to take effect in two phases, although the specifics of the phases vary from one wireless carrier (e.g., AT&T, Cingular, Sprint, etc.) to another. Phase I requires carriers, upon appropriate request by a local *Public Safety Answering Point (PSAP)*, to report the telephone number of a wireless 911 caller and the location of the cellular antenna that received the call. Phase II, which is being rolled out over a four-year period from October 2002 to December 2005, requires wireless carriers to provide information that will enable the PSAP to locate a caller within 50 meters 67 percent of the time and within 150 meters 95 percent of the time. By the end of Phase II, 100 percent of the new cell phones and 95 percent of all cell phones will have these location capabilities. It is expected that many other countries will follow the example of the United States in providing e-911 service.

Some expect that in the future cars will have a device for **automatic crash notification (ACN)**. This still-experimental device will automatically notify the police of an accident involving an ACN-equipped car and its location. Also, following a school bus hijacking in Pennsylvania, the state legislature is considering a bill to mandate satellite tracking in all school buses.

Telematics and Telemetry Applications

Telematics refers to the integration of computers and wireless communications in order to improve information flow (see Chatterjee et al., 2002, and Zhao, 2002). It uses the principles of *telemetry*, the science that measures physical remoteness by means of wireless transmission from a remote source (such as a vehicle) to a receiving station. MobileAria (*mobilearia.com*) is a proposed standards-based telematics platform designed to bring multimedia services and m-commerce to automobiles.

Using *mobile telemetry*, technicians can diagnose maintenance problems in equipment. Car manufacturers use the technology for remote vehicle diagnosis and preventive maintenance. Finally, doctors can monitor patients and control medical equipment from a distance.

General Motors Corporation popularized automotive telematics with its OnStar system. Nokia has set up a business unit, called Smart Traffic Products, that is focusing solely on telematics. Nokia believes that every vehicle will be equipped with at least one Internet Protocol (IP) address by the year 2010. Smart cars and traffic products are discussed in more detail in Section 6.9.

Barriers to L-Commerce

What is holding back the widespread use of location-based commerce? Several factors come into play:

- **Accuracy.** Some of the location technologies are not as accurate as people expect them to be. However, a good GPS provides a location that is accurate

up to 15 meters. Less expensive, but less accurate, technologies can be used instead to find an approximate location (within about 500 meters).

- **The cost-benefit justification.** For many potential users, the benefits of l-commerce don't justify the cost of the hardware or the inconvenience and time required to utilize the service (e.g., Hamblen, 2001). After all, they seem to feel, they can just as easily obtain information the "old-fashioned" way.
- **The bandwidth of GSM networks.** GSM bandwidth is currently limited; it will be improved as 3G technology spreads. As bandwidth improves, applications will improve, which will attract more customers.
- **Invasion of privacy.** When "always-on" cell phones are a reality, a number of people will be hesitant to have their whereabouts and movements tracked throughout the day, even if they have nothing to hide. This issue will be heightened when our cars, homes, appliances, and all sorts of other consumer goods are connected to the Internet, as discussed in the next section.

6.9 PERVASIVE COMPUTING

Steven Spielberg's sci-fi thriller *Minority Report* depicts the world of 2054. Based on a 1956 short story by Philip K. Dick, the film immerses the viewer in the consumer-driven world of pervasive computing 50 years from now. Spielberg put together a three-day think tank, headed by Peter Schwartz, president of Global Business Network (*gbn.com*), to produce a realistic view of the future (Mathieson, 2002). The think tank projected out from today's marketing and media technologies—Web cookies, GPS, Bluetooth, personal video recorders, barcode scanners, and the like—to create a society where billboards beckon you by name, newspapers are delivered instantly over broadband wireless networks, holographic hosts greet you at retail stores, and cereal boxes broadcast live commercials. While the technologies in the film were beyond the leading edge, none was beyond the realm of the plausible.

A world in which virtually every object has processing power with wireless or wired connections to a global network is the world of **pervasive computing**. (The term pervasive computing also goes by the names *ubiquitous computing*, *embedded computing*, or *augmented computing*.) The idea of pervasive computing has been around for years. However, the current version was articulated by Mark Weiser in 1988 at the computer science lab of Xerox PARC. From Weiser's perspective, pervasive computing was the opposite of virtual reality. In virtual reality, the user is immersed in a computer-generated environment. In contrast, pervasive computing is invisible "everywhere computing" that is embedded in the objects around us—the floor, the lights, our cars, the washing machine, our cell phones, our clothes, and so on (Weiser, 1991, 2002).

Invisible Computing Everywhere

By "invisible," Weiser did not mean to imply that pervasive computing devices would not be seen. He meant, rather, that unlike a desktop computer, these embedded computers would not intrude on our consciousness. Think of a pair of eyeglasses. The wearer doesn't have to think about using them. He or she simply puts them on and they augment the wearer's ability to see. This is Weiser's vision for pervasive computing. The user doesn't have to think about



how to use the processing power in the object; rather, the processing power automatically helps the user perform a task.

Invisible is how you would describe some of the new embedded technology already in use at Prada's "epicenter" stores in New York, San Francisco, and Los Angeles (Duan, 2002). Prada is a high-end fashion retailer. In the company's epicenters, the items for sale have an **RFID (radio frequency identification)** tag attached. The tag contains a processor and an antenna. If a customer wants to know about a particular item, she or he can move with the item toward one of the many displays around the store. The display automatically detects the item and provides sketches, video clips of models wearing the item, and information about the item (color, cut, fabric, materials, and availability). If a customer takes a garment into one of the dressing rooms, the tags are automatically scanned and detected via an antenna embedded in the dressing room. Information about the item will be automatically displayed on an interactive touch screen in the dressing room. The dressing rooms also have a video-based "Magic Mirror." When the customer tries on the garment and turns around in front of the mirror, the images will be captured and played back in slow motion. (See Section 6.10 for a related privacy issue).

Invisible is also a term that characterizes a device manufactured and sold by FitSense Technology (*fitsense.com*), a Massachusetts developer of Internet sports and fitness monitors. With this 1-ounce device that is clipped to a shoelace, runners are able to capture their speed and the distance they have run. The device transmits the data via a radio signal to a wrist device that can capture and transmit the data wirelessly to a desktop computer for analysis. Along the same lines, Champion Chip (*championchip.com*), headquartered in the Netherlands, has developed a system that keeps track of the tens of thousands of participants in very popular long-distance races. The tracking system includes miniature transponders attached to the runners' shoelaces or ankle bracelets and antenna mats at the finish line that use radio frequencies to capture start times, splits, and finish times as the runners cross them.

Active badges can be worn as ID cards by employees who wish to stay in touch at all times while moving around the corporate premises. The clip-on badge contains a microprocessor that transmits its (and its wearer's) location to the building's sensors, which send it to a computer. When someone wants to contact the badge wearer, the phone closest to the person is identified automatically. When badge wearers enter their offices, their badge identifies them and logs them on to their personal computers.

Similarly, *memory buttons* are nickel-sized devices that store a small database relating to whatever it is attached to. These devices are analogous to a bar code, but with far greater informational content and a content that is subject to change. For example, the U.S. Postal Service is placing memory buttons in residential mailboxes to track and improve collection and delivery schedules.

For a short list of the technical foundation of pervasive computing, see Online File W6.11 at the book's Web site.



Contextual Computing and Context Awareness

Location can be a significant differentiator when it comes to advertising services. However, knowing that the user is at the corner of the street will not tell you what he or she is looking for. For this, we might need to know the time of day, or access our user's calendar or other relevant *contextual attributes*. **Context**

awareness refers to capturing a broad range of contextual attributes to better understand what the consumer needs, and what products or services he or she might possibly be interested in.

Context awareness is part of **contextual computing**, which refers to the enhancement of a user's interactions by understanding the user, the context, and the applications and information being used, typically across a wide set of user goals (see Pitkow et al., 2002 for details). Contextual computing is about actively adapting the computational environment for each user, at each point of computing.

Contextual computing and context awareness are viewed by many as the Holy Grail of m-commerce, as contextual computing ultimately offers the prospect of applications that could anticipate our every wish and provide us what the exact information and services we are looking for—and also help us filter all those annoying promotional messages that we really do not care for. Such applications are futuristic at the present time, but as shown in *IT At Work 6.4* they already exist in a research university.

Applications of Pervasive Computing

According to Estrin et al. (2000), 98 percent of all processors on the planet are not in traditional desktop computer systems, nor even in laptops. They are in household appliances, vehicles, and machines. Such existing and future applications of pervasive computing are illustrated in Figure 6.8. Notice that all 15 devices can be connected to the Internet. Several of these applications are described in the remaining of this section. We will look at four applications in particular: smart homes, smart appliances, smart cars, and smart things.

Smart Homes

In a *smart home*, your home computer, television, lighting and heating controls, home security system, and many appliances within the home can “talk” to each other via the Internet or a home intranet. These linked systems can be controlled through various devices, including your pager, cellular phone, television, home computer, PDA, or even your automobile.

In the United States, tens of thousands of homes are already equipped with home-automation devices, and there are signs that Europe—which has much lower home Internet penetration levels—is also warming to the idea. For instance, a 2001 study by the UK's Consumers' Association found that almost half those surveyed were interested in having the functions a “smart home” could offer, if they were affordable (Edgington, 2001).

Here are some of the tasks and services supported today by home automation systems:

- **Lighting.** You can program your lights to go on, off, or dim to match your moods and needs for comfort and security.
- **Energy management.** A home's HVAC (heat, ventilation, and air conditioning) system can be programmed for maximum energy efficiency and controlled with a touch panel. When you leave in the morning, your automated system calibrates to the right temperature so that you don't waste energy when you're not around. Conversely, you can get a head start in cranking up the heat or air conditioner before you get home by calling the automated system via your telephone or PDA.
- **Water control.** What if you are on a trip and the water hose to your dishwasher bursts? Watercop (watercop.com) is a device manufactured by DynaQuip Controls Corporation that can handle this situation. The device



IT At Work 6.4

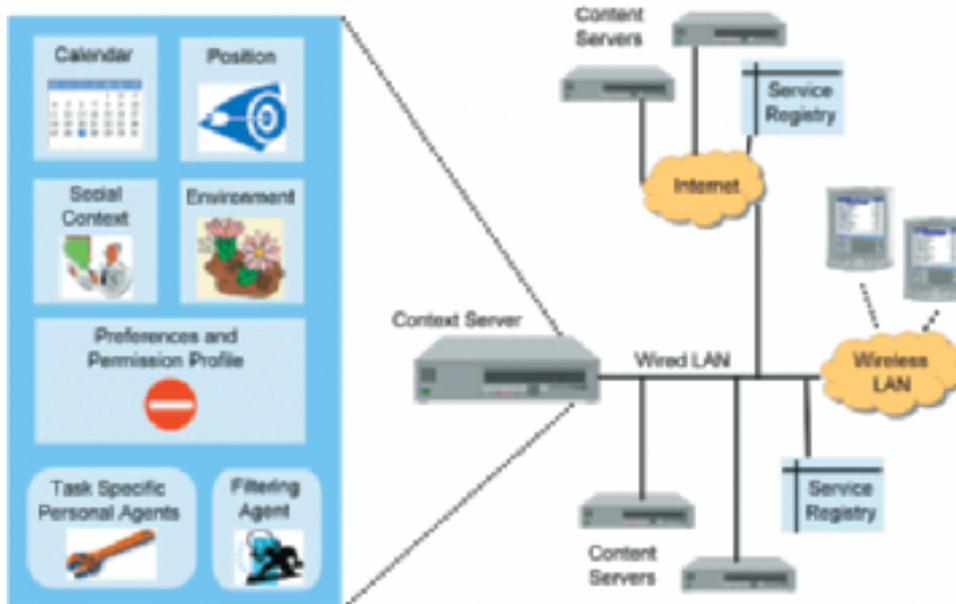
CONTEXT-AWARE ENVIRONMENT AT CARNEGIE MELLON UNIVERSITY



Carnegie Mellon University (CMU) is known for its advanced science projects including robotics and artificial intelligence. Students participate in a context-awareness experiment in the following manner: Each participating student is equipped with a PDA from which he or she can access Internet services via the campus Wi-Fi network. The students operate in a context-aware environment whose architecture is shown in the attached figure.

messages, determine what to show to the students, and when. For example, while attending classes the student may block all messages, except from her boyfriend. That is, certain messages will be shown only if the student is in a certain place and/or time; others will not be shown at all.

A user's context information can be accessed by a collection of *personal agents*, each in charge of assisting with different tasks, while locating and invoking relevant Internet services identified through services registries (see the figure).



A user's content (left of figure) includes his or her:

- Calendar information.
- Current location (position), which is regularly updated using location-tracking technology.
- Weather information, indicating whether it is sunny, raining, or snowing, and the current outside temperature (environment).
- Social context information, including the student's friends and his or her teachers, classmates, and so forth.

The preferences of each student are solicited and entered into system, as is a personal profile. This is shown as the "preferences and permissions" in the figure. All of the above information helps the system to filter incoming

An example of a simple agent is a *restaurant concierge* that gives suggestions to students about places to have lunch, depending on their food preferences, the time they have available before their next class, their location on campus, and the weather. For example, when it is raining, the agent attempts to find a place that does not require going outside of the building where the student is located. The recommendation (usually several choices) appears on the PDA, with an overall rating and a "click for details" possibility.

For Further Exploration: Does the usefulness of such a service justify the need to disclose private preferences? Can such a system be developed for consumers who are not members of a defined community such as a university?

Source: Compiled from Sadeh (2002).

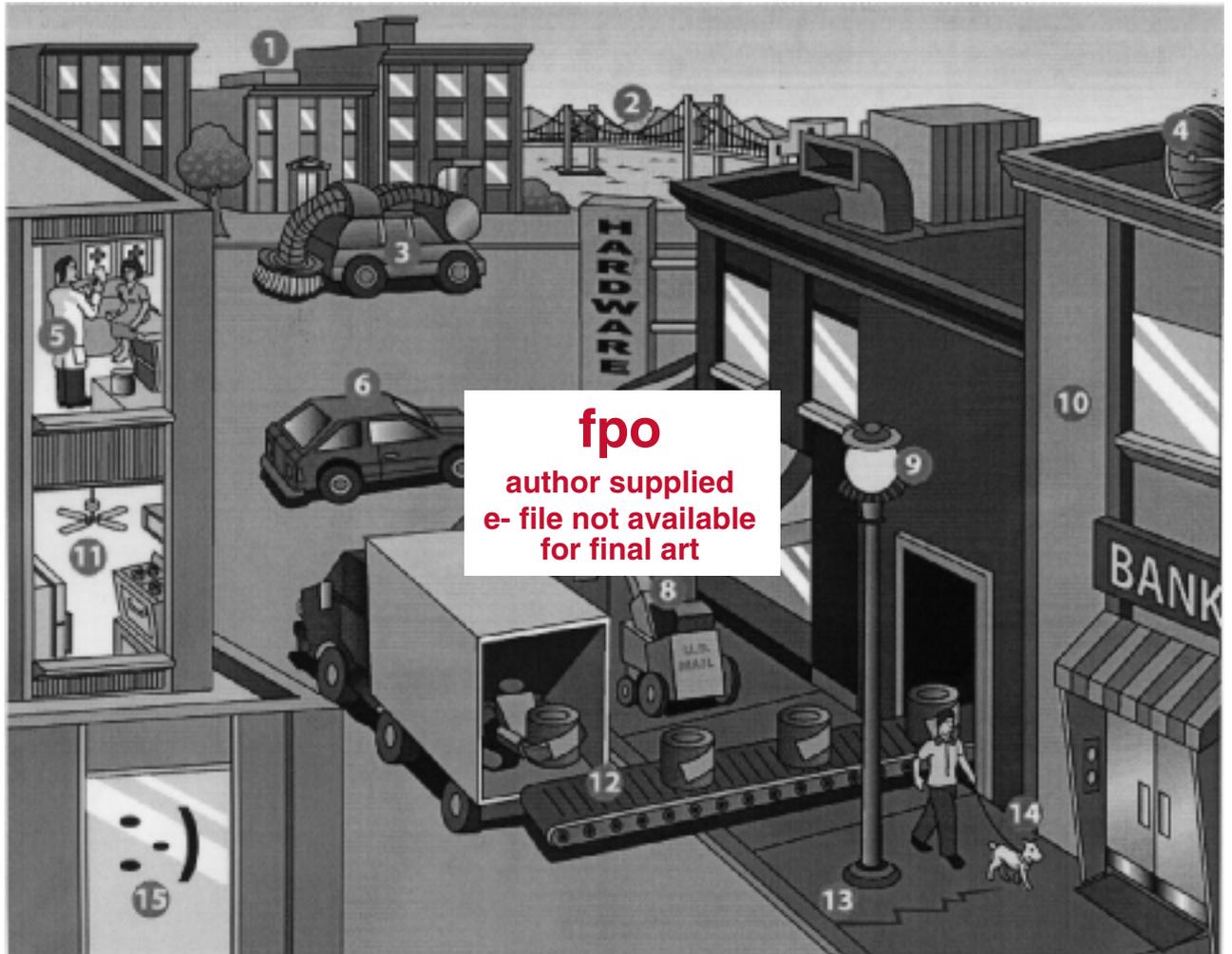


FIGURE 6.8 Embedded Computing Devices Everywhere (Source: Estrin et al., 2000, pp. 38–39.)

relies on a series of strategically placed moisture-detection sensors. When the moisture level rises in one of these sensors, it sends a wireless signal to the Watercop control unit, which turns off the main water supply.

- **Home security and communications.** The window blinds, garage doors, front door, smoke detectors, and home security systems can all be automated from a network control panel. These can all be programmed to respond to scheduled events (e.g., when you go on vacation).
- **Home theater.** You can create a multi-source audio and video center around your house that you can control with a touch pad or remote. For example, if you have a DVD player in your bedroom but want to see the same movie in your child's room, you can just click a remote to switch rooms. Ditto for the music you want to pipe into different rooms.

Analysts generally agree that the market opportunities for smart homes will take shape over the next three to five years. These opportunities are being



driven by the increasing adoption of broadband (cable and DSL) services and the proliferation of wireless local area networks (Wi-Fi) within the home and by the trend to integrate currently independent devices. Online File W6.12 shows a wireless connected house.

Smart Appliances

One of the key elements of a smart home is the *smart appliance*, an Internet-ready appliance that can be controlled by a small handheld device or desktop computer via a home intranet (wire or wireless) or the public Internet.

One organization that is focused on smart appliances is the Internet Home Alliance (internethomealliance.com). The alliance is made up of a number of appliance manufacturers (e.g., Whirlpool and Sunbeam), computer hardware companies (e.g., IBM and Cisco), retailers (e.g., Best Buy), and vendors specializing in home automation (e.g., Lutron Electronics). The mission of the alliance is to accelerate the process of researching, developing, and testing new home products and services that require a broadband or persistent connection to the Internet. Online File W16.13 exemplifies some of the types of smart appliances being developed by members of the alliance; in this case, however, the appliances are being used for commercial purposes, not in the home.



The appliance manufacturers are interested not only in the sale of appliances but also in service. In most cases, when an appliance is purchased and taken home, the manufacturer loses touch with the appliance unless the customer registers the product for warranty purposes. Potentially, a networked appliance could provide a manufacturer, as well as the owner of the appliance, with information that could be used to capture or report on the operation, performance, and usage of a device. In addition, the networked appliance could provide information for diagnostic purposes—for monitoring, troubleshooting, repairing, or maintaining the device (Pinto, 2002).

To date, however, consumers have shown little interest in smart appliances. As a result, the manufacturers of these appliances are focusing on improving people's lives by eliminating repetitive, non-quality tasks. One example is Sunbeam's corded HLT (Home Linking Technology) products that communicate with one another using an embedded technology called PLC (Power Line Communication). For instance, an HLT alarm clock can coordinate an entire morning's routine: The heating system, the coffee maker, and the lights in the kids' rooms go on, and the electric blanket goes off.

Whether offerings of this sort will prove is an open question. In the near term, one of the biggest technical barriers to widespread adoption of smart appliances will continue to be the fact that most homes lack broadband connection to the Internet. However, this situation is rapidly changing.

Smart Cars

Every car today has at least one computer on board to operate the engine, regulate fuel consumption, and control exhaust emissions. The average automobile on the road today has 20 or more microprocessors, which are truly invisible. They are under the hood, behind the dash, in the door panels, and on the undercarriage. Microprocessors control the radio, decide when your transmission should shift gears, remember your seat position, and adjust the temperature in the passenger cabin. They can make the suspension work better, help you see in the dark, and warn when a tire is low. In the shop, the onboard microprocessors are used to diagnose problems. Car computers often operate independently, but some swap data among themselves—a growing trend. The microprocessors in a car

require little maintenance, continuing to operate through extreme temperature, vibration, and humidity.

In 1998, the U.S. Department of Transportation (DOT) identified eight areas where microprocessors and intelligent systems could improve or impact auto safety (www.its.dot.gov/ivi/ivi.htm). The list included four kinds of collision avoidance, (see Jones, 2001), computer “vision” for cars, vehicle stability, and two kinds of driver monitoring. The automotive industry is in the process of testing a variety of experimental systems addressing the areas identified by the DOT. For example, GM in partnership with Delphi Automotive Systems has developed an Automotive Collision Avoidance System that employs radar, video cameras, special sensors, and GPS to monitor traffic and driver actions in an effort to reduce collisions with other vehicles and pedestrians (Sharke, 2003).

There is also a growing trend to connect car microprocessors to mobile networks and to the Internet (see Moore, 2000). Emergency assistance, driving directions, and e-mail are some of the services these connections can support. To increase safety, drivers can use voice-activated controls, even to access the Web (Bretz, 2001) GM’s OnStar system (onstar.com) already supports many of these services (see Online File W6.14).



OnStar is the forerunner of smart cars of the future. The next generation of smart cars is likely to provide even more automated services, especially in emergency situations. For instance, although OnStar will automatically signal the service center when the air bags are deployed and will immediately contact emergency services if the driver and passengers are incapacitated, what OnStar cannot provide is detailed information about a crash. Newer systems are under development that will automatically determine the speed upon impact, whether the car has rolled over, and whether the driver and passengers were wearing seat belts. Information of this sort might be used by emergency personnel to determine the severity of the accident and what types of services will be needed.

Ideally smart cars eventually will be able to drive themselves. Known as “autonomous land vehicles” (ALVs), these cars follow GIS maps and use sensors in a wireless environment to identify obstacles. These vehicles are already on the roads in California, Pennsylvania, and Germany (on an experimental base, of course).

Smart “Things”

Several other devices and instruments can be made to be “smart.” Some examples are discussed below.

BARCODES. A typical barcode, known as the *Universal Product Code (UPC)*, is made up of 12 digits, in various groups. The first two show the country where it was issued, the next four represent the manufacturer, and the remaining six are the product code assigned by the manufacturer. On a package the code is represented by a series of bars and spaces of varying widths.

Barcodes are used at various points in the supply chain to track inventory and shipments and to identify items at the point of sale. A barcode scanner is required to support these tasks. It consists of a scanning device for reading the code and translating it into an electrical output, a decoder for converting the electrical output to data that a computer or terminal can recognize, and a cable that connects the decoder to a computer or terminal.



Barcodes have worked pretty well over the past 25 years. But, they have their limitations. First, they require line-of-sight of the scanning device. This is fine in a store but can pose substantial problems in a manufacturing plant, a warehouse, or on a shipping/receiving dock. Second, they are printed on paper, meaning that they can be ripped, soiled, or lost. Third, the barcode identifies the manufacturer and product, not the item. For example, every carton of milk of a given producer has the same barcode, regardless of when it was produced. This makes a barcode useless in determining things like the expiration date. There is an alternative identification method, called Auto-ID, that overcomes the limitations of barcodes.

AUTO-ID. This method has been promoted over the past couple of years by the **Auto Identification (Auto-ID) Center** (autoidcenter.org), a joint partnership among more than 87 global companies and three of the world's leading research universities—MIT in the U.S., the University of Cambridge in the U.K., and the University of Adelaide in Australia. The companies include manufacturers (e.g., Coca-Cola, Gillette, and Canon), retailers (e.g., Wal-Mart, Tesco in the U.K.), shippers (e.g., UPS and the U.S. Postal Service), standards bodies (e.g., Uniform Code Council), and government agencies (e.g., the U.S. Department of Defense).

The mission of the Auto-ID Center goes well beyond replacing one code with another. Its stated aim is to create an **Internet of “things,”** a network that connects computers to objects—boxes of laundry detergent, pairs of jeans, airplane engines. This Internet of things will provide the ability to track individual items as they move from factories to store shelves to recycling facilities. This will make possible near-perfect supply chain visibility.



The key technical elements of the Auto-ID system and the explanation how it work are provided in Online File W6.15.

RFID: CAPABILITIES AND COST. RFID has been around awhile. During World War II, RFIDs were used to identify friendly aircraft. Today, they are used in wireless tollbooth systems, such as E-Z Pass. In Singapore they are used in a system called Electronic Road Pricing, which charges different prices to drive on different roads at different times, encouraging drivers to stay off busy roads at busy times. Every car has an RFID tag that communicates with card readers on the major roads (similar to the story of Highway 91 in *IT At Work 6.3*).

Until now the problem with RFID has been the expense. Tags have cost at least 50 cents, which makes them unusable for low-priced items. A California company called Alien Technology (alientechnology.com) has invented a way to mass-produce RFID tags for less than 10 cents apiece for large production runs. In January 2003, Gillette placed an order with Alien Technology for 500 million RFID tags (*RFID Journal*, 2002). Gillette uses the tags in a number of trial programs. In one of the early trials, Gillette attached the tags to the Mach 3 razors they ship to Wal-Mart, whose store shelves are equipped with special RFID readers. The overall success of RFID tags in the market place will depend on the outcome of trials such as this.

Large-Scale Pervasive Systems

Smart appliances, cars and barcodes can certainly make our lives more comfortable, but pervasive computing can make even larger contribution when large number of computing devices are put together, creating massive intelligent

systems. These systems include factories, airports, schools, and even entire cities. At the moment most of them are experimental and on a relatively small scale. Let's look at some examples.

SMART SCHOOLS. The University of California at Los Angeles is experimenting with a smart kindergarten (Chen et al., 2002). Exploring communication between students, teachers, and the environment, the project aims to create a smart learning environment.

Intelligent Elder-Care. The increased age of the population in many countries brings a problem of caring for more elderly for longer times. Long-term care facilities, where different patients require different level of care, bring the problem of how to provide such care efficiently and effectively. The experimental project titled Elite-care has demonstrated the benefits of using pervasive computing in such settings, as described in *IT At Work 6.5*.

SMART OFFICES. The original work of Weiser (1991) centered around an intelligent office. And indeed several projects are experimenting with such an environment which can interact with users through voice, gesture, or movements and can anticipate their activities. By monitoring office employees, the SmartOffice (Le Gal et al., 2001) even anticipates user intentions and augments the environment to communicate useful information.

DIGITAL CITIES. According to Ishida (2002a) the concept of **digital cities** is to build an area in which people in regional communities can interact and share knowledge, experiences, and mutual interests. Digital cities integrate urban information (both real time and stored) and create public spaces for people living in or visiting the cities. Digital cities are being developed all over the world (see Ishida, 2002a, 2002b). In Europe alone there are over 100 projects (e.g., Amsterdam, Helsinki).

In the city of Kyoto, Japan, for example, the digital city complements and corresponds to the physical city (Ishida, 2002a) Three layers are constructed: The first is an information layer, where Web archives and real-time sensory data are integrated to provide information any where, any time. The second layer is 2D and 3D interfaces, which provide views of cars, buses, and pictures that illustrate city services (for attractive and natural presentation). Finally, there is an interactive layer. Extensive use of GIS supports the project. One area of emphasis is a digital tour guide to visitors. Also, the system uses avatars (animated computer characters) that appear on a handheld device and “walk” with visitors around the city in real time.

Another digital-city experiment is the city of Lancaster (U.K.), where wireless devices are being used to improve services to both visitors and residents (Davies et al., 2002). The experimental Lancaster City Guide is based on a network of Wi-Fi context-sensitive and location-aware applications. One area that was developed first is services to tourists. By knowing where the tourist is (using a GPS) and his (her) preferences, the system can recommend tourist sites in the same general area. (This application is similar to the Carnegie Mellon application described in *IT At Work 6.4*.)

For other digital-city experiments, see Raskin, 2003, Mankins, 2002, and Fleck et al., 2002. For information on other large-scale pervasive computing projects, see Weise, 2002, and Standford, 2002b.



IT At Work 6.5 USING PERVASIVE COMPUTING TO DELIVER ELDER CARE



Delivering health services to the elderly is becoming a major societal problem in many countries, especially in countries where there are relatively fewer and fewer young people to take care of more and more elderly. The problem is already acute in Japan, and it is expected to be very serious in 10 to 15 years in several European countries and in China. Managing and delivering health care involves large number of diversified decisions, ranging from allocation of resources to determining what treatment to provide to each patient at each given time.

Elderly residents in assisted-living facilities require differing levels of care. Some residents need minimal assistance, others have short-term memory problems, and yet others have more severe problems like Alzheimer's disease so they require more supervision and help. At Elite Care's Estates Cluster Residential Care Facility in Milwaukie, Oregon, pervasive computing is being used to increase the autonomy and care level of all of its residents, regardless of their individual needs.

Elite Care, a family owned business (*elite-care.com*), has been built from the ground up to provide "high tech, high touch" programs. Its advisory committee, which includes among others representatives from the Mayo Clinic, Harvard University, the University of Michigan, the University of Wisconsin, and Sandia National Laboratory, has contributed a number of ideas that have been put into practice.

The entire facility is wired with a 30 miles network of (wireline and wireless) of unobtrusive sensors and other devices including: biosensors (e.g., weight sensors) attached to each resident's bed; movement sensors embedded in badges worn by the residents and staff (wearable computers); panic buttons used to call for help; Internet access via touch screens in each room; video conferencing using Webcams; and climate control, lights, and other regulated appliances. These devices and others allow the staff to monitor various patient activity. For example, staff can determine the location of any patient, to tell whether he or she is in an expected area of the facility. Devices that monitor length of

absence from bed might alert personnel that the patient has fallen or is incapacitated in other ways. Medical personnel can watch for weight loss (possibly indicating conditions like impending congestive heart failure), restlessness at night (indicating conditions like insufficient pain medication), and frequency of trips to the bathroom (indicating medical problems like infection). Also, close monitoring of conditions enables staff to give medicine and/or other treatments as needed, rather than at predetermined periods. All of these capabilities enable true one-to-one care, which is both more effective and less expensive.

One of the initial concerns with these monitors is that the privacy of the residents would be unnecessarily invaded. To alleviate these concerns, residents and their families are given the choice of participating or not. Most choose to participate because the families believe that these monitors provide better tracking and care. The monitors also increase the autonomy of all the patients because their use reduces the need for staff to constantly monitor residents in person, especially those with more acute care needs.

All of these sensors and systems are connected through a high-speed Ethernet (see Tech Guide 4). The data produced by the sensors and systems is stored in a database and can be used to alert the staff in real-time if necessary. These data are used for analytical purposes or for developing individualized care programs. The same database is also used for administrative purposes such as monitoring staff performance in timely delivery.

A similar concept is used in Swan Village of Care in Bentley, Australia. At the present time such projects are experimental and expensive, but some day they will be affordable to many.

For Further Exploration: What types of data do these devices provide? How can pervasive computing increase the quality of elder care? How to consider the privacy issue?

Sources: Compiled from Stanford, 2002, *elite-care.com*, and *ECC.online.wa.gov.au/news* (January 14, 2003).

6.10 INHIBITORS AND BARRIERS OF MOBILE COMPUTING

Several limitations are either slowing down the spread of mobile computing or are leaving many m-commerce customers disappointed or dissatisfied (e.g., see Islam and Fayad, 2003). Representative inhibitors and barriers of mobile computing are covered in the following discussion.



The Usability Problem

When mobile Internet users visit mobile Internet sites, the *usability* of the site is critical to attract attention and retain “user stickiness” (the degree to which users stay at a site). There are three dimensions to usability, namely *effectiveness*, *efficiency*, and *satisfaction*. However, users often find current mobile devices to be ineffective, particularly with respect to restricted keyboards and pocket-size screens, limiting their usability. In addition, because of the limited storage capacity and information access speed of most smartphones and PDAs, it is often difficult or impossible to download large files to these devices.

Mobile visitors to a Web site are typically paying premium fees for connections and are focused on a specific goal (e.g., conducting a stock trade). Therefore, if customers want to find exactly what they are looking for, easily and quickly, they need more than text-only devices with small screens. In 2003, many WAP applications were still text-based, and had only simple black-and-white graphics. This made tasks such as mobile shopping difficult. Because all the transactions were essentially text-based, mobile users could not “browse” an online picture-based catalog. However, more and faster multimedia are becoming available as 3G spreads.

The major technical and other limitations have slowed the spread of m-commerce are summarized in Table 6.5.

Ethical and Legal Issues

Several ethical and legal issues are unique to mobile computing. For example, fashion retailer Benetton Group SpA was considering attaching RFID “smart

TABLE 6.5 Technical and Other Limitations of Mobile Computing

Limitation	Description
Insufficient bandwidth	Sufficient bandwidth is necessary for widespread use and it must be inexpensive. It will take a few years until 3G is in many places. Wi-Fi solves some of the problem.
Security standards	Universal standards were not available in 2003. It may take 3 or more years to have them.
Power consumption	Batteries with long life are needed for mobile computing. Color screens and Wi-Fi consume more electricity, but new chips are solving some of the power-consumption problems.
Transmission interferences	Weather and terrain problems as well as distance-limited connection exist with some technologies. Reception in tunnels and some buildings is poor.
GPS accuracy	GPS may be accurate in a city with tall buildings.
WAP limitations	According to <i>mofileinfo.com</i> , in 2002 there were only about 50,000 WAP sites (compared to millions Web sites). WAP still is a cumbersome process to work with.
Potential health hazards	Potential health damage from cellular radio frequency emission is not known yet. However more car accidents are related to drivers who were talking (some places bar the use of cell phones while you drive). Also, cell phones may interfere with sensitive medical devices.
Legal issues	Potential legal issues against manufacturer of cell phones and against service providers exist, due to the potential health problems (Borland, 2000).
Human interface with device	Screens and keyboards are too small and uncomfortable and tedious for many people to use.
Complexity	Too many optional add-ons are available (e.g., battery chargers, external keyboards, headset, microphone, cradles). Storing and using the optional add-ons is a problem to some.



tags” to its Sisley line of clothing to help track shipping, inventory, and sales in the company’s 5,000 stores worldwide. (Also, the tags could help prevent shoplifting.) The idea was to integrate the RFID tag into the clothing labels. Using the tags, the store would know where each piece of clothing is, at any given time. However, privacy groups expressed concern that the tags could also be used to track buyers, and some groups even urged that the company’s clothing be boycotted. As a result, Benetton backed away from the plan, at least until an impact study is done (Rosencrance, 2003).

According to Hunter (2002) privacy is in a great danger in the world of ubiquitous computing because of the proliferation of networked devices used by individual, businesses and government. The Elite-Care project described in *IT At Work* 6.5, for example, raised the issue of protecting information collected by sensors. Also, privacy is difficult to control in other types of context-aware systems (e.g., see Jiang and Landay, 2002). As indicated earlier, security is especially difficult in Wi-Fi systems.

Challenges in Deploying Ubiquitous Systems

For pervasive (ubiquitous) systems to be widely deployed, it is necessary to overcome both the technical and ethical/legal barriers associated with wireless computing, plus overcoming other barriers unique to pervasive computing. Davies and Gellersen (2002) provide a comprehensive list of both technical challenges, social and legal issues, economic concerns (including finding appropriate business models) and lack of experiences in deploying ubiquitous systems. They also cite research challenges such as component interaction, adaptation and contextual sensitivity, user interface interaction, and appropriate management mechanisms.

Failures in Mobile Computing and M-Commerce

As with any other technology, especially a new one, there have been many failures of both applications as well as entire companies in mobile computing and m-commerce. It is important to anticipate and plan for possible failures as well as to learn from them. The case of Northeast Utilities provides some important insights. According to Hamblen (2001), Northeast Utilities (located in Berlin, Connecticut), which supplies energy products and services to 1.2 million customers from Maine to Maryland, embarked on a wireless project in 1995 in which its field inspectors used wireless devices to track spills of hazardous material and report them to headquarter in real time. After spending a year and a half and \$1 million, the project failed. Some of the lessons learned are:



- Do not start without appropriate infrastructure.
- Do not start a full-scale implementation; use a small pilot for experimentation.
- Pick up an appropriate architecture. Some users don’t need to be persistently connected, for example.
- Talk with a range of users, some experienced and some not, about usability issues.
- Users must be involved; use bi-weekly meetings if possible.
- Use wireless experts if you are not one.
- Wireless is a different medium from other forms of communication. Remember that people are not used to the wireless paradigm.

Having learned from the failure, Northeast made its next wireless endeavor a success. Today, 15 field inspectors carry rugged wireless laptops that are

connected to the enterprise intranet and databases. The wireless laptops are used to conduct measurements related to electricity transformers, for example. Then the laptops transmit the results, in real time, to chemists and people who prepare government reports about hazardous materials spills. In addition, time is saved, because all the information is entered directly into proper fields of electronic forms without having to be transcribed. The new system is so successful that it has given IT workers the confidence to launch other applications such as sending power-outage report to executives via smart phones and wireless information to crews repairing street lights.

MANAGERIAL ISSUES

1. **Comparing wireless to synchronized mobile devices.** In many cases, transmitting data in the evening, using a docking device, is sufficient. In others, real time communication is needed, justifying a wireless system.
2. **Timetable.** Although there has been much hype about m-commerce in the last few years, only a small number of large-scale mobile computing applications have been deployed to date. The most numerous applications are in e-banking, stock trading, emergency services, and some B2B tasks. Companies still have time to carefully craft an m-commerce strategy. This will reduce the number of failed initiatives and bankrupted companies. For calculating the total cost of wireless computing ownership and how to justify it, see Intel, 2002.
3. **Setting applications priorities.** Finding and prioritizing applications is a part of an organization's e-strategy. Although location-based advertising is logically attractive, its effectiveness may not be known for several years. Therefore, companies should be very careful in committing resources to m-commerce. For the near term, applications that enhance the efficiency and effectiveness of mobile workers are likely to have the highest payoff.
4. **Just a buzzword?** In the short run, mobile computing, m-commerce, and especially l-commerce, may be just buzzwords due to the many limitations they now face. However, in the long run, the concepts will be increasingly popular. Management should monitor the technological developments and make plans accordingly.
5. **Choosing a system.** The multiplicity of standards, devices, and supporting hardware and software can confuse a company planning to implement mobile computing. An unbiased consultant can be of great help. Checking the vendors and products carefully, as well as who is using them, is also critical. This issue is related to the issue of whether or not to use an application service provider (ASP) for m-commerce.



ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; additional resources such as cases, tables, and figures; updates; additional exercises; links; and demos and activities can be found on the book's Web site.



KEY TERMS

1G (p. ●●●)	Hotspot (p. ●●●)	Subscriber identification module card (SIM) (p. ●●●)
2G (p. ●●●)	Internet of things (p. ●●●)	Telematics (p. ●●●)
2.5G (p. ●●●)	Location-based commerce (l-commerce) (p. ●●●)	Time Division Multiple Access (TDMA) (p. ●●●)
3G (p. ●●●)	M-wallet (mobile wallet) (p. ●●●)	Ubiquity (p. ●●●)
4G (p. ●●●)	Mobile commerce (m-commerce, m-business) (p. ●●●)	Voice portal (p. ●●●)
802.11b (p. ●●●)	Mobile computing (p. ●●●)	Wearable devices (p. ●●●)
Auto Identification (Auto-ID) Center (p. ●●●)	Mobile devices (p. ●●●)	Wireless 911 (e-911) (p. ●●●)
Automatic crash notification (ACN) (p. ●●●)	Mobile employees/workers (p. ●●●)	Wireless access point (for Wi-Fi) (p. ●●●)
Bluetooth (p. ●●●)	Mobile handset (p. ●●●)	Wireless Application Protocol (WAP) (p. ●●●)
Code Division Multiple Access (CDMA) (p. ●●●)	Mobile portals (p. ●●●)	Wireless fidelity (Wi-Fi) (p. ●●●)
Context awareness (p. ●●●)	Multimedia messaging service (MMS) (p. ●●●)	Wireless local area network (WLAN) (p. ●●●)
Contextual computing (p. ●●●)	Personal digital assistant (PDA) (p. ●●●)	Wireless Markup Language (WML) (p. ●●●)
Enhanced messaging service (EMS) (p. ●●●)	Pervasive computing (p. ●●●)	Wireless mobile computing (p. ●●●)
Frequency Division Multiple Access (FDMA) (p. ●●●)	Radio frequency identification (RFID) (p. ●●●)	Wireless wide area networks (WWAN) (p. ●●●)
Geographical information system (GIS) (p. ●●●)	Screenphones (wireless) (p. ●●●)	
Global positioning system (GPS) (p. ●●●)	Short messaging service (SMS) (p. ●●●)	
	Smartphone (p. ●●●)	

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 Mobile computing is based on mobility and reach. These characteristics provide ubiquity, convenience, instant connectivity, personalization, and product and service localization.
- 2 The major drivers of mobile computing are: large numbers of users of mobile devices, especially cell phones; no need for a PC; a developing “cell phone culture” in some areas; vendor marketing; declining prices; increasing bandwidth; and the explosion of EC in general.
- 3 Mobile computing and m-commerce require mobile devices (e.g., PDAs, cell phones) and other hardware, software, and wireless technologies. Commercial services and applications are still emerging. These technologies allow users to access the Internet anytime, anywhere.
- 3 For l-commerce, a GPS receiver is also needed.
- 4 Standards are being developed by several organizations in different countries, resulting in competing systems. It is expected that with time some of these will converge.
- 5 Many EC applications in the service industries (e.g., banking, travel, and stocks) can be conducted with wireless devices. Also, shopping can be done from mobile devices.
- 5 Location-based advertising and advertising via SMSs on a very large scale is expected.
- 5 Mobile portals provide content (e.g., news) to millions.
- 6 Large numbers of intrabusiness applications, including inventory management, sales force automation, wireless voice, job dispatching, wireless office, and more are already evident inside organizations.
- 7 Emerging mobile B2B applications are being integrated with the supply chain and are facilitating cooperation between business partners.
- 8 M-commerce is being used to provide applications in travel, gaming, entertainment, and delivery of medical services. Many other applications for individual consumers are planned for, especially targeted advertising.
- 9 Most non-Internet applications involve various types of smart cards. They are used mainly in transportation, security, and shopping from vending machines and gas pumps.

- 10 Location-based commerce, or l-commerce, is emerging in applications such as calculating arrival time of buses (using GPS) and emergency services (wireless 911). In the future, it will be used to target advertising to individuals based on their location. Other innovative applications also are expected.
- 11 This is the world of invisible computing in which virtually every object has an embedded microprocessor that is connected in a wired and/or wireless fashion to the Internet. This Internet of Things—homes, appliances, cars, and any manufactured items—will provide a number of life-enhancing, consumer-centric, and B2B applications.
- 11 In context-aware computing, the computer captures the contextual variables of the user and the environment and then provides, in real time, various services to users.
- 12 The major limitations of mobile computing are: small screens on mobile devices, limited bandwidth, high cost, lack of (or small) keyboards, transmission interferences, unproven security, and possible health hazards. Many of these limitations are expected to diminish over time. The primary legal/ethical limitations of m-commerce relate to privacy issues.

REVIEW QUESTIONS

1. Define mobile computing and m-commerce.
2. Define the following terms: PDA, WAP, SMS, GPS, Wi-Fi and smartphone.
3. List the value-added attributes of mobile computing.
4. List at least five major drivers of mobile computing.
5. Describe the major hardware devices used for mobile computing.
6. List the major software items used for mobile computing.
7. Describe the major components of a mobile network.
8. Define the terms FDMA, TDMA, and CDMA.
9. List the major standards used by mobile phone systems (e.g., GSM).
10. Describe the major components of a WLAN.
11. Define 1G, 2G, 2.5G, 3G, and 4G.
12. List some of the key security issues in an m-commerce transaction.
13. List some of the uses of voice portals.
14. Discuss mobile micropayments.
15. Describe the m-wallet and wireless bill payments.
16. Describe how mobile devices can be used to shop.
17. Explain targeted advertising in the wireless environment and in pervasive computing.
18. Describe mobile portals and what kind of information they provide.
19. Describe wireless job dispatch.
20. Discuss how wireless applications can be used to provide customer support.
21. List some of the major intrabusiness wireless applications.
22. Describe wireless support along the supply chain.
23. How can telemetry improve supply chain operations?
24. Describe the application of wireless and mobile technologies to games and entertainment.
25. Discuss some of the potential applications of Wi-Fi and Bluetooth technologies in hotels.
26. Describe some potential uses of mobile and wireless technologies in providing medical care.
27. Describe some of the potential uses of l-commerce.
28. Discuss the technologies used in providing l-commerce services.
29. Describe GPS and GIS.
30. Discuss telematics.
31. List some of the barriers to l-commerce.
32. Define pervasive computing.
33. List some of the major properties of pervasive computing.
34. Discuss some of the ways that pervasive computing can be used in the home.
35. Describe a smart car.
36. Describe some of the ways that microprocessors are being used to enhance the intelligence of appliances.
37. What is contextual computing?
38. Discuss the role that usability plays in the adoption of m-commerce.
39. List the technical limitations of m-commerce.

DISCUSSION QUESTIONS

1. Discuss how mobile computing can solve some of the problems of the *digital divide* (the gap within a country or between countries with respect to people's ability to access the Internet). (See International Communications Union 1999 and Chapter 16).



2. Discuss how m-commerce can expand the reach of e-business.
3. Explain the role of protocols in mobile computing.
4. Discuss the impact of wireless computing on emergency medical services.
5. How do smartphones and screenphones differ? What characteristics do they share?
6. How are GIS and GPS related?
7. List three to four major advantages of wireless commerce to consumers, presented in this chapter, and explain what benefits they provide to consumers.
8. You can use location-based tools to help you find your car or the closest gas station. However, some people see location-based tools as an invasion of privacy. Discuss the pros and cons of location-based tools.
9. Discuss how wireless devices can help people with disabilities.
10. Discuss the benefits of telemetry-based systems.
11. Discuss the ways in which Wi-Fi is being used to support mobile computing and m-commerce. Describe the ways in which Wi-Fi is affecting the use of cellular phones for m-commerce.
12. Which of the applications of pervasive computing—smart cars, homes, appliances, and things—do you think are likely to gain the greatest market acceptance of the next few years? Why?
13. Which of the current mobile computing and m-commerce limitations do you think will be minimized within 5 years? Which ones will not?
14. Describe some m-commerce B2B applications along the supply chain.
15. It is said that Wi-Fi is winning a battle against 3G. In what sense this is true? In what sense this is false?

GROUP ASSIGNMENTS

1. Each team should examine a major vendor of mobile devices (Nokia, Kyocera, Motorola, Palm, BlackBerry, etc.). Each team will research the capabilities and prices of the devices offered by each company and then make a class presentation, the objective of which is to convince the rest of the class why one should buy that company's products.
2. Each team should explore the commercial applications of m-commerce in one of the following areas: financial services, including banking, stocks, and insurance; marketing and advertising; manufacturing; travel and transportation; human resources management; public services; and health care. Each team will present a report to the class based on their findings. (Start at *mobiforum.org*.)
3. Each team will investigate a global organization involved in m-commerce, such as *gmcforum.com* and *openmobilealliance.com*. The teams will investigate the membership and the current projects the organization is working on and then present a report to the class based on their findings.
4. Each team will investigate a standards-setting organization and report on its procedures and progress in developing wireless standards. Start with the following: *atis.org*, *etsi.org*, and *tiaonline.org*.
5. Each team should take one of the following areas—homes, cars, appliances, or other consumer goods like clothing—and investigate how embedded microprocessors are currently being used and will be used in the future to support consumer-centric services. Each team will present a report to the class based on their findings.

INTERNET EXERCISES

1. Learn about PDAs by visiting vendors' sites such as Palm, SONY, Hewlett-Packard, IBM, Phillips, NEC, Hitachi, Compaq, Casio, Brother, Texas Instruments, and others. List some m-commerce devices manufactured by these companies.
2. Access *progressive.com*, an insurance company, from your cell phone (use the "Go to..." feature). If you have a Sprint PCS wireless phone, do it via the Finance menu. Then try to visit *mobileprogressive.com* from a wireless PDA. If you have a Palm i705, you can download the Web-clipping application from Progressive. Report on these capabilities.
3. Research the status of 3G and the future of 4G by visiting *itu.int*, *4g.newstrove.com*, and *3gnewsroom.com*. Prepare a report on the status of 3G and 4G based on your findings.
4. Explore *nokia.com*. Prepare a summary of the types of mobile services and applications Nokia currently supports and plans to support in the future.
5. Enter *kyocera-wireless.com*. Take the smart tour and view the demos. What is a smartphone? What are its capabilities? How does it differ from a regular cell phone?
6. Enter *www.i3mobile.com*. Run the Pronto demo. What types of services are provided by Pronto? What types of

users would be more likely to use Pronto rather than a smart phone?

7. Enter *ibm.com*. Search for *wireless e-business*. Research the resulting stories to determine the types of wireless capabilities and applications IBM's software and hardware supports. Describe some of the ways these applications have helped specific businesses and industries.
8. Using a search engine, try to determine whether there are any commercial Wi-Fi hotspots in your area. Enter *wardriving.com*. Based on information provided at this site, what sorts of equipment and procedures could you use to locate hotspots in your area?
9. Enter *mapinfo.com* and look for the location-based services demos. Try all the demos. Find all of the wireless services. Summarize your findings.
10. Visit *ordersup.com*, *astrology.com*, and similar sites that capitalize on l-commerce. What features do these sites share?
11. Enter *packetvideo.com* and *microsoft.com/mobile/pocketpc*. Examine their demos and products and list their capabilities.
12. Enter *internethomealliance.com* and review their whitepapers. Based on these papers, what are the major appliances that are currently in most U.S. homes? Which of these appliances would most homeowners be likely to connect to a centrally controlled network?
13. Enter *onstar.com*. What types of *fleet* services does OnStar provide? Are these any different from the services OnStar provides to individual car owners?
14. Enter *autoidcenter.org*. Read about the Internet of Things. What is it? What types of technologies are needed to support it? Why is it important?
15. Enter *msi-advantex.com* and review the wireless products for the enterprise. Summarize the advantages of the different products.
16. Enter *attwireless.com/mlife* and prepare a list of the services available there.
17. Enter *wirelesscar.com*. Examine all the services provided and relate them to telemetry.
18. Enter the site of a wireless e-mail provider (BlackBerry, T-mobile, Handspring); collect information about the capabilities of the products and compare them.
19. Enter *zilog.com/about/partners/011600.html* and find information about smart appliances.
20. Enter *hel.fi/infocities* and write a report on the digitization of the city of Helsinki.
21. Enter *med-i-nets.com* and find information about Pharm-i-net. Trace the supply chain and the support of wireless. Make a diagram.



Minicase 1

Hertz Goes Wireless

The car rental industry is very competitive, and Hertz (*hertz.com*), the world's largest car rental company, competes against hundreds of companies in thousands of locations. The competition focuses on customer acquisition and loyalty. In the last few years, competition has intensified, and profits in the industry have been drifting downward. Hertz has been a "first mover" to information technologies since the 1970s, so it has naturally looked for new technologies to improve its competitive position. In addition to data warehousing and mining, a superb executive information system, and e-commerce, Hertz has pioneered some mobile commerce applications:

- **Quick rentals.** Upon arrival at the airport, Hertz's curbside attendant greets you and transmits your name wirelessly to the renting booth. The renting-booth employee advises the curbside attendant about the location of your car. All you need to do is go to the slot where the car is parked and drive away. This system, which once operated over a WLAN, is now part of a national wireless network that can check credit cards, examine your rental history, determine which airline to credit your loyalty mileage to, and more.
- **Instant returns.** Pioneered by Hertz in 1987, a handheld device connected to a database via a wireless system expedites the car return transaction. Right in the parking lot, the lot attendant uses a handheld device to calculate the cost of the rental and print a receipt for the renter. You check out in less than a minute, and you do not have to enter the renting booth at all.
- **In-car cellular phones.** Starting in 1988, Hertz began renting cell phones with its cars. Today, of course, this is not as "big a deal" as it was in 1988, when it was a major innovation.
- **NeverLost Onboard.** Some cars come equipped with an onboard GPS system, which provides route guidance in the form of turn-by-turn directions to many destinations. The information is displayed on a screen with computer-generated voice prompts. An electronic mapping system (GIS) is combined with the GPS, enabling you to see on the map where you are and where you are going. Also, consumer information about the locations of the nearest hospitals, gas stations, restaurants, and tourist areas is provided.
- **Additional customer services.** Hertz's customers can download city guides, Hertz's location guide, emergency telephone numbers, city maps, shopping guides, and even reviews of restaurants, hotels, and entertainment into their PDAs and other wireless devices. Of course, driving directions are provided.
- **Car locations.** Hertz is experimenting with a GPS-based car-locating system. This will enable the company to know where a rental car is at any given time, and even how fast it is being driven. Although the company promises to provide discounts based on your usage pattern, this capability is seen by many as an invasion of privacy. On the other hand, some may feel safer knowing that Hertz knows where they are at all times.

Hertz has been the top car rental company and still maintains that position. It is also a very profitable company that is expanding and growing continuously. Its success is attributed to being customer-centric, as facilitated by its use of wireless technologies and EC.

Questions for Minicase 1

1. Which of these applications are intrabusiness in nature?
2. Identify any finance- and marketing-oriented applications.
3. What are the benefits to Hertz of knowing exactly where each of its cars is? As a renter, how do you feel about this capability?

Source: *hertz.com* (2003) and Martin (2003).



Minicase 2

Washington Township Fire Department Goes Wireless

The Washington Township Fire Department (WTFD) is located just north of Columbus, Ohio. WTFD responds to more than 4,500 emergency medical services (EMS) calls every year. Time is critical when WTFD is responding to emergencies, which range from heart attacks to fire injuries to highway accidents. The service is run by emergency medical technicians (EMTs).

Rushing victims to the hospitals is only one part of the service offered by these dedicated technicians. Providing first aid at the accidents' scene and while transporting the injured in the ambulances is the other part. When a patient is transferred to the hospital, the EMTs must also provide information on what treatments and medications were administered, and what health-related signs they observed in the patient. Such patient care reports are critical to the continuance of the treatment in the hospital, and they become a permanent part of the medical record. The information is also used to keep EMS records for planning, budgeting, training, and reporting to the state of Ohio.

In the past, the department had problems using 8" × 14," multipart, multicopy paper forms. According to Jack McCoy, using paper forms caused several problems. First, not everyone's handwriting is legible, so it was often difficult for hospital personnel as well as the WTFD office people to decipher the information. Second, on many occasions, the information was incomplete, or even inaccurate. To restore the information it took considerable valuable time. Office employees at WTFD had to spend close to 1,800 hours a year processing information after the completion of the patient care report. In fact, 85 percent of one full-time office employees were required just to re-enter data that was already entered on the paper reports. But the major problem was the time spent by EMTs filling out forms, since this prevented them from returning quickly to the station, responding to other emergency calls.

A solution to the paperwork problems was a mobile data collection device (Mobile EMS of Clayton I.D.S. Corp. powered by SQL Anywhere Studio from Sybase Corp.). The device allows EMTs to collect patient information quickly, easily, and accurately at the scene and to deliver

that information to the hospital in a print-out. This is done by using a series of data entry screens with drop-down menus containing vital information such as diagnoses, treatment rendered, drug administered, and even street names. It also includes a signature capture feature that allows EMTs to document a patient's refusal of treatment as well as transfer of care to the hospital.

Once the incident data is entered into the system's embedded SQL database, printing reports is simple. The technician beams the information form MobileEMS to the hospital printer's infrared port and a clear document is produced. Back at the station, the EMTs synchronize the data in their handhelds with the department computer systems by placing MobileEMS in a docking station.

According to McCoy, it takes about 15 seconds to move the data into the system. This is a significant improvement over manual re-keying; using MobileEMS has reduced costs by more than 90 percent. Also by eliminating handwriting and mandating the completion of required data fields that previously could have been skipped, the accuracy increased significantly.

Finally, the system is customizable. Fields can be added and additional information can be stored. Thus, additional applications are leading to a completely paperless environment.

Question for Minicase 2

1. The system uses a mobile device with a docking station for data synchronization, but no wireless is used. Would you recommend adding wireless? What for? Why or why not?
2. What are the potential legal issues in this case?
3. The system is based on electronic forms with checkmarks. Why not use a similar set of paper forms?
4. What are the benefits of the mobile system to the patient, to the hospital, and to the employees?
5. What are the benefits to WTFD?

Source: Compiled from Sybase.com (2003).



Virtual Company Assignment

Mobility and The Wireless Café

While you were sitting at The Wireless Café's counter having a soda and thinking about data flows, you noticed that the wait-staff made a lot of trips to the kitchen counter to place orders and to check up on order readiness. You remembered seeing an ad for a product called Wireless Waitress (<http://wirelesswaitress.com/>) when you were browsing through some industry publications in Jeremy's office and decided to do some research on the genre of wireless products for wait-staff to present to the three shift managers.

1. How would the Wireless Waitress be used in The Wireless Café? Describe some of the changes that this appli-

cation would bring about in the way wait-staff do their job.

2. Are any of the location-based commerce applications or mobile commerce applications useful in the restaurant business? Pick an application described in the chapter and apply it to The Wireless Café.
3. It is clear that restaurants and The Wireless Café are headed in the direction of wireless applications. Prepare a memo to Barbara and Jeremy with your advice on how they should strategically position The Wireless Café vis-a-vis wireless applications.

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PART III
Organizational Applications



- ▶ 7. Transaction Processing, Functional Applications, CRM, and Integration
- 8. Supply Chain Management and Enterprise Resource Planning
- 9. IT Planning and Business Process Redesign

CHAPTER

7

Transaction Processing, Functional Applications, CRM, and Integration

Dartmouth-Hitchcock Medical Center

7.1

Functional Information Systems

7.2

Transaction Processing Information Systems

7.3

Managing Production/Operations and Logistics

7.4

Managing Marketing and Sales Systems

7.5

Managing the Accounting and Finance Systems

7.6

Managing Human Resources Systems

7.7

Customer Relationship Management (CRM)

7.8

Integrating Functional Information Systems

Minicases: (1) Dollar General / (2) QVC

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Relate functional areas and business processes to the value chain model.
- 2 Identify functional management information systems.
- 3 Describe the transaction processing system and demonstrate how it is supported by IT.
- 4 Describe the support provided by IT and the Web to production/operations management, including logistics.
- 5 Describe the support provided by IT and the Web to marketing and sales.
- 6 Describe the support provided by IT and the Web to accounting and finance.
- 7 Describe the support provided by IT and the Web to human resources management.
- 8 Describe the role of IT in facilitating CRM.
- 9 Describe the benefits and issues of integrating functional information systems.



WIRELESS INVENTORY MANAGEMENT SYSTEM AT DARTMOUTH-HITCHCOCK MEDICAL CENTER

➡ THE PROBLEM

Dartmouth-Hitchcock Medical Center (DHMC) is a large medical complex in New Hampshire with hospitals, a medical school, and over 600 practicing physicians in its many clinics. DHMC is growing rapidly and is encountering a major problem in the distribution of medical supplies. These supplies used to be ordered by nurses. But nurses are usually in short supply, so having them spending valuable time ordering supplies—left them less time for their core competency—nursing. Furthermore, having nurses handling supply orders led to inventory management problems: Busy nurses tended to over-order in an effort to spend less time managing inventory. On the other hand, they frequently waited until the last minute to order supplies, which led to costly rush orders.

One solution would have been to transfer the task of inventory ordering and management to other staff, but doing so would have required hiring additional personnel and the DHMC was short on budget. Also, the coordination with the nurses to find what is needed and when, as well as maintaining the stock, would have been cumbersome.

What the medical center needed was a solution that would reduce the burden on the nurses, but also reduce the inventory levels and the last-minute, expensive ordering. Given the size of the medical center, and the fact that there are over 27,000 different inventory items, this was not a simple task.

➡ THE SOLUTION

DHMC realized that their problem related to the supply chain, and so it looked to IT for solutions. The idea the DHMC chose was to connect wireless handheld devices with a purchasing and inventory management information system. Here is how the new system works (as of the summer of 2002): The medical center has a wireless LANs (Wi-Fi) into which handhelds are connected. Information about supplies then can be uploaded and downloaded from the devices to the network from anywhere within the range of the Wi-Fi. In remote clinics without Wi-Fi, the handhelds are docked into wireline network PCs.

For each item in stock a “par level” (the level at which supplies must be reordered) was established, based on actual usage reports and in collaboration between the nurses and the materials management staff. Nurses simply scan an item when it is consumed, and the software automatically adjusts the recorded inventory level. When a par level is reached for any inventory item, an order to the supplier is generated automatically. Similarly, when the inventory level at each nursing station dips below the station’s par level, a shipment is arranged from the central supply room to that nursing station. The system also allows for nurses to make restocking requests, which can be triggered by scanning an item or scanning the supply cart (where items are stocked at each nursing station). The system works for



the supplies of all non-nursing departments as well (e.g., human resources or accounting). Overall, the Wi-Fi systems includes over 27,000 line items.

The system is integrated with other applications from the same vendor (PeopleSoft Inc.). One such application is Express PO, which enables purchasing managers to review standing purchase orders, e-procurement, and contract management.

THE RESULTS

Inventory levels were reduced by 50 percent, paying for the system in just a few months. Materials purchasing and management now are consistent across the enterprise, the time spent by nurses on tracking materials has been drastically reduced, and access to current information has been improved. All of this contributed to reduced cost and improved patient care.

Sources: Compiled from Grimes (2003), and *peoplesoft.com* (site visited March 31, 2003).

LESSONS LEARNED FROM THIS CASE

The DHMC case provides some interesting observations about implementing IT: First, IT can support the routine processes of inventory management, enabling greater efficiency, more focus on core competencies, and greater satisfaction for employees and management. The new system also helped to modernize and redesign some of the center's business processes. (e.g. distribution, procurement), and was able to support several business processes (e.g., operations, finance, and accounting), not just one. Although the system's major application is in inventory management, the same software vendor provided ready-made modules, which were *integrated* with the inventory module and with each other (for example, with purchasing and contract management). The integration also included connection to suppliers, using the Internet. This IT solution has proven useful for an organization whose business processes cross the traditional functional departmental lines. In this case nursing is considered operations/production; inventory control, purchasing, and contract management are in the finance/accounting area.

To offer service in the digital economy, companies must continuously upgrade their functional information systems by using state-of-the-art technology. Furthermore, the functional processes must be improved as needed. Finally, as we will show in Chapter 8, supply chain software is needed in some segments of the supply chain. These segments may include functional information systems.

Functional information systems get much of their data from the systems that process routine transactions (*transaction processing systems, TPSs*). Also, many applications in business intelligence, e-commerce, CRM, and other areas use data and information from two or more functional information systems. Therefore, there is a need to integrate the functional systems applications among themselves, with the TPS, and with other applications. These relationships are shown in Figure 7.1, which provides a pictorial view of the topics discussed in this chapter. (Not showing in the figure are applications discussed in other chapters, such as e-commerce and knowledge management.)

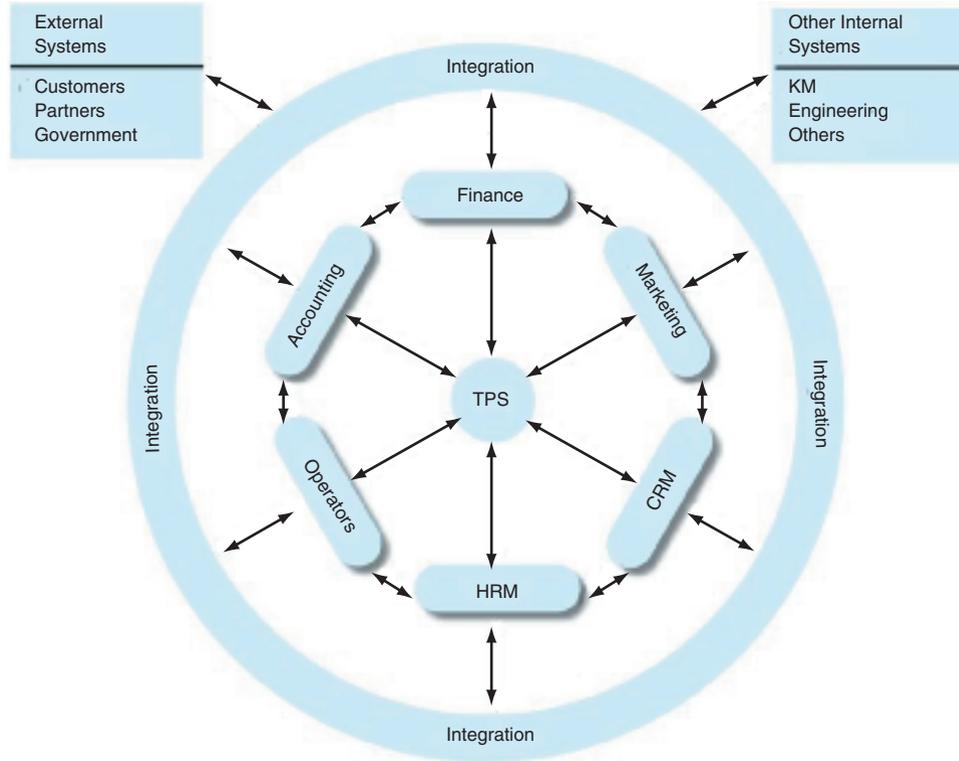


FIGURE 7.1 The functional areas, TPS, CRM, and integration connection. Note the flow of information from the TPS to the functional systems. Flow of information between and among functional systems is done via the integration component. (Not showing in the figure are applications discussed in other chapters, such as e-commerce and knowledge management.)

7.1 FUNCTIONAL INFORMATION SYSTEMS

The major functional areas in many companies are the production operations, marketing, human resources, accounting and finance departments. Traditionally, information systems were designed within each functional area, to support the area by increasing its internal effectiveness and efficiency. However, as we will discuss in Chapter 9, the traditional functional hierarchical structure may not be the best structure for some organizations, because certain business processes involve activities that are performed in several functional areas. Suppose a customer wants to buy a particular product. When the customer's order arrives at the marketing department, the customer's credit needs to be approved by finance. Someone checks to find if the product is in the warehouse (usually in the production/operations area). If it is there, then someone needs to pack the product and forward it to the shipping department, which arranges for delivery. Accounting prepares a bill for the customer, and finance may arrange for shipping insurance. The flow of work and information between the different departments may not work well, creating delays or poor customer service.

One possible solution is to restructure the organization. For example, the company can create cross-functional teams, each responsible for performing a complete business process. Then, it is necessary to create appropriate information systems applications for the restructured processes. As we will discuss in Chapter 9, this arrangement can be a difficult-to-implement solution. In other cases, the company can use IT to create minor changes in the business processes

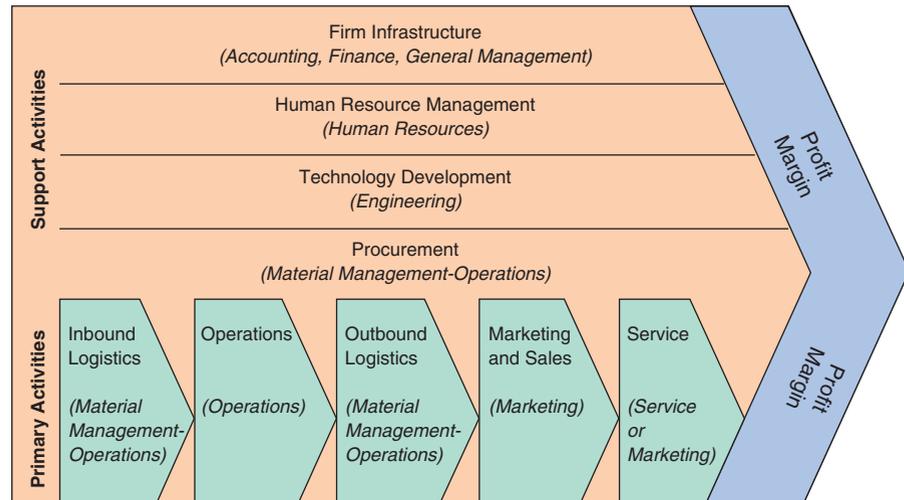


FIGURE 7.2 Typical functional areas mapped on the value chain of a manufacturing company.

and organizational structure, but this solution may not solve problems such as lack of coordination or an ineffective supply chain. One other remedy may be an *integrated approach* that keeps the functional departments as they are, but creates an integrated supportive information system to help communication, coordination, and control. The integrated approach is discussed in Section 7.8.

But even if the company were to restructure its organization, as suggested in Chapter 9, the functional areas might not disappear completely since they contain the expertise needed to run the business. Therefore, it is necessary to drastically improve operations in the functional areas, increasing productivity, quality, speed, and customer service, as we will see in this chapter.

Before we demonstrate how IT facilitates the work of the functional areas, and makes possible their integration, we need to see how they are organized and how they relate to the corporate value chain and the supply chain.

Porter's Value Chain Model and the Supply Chain

The *value chain* model, introduced in Chapter 3, views activities in organizations as either primary (reflecting the flow of goods and services) or secondary (supporting the primary activities). The organizational structure of firms is intended to support both of these types of activities. Figure 7.2 maps the major *functional departments* onto the value chain structure.

As described in Chapter 2, the *supply chain* is a business process that links all the procurement from suppliers, the transformation activities inside a firm, and the distribution of goods or services to customers via wholesalers and retailers. In this chapter we present innovative applications that increase mainly internal functional efficiency, and we provide examples of improved communication and collaboration with customers and business partners as a result of these applications. First, let us examine the characteristics of functional information systems.

Major Characteristic of Functional Information Systems

Functional information systems share the following characteristics:

- **Composed of smaller systems.** A functional information system consists of several smaller information systems that support specific activities performed in the functional area.

- **Integrated or independent.** The specific IS applications in any functional area can be integrated to form a coherent departmental functional system, or they can be completely independent. Alternatively, some of the applications within each area can be integrated across departmental lines to match a business process.
- **Interfacing.** Functional information systems may interface with each other to form the organization-wide information system. Some functional information systems interface with the environment outside the organization. For example, a human resources information system can collect data about the labor market.
- **Supportive of different levels.** Information systems applications support the three levels of an organization's activities: *operational*, *managerial*, and *strategic* (see Chapter 2).



A model of the IS applications in the production/operations area is provided in *Online File W7.1*. Other functional information systems have a similar basic structure.

In this chapter we describe IT applications in some of the key primary and support areas of the value chain. However, since information systems applications receive much of the data that they process from the corporate *transaction processing system*, we deal with this system first.

7.2 TRANSACTION PROCESSING INFORMATION SYSTEMS

The core operations of organizations are enabled by transaction processing systems.

Computerization of Routine Transaction Processes

In every organization there are business transactions that provide its mission-critical activities. Such transactions occur when a company produces a product or provides a service. For example, to produce toys, a manufacturer needs to buy materials and parts, pay for labor and electricity, build the toys, ship them to customers, bill customers, and collect money. A bank that maintains the toy company's checking account must keep the account balance up-to-date, disperse funds to back up the checks written, accept deposits, and mail a monthly statement.

Every transaction may generate additional transactions. For example, purchasing materials will change the inventory level, and paying an employee reduces the corporate cash on hand. Because the computations involved in most transactions are simple and the transaction volume is large and repetitive, such transactions are fairly easy to computerize.

As defined in Chapter 2, the information system that supports these *transactions* is the **transaction processing system (TPS)**. The transaction processing system monitors, collects, stores, processes, and disseminates information for all routine core business transactions. These data are input to functional information systems applications, as well as to decision support systems (DSS), customer relationship management (CRM), and knowledge management (KM). The TPS also provides critical data to e-commerce, especially data on customers and their purchasing history.



Transaction processing occurs in all functional areas. Some TPSs occur within one area, others cross several areas (such as payroll). *Online File W7.2* provides a list of TPS activities mapped on the major functional areas. The

TABLE 7.1 The Major Characteristics of a TPS

- Typically, *large amounts of data* are processed.
- The *sources of data are mostly internal*, and the output is intended mainly for an *internal audience*. This characteristic is changing somewhat, since trading partners may contribute data and may be permitted to use TPS output directly.
- The TPS processes information on a *regular basis*: daily, weekly, biweekly, and so on.
- *Large storage (database) capacity* is required.
- *High processing speed* is needed due to the high volume.
- The TPS basically *monitors and collects past data*.
- Input and output *data are structured*. Since the processed data are fairly stable, they are formatted in a standard fashion.
- A *high level of detail* (raw data, not summarized) is usually observable, especially in input data but often in output as well.
- *Low computation complexity* (simple mathematical and statistical operations) is usually evident in a TPS.
- A high level of *accuracy, data integrity, and security* is needed. Sensitive issues such as privacy of personal data are strongly related to TPSs.
- *High reliability* is required. The TPS can be viewed as the lifeblood of the organization. Interruptions in the flow of TPS data can be fatal to the organization.
- *Inquiry processing* is a must. The TPS enables users to query files and databases (even online and in real time).

information systems that automate transaction processing can be part of the departmental systems, and/or part of the enterprisewide information systems. For a comprehensive coverage of TPSs, see Subrahmanyam (2002) and Bernstein and Newcomer, 1997.

Objectives of TPS

The primary goal of TPS is to provide all the information needed by law and/or by organizational policies to keep the business running properly and efficiently. Specifically, a TPS has to efficiently handle high volume, avoid errors due to concurrent operations, be able to handle large variations in volume (e.g., during peak times), avoid downtime, never lose results, and maintain privacy and security. (see Bernstein and Newcomer, 1997). To meet these goals, a TPS is usually automated and is constructed with the major characteristics listed in Table 7.1

Specific objectives of a TPS may include one or more of the following: to allow for efficient and effective operation of the organization, to provide timely documents and reports, to increase the competitive advantage of the corporation, to provide the necessary data for tactical and strategic systems such as Web-based applications, to ensure accuracy and integrity of data and information, and to safeguard assets and security of information. It also is important to remember that TPSs must closely interface with many IT initiatives, especially with e-payment, e-procurement, and e-marketing.

It should be emphasized that TPSs are the most likely candidates for restructuring and usually yield the most tangible benefits of IT investments. They were the first to be computerized so they have had more improvement opportunities. Also, their information volume is high, so even a small improvement may result in a high payoff.

Activities and Methods of TPS

Regardless of the specific data processed by a TPS, a fairly standard process occurs, whether in a manufacturer, in a service firm, or in a government organization. First, data are collected by people or sensors and entered into the

computer via any input device. Generally speaking, organizations try to automate the TPS data entry as much as possible because of the large volume involved.

Next, the system processes data in one of two basic ways: *batch* or *online processing*. In **batch processing**, the firm collects data from transactions as they occur, placing them in groups or batches. The system then prepares and processes the batches periodically (say, every night). Batch processing is particularly useful for operations that require processing for an extended period of time. Once a batch job begins, it continues until it is completed or until an error occurs. In **online processing**, data are processed as soon as a transaction occurs.

To implement online transaction processing, *master files* containing key information about important business entities are placed on hard drives, where they are directly accessible. The *transaction files* containing information about activities concerning these business entities, such as orders placed by customers, are also held in online files until they are no longer needed for everyday transaction processing activity. This ensures that the transaction data are available to all applications, and that all data are kept up-to-the-minute. These data can also be processed and stored in a data warehouse (Chapter 11). The entire process is managed by a *transaction manager* (see Subrahmanyam 2002, for details).

The flow of information in a typical TPS is shown in Figure 7.3. An event, such as a customer purchase, is recorded by the TPS program. The processed information can be either a report or an activity in the database. In addition to a scheduled report, users can query the TPS for nonscheduled information (such as, “What was the impact of our price cut on sales during the first five days, by day?”). The system will provide the appropriate answer by accessing a database containing transaction data.

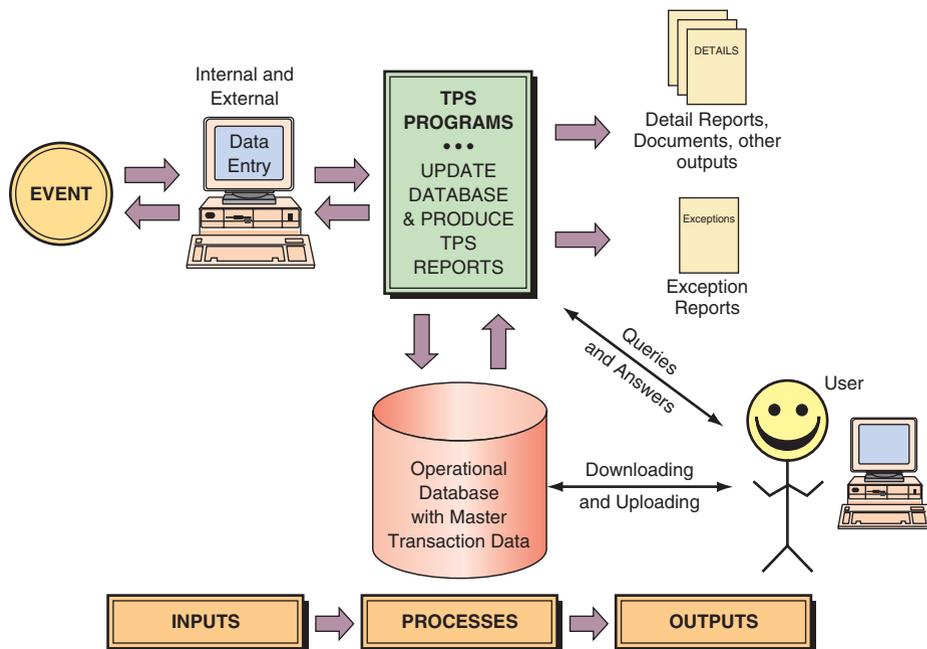


FIGURE 7.3 The flow of information in transaction processing.

Web-Based and Online Transaction Processing Systems



Transaction processing systems may be fairly complex, involving customers, vendors, telecommunications, and different types of hardware and software. Traditional TPSs are centralized and run on a mainframe. However, innovations such as online transaction processing require a client/server architecture. In **online transaction processing (OLTP)**, transactions are processed as soon as they occur. For example, when you pay for an item at a POS at a store, the system records the effects of the sale by reducing the inventory on hand by a unit, increasing the store's cash position by the amount you paid, and increasing sales figures for the item by one unit. A relatively new form of Web-based transaction processing is *object-oriented transaction processing*, which is described in *Online File W7.3*.

With OLTP and Web technologies such as an extranet, suppliers can look at the firm's inventory level or production schedule in real time. The suppliers themselves, in partnership with their customers, can then assume responsibility for inventory management and ordering. Such Web-based systems would be especially useful in processing orders involving several medium-to-large business partners. Customers too can enter data into the TPS to track orders and even query it directly, as described in the *IT At Work 7.1*.

WEB-BASED INTERACTIVE TRANSACTION PROCESSING. Rather than isolated exchanges of simple text and data over private networks, such as traditional EDI and EFT, transactions are increasingly conducted over the Internet and intranets



IT At Work 7.1 **MODERNIZING THE TPS CUTS DELIVERY TIME AND SAVES MONEY**



Here are some examples of how modernizing transaction processing systems has saved time and/or money: Each time you make a copy at Kinko's, a copying transaction and a payment transaction occur. In the past you received a device (a card, the size of a credit card) and inserted it into a control device attached to the copy machine, and it recorded the number of copies that you made. Then you stood in line to pay: The cashier placed the device in a reader to see how many copies were made. Your bill was computed, with tax added. Kinko's cost was high in this system, and some customers were unhappy about standing in line to pay for only a few copies. Today, using Kinko's new system, you insert your credit card (or a stored-value card purchased from a machine) into a control device, make the copies, print a receipt, and go home. You no longer need to see a Kinko's employee to complete your purchase.

Grossman's Bargain Centers, a retailer in Braintree, Massachusetts, replaced all its point-of-sale terminals with a network of PCs. The network rings up sales, updates inventory, and keeps customers' histories at 125 stores. The PCs automatically record stock from a remote database and

trace out-of-stock items available at other stores. This way, customers can get locally unavailable items within hours or a day. Employees no longer have to count inventory or order merchandise. The \$3 million investment paid for itself in less than two years.

Seconds after you enter an address and a Zip code into a terminal at UPS delivery outlets at a UPS Store, a shipping label and a receipt are generated. Your shipping record stays in the database, so if you send another package to the same person, you do not need to repeat the address again.

Using an object-oriented approach, Sprint Inc. has improved its order processing for new telephones. In the past it took a few days for a customer to get a new telephone line; with its new system, Sprint can process an order in only a few hours. The order application itself takes less than 10 minutes, experiences fewer errors, and can be executed on electronic forms on a salesperson's desktop or laptop computer.

For Further Exploration: Why is the back-ordering cycle usually reduced with a networked TPS? Could Kinko's operate without employees at their outlets? Why is there an attempt to save time, and whose time is being saved?

in a more complex manner. As a result, OLTP has broadened to become *interactive Internet TPS*. Internet transaction processing software and servers allow multimedia data transfer, fast response time, and storage of large amount of graphics and video—all in real time and at low cost. The interactivity feature allows for easy and fast response to queries. OLTP also offers flexibility to accommodate unpredictable growth in processing demand (scalability) and timely search and analysis of large databases. Companies that accept and process large number of orders, such as Dell Computer, tend to have a sophisticated Web-based ordering system.

Typical Task in Transaction Processing

Transaction processing exists in all functional areas. In later sections (7.3 through 7.6) we will describe the key TPS activities in major functional areas. Here we describe in some detail one application that crosses several functional areas—order processing.

ORDER PROCESSING. Orders for goods and/or services may flow from customers to a company by phone, on paper, or electronically. Fast and effective order processing is recognized as a key to customer satisfaction. Orders can also be internal—from one department to another. Once orders arrive, an order processing system needs to receive, document, route, summarize, and store the orders. A computerized system can also track sales by product, by zone, or by salesperson, providing sales or marketing information that may be useful to the organization. As described in Chapter 6, more and more companies are providing systems for their salespeople that enable them to enter orders from a business customer's site using wireless notebook computers, PDAs, or Web-enabled cell phones. Some companies spend millions of dollars reengineering their order processing as part of their transformation to e-business (e.g., see Siemens case, Chapter 1). IBM, for example, restructured its procurement system so its own purchasing orders are generated quickly and inexpensively in its e-procurement system.

Orders can be for services as well as for products. Otis Elevator Company, for example, tracks orders for elevator repair. The processing of repair orders is done via wireless devices that allow effective communication between repair crews and Otis physical facilities. Orders also can be processed by using innovative IT technologies such as global positioning systems, as shown in the *IT At Work 7.2*.

OTHER TPS ACTIVITIES. Other typical TPS activities are summarized in Table 7.2. Most of these routine tasks are computerized.

Transaction Processing Software



There are dozens of commercial TPS software products on the market. Many are designed to support Internet transactions. (See a sampler of TPS software products and vendors in *Online File W7.4*.)

The problem, then, is how to evaluate so many software packages. In Chapter 14, there is a discussion on software selection that applies to TPS as well. But the selection of a TPS software product has some unique features. Therefore, one organization, the Transaction Processing Performance Council (*tpc.org*), has been trying to assist in this task. This organization is conducting *benchmarking* for TPS. It checks hardware vendors, database vendors, middleware vendors, and so forth. Recently it started to evaluate e-commerce transactions (*tpc.org/tpcw*; there, see “transactional Web e-commerce benchmark”). Also, the organization has several decision support benchmarks (e.g., TPC-H, and TPC-R).



IT At Work 7.2 AUTOMATIC VEHICLE LOCATION AND DISPATCH SYSTEM IN SINGAPORE



Taxis in Singapore are tracked by a *global positioning system (GPS)*, which is based on the 24 satellites originally set up by the U.S. government. The GPS allows its users to get an instant fix on the geographical position of each taxi (see attached figure).

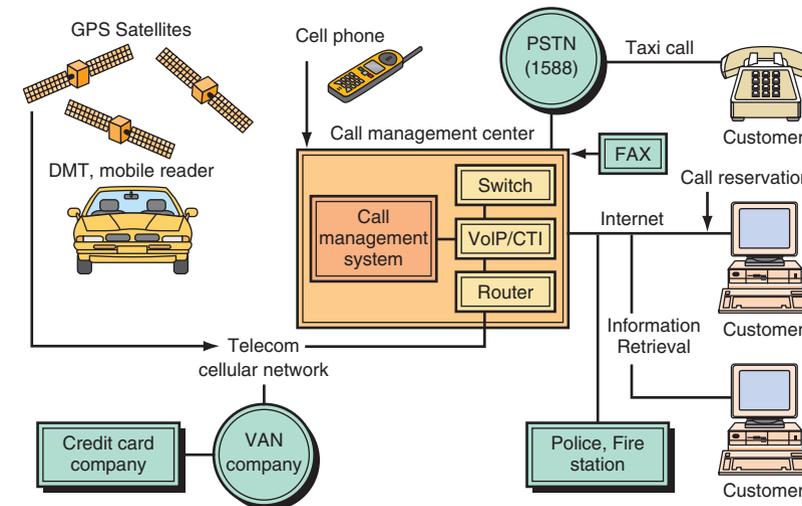
Here's how the system works: Customer orders are usually received via a cell phone, regular telephone, fax, or e-mail. Customers can also dispatch taxis from special kiosks (called CabLink) located in shopping centers and hotels. Other booking options include portable taxi-order terminals placed in exhibition halls. Frequent users enter orders from their offices or homes by keying in a PIN number over the telephone. That number identifies the user automatically, together with his or her pickup point. Infrequent customers use an operator-assisted system.

The computerized ordering system is connected to the GPS. Once an order has been received, the GPS finds a vacant cab nearest the caller, and a display panel in the taxi alerts the driver to the pickup address. The driver has ten seconds to push a button to accept the order. If he does not, the system automatically searches out the next-nearest taxi for the job.

The system completely reengineered taxi order processing. First, the transaction time for processing an order for a frequent user is much shorter, even during peak demand, since they are immediately identified. Second, taxi drivers are not able to pick and choose which trips they want to take, since the system will not provide the commuter's destination. This reduces the customer's average waiting time significantly, while minimizing the travel distance of empty taxis. The system increases the capacity for taking incoming calls by 1,000 percent, providing a competitive edge to those cab companies that use the system. It also reduces misunderstanding between drivers and dispatchers, and driver productivity increase since they utilize their time more efficiently. Finally, customers who use terminals do not have to wait a long time just to get a telephone operator (a situation that exists during rush hours, rain, or any other time of high demand for taxis). Three major taxi companies with about 50,000 taxis are connected to the system.

For Further Exploration: What tasks do computers execute in this order processing system? What kinds of priorities can be offered to frequent taxi customers?

Source: Compiled from Liao (2003) and author's experience.



VAN (Value Added Network)
PSTN (Public Switched Telecommunication)

VoIP (Voice Over Internet Protocol)
CTI (Computer Telephone Integration)

Location tracking of taxicabs in Singapore

TABLE 7.2 Typical TPS Activities

Activities	Description
The ledger	The entire group of an organization's financial accounts. Contains all of the assets, liabilities, and owner's (stockholders') equity accounts.
Accounts payable and receivable	Records of all accounts to be paid and those owed by customers. Automated system can send reminder notes about overdue accounts.
Receiving and shipping records	Transaction records of all items sent or received, including returns.
Inventory-on -and records	Records of inventory levels as required for inventory control and taxation. Use of bar codes improves ability to count inventory periodically.
Fixed-assets management	Records of the value of an organization's fixed assets (e.g., buildings, cars, machines), including depreciation rate and major improvements made in assets, for taxation purposes.
Payroll	All raw and summary payroll records.
Personnel files and skills inventory	Files of employees' history, evaluations, and record of training and performance
Reports to government	Reports on compliance with government regulations, taxes, etc.
Other periodic reports and statements	Financial, tax, production, sales, and other routine reports.

7.3 MANAGING PRODUCTION/OPERATIONS AND LOGISTICS

The *production and operations management (POM)* function in an organization is responsible for the processes that transform inputs into useful outputs (see Figure 7.4). In comparison to the other functional areas, the POM area is very diversified and so are its supporting information systems. It also differs considerably among organizations. For example, manufacturing companies use completely

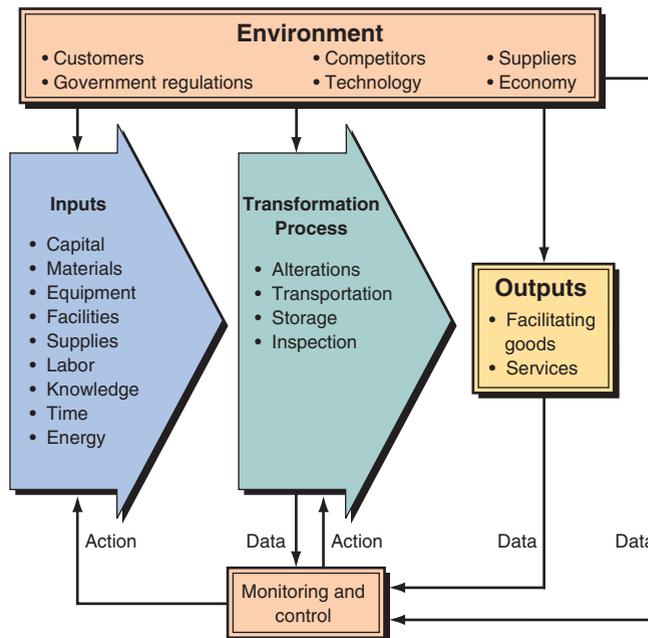


FIGURE 7.4 The production/operations management functions transform inputs into useful outputs. (Source: J. R. Meredith and S. M. Shafer, *Operations Management*. New York: Wiley, 2002. Reprinted by permission of John Wiley & Sons, Inc.)

different processes than do service organizations, and a hospital operates much differently from a university. (Look again at Online File W7.1 for an example of the complexity of the POM field. Note that the internal interfaces are on the left and the external ones on the right.)



In-House Logistics and Materials Management

Because of the breadth and variety of POM functions, here we present four IT-supported POM topics: in-house logistics and materials management, planning production/operations, computer-integrated manufacturing (CIM), and product lifecycle management (PLM). A fifth topic, automating design work and manufacturing, is presented in *Online File W7.5*.

Logistics management deals with ordering, purchasing, inbound logistics (receiving), and outbound logistics (shipping) activities. In-house logistics activities are a good example of processes that cross several primary and support activities in the value chain. Both conventional purchasing and e-procurement result in incoming materials and parts. The materials received are inspected for quality and then stored. While the materials are in storage, they need to be maintained until distributed to those who need them. Some materials are disposed of when they become obsolete or their quality becomes unacceptable.

All of these activities can be supported by information systems. For example, many companies today are moving to some type of e-procurement (Chapter 5). Scanners and voice technologies, including wireless ones, can support inspection, and robots can perform distribution and materials handling. Large warehouses use robots to bring materials and parts from storage, whenever needed. The parts are stored in bins, and the bins are stacked one above the other (similar to the way safe deposit boxes are organized in banks). Whenever a part is needed, the storekeeper keys in the part number. The mobile robot travels to the part's "address," takes the bin out of its location (e.g., using magnetic force), and brings the bin to the storekeeper. Once a part is taken out of the bin, the robot is instructed to return the bin to its permanent location. In intelligent buildings in Japan, robots bring files to employees and return them for storage. In some hospitals, robots even dispense medicines.

INVENTORY MANAGEMENT. *Inventory management* determines how much inventory to keep. Overstocking can be expensive; so is keeping insufficient inventory. Three types of costs play important roles in inventory decisions: the cost of maintaining inventories, the cost of ordering (a fixed cost per order), and the cost of not having inventory when needed (the shortage or opportunity cost). The objective is to minimize the total of these costs.

Two basic decisions are made by operations: when to order, and how much to order. Inventory models, such as the economic order quantity (EOQ) model, support these decisions. Dozens of models exist, because inventory scenarios can be diverse and complex. A large number of commercial inventory software packages to automate the application of these models are available at low cost. For example, using DSS models in a Web-based system, more and more companies are improving their inventory management and replenishment, better meeting customers' demand (Amato-McCoy, 2002c).

Once management has made decisions about how much to order and when, an information system can track the level of inventory for each item that management wants to control. (Not every item needs such control. For example, items whose consumption is basically fixed, such as toilet paper or pencils, may



not be closely controlled.) When the inventory falls to a certain level, called the *reorder point*, the computer automatically generates a purchase order. The order is transferred electronically either to a vendor or if the item is manufactured in-house, to the manufacturing department.

Many large companies (such as Wal-Mart) allow their suppliers to monitor the inventory level and ship when needed, eliminating the need for sending purchasing orders. Such a strategy, in which the supplier monitors inventory levels and replenishes when needed, is called **vendor-managed inventory (VMI)**. The monitoring can be done by using mobile agents over the Internet. It can be also done by using Web services as Dell Computer is doing.

In Chapter 8 we demonstrate how IT and EC help in reducing inventories.

QUALITY CONTROL. Manufacturing quality-control systems can be stand-alone systems or can be part of an enterprise-wide total quality management (TQM) effort. They provide information about the quality of incoming material and parts, as well as the quality of in-process semifinished and finished products. Such systems record the results of all inspections. They also compare actual results to metrics.

Quality-control data may be collected by Web-based sensors and interpreted in real time, or they can be stored in a database for future analysis. Periodic reports are generated (such as percentage of defects, percentage of rework needed), and management can compare performance among departments on a regular basis or as needed.

Web-based quality control information systems are available from several vendors (e.g., HP and IBM) for executing standard computations such as preparing quality control charts. First, manufacturing data are collected for quality-control purposes by sensors and other instruments. After the data have been recorded, it is possible to use Web-based expert systems to make interpretations and recommend actions (e.g., to replace equipment).

Planning Production/ Operations

The POM planning in many firms is supported by IT. Some major areas of planning and their computerized support are described here.

MATERIAL REQUIREMENTS PLANNING (MRP). Inventory systems that use an EOQ approach are designed for those individual items for which demand is completely independent (for example, the number of chairs a furniture manufacturer will sell). However, in manufacturing systems, the demand for some items can be interdependent. For example, a company may make three types of chairs that all use the same legs, screws, and bolts. Thus, the demand for legs, screws, and bolts depends on the total demand for all three types of chairs and their shipment schedule.

The software that facilitates the plan for acquiring (or producing) parts, sub-assemblies, or materials in the case of interdependent items is called **material requirements planning (MRP)**. MRP is computerized because of the complex interrelationship among many products and their components, and the need to change the plan each time that a delivery date or the order quantity is changed. Several MRP packages are commercially available.

MRP deals only with production scheduling and inventories. A more complex process will also involve allocation of related resources. In such a case, more complex, integrated software is available—MRP II.



MANUFACTURING RESOURCE PLANNING (MRP II). A POM system called **manufacturing resource planning (MRP II)** adds functionalities to a regular MRP. For example, in addition to the output similar to that of MRP, MRP II determines the costs of parts and the cash flow needed to pay for parts. It also estimates costs of labor, tools, equipment repair, and energy. Finally, it provides a detailed, computerized budget for the parts involved. Several MRP II software packages are commercially available. MRP II evolved to ERP, which is described in Chapter 8.

JUST-IN-TIME SYSTEMS. In mass customization and build-to-order production, the just-in-time concept is frequently used. **Just-in-time (JIT)** is an approach that attempts to minimize waste of all kinds (of space, labor, materials, energy, and so on) and to continuously improve processes and systems. For example, if materials and parts arrive at a workstation *exactly when needed*, there is no need for inventory, there are no delays in production, and there are no idle production facilities or underutilized workers. Many JIT systems are supported by software from vendors such as HP, IBM, CA, and Cincom Systems.

JIT systems have resulted in significant benefits. At Toyota, for example, benefits included reducing production cycle time from 15 days to 1 day, reducing cost by 30 to 50 percent, and achieving these cost savings while increasing quality. JIT is especially useful in supporting Web-based mass customization, as in the case of Dell Computer's model of assembling computers only after orders are received. To ship computers quickly, components and parts are provided just in time. As of 2001, car manufacturers were rapidly adopting a make-to-order process. To deliver customized cars quickly and with cost efficiency, manufacturers need a JIT system.

PROJECT MANAGEMENT. A *project* is usually a one-time effort composed of many interrelated activities, costing a substantial amount of money, and lasting for weeks or years. The management of a project is complicated by the following characteristics.

- Most projects are unique undertakings, and participants have little prior experience in the area.
- Uncertainty exists due to the generally long completion times.
- There can be significant participation of outsiders, which is difficult to control.
- Extensive interaction may occur among participants.
- The many interrelated activities make changes in planning and scheduling difficult.
- Projects often carry high risk but also high profit potential.

The management of projects is enhanced by project management tools such as the *program evaluation and review technique (PERT)* and the *critical path method (CPM)*. The essence of these tools is to break complex projects or operations into a sequence of events, to examine the relationships among these events, and to schedule these events to minimize the time needed to complete the project. These tools are easily computerized, and indeed there are dozens of commercial packages on the market. For example, developing Web applications is a major project, and several IT tools are available to support and help manage these activities (see *citadon.com*). Merrill-Lynch uses such computerized tools to plan and manage its main projects (Bielski, 2002), significantly improving



resource allocation and decision making. For project cost estimation using special software, see Vijayakumar (2002).

WORK MANAGEMENT SYSTEMS. **Work management systems (WMS)** automatically manage the prioritization and distribution of work. These systems deal with resource allocation, an activity that is missing from *workflow systems* (see Chapter 4). For example, if an operator is unavailable, WMS recalculates the process and reallocates human resources to meet the business need. For details and a case study from the U.K., see Collins (1999).

TROUBLESHOOTING. Finding what's wrong in the factory's internal operations can be a lengthy and expensive process. Intelligent systems can come to the rescue. Bizworks, from InterBiz Solutions, is an example of a successful software product that tackles thorny POM problems, such as interpretation of data gathered by factory sensors. The product is useful for quality control, maintenance management, and more. Similar products cut diagnosis time from hours to seconds. Many detecting systems are Web-based (see *gensym.com*).

OTHER AREAS. Many other areas of planning production and operations are improved by IT. For example, Lee and Chen (2002) developed a Web-based production planning optimization tool. Factory layout planning and design also have been greatly improved due to IT tools (Benjaafar et al., 2002).

Computer-Integrated Manufacturing

Computer-integrated manufacturing (CIM) is a concept or philosophy that promotes the integration of various computerized factory systems. CIM has three basic goals: (1) the *simplification* of all manufacturing technologies and techniques, (2) *automation* of as many of the manufacturing processes as possible, and (3) *integration and coordination* of all aspects of design, manufacturing, and related functions via computer hardware and software. Typical technologies to be integrated are flexible-manufacturing systems (FMS), JIT, MRP, CAD, CAE, and group technology (GT).

THE CIM MODEL. All of the hardware and software in the world will not make a computer-integrated manufacturing system work if it does not have the support of the people designing, implementing, and using it. According to Kenneth Van Winkle, manager of manufacturing systems at Kimball International, a furniture manufacturer, "Computer technology is only 20 percent of CIM. The other 80 percent is the *business processes and people*." In order to bring people together and formulate a workable business process, CIM must start with a plan. This plan comes from the CIM model, which describes the CIM vision and architecture. The basic CIM model is shown in Figure 7.5.

The CIM model is derived from the CIM *enterprise wheel* developed by the Technical Council of the Society of Manufacturing Engineers. Its outer circle represents general business management. The inner circles represent four major "families" of processes that make up CIM: (1) product and process definition, (2) manufacturing planning and control, (3) factory automation, and (4) information resource management. Each of these five dimensions is a composite of more specific manufacturing processes, and each dimension is interrelated with the others. Thus, when planning a CIM system, no dimension can be ignored.

The hub of the wheel (the solid gold circle and the lighter gold circle around it) represents the IT resources and technologies necessary for the integration of

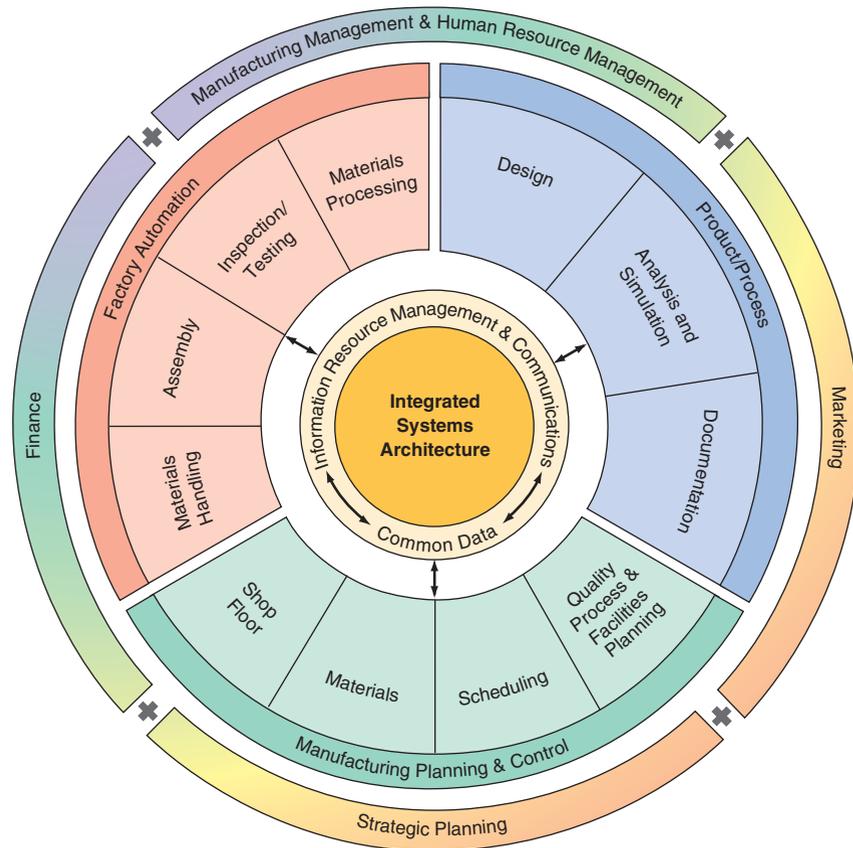


FIGURE 7.5 The CIM model: integration of all manufacturing activities under unified management. (Source: Reprinted from the CASA/SME Manufacturing Enterprise Wheel, with permission from the Society of Manufacturing Engineers, Dearborn, Michigan. 1999, Third Edition.)

CIM. Without an integrated plan, trying to implement CIM would be next to impossible. There must be communication, data sharing, and cooperation among the different levels of management and functional personnel.

The major advantages of CIM are its comprehensiveness and flexibility. These are especially important in business processes that are being completely restructured or eliminated. Without CIM, it may be necessary to invest large amounts of money to change existing information systems to fit the new processes. For an example of how a furniture company uses CIM, see *kimball.com* (click on Electronic Manufacturing Services). For more on a unified framework for integrated manufacturing, using intelligent systems and PLM, see Zaremba and Morel (2003).

Product Lifecycle Management (PLM)

Product lifecycle management (PLM) is a business strategy that enables manufacturers to control and share product-related data as part of product design and development efforts and in support of supply chain operations (see Day, 2002). In PLM, Web-based and other new technologies are applied to *product development* to automate its *collaborative aspects*, which even within a given organization can prove tedious and time-consuming. By overlapping formerly disparate functions, such as a manufacturing process and the logistics that support it, a dynamic collaboration takes place among the functions, essentially forming a single large product team from the product's inception.

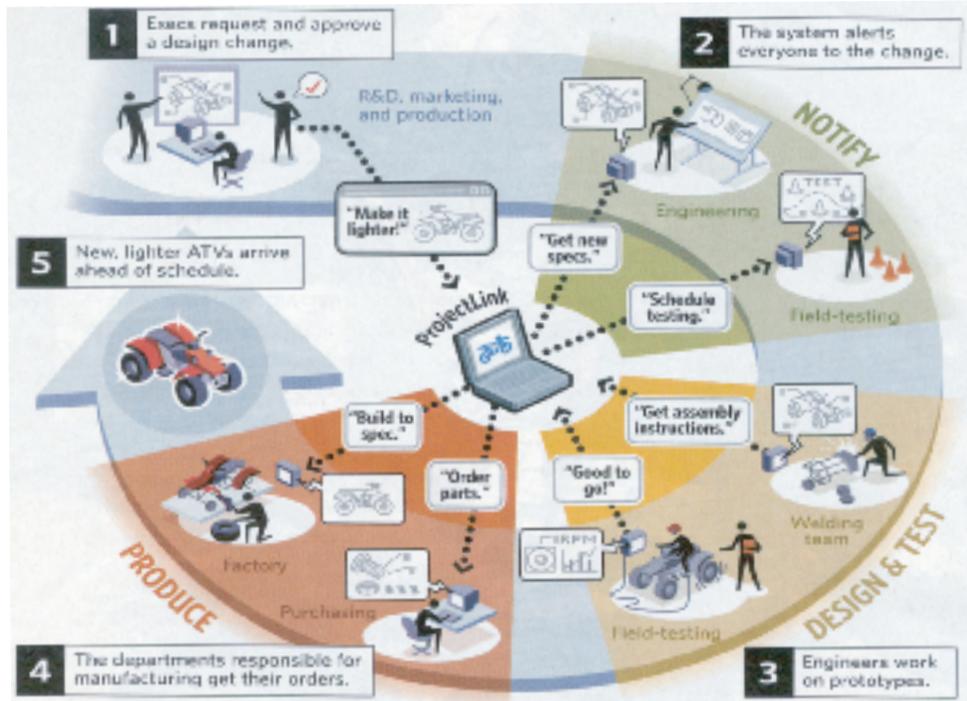


FIGURE 7.6 How Product Life Cycle Management Works. (Source: Raskin (2002), p. 50.)

An example of a Web-based PLM product (from PTC Corp.) for designing popular ATV bikes is provided in Figure 7.6. The collaboration is achieved via “ProductLink” (at the center of the figure). Using this PLM, bike-maker Cannondale Corp. was able to design its 2003 model significantly faster.

PLM can have a significant beneficial impact in engineering change, cycle time, design reuse, and engineering productivity. Studies have shown that electronic-based collaboration can reduce product cost and travel expenses, as well as significantly reduce costs associated with product-change management. Moreover, an explosion of new products that have short life cycles, as well as increasing complexity in supply chain management, are driving the need for PLM.

PLM is a big step for an organization, requiring it to integrate a number of different processes and systems. Ultimately, its overall goal from the organization’s point of view is to move information through an organization as quickly as possible in order to reduce the time it takes to get a product to market and to increase profitability. PLM tools are offered by SAP (MYSAP PLM), Matrix One, EDS, PTC, Dassault Systems, and IBM (IBM PLM).

7.4 MANAGING MARKETING AND SALES SYSTEMS

In Chapters 1 through 6 we emphasized the increasing importance of a customer-focused approach and the trend toward customization and consumer-based organizations. How can IT help? First we need to understand how products reach customers, which takes place through a series of marketing entities known as *channels*.

Channel systems are all the systems involved in the process of getting a product or service to customers and dealing with all customers' needs. The complexity of channel systems can be observed in Figure 7.7, where seven major systems are interrelated.

Channel systems can link and transform marketing, sales, procurement, logistics, and delivery, and other activities. Added market power comes from the integration of channel systems with the corporate functional areas. The problem is that a change in any of the channels may affect the other channels. Therefore, the supporting information systems must be coordinated or even integrated.

We describe only a few of the many channel-system activities here, organizing them into three groups: customer relations, distribution channels and in-store innovations, and marketing management. A fourth topic, telemarketing, is presented in *Online File W7.6* on the Web site.



“The Customer Is King/Queen”

It is essential for companies today to know who their customers are and to treat them like royalty. New and innovative products and services, successful promotions, customization, and superb customer service are becoming a necessity for many organizations. In this section we will briefly describe a few activities related to *customer-centric* organizations. More are described in Section 7.7, where customer relationship management (CRM) is presented.

CUSTOMER PROFILES AND PREFERENCE ANALYSIS. Information about existing and potential customers is critical for success. Sophisticated information systems are being developed to collect data on customers, their demographics (age, gender, income level), and preferences.

Consumer behavior online can be tracked by cookies (small data files placed on a user's hard drive by a Web server). Then (as explained in Chapter 5), the consumer's online behavior can be analyzed and used for marketing purposes. By checking the demographics of its millions of customers and their locations, America Online (AOL), for example, can match appropriate ads of advertisers with specific customers. The effectiveness of such ads is very high. Even more powerful is the combination of off-line and online data (e.g., see *doubleclick.com*). For approaches to targeted marketing and/or advertising, see Chapter 5 and Strauss et al. (2003).

PROSPECTIVE CUSTOMER LISTS AND MARKETING DATABASES. All firms need to know who their customers are, and IT can help create customer databases of both existing and potential customers. It is possible today to purchase computerized lists from several sources and then merge them electronically. These prospective-customer lists then can be analyzed and sorted by any desired classification for direct mailing, e-mailing, or telemarketing. Customer data can be stored in a corporate database or in special marketing databases for future analysis and use. For how Sears uses a marketing database, see Amato-McCoy (2002b). (We discuss database marketing further in Chapter 11.)

Several U.S. retailers ask customers to tell them only the Zip (postal) code in which they live. With this limited piece of information, the retailers do not get involved in privacy issues, yet they are able to gather valuable locational data. For example, they can match the geographical information with the items purchased in order to do sales analysis and make various marketing decisions. With

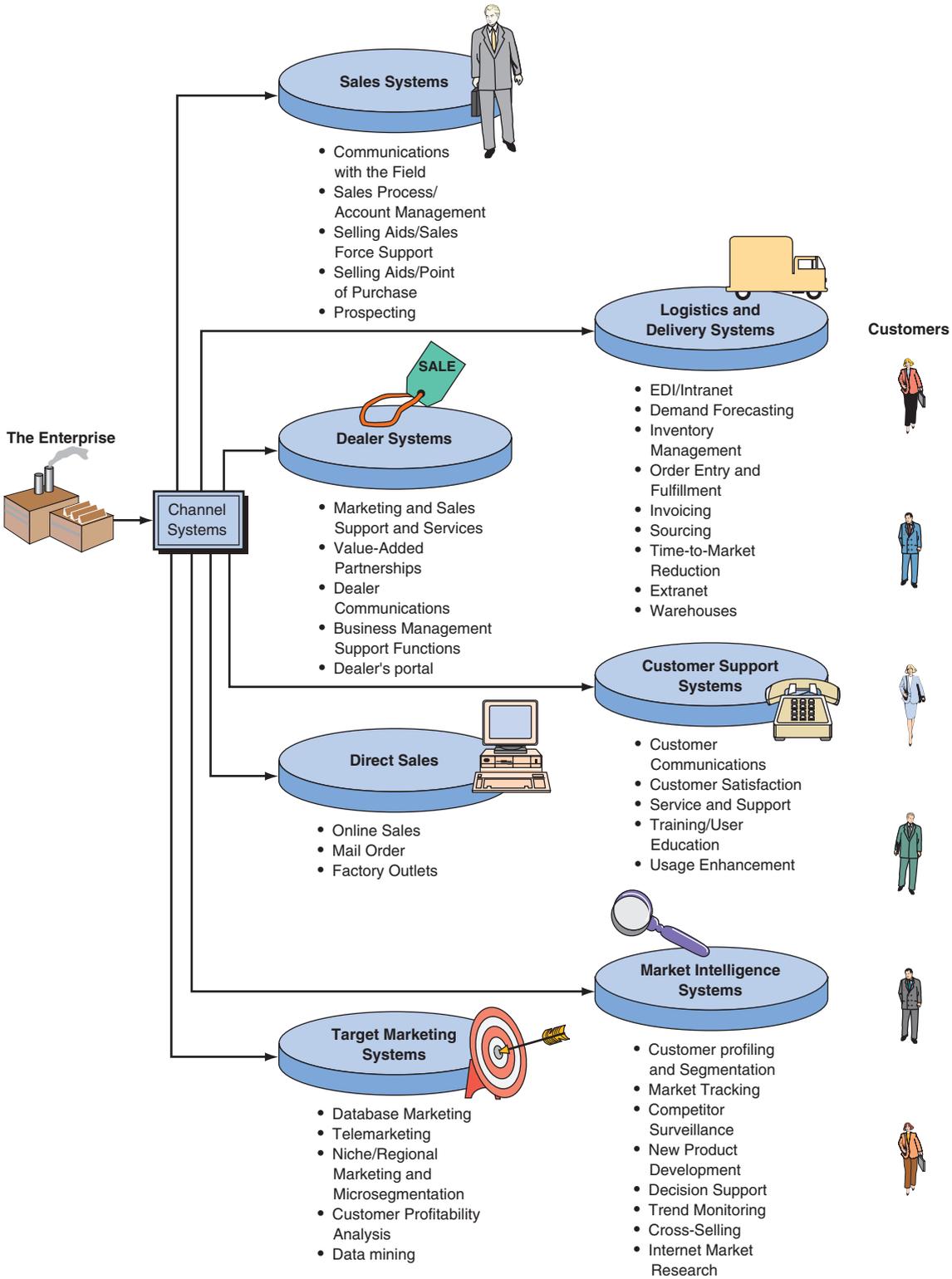


FIGURE 7.7 Marketing channel systems.

TABLE 7.3 The Changing Face of Marketing

	Old Model	New Model
	Mass and Segmented Marketing	Customization
Relationships with customers	Customer is a passive participant in the exchange	Customer is an active co-producer
Customer needs	Articulated	Articulated and unarticulated
Segmentation	Mass market and target segments	Segments looking for customized solutions and “segments one” (a segment of only one person)
Product and service offerings	Line extensions and modification	Customized products, services, and marketing
New-product development	Marketing and R&D drive new-product development	R&D focuses on developing the platforms that allow consumers to customize
Pricing	Fixed prices and discounting	Customer-determined pricing (e.g., Priceline.com; auctions). Value-based pricing models
Communication	Advertising and public relations	Integrated, interactive, and customized marketing communication, education, and entertainment
Distribution	Traditional retailing and direct marketing	Direct (online) distribution and rise of third-party logistics services
Branding	Traditional branding and co-branding	Use of the customer’s name as the brand (e.g., My brand or Brand 4 ME)
Basis of competitive advantage	Marketing power	Marketing finesse and “capturing” the customer as “partner” while integrating marketing, operations, R&D, and information

Source: Wind (2001), p.41.

this geographical information system (GIS) software, retailers can learn a lot about the company’s customers and the location of competitors and can experiment with potential strategies, such as decisions about where to open new branches and outlets. (See Chapter 11 for more on use of GIS in decision making.)

MASS CUSTOMIZATION. Increasingly, today’s customers want customized products. Some manufacturers offer different product configurations, and in some products dozens of options are available. The result is *mass customization*, as practiced successfully by Dell Computer and many other companies (see Appendix 3A). Customization is possible both in manufactured goods and in services.

Wind (2001) analyzed the impact of customization on marketing and the resultant changes (see Table 7.3). As shown in throughout this book, these changes are being supported by IT. For example, the Web can be used to expedite the ordering and fulfillment of customized products, as demonstrated in *IT At Work 7.3* about building a Jaguar.

Mass customization is not for everyone, and it does have several limitations (Zipkin, 2001). The major limitations are that it requires: a highly flexible production technology, an elaborate system for eliciting customers’ wants and needs, and strong direct-to-customer logistics system. Another limitation is



IT At Work 7.3

BUILD YOUR JAGUAR ONLINE



Prospective Jaguar car buyers can build, see, and price the car of their dreams online. As of October 2000, you can configure the car at *jaguar.com* in real time. Cars have been configured online since 1997, but Jaguar was an industry first to offer comprehensive services, delivered in many languages.

Using a virtual car, users can view more than 1,250 possible exterior combinations, rotating the car through 360 degrees, by moving directional arrows. As you select the model, color, trim, wheels, and accessories, both image and price information automatically update. The design choices are limited to current models. Up to 10 personalized car selections per customer can be stored in a “virtual garage.” Customers can “test” virtual cars and conduct comparisons of different models. Once the buyer makes a decision, the order is forwarded to a dealer of his or her choice.

Like most other car manufacturers, Jaguar will not let you consummate the purchase online. To negotiate price, customers can go to a Jaguar dealer or use Auto By Tel (*autobytel.com*), which connects nearby dealers to the customer. However, Jaguar’s system helps get customers to the point of purchase. It helps them *research* the purchase and explore, price, and visualize options. Customers thus

familiarize themselves with the Jaguar before even visiting a showroom. The ability to see a 3-D photo of the car is an extremely important customer service. Finally, the order for the customer-configured can be transmitted electronically to the production floor, reducing the time-to-delivery cycle.

The IT support for this innovation includes a powerful configuration database integrated with Jaguar’s production system (developed by Ford Motor Company and Trilogy Corp.) and the “virtual car” (developed by Global Beach Corp.).

As of mid-2000, most car manufacturers had introduced Web-based make-to-order systems. In order to avoid channel conflicts, these systems typically involve the dealers in the actual purchase. All major car manufacturers are attempting to move car ordering to the Web.

For Further Exploration: Why would manufacturers be interested in the Web if the actual purchase is done at the dealers’ site?

Sources: Compiled from *jaguar.com* press releases (October–November, 2000); *ford.com* (2000) (go to Services); and *autobytel.com* (2002).

cost: some people are unable or unwilling to pay even the slightly higher prices that customization often entails. Holweg and Pil (2001) provide some guidelines for how to overcome these limitations.

PERSONALIZATION. Using cameras, retailers can find what people are doing while they visit physical stores. Similarly, tracking software can find what people are doing in a virtual store. This technology provides information for real-time marketing and is also used in m-commerce (see Chapter 6 and also Sadeh, 2002). Personalized product offers then are made, based on where the customer spent the most time and on what what he or she purchased. A similar approach is used in Web-based *cross-selling* (or *up-selling*) efforts, in which advertisement of related products is provided. For example, if you are buying a car, car insurance is automatically offered (see Strauss et al., 2003).

ADVERTISING AND PROMOTIONS. The Internet opens the door to a new advertising medium. As was shown in Chapter 5, online advertising, mainly via e-mail and banners, is growing rapidly. Innovative methods such as viral marketing (Reda, 2002) are possible only on the Internet. Wireless and pervasive computing applications also are changing the face of advertising (Chapter 6). For example, in order to measure attention to advertising, a mobile-computing

device called Arbitron is carried by customers (see Gentile, 2002). Whoever is wearing the device automatically logs advertising seen or heard any time, anywhere in their daily travels.

Distribution Channels and In-Store Innovations

Organizations can distribute their products and services through several available delivery channels. For instance, a company may use its own outlets or distributors. Digitalizable products can be distributed online, or can be delivered on CD ROMs. Other products can be delivered by trucks or trains, with the movement of goods monitored by IT applications. The Web is revolutionizing distribution channels (Chaudhury, et al., 2001). Here we look at some representative topics relating to distribution channels.

NEW IT-SUPPORTED DISTRIBUTION CHANNELS. In addition to the Internet, IT enables other new or improved channels through which to distribute goods or services. For example, by connecting mapping technology with databases of local employers, retailers and fast-food marketers are providing goods and services to employees during their lunch breaks. Using the Internet, retailers offer special incentives (e.g., coupons) to lunchtime shoppers. According to Seidman (2002), fast food, paint, and tires top the list of items sold in this new channel. A leading vendor in this area is SBS Technologies (*sbs.com*); it works with Mapinfo.com, which provides electronic maps showing a marketer who is working where, so they can design promotions accordingly.

Another new distribution channel is self-service convenience stores, which are popular at railway stations, highway rest areas, airports, and gasoline stations. While some of these have an employee or two, most are without employees. They are used by manufacturers (e.g., Mattel) as well as by retailers to offer their products to the public. What is new about this distribution channel is that payment can be made by inserting a credit card into a card reader or by using a smart card, even for a small purchase amount.

IMPROVING SHOPPING AND CHECKOUT AT RETAIL STORES. The modern shopper is often pressed for time, and most are unhappy about waiting in long lines. Using information technology, it is possible to reengineer the shopping and the checkout process. For example:

- Several companies use hand-held wireless devices that scan the bar code UPC of the product you want to buy, giving you all product information, including options such as maintenance agreements. The desired purchase is matched with your smart card (or credit card), and an order to send the product(s) to the cashier is issued. By the time you arrive at the cashier, the bill and the merchandise are ready.
- An alternative to the hand-held computer is the information kiosk. The kiosks enable customers to view catalogs in stores, conduct product searches, and even compare prices with those of competitors. Kiosks at some stores (e.g., 7-Eleven stores in some countries) can be used to place orders on the Internet. (For details about use of in-store kiosks, see *Online File W7.7* and Sweeney, 2001.)
- Video-based systems count the number of shoppers and track where they go in physical stores. These are not security systems per se; rather, their purpose is to gather information about shopping patterns. The collected data are



analyzed and used for computer-based decisions regarding displays, store design, and in-store marketing messages and promotions. The information is also used to determine when shopping traffic is heaviest, in order to schedule employees (see Kroll, 2002, for details).

- Some stores that have many customers who pay by check (e.g., large grocery stores, Wal-Mart stores) have installed check-writers. All you have to do is submit the blank check to the cashier, who runs it through a machine attached to the cash register. The machine prints the name of the store as the payee and the amount, you sign the check, and in seconds the check is validated, your bank account is debited, and you are out of the store with your merchandise.
- Computerization of various activities in retail stores can save time and money and provide better customer service. Cash Register Express offers many products, such as Video Express, barcode express, portable data collectors, and inventory-track express. For details about these and other computerized cash register services, see pcamerica.com.
- An increasing number of retailers are installing self-checkout machines. Not only does the retailer save the cost of employees' salaries, but customers are happier for saving time. (And some enjoy "playing cashier" briefly.) A major device is U-Scan, which is being used in many supermarkets (see photo).

DISTRIBUTION CHANNELS MANAGEMENT. Once products are in the distribution channels, firms need to monitor and track them, since only fast and accurate delivery times guarantee high customer satisfaction and repeat business. FedEx, UPS, HDL, and other large shipping companies provide customers with sophisticated tracking systems. These shippers track the location of their trucks and airplanes using GPSs; they also scan the packages so they know their whereabouts. Shipping companies also offer customers the ability to self-track



U-Scan kiosk

packages using Web-based systems, thus reducing the need for customer service employees.

Marketing Management



Many marketing management decision applications are supported by computerized information systems. (*Online File W7.8* shows the marketing management decision framework.) Here are some representative examples of how this is being done.

PRICING OF PRODUCTS OR SERVICES. Sales volumes are largely determined by the prices of products or services. Price is also a major determinant of profit. Pricing is a difficult decision, and prices may need to be changed frequently. For example, in response to price changes made by competitors, a company may need to adjust its prices or take other actions.

Pricing decisions are supported by a number of computerized systems: Three pricing models for retailers with thousands of items to price were developed by Sung and Lee (2000). Many companies are using online analytical processing (OLAP) to support pricing and other marketing decisions (see Chapter 10). In Chapter 1 we discussed the optimization models used to support prices at Longs Drug Stores and others (see *A Closer Look 2.2*). Web-based comparison engines enable customers to select a vendor at the price they want, and they also enable vendors to see how their prices compare with others. For an overview on pricing and the Internet, including quick price testing, see Baker et al., 2001.

SALESPERSON PRODUCTIVITY. Salespeople differ from each other; some excel in selling certain products, while others excel in selling to a certain type of customer or in a certain geographical zone. This information, which is usually collected in the sales and marketing TPS, can be analyzed, using a comparative performance system, in which sales data by salesperson, product, region, and even the time of day are evaluated. Actual current sales can be compared to historical data and to standards. Multidimensional spreadsheet software facilitates this type of analysis. Assignment of salespeople to regions and/or products and the calculation of bonuses can also be supported by this system.

In addition, sales productivity can be boosted by Web-based systems. For example, in a Web-based call center, when a customer calls a sales rep, the rep can look at the customer's history of purchases, demographics, services available where the customer lives, and more. This information enables reps to work faster, while providing better customer service. Customers' information can be provided by marketing customer information file technology (MCIF) (see Totty, 2000).

Sales Force Automation. The productivity of salespeople in the field also can be greatly increased by what is known as **sales-force automation**—providing salespeople with mobile devices, access to databases, and so on. It empowers the field sales force to close deals at the customer's office and to configure marketing strategies at home. (Recall the Maybelline case, Chapter 2; for additional details, see Schafer, 1997). For other uses of the Web by the sales force, see Varney (1996) and the case of PAVECA (Chapter 5).

Sales force automation can be boosted in many ways by using Web-based tools. For example, Netgain (from *netgainservices.com*) lets a multimedia company's design and sales teams collaborate over the Web, passing off sales leads, bringing in new sales reps to clinch different parts of a deal, and tracking reports on sales progress.



Productivity Software. **Sales automation software** is especially helpful to small businesses, enabling them to rapidly increase sales and growth. Such Web-based software can manage the flow of messages and assist in writing contracts, scheduling, and making appointments. Of course it provides word processing and e-mail; and it helps with mailings and follow-up letters. Electronic stamps (e.g., *stamp.com*) can assist with mass mailings.

PROFITABILITY ANALYSIS. In deciding on advertising and other marketing efforts, managers often need to know the profit contribution of certain products and services. Profitability information for products and services can be derived from the cost-accounting system. For example, profit performance analysis software available from Comshare (*comshare.com*) is designed to help managers assess and improve the profit performance of their line of business, products, distribution channels, sales regions, and other dimensions critical to managing the enterprise. Northwest Airlines, for example, uses expert systems and DSS to set prices based on profitability. They also use a similar system to audit tickets and for calculating commissions to travel agents.

In addition, identification of profitable customers and the frequency with which they interact with the organization can be derived from special promotional programs, such as hotels' frequent-stayer programs. This information can be used for loyalty and other programs.

SALES ANALYSIS AND TRENDS. The marketing TPS collects sales figures that can be segregated along several dimensions for early detection of problems and opportunities, by searching for trends and relationships. For example, if sales of a certain product show a continuous decline in certain regions but not in other regions, management can investigate the declining region. Similarly, an increasing sales volume of a new product calls attention to an opportunity if it is found to be statistically significant. This application demonstrates the reliance of decision making on the TPS. Also, data mining can be used to find relationships and patterns in large databases (see Chapter 11).

NEW PRODUCTS, SERVICES, AND MARKET PLANNING. The introduction of new or improved products and services can be expensive and risky. An important question to ask about a new product or service is, "Will it sell?" An appropriate answer calls for careful analysis, planning, and forecasting. These can best be executed with the aid of IT because of the large number of determining factors and the uncertainties that may be involved. Market research also can be conducted on the Internet, as described in Chapter 5. A related issue is the speed with which products are brought to market. An example of how Procter & Gamble expedites the time-to-market by using the Internet is provided in *IT At Work 7.4*.

WEB-BASED SYSTEMS IN MARKETING. The use of Web-based systems in support of marketing and sales has grown rapidly, as demonstrated by the Procter & Gamble case earlier. A summary of some Web-based impacts is provided in Figure 7.8.

Marketing activities conclude the primary activities of the value chain. Next we look at the functional systems that are secondary (support) activities in the value chain: accounting/finance and human resources management.



IT At Work 7.4

INTERNET MARKET RESEARCH EXPEDITES TIME-TO-MARKET AT PROCTER & GAMBLE



For decades, Procter & Gamble (P&G) and Colgate-Palmolive have been competitors in the market for personal care products. Developing a major new product, from concept to market launch, used to take over 5 years. First, a concept test was done; the companies sent product photos and descriptions to potential customers, asking whether they might buy it. If the feedback was negative, they tried to improve the product concept and then repeated the concept testing. Once positive response was achieved, sample products were mailed out, and customers were asked to fill out detailed questionnaires. When customers' responses met the companies' internal hurdles, the company would start with mass advertising on television and in magazines.

However, thanks to the Internet, it took P&G only three-and-a-half years to get Whitestrips, the teeth-brightening product, onto the market and to a sales level of \$200 million a year—considerably quicker than other oral care products. In September 2000, P&G threw out the old marketing test model and instead introduced Whitestrips on the Internet, offering the product for sale on P&G's Web site. The company spent several months studying who was coming to the site and buying the product and collecting

responses to online questionnaires, which was much faster than the old mail-outs.

The online research, which was facilitated by data mining conducted on P&G's huge historical data (stored in a data warehouse) and the new Internet data, revealed the most enthusiastic groups. These included teenage girls, brides-to-be, and young Hispanic Americans. Immediately, the company started to target these segments with appropriate advertising. The Internet created a product awareness of 35 percent, even before any shipments were made to stores. This "buzz" created a huge demand for the product by the time it hit the shelves.

From this experience, P&G learned important lessons about flexible and creative ways to approach product innovation and marketing. The whole process of studying the product concept, segmenting the market, and expediting product development has been revolutionized.

For Further Exploration: How did the Internet decrease time-to-market in this situation? What is the role of data mining? Why is so much testing needed?

Sources: Compiled from Buckley, 2002, and from *pg.com* (February–December 2002).

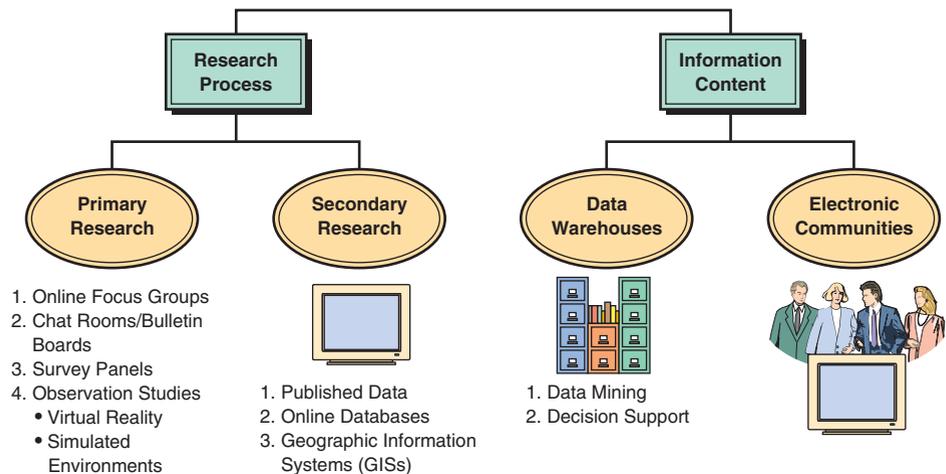


FIGURE 7.8 The impact of the Web on marketing information services. Channel-driven advantages are (1) transaction speed (real-time response) because of the interactive nature of the process, (2) global reach, (3) reduced costs, (4) multimedia content, and (5) reliability. (Source: P. K. Kannan et al., "Marketing Information on the I-Way," *Communications of the ACM*, 1999, p. 36. (Association for Computing Machinery, Inc. Reprinted by permission.)

7.5 MANAGING THE ACCOUNTING AND FINANCE SYSTEMS

A primary mission of the accounting/finance functional area is to manage money flows into, within, and out of organizations. This is a very broad mission since money is involved in all functions of an organization. Some repetitive accounting/financing activities such as payroll, billing, and cash management were computerized as early as the 1950s. Today, accounting/finance information systems are very diverse and comprehensive.

The general structure of an accounting/finance system is presented in Figure 7.9. It is divided into three levels: strategic, tactical, and operational. Information technology can support all almost the activities listed, as well as the communication and collaboration of accounting/finance with internal and external environments. We describe some selected activities in the rest of this section. For others, see Reed et al., 2001.

Financial Planning and Budgeting

Appropriate management of financial assets is a major task in financial planning and budgeting. Managers must plan for both the acquisition of financial

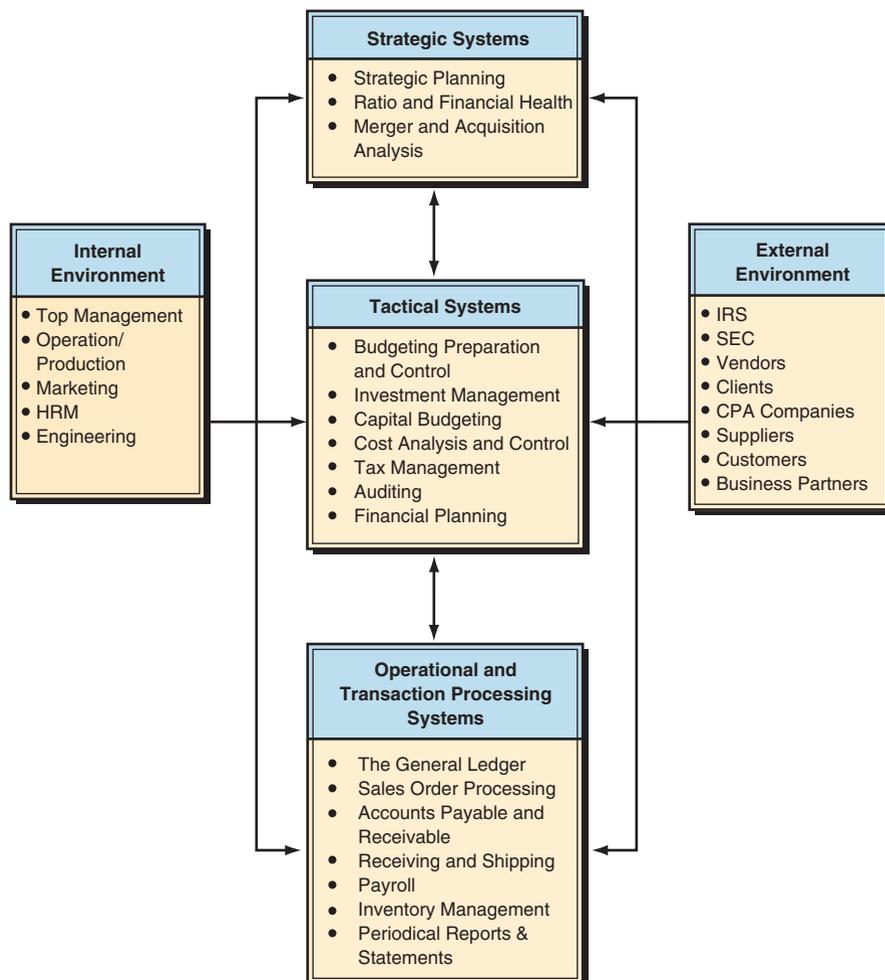


FIGURE 7.9 Major activities of the accounting/finance system.



resources and their use. Financial planning, like any other functional planning, is tied to the overall organizational planning and to other functional areas. It is divided into short-, medium-, and long-term horizons, much like activities planning. Financial analysts use Web resources and computerized spreadsheets to accomplish the organization's financial planning and budgeting activities.

FINANCIAL AND ECONOMIC FORECASTING. Knowledge about the availability and cost of money is a key ingredient for successful financial planning. Especially important is the projection of cash flow, which tells organizations what funds they need and when, and how they will acquire them. This function is important for all firms, but is especially so for small companies, which tend to have little financial cushion. Inaccurate cash flow projection is the number one reason why many small businesses go bankrupt. Availability and cost of money depend on corporate financial health and the willingness of lenders and investors to infuse money into the corporation (see Banks, 2001).

Financial and economic analysis is facilitated by intelligent systems such as neural computing (Chapter 12). Many software packages are available for conducting economic and financial forecasting. Economic and financial forecasts are also available for a fee, frequently over the Internet.

PLANNING FOR INCOMING FUNDS. Funds for running organizations come from several sources, including stockholders' investments, sale of bonds, loans from banks, sales of products and services, and income from investments. Using the information generated by financial and economic forecasts, the organization can build a decision support model for planning incoming funds. For example, if the forecast indicates that interest rates will be high, the company can defer borrowing until the interest rates drop. Decisions about when and how much to refinance can be supported by expert systems.

BUDGETING. The best-known part of financial planning is the annual budget, which allocates the financial resources of an organization among participants and activities. The budget is the financial expression of the organization's plans. It allows management to allocate resources in the way that best supports the organization's mission and goals. IT enables the introduction of financial intelligence into the budgeting process.

Software Support. Several software packages, many of which are Web-based, are available to support budget preparation and control (e.g., Budget 2000 from EPS Consultants and Comshare MPC, from Comshare Inc.) and to facilitate communication among all participants in the budget preparation.

Since budget preparation may involve both top-down and bottom-up processes, modeling capabilities in some packages allow the budget coordinator to take the top-down numbers, compare them with the bottom-up data from the users, and reconcile the two.

Software also makes it easier to build complex budgets that involve multiple sites, including foreign countries. Budgeting software also allows various internal and external comparisons. One of the latest trends is industry-specific packages such as for hospitals, banks, or retailing. Budgeting software is frequently bundled with financial analysis and reporting functions. For example, Comshare's MPC, integrates budgeting with planning, financial analysis, forecasting, and production reporting (see comshare.com/mpc/index.cfm).



The major benefits of using budgeting software, according to Freeman (1997), are that it can: reduce the time and effort involved in the budget process, explore and analyze the implications of organizational and environmental changes, facilitate the integration of the corporate strategic objectives with operational plans, make planning an ongoing, continuous process, and automatically monitor exceptions for patterns and trends.

CAPITAL BUDGETING. Capital budgeting is the financing of asset acquisitions, including the disposal of major organizational assets. It usually includes a comparison of options, such as keep the asset, replace it with an identical new asset, replace it with a different one, or discard it. The capital budgeting process also evaluates buy-versus-lease options.

Capital budgeting analysis uses standard financial models, such as net present value (NPV), internal rate of return (IRR), and payback period, to evaluate alternative investment decisions. Most spreadsheet packages include built-in functions of these models.

Managing Financial Transactions

An accounting/finance information system is also responsible for gathering the raw data necessary for the accounting/finance TPS, transforming the data into information, and making the information available to users, whether aggregate information about payroll, the organization's internal managers, or external reports to stockholders or government agencies.

Many packages exist to execute routine accounting transaction processing activities. Several are available free on the Internet (try *tucows.com*). Many software packages are integrated. In these integrated systems, the accounting/finance activities are combined with other TPSs such as those of marketing and production and operations management. The data collected and managed for the accounting/finance transaction processing system are also inputs for the various functional information systems.

One such integrated system is MAS 90 and MAS 200 (from *bestsoftwareinc.com/mass90/index*). It is a collection of standard accounting modules, as shown in Figure 7.10 (the "wheel" in the diagram). Communication and inquiry modules (right side) support the accounting modules. The user can integrate as many of the modules as needed for the business. On the left side is a list of other business processes and functional applications that can interface with accounting applications. Note that the software includes an e-commerce module, which provides dynamic Web access to MAS 90. This module includes account and order inquiry capabilities as well as a shopping cart for order entry. The 2003 version of MAS 90 includes modules for business intelligence, e-commerce, CRM, sales force automation (SFA), and financial reporting.

Another integrated accounting software package is *peachtree.com* (from Best Software), which offers a sales ledger, purchase ledger, cash book, sales order processing, invoicing, stock control, job casting, fixed-assets register, and more. Other software vendors are Great Plains and Solomon (see Business Solutions at *Microsoft.com*); see their demos. Other accounting packages can be found at *2020software.com* and *findaccountingsoftware.com*.

The accounting/finance TPS also provides a complete, reliable audit trail of all transactions transmitted through the network. This feature is vital to accountants and auditors. (For more, see the "Control and Auditing" section below.)

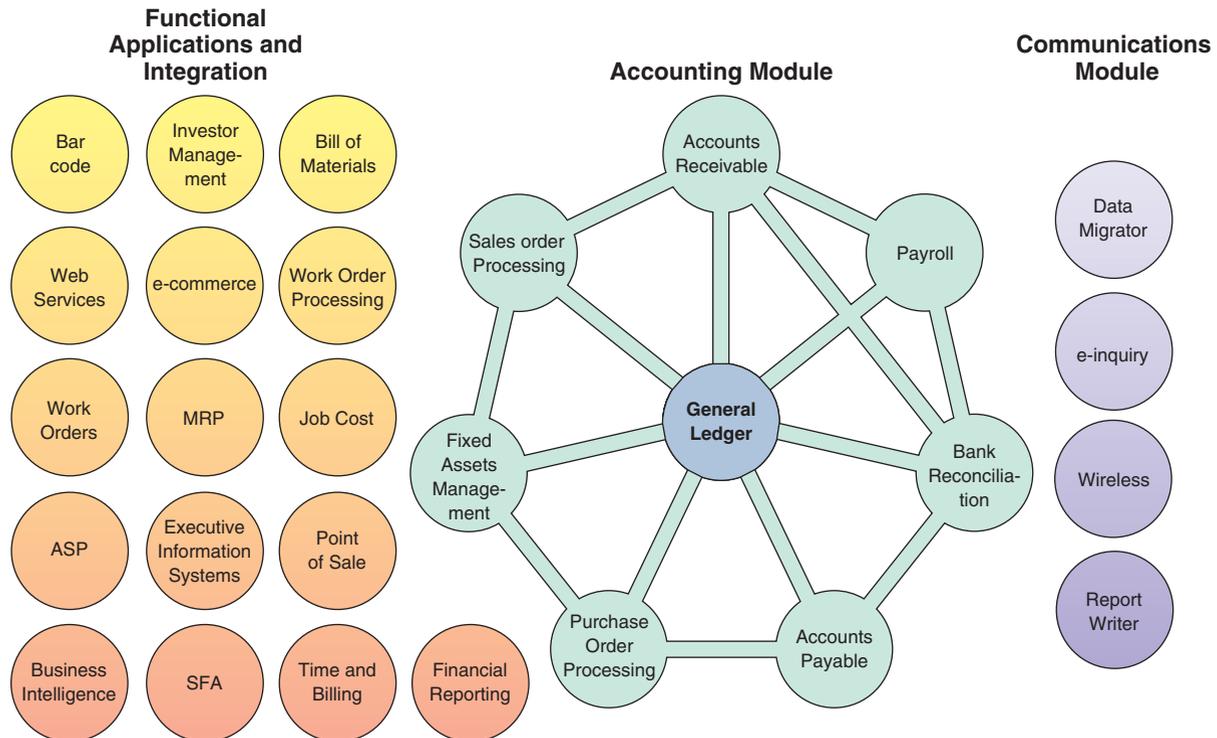


FIGURE 7.10 Integrated accounting/business software.

E-COMMERCE APPLICATIONS OF FINANCIAL TRANSACTIONS. Companies doing e-commerce need to access financial data of customers (e.g., credit line), inventory levels, and manufacturing databases (to see available capacity, to place orders, etc.). Great Plains (*bestsoftware.com*) offers 50 modules to choose from, to meet the most common financial, project, distribution, manufacturing, and e-business needs.

Diversified financial transactions also lend themselves to e-commerce applications, especially Web-based ones. In Chapter 5, we described e-banking, electronic transactions of stock markets, e-financial services, and more. Many of these can be done in a wireless environment (Chapter 6, and case of Handlesbanken in Chapter 1). Here we provide a few other examples.

Global Stock Exchanges. According to Maxemchuk and Shur (2001), financial markets are moving toward global, 24-hour, distributed electronic stock exchanges that will use the Internet for both the transactions and multicasting of real-time stock prices.

Handling Multiple Currencies. Global trade involves financial transactions in different currencies. Conversion ratios of many of them change every minute. Zakaria (2002) reports on a Web-based system (from SAP AG) that takes financial data from seven Asian countries and converts the currencies to dollars in seconds. Reports based on these data, which used to take weeks to generate, now take minutes. The system handles the multiplicity of languages as well.

E-Bonds. The World Bank is now using e-bonds, a system for marketing, distributing, and trading bonds over the Internet. The system expanded in 2003

to include electronic applications to currency and derivatives trading. For details see *gs.com* (2001).

Factoring Online. *Factors* are financial institutions that buy accounts receivable, usually at a discount. Factoring of receivables gives the selling company an immediate cash inflow. The factor takes on the risks and expenses of collecting the debts. Factoring on the Web is becoming very popular. For details see Salodof-MacNeil, 2002.

Electronic Re-presentation of Checks. Companies face a problem of bad checks (insufficient funds). Paper checks that do not clear are usually re-presented (manually or electronically). Electronic re-presentation can be organized as part of cash management information systems. Such systems consolidate checks from different banks and conduct a return analysis (analysis of why checks are not honored, who is likely to pass bad checks, etc.) (see Giesen, 2002).

Electronic Bill Presentment and Payments. One of the most successful areas of e-commerce is that of electronic presentment and payments. In its simplest form it is an electronic payment of bills. However, third-party companies provide a service in which they calculate, print and electronically present the bills to customers (see Chapter 5 and Boucher-Ferguson, 2002).

VIRTUAL CLOSE. Companies close their books (accounting records) quarterly, mainly to meet regulatory requirements. Some companies want to be able to close their books any time, on short notice. Called a **virtual close**, the ability to close the books quickly may give almost real-time information on the financial health of a company (see McClenahan, 2002). With an advanced IT program developed by Cisco (see *Online File W7.9*) it will soon be possible, even for a large multinational corporation, to close the books in a matter of hours.



INTEGRATION OF FINANCIAL TRANSACTIONS WITH E-COMMERCE APPLICATIONS. ACCPAC International (*accpaconline.com*) integrated its financial accounting software with e-business solutions (software, system building, consulting, and integration) to help global traders. The e-commerce module (eTransact) is tightly integrated with AACPAC for Windows, offering a single, unifying financial and business management system.

EXPENSE MANAGEMENT AUTOMATION. **Expense management automation (EMA)** refers to systems that automate data entry and processing of travel and entertainment expenses. These expenses can account for 20 percent of the operating expenses of large corporations (Degnan, 2003). EMA systems (by companies such as Captura, Concur, Extensity, and Necho) are Web-based applications that replace the paper forms and rudimentary spreadsheet. These systems let companies quickly and consistently collect expense information, enforce company policies and contracts, and reduce unplanned purchases of airline and hotel services. The software forces travelers to be organized before a trip starts. In addition to benefits to the companies, employees also benefited from quick reimbursement (since expense approvals are not held up by sloppy or incomplete documentation). (For details, see "What EMA systems now offer..." 2002.)

Investment Management

Organizations invest large amounts of money in stocks, bonds, real estate, and other assets. Some of these investments are short-term in nature; others are long term. If you examine the financial records of publicly traded corporations,

you will see that some of them have billions of dollars of assets. Furthermore, organizations need to pay pensions to their employees, so they need to manage the pension funds as an asset.

Investment management is a difficult task. For one thing, there are thousands of investment alternatives. On the New York Stock Exchange alone, there are more than 2,000 stocks, and millions of possible combinations for creating portfolios. Investment decisions are based on economic and financial forecasts and on various multiple and conflicting objectives (such as high yield, safety, and liquidity). The investment environment also includes opportunities in other countries. Another factor that contributes to the complexity of investment management is that investments made by many organizations are subject to complex regulations and tax laws. Finally, investment decisions need to be made quickly and frequently. Decision makers can be in different locations, and they need to cooperate and collaborate. Therefore, computerization is especially popular in financial institutions that are involved in investments, as illustrated in *IT At Work 7.5*.



In addition, data-mining tools and neural networks (Chapter 12) are used by many institutional investment managers to analyze historical databases, so they can make better predictions. For a data-mining tool, see *wizsoft.com*. Some typical financial applications of neural computing are provided in *Online File W7.10*.



IT At Work 7.5

MATLAB MANAGES EQUITY PORTFOLIOS AT DAIWA SECURITIES



Daiwa Securities of Japan (*daiwa.co.jp*) is one of the world's largest and most profitable multinational securities firms. Many of the company's traders are engineers and mathematicians who use computers to constantly buy and sell securities for the company's own portfolio. Daiwa believes that identifying mispricings in the stock markets holds great profit potential. Toward this end the company uses leading-edge computerized quantitative analysis methods, to look for securities that are underpriced by the market. The software compares stock price performance of individual companies to that of other companies in the same market sector. In an attempt to minimize risk, the model then suggests a buy, sell, or sell-short solution for each investigated security.

The company is using an arbitrage approach, which looks for the opportunity to make profits with very little risk. It may keep undervalued stocks, but it sells short overvalued stocks and futures. The buy-sell recommendations are generated by a system (coded in MATLAB, from Mathworks.com), which is based on modern portfolio theory. The system uses two models: one for the short term (3 to 10 days) and one for the longer term (3 to 6 weeks). It

follows over 1,200 stocks and includes many variables, some of which are very volatile. Changes in the MATLAB model can be made quickly on the Excel spreadsheet it uses. Complex statistical tools are used for the computations. The system attempts to minimize the risk of the portfolio yet maximize its profit. Since these two goals usually contradict each other, trade-offs must be considered.

The system is based on neural networks and fuzzy logic. The advantage of neural networks is that they can closely approximate the underlying processes that may be moving the financial markets in a particular direction.

To motivate the traders to use the system, as well as to quickly build modifications using Excel, the company pays generous bonuses for successful trades. As a matter of fact, some young MBA and Ph.D. traders have earned-commanded bonuses of hundreds of thousands of dollars each year.

For Further Exploration: What is the logic of the arbitrage strategy? Why would bonuses be used to motivate employees to use the system?

Sources: Compiled from Pittaras, 1996, and *daiwa.co.jp* (press releases 2000).

The following are the major areas of support that IT can provide to investment management.



ACCESS TO FINANCIAL AND ECONOMIC REPORTS. Investment decisions require managers to evaluate financial and economic reports and news provided by federal and state agencies, universities, research institutions, financial services, and corporations. There are hundreds of Web sources, many of which are free; a sampling is listed in *Online File W7.11*. Most of these services are useful both for professional investment managers and for individual investors.

To cope with the large amount of online financial data, investors use three supporting tools: (1) Internet search engines for finding financial data, (2) Internet directories and yellow pages, and (3) software for monitoring, interpreting, and analyzing financial data and for alerting management.

FINANCIAL ANALYSIS. Financial analysis can be executed with a spreadsheet program, or with commercially available ready-made decision support software (e.g., see *tradeportal.com/tradematrix.asp*). Or, it can be more sophisticated, involving intelligent systems. Other information technologies can be used as well. For example, Morgan Stanley and Company uses virtual reality on its intranet to display the results of risk analysis in three dimensions. Seeing data in 3-D makes it easier to make comparisons and intuitive connections than would seeing a two-dimensional chart.

One area of analysis that is becoming popular is referred to as **financial value chain management (FVCM)**. According to this approach, financial analysis is combined with operations analysis. All financial functions are analyzed (including international trades). Combining financial and operations analysis provides better financial control. For example, if the organization runs its operations at a lower-than-planned level, it is likely to need less money; if it exceeds the operational plan, it may well be all right to exceed the budgeted amounts for that plan. For details see Aberdeen.com (2002).

Control and Auditing

The major reason organizations go out of business is their inability to forecast and/or secure sufficient *cash flow*. Underestimating expenses, overspending, fraud, and financial mismanagement can lead to disaster. Good planning is necessary, but not sufficient, and must be supplemented by skillful control. Control activities in organizations take many forms, including control and auditing of the information systems themselves (see Chapter 15). Information systems play an extremely important role in supporting organizational control, as we show throughout the text. Specific forms of financial control are present next.

BUDGETARY CONTROL. Once the annual budget has been decided upon, it is divided into monthly allocations. Managers at various levels then monitor departmental expenditures and compare them against the budget and operational progress of the corporate plans. Simple reporting systems summarize the expenditures and provide *exception reports* by flagging any expenditure that exceeds the budget by a certain percent or that falls significantly below the budget. More sophisticated software attempts to tie expenditures to program accomplishment. Numerous software programs can be used to support budgetary control; most of them are combined with budget preparation packages such as Comshare BudgetPlus (*budgetplus.com*), Sumco ERP (*symcosof.com*), and Homepages.nildram.co.uk.

AUDITING. The major purpose of auditing is to ensure the accuracy and condition of the financial health of an organization. Internal auditing is done by the organization's accounting/finance personnel, who also prepare for external auditing by CPA companies. There are several types of auditing, including financial, operational, and concurrent. In *financial auditing* the accuracy of the organization's records are verified. The *operational audit* attempts to validate the effectiveness of the procedures of collecting and processing the information, for example, the adequacy of controls and compliance with company policies. When the operational audit is ongoing (all the time) it is called a *concurrent audit*.

IT can facilitate auditing. For example, intelligent systems can uncover fraud by finding financial transactions that significantly deviate from previous payment profiles. Also, IT provides real time data whenever needed (see peoplesoft.com/go/pt_financials).

FINANCIAL RATIO ANALYSIS. A major task of the accounting/finance department is to watch the financial health of the company by monitoring and assessing a set of financial ratios. These ratios are mostly the same as those used by external parties when they are deciding whether to invest in an organization, loan money to it, or buy it. But internal parties have access to much more detailed data for use in calculating financial ratios.

The collection of data for ratio analysis is done by the transaction processing system, and computation of the ratios is done by financial analysis models. The *interpretation* of the ratios, and especially the prediction of their future behavior, requires expertise and is sometimes supported by expert systems.

PROFITABILITY ANALYSIS AND COST CONTROL. Many companies are concerned with the profitability of individual products or services as well as with the financial health of the entire organization. Profitability analysis DSS software (see Chapter 12) allows accurate computation of profitability. It also allows allocation of overheads. One way to control cost is by properly estimating it. This is done by special software; see Vijayakumar (2002).

PRODUCT PRICING. The pricing of products is an important corporate decision since it determines competitiveness and profitability. The marketing department may wish to reduce prices in order to increase market share, but the accounting/finance system must check the relevant cost in order to provide guidelines for such price reductions. Decision support models can facilitate product pricing. Accounting, finance, and marketing, supported by integrated software and intranets, can team up to jointly set appropriate product prices.

Several more applications in the financial/accounting area are described in *Online File W7.12*. Many more can be found at Reed (2001).



7.6 MANAGING HUMAN RESOURCES SYSTEMS

Developments in Web-based systems increased the popularity of human resources information systems (HRISs) as of the late 1990s. Initial HRIS applications were mainly related to transaction processing systems. (For examples, see Thomas and Ray, 2000; and Bussler and Davis, 2001–2002.) In recent



years, as systems generally have been moved to intranets and the Web, so have HRIS applications, many of which can be delivered via an HR portal (see *Online File W7.13*). Many organizations use their Web portals to advertise job openings and conduct online hiring and training. Ensher et al. (2002) describe the impact of the Internet on acquiring, rewarding, developing, protecting, and retaining human resources. Their findings are summarized in Table 7.4. Perhaps the biggest benefit to companies of human relations IT services is the release of HR staff from intermediary roles, so they can focus on strategic planning and human resources organization and development. In the following sections we describe in more detail how IT facilitates the management of human resources (HRM).

Recruitment

Recruitment is finding employees, testing them, and deciding which ones to hire. Some companies are flooded with viable applicants, while others have difficulty finding the right people. Information systems can be helpful in both cases. Here are some examples.

USING THE WEB FOR RECRUITMENT. With millions of resumes available online, it is not surprising that companies are trying to find appropriate candidates on the Web, usually with the help of specialized search engines. Also, hundreds of thousands of jobs are advertised on the Web (see Thomas and Ray, 2000, and Jandt and Nemnich, 1999). Many matching services exist (see Internet Exercise 3). Online recruiting is able to “cast a wide net” to reach more candidates, which may bring in better applicants. In addition, the costs of online recruitment are lower. Other benefits of online recruitment for employers, plus some disadvantages, are shown in *Online File W7.14*.



Recruitment online is beneficial for candidates as well. They are exposed to a larger number of job offerings, can get details of the positions quickly, and can begin to evaluate the prospective employer. To check the competitiveness of salary offerings, or to see how much one can make elsewhere in several countries, job candidates can go to *monster.com*.

Online recruitment may be facilitated by intelligent system such as Resumix, described in *IT At Work 7.6*.

For a complete analysis of and guidelines for e-recruitment, see Thomas and Ray (2000) and Borck (2000).

POSITION INVENTORY. Large organizations frequently need to fill vacant positions. To do so, they maintain a file that lists all open positions by job title, geographical area, task content, and skills required. Like any other inventory, this position inventory is updated each time a position is added, modified, and so on. In some cases, position inventories are used to improve national employment conditions. The government of the Philippines, for example, provides a list of available positions in that country, and that list is accessible via the Internet. For those people without Internet access, the government provides access via computers in kiosks in public places and government facilities.

An advanced intranet-based position inventory system keeps the position inventory list current, matches openings with available personnel, and allows data to be viewed by an employee over the corporate portal from any location at any time. Outsiders can view openings from the Internet. In addition, it is possible to match openings to available personnel.

TABLE 7.4 Comparison of Traditional Human Resources to E-Human Resources

Key HR Process	Traditional HR	E-HR
<i>Acquiring Human Resources</i>		
Recruitment and selection	<ul style="list-style-type: none"> ● Paper resumes and paper postings ● Positions filled in months ● Limited by geographical barriers 	<ul style="list-style-type: none"> ● Electronic resumes and Internet postings ● Positions filled in weeks or days ● Unlimited access to global applicants
Selection	<ul style="list-style-type: none"> ● Costs directed at attracting candidates ● Manual review of resumes ● Face-to-face (FTF) process 	<ul style="list-style-type: none"> ● Costs directed at selecting candidates ● Electronic review of resumes (scanning) ● Some distance interviewing (mostly still FTF)
<i>Rewarding Human Resources</i>		
Performance evaluation	<ul style="list-style-type: none"> ● Supervisor evaluation ● Face-to-face evaluation 	<ul style="list-style-type: none"> ● 360-degree evaluation ● Appraisal software (online and hard copy)
Compensation and benefits	<ul style="list-style-type: none"> ● Time spent on paperwork (benefits changes) ● Emphasis on salary and bonuses ● Naïve employees ● Emphasis on internal equity ● Changes made by HR 	<ul style="list-style-type: none"> ● Time spent on assessing market salaries ● Emphasis on ownership and quality of work-life ● Knowledgeable employees ● Emphasis on external equity ● Changes made by employees online
<i>Developing Human Resources</i>		
Training and development	<ul style="list-style-type: none"> ● Standardized classroom training ● Development process is HR-driven 	<ul style="list-style-type: none"> ● Flexible online training ● Development process is employee-driven
Career management	<ul style="list-style-type: none"> ● HR lays out career paths for employees ● Reactive decisions ● Personal networking (local area only) 	<ul style="list-style-type: none"> ● Employees manage their careers in concert with HR ● Proactive planning with technology ● Electronic and personal networking
<i>Protecting Human Resources</i>		
Health and safety	<ul style="list-style-type: none"> ● Building and equipment safety ● Physical fatigue ● Mostly reactive programs ● Limited to job-related stressors ● Focus on employee-management relations 	<ul style="list-style-type: none"> ● Ergonomic considerations ● Mental fatigue and wellness ● Proactive programs to reduce stress ● Personal and job-related stressors ● Focus on employee-employee relations
Employee relations/legal	<ul style="list-style-type: none"> ● Stronger union presence ● Sexual harassment/discrimination ● Task performance monitoring 	<ul style="list-style-type: none"> ● Weaker union presence ● Equal employment opportunity ● Use of technology monitoring/big brother ● Intellectual property/data security ● Inappropriate uses of technology
<i>Retaining Human Resources</i>		
Retention strategies	<ul style="list-style-type: none"> ● Not a major focal point 	<ul style="list-style-type: none"> ● Currently the critical HR activity ● Online employee opinion surveys ● Cultivating an effective company culture ● Mundane tasks done by technology, freeing time for more interesting work
Work-family balance	<ul style="list-style-type: none"> ● Not a major focal point 	<ul style="list-style-type: none"> ● Development and monitoring of programs ● Providing childcare and eldercare ● Erosion of work-home boundaries

Source: Ensher et al. (2002), p. 240, Table 1.



IT At Work 7.6

RESUMIX



From the time a position becomes available or a resume is received, Resumix (*resumix.com*, now a subsidiary of Yahoo Enterprise Solutions) gives the recruiter the control while dispersing the work of processing job applications. Hiring managers can view job applications; operators can scan resumes; and a recruiter can search for a candidate or identify existing employees for training programs, redeployment opportunities, or new initiatives.

The core of this powerful system is Resumix's Knowledge Base. As a computerized intelligent system, it goes beyond simply matching words. The Knowledge Base interprets a candidate's resume, determining skills based on context and matching those skills to the position criteria. For example,

you might be looking for a product manager. Being a member of the AMA (American Marketing Association) might be one of the desirable properties for the job. However, with a basic keyword search, you might get candidates who have listed AMA, but are really members of the American Medical Association or American Meatpackers Association. Those are not relevant to your search. Resumix Knowledge Base would select only the candidates with relevant skills.

For Further Exploration: Can Resumix eliminate human resume evaluators? Is the machine probe into your resume considered an invasion of privacy?

Source: resumix.com (accessed May 3, 2003).

By analyzing the position inventory and its changes over time, human resources personnel can find other useful information, such as those jobs with high turnover. Such information can support decisions about promotions, salary administration, and training plans.

HRM PORTALS AND SALARY SURVEYS. One advantage of the Web is the large amount of information related to job matching (see Chapter 5). There are also many private and public HR-related portals. The portal is a search engine, on index of jobs, posted on corporate-member sites. For example, several large companies (e.g., IBM, Xerox, GE) created jointly a career portal called DirectEmployers.com. Commercial, public online recruiters, such as Monster.com, help corporate recruiters find candidates for difficult-to-fill positions. For details see Harrington (2002).

Another area for HR portals is salary surveys. Salary surveys help companies determine how much to pay their employees. Companies used to pay up to \$10,000 for a one-time survey (Bussler and Davis, 2001–2002). Now they can conduct such surveys themselves by utilizing free data from vendors such as Salary.com.

EMPLOYEE SELECTION. The human resources department is responsible for screening job applicants, evaluating, testing, and selecting them in compliance with state and federal regulations. The process of employee selection can be very complex since it may involve many external and internal candidate and multiple criteria. To expedite the testing and evaluation process and ensure consistency in selection, companies use information technologies such as Web-based expert systems. Figure 7.11 shows the multiple criteria involved in employee selection and illustrates the role of an expert system in this process and in related tasks such as performance appraisal.

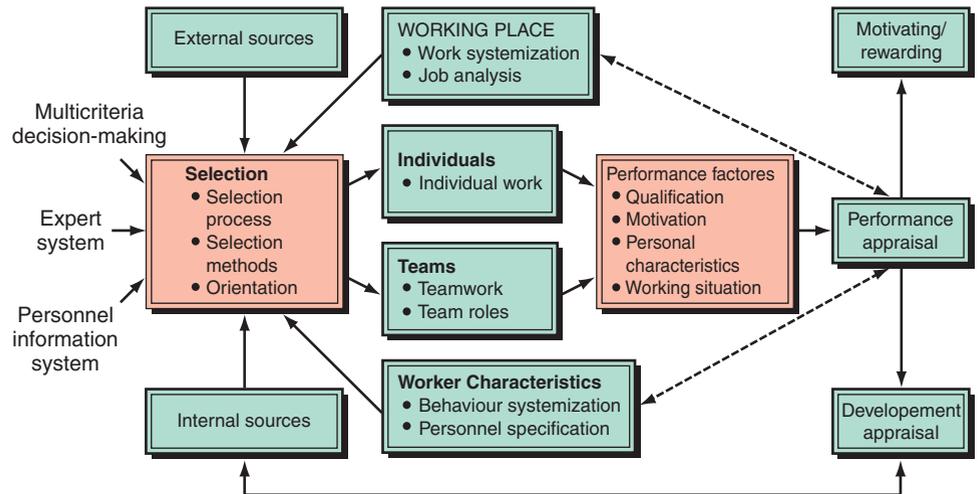


FIGURE 7.11 Intelligent Personnel Selection Model. (Source: Jareb and Rajkoric, 2001.)

Human Resources Maintenance and Development

Once recruited, employees become part of the corporate human resources pool, which needs to be maintained and developed. Some activities supported by IT are the following.

PERFORMANCE EVALUATION. Most employees are periodically evaluated by their immediate supervisors. Peers or subordinates may also evaluate others. Evaluations are usually recorded on paper or electronic forms. Once digitized, evaluations can be used to support many decisions, ranging from rewards to transfers to layoffs. Using such information manually is a tedious and error-prone job. Managers can analyze employees' performances with the help of expert systems, which provide an unbiased and systematic interpretation of performance over time. Many universities evaluate professors online. The evaluation form appears on the screen, and the students fill it in. Results can be tabulated in minutes.

Wage review is related to performance evaluation. For example, Hewlett-Packard's Atlanta-based U.S. Field Services Operations Group (USFO) has developed a paperless wage review (PWR) system. The Web-based system uses intelligent agents to deal with quarterly reviews of HP's 15,000 employees. The agent software lets USFO managers and personnel access employee data from both the personnel and functional databases. The PWR system tracks employee review dates and automatically initiates the wage review process. It sends wage review forms to first-level managers by e-mail every quarter.

TRAINING AND HUMAN RESOURCES DEVELOPMENT. Employee training and retraining is an important activity of the human resources department. Major issues are planning of classes and tailoring specific training programs to meet the needs of the organization and employees. Sophisticated human resources departments build a career development plan for each employee. IT can support the planning, monitoring, and control of these activities by using workflow applications.

IT also plays an important role in training (see discussion on e-learning, Chapter 4). Some of the most innovative developments are in the areas of



intelligent computer-aided instruction (ICAI) and application of multimedia support for instructional activities. Instruction is provided online at 38 percent of all Fortune 1,000 corporations, according to OmniTech Consulting (“Web Breathes Life,” 1988). Training salespeople is an expensive and lengthy proposition. To save money on training costs, companies are providing sales-skills training over the Internet or intranet. *Online File W7.15* provides examples of the variety of employee training available on the Internet and intranets.

Training can be improved using Web-based video clips. For example, using a digital video-editing system, Dairy Queen’s in-house video production department produces a higher-quality training video at 50 percent lower cost than outsourcing. The affordability of the videos encourages more Dairy Queen franchisees to participate in the training program. This improves customer service as well as employee skill.

Finally, training can be enhanced by virtual reality. Intel, Motorola, Samsung Electronic, and IBM are using virtual reality (Chapter 11) to simulate different scenarios and configurations. The training is especially effective in complex environments where mistakes can be very costly (see Boisvert, 2000).

Human Resources Planning and Management

Managing human resources in large organizations requires extensive planning and detailed strategy (Bussler and Davis, 2001–2002). In some industries, labor negotiation is a particularly important aspect of human resources planning. For most companies, administering employee benefits is also a significant part of the human resources function. Here are some examples of how IT can help.

PERSONNEL PLANNING. The human resources department forecasts requirements for people and skills. In some geographical areas and for overseas assignments it may be difficult to find particular types of employees. Then the HR department plans how to find (or develop from within) sufficient human resources.

Large companies develop qualitative and quantitative workforce planning models. Such models can be enhanced if IT is used to collect, update, and process the information.

LABOR-MANAGEMENT NEGOTIATIONS. Labor-management negotiations can take several months, during which time employees may present management with a large number of demands. Both sides need to make concessions and trade-offs. Large companies (like USX, formerly U.S. Steel, in Pittsburgh, Pennsylvania) have developed computerized DSS models that support such negotiations. The models can simulate financial and other impacts of fulfilling any demand made by employees, and they can provide answers to queries of the negotiators in a matter of seconds.

Another information technology that has been successfully used in labor-management negotiations is group decision support systems (see Chapter 12), which have helped improve the negotiation climate and considerably reduced the time needed for reaching an agreement.

PAYROLL AND EMPLOYEES’ RECORDS. The HR department is responsible for payroll preparation, which can be executed in-house or may be outsourced. It is done usually with the help of computers that print the payroll checks or transfer the money electronically to the employees’ bank accounts (Bussler and Davis,

2001–2002). The HR department is also responsible for all personnel record keeping and its privacy and security. In most companies this is done electronically.

BENEFITS ADMINISTRATION. Employees' contributions to their organizations are rewarded by salary/wage, bonuses, and other benefits. Benefits include those for health and dental care as well as contributions for pensions. Managing the benefits system can be a complex task, due to its many components and the tendency of organizations to allow employees to choose and trade off benefits ("cafeteria style"). In large companies, using computers for benefits selection can save a tremendous amount of labor and time for HR staff.

Providing flexibility in selecting benefits is viewed as a competitive advantage in large organizations. It can be successfully implemented when supported by computers. Some companies have automated benefits enrollments. Employees can self-register for specific benefits using the corporate portal or voice technology. Employees self-select desired benefits from a menu. The system specifies the value of each benefit and the available benefits balance of each employee. Some companies use intelligent agents to assist the employees and monitor their actions. Expert systems can answer employees' questions and offer advice online. Simpler systems allow for self-updating of personal information such as changes in address, family status, etc. When employees enroll in benefits programs by themselves, change addresses and other demographic data, and conduct other HR record-keeping tasks electronically, there are very few data entry errors.

For a comprehensive resource of HRM on the Web, see shrm.org/hrlinks.

EMPLOYEE RELATIONSHIP MANAGEMENT. In their effort to better manage employees, companies are developing *human capital management (HCM)*, facilitated by the Web, to streamline the HR process. These Web applications are more commonly referred to as **employee relationship management (ERM)**. For example, self-services such as tracking personal information and online training are very popular in ERM (and in CRM). Improved relationships with employees results in better retention and higher productivity. For an example how ERM is done in a global grocery chain, see Buss, 2002. ERM technologies and applications are very similar to that of CRM, which we discuss next.

7.7 CUSTOMER RELATIONSHIP MANAGEMENT (CRM)

Customer relationship management (CRM) recognizes that customers are the core of a business and that a company's success depends on effectively managing relationships with them (see Greenberg, 2002). CRM focuses on building long-term and sustainable customer relationships that add value both for the customer and the company (Romano and Fjermestad, 2001–2002, and Kalakota and Robinson, 2000). (See also crm-forum.com and crmassist.com.)

What Is CRM?

Greenberg (2002) provides more than ten definitions of CRM, several made by CEOs of CRM providers or users. The Patricia Seybold Group (2002) provides several additional definitions, as do Tan et al. (2002). Why are there so many definitions? The reason is that CRM is new and still evolving. Also, it is an interdisciplinary field, so each discipline (e.g., marketing, management) defines CRM differently. We will provide a well-known definition here: "CRM is a



business strategy to select and manage customers to optimize long-term value. CRM requires a customer-centric business philosophy and culture to support effective marketing, sales and services processes" (Thompson, 2003).

Types of CRM

We distinguished three major types of CRM activities: operational, analytical, and collaborative. *Operational CRM* is related to typical business functions involving customer services, order management, invoice/billing, and sales/marketing automation and management. *Analytical CRM* involves activities that capture, store, extract, process, interpret, and report customer data to a user, who then analyzes them as needed. *Collaborative CRM* deals with all the necessary communication, coordination, and collaboration between vendors and customers.

Other classifications of CRM have been devised by the types of programs (e.g., loyalty programs; see Tan, 2002) or by the service or product they offer (e.g., self-configuration, account tracking, call centers).

THE EVALUATION OF CRM. In general, CRM is an approach that recognizes that customers are the core of the business and that the company's success depends on effectively managing relationships with them. (See Brown, 2000.) It overlaps somewhat with the concept of relationship marketing, but not everything that could be called relationship marketing is in fact CRM. Customer relationship marketing is even broader, in that it includes a *one-to-one* relationship of customer and seller. To be a genuine one-to-one marketer, a company must be able and willing to change its behavior toward a specific customer, based on what it knows about that customer. So, CRM is basically a simple idea: *Treat different customers differently*. It is based on the fact that no two customers are exactly the same.

Therefore, CRM involves much more than just sales and marketing, because a firm must be able to change how its products are configured or its service is delivered, based on the needs of individual customers. Smart companies have always encouraged the active participation of customers in the development of products, services, and solutions. For the most part, however, being customer-oriented has traditionally meant being oriented to the needs of the *typical* customer in the market—the average customer. In order to build enduring one-to-one relationships, a company must continuously interact with customers, *individually*. One reason so many firms are beginning to focus on CRM is that this kind of marketing can create high customer loyalty and, as a part of the process, help the firm's profitability.

eCRM. CRM has been practiced manually by corporations for generations. However, since the mid 1990s, CRM has been enhanced by various types of information technologies. CRM technology is an evolutionary response to environmental changes, making use of new IT devices and tools. The term **eCRM** (electronic CRM) was coined in the mid-1990s, when customers started using Web browsers, the Internet, and other electronic touch points (e-mail, POS terminals, call centers, and direct sales). The use of these technologies made customer services, as well as service to partners (see PRM in Chapter 8), much more effective and efficient than it was before the Internet.

Through Internet technologies, data generated about customers can be easily fed into marketing, sales, and customer service applications and analysis. eCRM also includes online process applications such as segmentation and personalization. The success or failure of these efforts can now be measured and modified

in real time, further elevating customer expectations. In the world connected by the Internet, eCRM has become a requirement for survival, not just a competitive advantage. eCRM covers a broad range of topics, tools, and methods, ranging from the proper design of digital products and services to pricing and loyalty programs (e.g., see *e-sj.org*, *Journal of Service Research*, and *ecrmguide.com*).

According to Voss (2000), there are three levels of eCRM: (1) *Foundational services* include the *minimum necessary* services such as site responsiveness (e.g., how quickly and accurately the service is provided), site effectiveness, and order fulfillment. (2) *Customer-centered services* include order tracking, configuration and customization, and security/trust. These are the services that *matter the most* to customers. (3) *Value-added services* are *extra services* such as dynamic brokering, online auctions, and online training and education.

Supporting Operational and Analytical CRMs

In order to better understand the contribution of IT to CRM, let's look at the areas in which IT supports CRM activities, which are shown in Figure 7.12. The applications in the figure are divided into two main categories: operational CRM

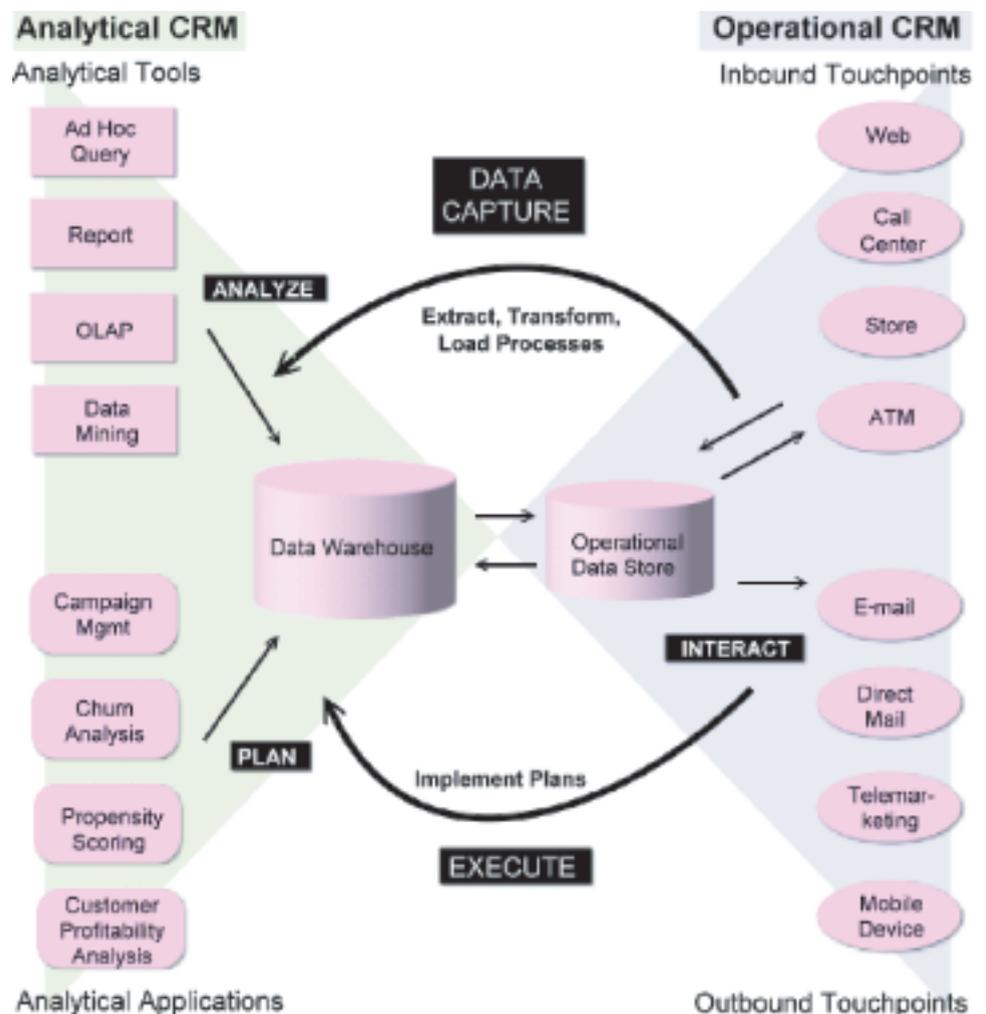


FIGURE 7.12
Classification of the CRM field. (Source: Goodhue et al. 2002.)



and analytical CRM. The major supported activities in each are listed in the figure. Many organizations are using the Web to facilitate their CRM activities.

Typical CRM activities and their IT support are listed in *Online File W7.16*. For other examples, see Brown (2000), Peppers and Rogers (1999), Petersen (1999), and Gilmore and Pine (2000).

CUSTOMER SERVICE ON THE WEB. Customer service on the Web can take many forms, such as answering customer inquiries, providing search and comparison capabilities, providing technical information to customers, allowing customers to track order status, and of course allowing customers to place an online order. We describe these different kinds of Web-based customer services below. (For fuller detail, see Greenberg, 2002.)

Providing Search and Comparison Capabilities. One of the major wishes of consumers is to find what they want. With the hundreds of thousands of online stores, it is difficult for a customer to find what he or she wants, even inside a single electronic mall. Search and comparison capabilities are provided internally in large malls (e.g., *amazon.com*), or by independent comparison sites (*mysimon.com*, *compare.com*). For many other EC shopping aids, see Turban et al., 2004.

Providing Free Products and Services. One approach companies use to differentiate themselves is to give something away free. For example, *Compubank.com* once offered free bill payments and ATM services. Companies can offer free samples over the Internet, as well as free entertainment, customer education, and more. For further discussion, see Keen (2001), and Strauss et al (2003).

Providing Technical and Other Information and Service. Interactive experiences can be personalized to induce the consumer to commit to a purchase and remain loyal. For example, General Electric's Web site provides detailed technical and maintenance information and sells replacement parts for discontinued models for those who need to fix outdated home appliances. Such information and parts are quite difficult to find off-line. Another example is Goodyear, which provides information about tires and their use at *goodyear.com*. The ability to download manuals and problem solutions at any time is another innovation of electronic customer service.

Allowing Customers to Order Customized Products and Services Online. Dell Computer has revolutionized purchasing of computers by letting customers design computers and then delivering them to customers' home. This mass customization process has been moved to the Internet, and now is used by hundreds of vendors for products ranging from cars (see the Jaguar case) to shoes (Nike). Consumers are shown prepackaged "specials" and are given the option to "custom-build" systems using software configurators.

Other companies have found ways that are unique to their industries to offer customized products and services online. Web sites such as *gap.com* allow you to "mix and match" your entire wardrobe. Personal sizes, color and style preferences, dates for gift shipment, and so on, can be mixed and matched by customers, any way they like. This increases sales and the repeat business. Web sites such as *hitsquad.com*, *musicalgreetings.com*, or *surprise.com* allow consumers to handpick individual titles from a library and customize a CD, a feature that is not offered in traditional music stores. Instant delivery of any digitized entertainment is a major advantage of EC.

Letting Customers Track Accounts or Order Status. Customers can view their account balances at a financial institution and check their merchandise shipping status, at any time and from their computers or cell phones. For example, customers can easily find the status of their stock portfolio, loan application, and so on. FedEx and other shippers allow customers to track their packages. If you ordered books from Amazon or others, you can find the anticipated arrival date. Amazon even goes one step further; it notifies you by e-mail of the acceptance of your order, the anticipated delivery date, and later, the actual delivery date. Many companies follow the Amazon model and provide similar services.

All of these examples of customer service on the Web demonstrate an important aspect of CRM: a focus on the individual customer.

TOOLS FOR CUSTOMER SERVICE. There are many innovative Web-related tools to enhance customer service and CRM. Here are the major ones:

Personalized Web Pages. Many companies allow customers to create their own individual Web pages. These pages can be used to record purchases and preferences, as well as problems and requests. For example, using intelligent agent techniques, American Airlines generates personalized Web pages for each of about 800,000 registered travel-planning customers.

Also, customized information (such as product and warranty information) can be efficiently delivered when the customer logs on to the vendor's Web site. Not only can the customer pull information as needed or desired, but also the vendor can push information to the customer. Information that formerly may have been provided to the customer one to three months after a transaction was consummated is now provided in real or almost real time. Transaction information is stored in the vendor's database, and then accessed and processed to support marketing of more products and to match valuable information about product performance and consumer behavior.

FAQs. Frequently asked questions (FAQs) (see Chapter 4) are the simplest and least expensive tool to deal with repetitive customer questions. Customers use this tool by themselves, which makes the delivery cost minimal. However, any nonstandard question requires an e-mail. Also, FAQs are usually not customized. Therefore, FAQs produce no personalized feeling nor do they contribute much to CRM. They may do so one day, when the system will know the customer's profile and be able to present customized FAQs and answers.

Chat Rooms. Another tool that provides customer service, attracts new customers, and increases customers' loyalty is a chat room (see Chapter 4). For example, retailer QVC (see Minicase 2) offers a chat room where customers can discuss their experiences shopping with QVC.

E-Mail and Automated Response. The most popular tool of customer service is e-mail. Inexpensive and fast, e-mail is used to disseminate information (e.g., confirmations), to send product information, and to conduct correspondence regarding any topic, but mostly to answer inquiries from customers. For details, see Chapter 4.

Call Centers. One of the most important tools of customer service is the *call center*, also known as *customer care center*, etc. As defined in Chapter 4, a *call center* is a comprehensive customer service entity in which companies take care of their customer service issues, communicated through various contact channels. Call centers are typically the "face" of the organization to its customers.



For example, investment company Charles Schwab's call center effectively handles over 1 million calls from investment customers every day.

New products are extending the functionality of the conventional call center to e-mail and to Web interaction. For example, *epicor.com* combines Web channels, such as automated e-mail reply, Web knowledge bases, and portal-like self-service, with call center agents or field service personnel. Such centers are sometimes called *telewebs*. Examples and details were provided in Chapter 4.

Troubleshooting Tools. Large amounts of time can be saved by the customers if they can solve problems by themselves. Many vendors provide Web-based troubleshooting software to assist customers in this task. The vendors of course dramatically reduce their expenses for customer support when customers are able to solve problems without further intervention of customer service specialists.

Wireless CRM. Many of the CRM tools and applications are going wireless. As shown earlier, mobile sales force automation is becoming popular. In addition, use of wireless devices by mobile service employees is enabling these employees to provide communication with headquarters and better customers service from the customer's site. Also, using SMS and e-mail from hand-held devices is becoming popular as a means of improving CRM. In Chapter 3, we presented the case of Expedia and its wireless customer service. Overall, we will see most of CRM services going wireless fairly soon.

CRM Failures



A large percentage of failures have been reported in CRM. For example, according to *Zdnetindia.com/news* (2000), the founder and CEO of Customer.com estimated that 42 percent of the top 125 CRM sites experienced failures. Numerous failures are also reported by *thinkanalytics.com*, *cio.com*, *CRM-forum.com*, and many more. However, according to *itgreycells.com*, CRM failures are declining, from a failure rate of up to 80 percent in 1998 to about 50 percent in 2000.

Some of the major issues relating to CRM failures are the following:

- Difficulty measuring and valuing intangible benefits. There are few tangible benefits to CRM.
- Failure to identify and focus on specific business problems.
- Lack of active senior management (non-IT) sponsorship.
- Poor user acceptance, which can occur for a variety of reasons such as unclear benefits (i.e., CRM is a tool for management, but doesn't help a rep sell more effectively) and usability issues.
- Trying to automate a poorly defined process.

Strategies to deal with these and other problems are offered by many. (For example, see *CIO.com* for CRM implementation. Also see *conspectus.com* for "10 steps for CRM success.")

CRM failures could create substantial problems. Some companies are falling behind in their ability to handle the volume of site visitors and the volume of buyers. DeFazio (2000) provides the following suggestions for implementing CRM and avoiding CRM failure.

- Conduct a survey to determine how the organization responds to customers.
- Carefully consider the four components of CRM: sales, service, marketing, and channel/partner management.



- Survey how CRM accomplishments are measured; use defined metrics. Make sure quality, not just quantity, is addressed. (For discussion of metrics, see *Online File W7.17.*)
- Consider how CRM software can help vis-a-vis the organization's objectives.
- Decide on a strategy: refining existing CRM processes, or reengineering the CRM.
- Evaluate all levels in the organization, but particularly frontline agents, field service, and salespeople.
- Prioritize the organization's requirements as: must, desired, and not important.
- Select an appropriate CRM software. There are more than 60 vendors. Some (like Siebel) provide comprehensive packages, others provide only certain functions. Decide whether to use the best-of-breed approach or to go with one vendor. ERP vendors, such as PeopleSoft and SAP, also offer CRM products.

For more resources, see Ebner et al. (2001).

7.8 INTEGRATING FUNCTIONAL INFORMATION SYSTEMS

Functional information systems can be built in-house, they can be purchased from large vendors (such as Computer Associates, Best Software Inc., Microsoft, Oracle, IBM, or PeopleSoft), or they can be leased from application service providers (ASPs). In any of these cases, there is a need for their integration.

Reasons for Integration

For many years most IT applications were developed in the functional areas, independent of each other. Many companies developed their own customized systems that dealt with standard procedures to execute transaction processing/operational activities. These procedures are fairly similar, regardless of what company is performing them. Therefore, the trend today is to buy commercial, off-the-shelf functional applications or to lease them from ASPs. The smaller the organization, the more attractive such options are. Indeed, several hundred commercial products are available to support each of the major functional areas.

Development tools are also available to build custom-made applications in a specific functional area. For example, there are software packages for building financial applications, a hospital pharmacy management system, and a university student registration system. Some software vendors specialize in one or a few areas. For example, Lawson Software concentrates on retailing (see Mini-case 1, and PeopleSoft's strength is in HRM).

However, to build information systems along business processes (which cross functional lines) requires a different approach. Matching business processes with a combination of several functional off-the-shelf packages may be a solution in some areas. For example, it may be possible to integrate manufacturing, sales, and accounting software if they all come from the same software vendor (as shown in the opening case). However, combining existing packages from several vendors may not be practical or effective. To build applications that will easily cross functional lines and reach separate databases often requires new approaches such as Web Services and integrated suites, such as Oracle 9i (Chapter 2).



Information systems integration tears down barriers between and among departments and corporate headquarters and reduces duplication of effort. For example, Palaniswamy and Frank (2000) studied five ERP systems and found in all cases that better cross-functional integration was a critical success factor. A framework for an integrated information system was developed by Yakhou and Rahali (1992) and is shown in *Online File W7.18*. In their integrated framework, there is data sharing as well as joint execution of business processes across functional areas, allowing individuals in one area to quickly and easily provide input to another area. Various functional managers are linked together in an enterprisewide system.

As described in Chapter 2, 4, 8, and 14, one of the key factors for integration, especially with business partners, are agreements on appropriate standards (see *openapplications.org*).

Integrated information systems can be built easily in a small company. In large organizations, and even in multinational corporations, integration may require more effort, as shown in *IT At Work 7.7*.



IT At Work 7.7

WEB-BASED INTEGRATED EMPLOYEES AND CUSTOMER PORTALS AT EUROPCAR



Europcar Internet (*europcar.com*), the largest European-based car rental agency, changed the structure of its entire organization, in addition to changing everyday work processes and methods. To support these changes, the company combined 55 different mainframe and minicomputer systems into a single client/server center known as Greenway. Located at corporate headquarters near Paris, the \$400 million system initially combined data from nine different countries within Europe, and today it has expanded to a global system.

The 55 original independent systems used various data types, many of which were incompatible and needed to be integrated. Europcar was interested in integrating the business processes, customer preferences, and related data into a single system. To complicate matters, the company had to simultaneously develop a uniform set of business practices (corporate standards) to support the new single business entity. Furthermore, Europcar had to consider the variety of languages spoken in the nine countries involved, as well as different currencies (before the Euro was adopted) and cultures.

Key business processes—including reservations, billing, fleet management, cost control, and corporate finance—were all integrated into Greenway. The system serves employees via an employee portal and customers

via a customer portal. As Europcar has expanded to 100 countries worldwide (as of 2003), its information system has expanded considerably as well. Reservations can be made on the corporate portal, and a smart card is available to enable customers to check in and out rapidly. Other customer-related benefits include: (1) fast service to calling customers since clerks no longer have to manually verify credit cards or calculate bills, (2) reservation desks linked to airline reservation systems like SABRE or Amadeus, (3) online reservation accessed via the customers portal, and (4) corporate customers managed from one location.

Europcar originally grew through the acquisition of geographically and culturally disparate entities. Through reengineering, IT helps support these business alliances to present more of a multicountry team-based organization. By 2003, several thousand Europcar employees at about 1,000 offices worldwide utilize Greenway.

For Further Exploration: What are some of the difficulties of integrating 55 systems from nine countries speaking different languages? What functional areas can you identify in the integrated system? What is the role of the different portals?

Sources: Based on *europcar.com/English* (press releases 2000–2003).

Another approach to integration of information systems is to use enterprise resource planning software. However, ERP requires a company to fit its business processes to the software. As an alternative to ERP, companies can choose the best-of-breed systems on the market, or use their own home-grown systems and integrate them. The latter approach may not be simple, but it may be more effective.

By whatever method it is accomplished, integrating information systems helps to reduce cost, increase employees' productivity, and facilitate information sharing and collaboration, which are necessary for improving customer service.

Integration of Front-Office with Back-Office Operations

In Chapters 2 and 5 we discussed the need to integrate front-office with back-office operations. This is a difficult task. It is easier to integrate the front-office operations among themselves and the back-office operations among themselves (which is basically what systems such as MAS 90 are doing).

Software from various vendors offers some front-office and back-office integration solutions. Oracle Corp., for example, is continuously expanding its front-office software, which offers a capability of connecting back-office operations with it. To do so, the software uses new integration approaches, such as process-centric integration. **Process-centric integration** refers to integration solutions designed, developed, and managed from a business-process perspective, instead of from a technical or middleware perspective. Oracle's 9i product offers not only internal integration of the back office and front office, but also integration with business partners (see McCullough, 2002). Among its capabilities are:

- **Field sales online:** a Web-based customer management application.
- **Service contracts:** contract management and service options (with ERP).
- **Mobile sales and marketing:** a wireless groupware for connecting different management groups.
- **Call center and telephony suite:** a Web-based call center.
- **Internet commerce:** an order-taking and payment unit interconnected with ERP back-office applications. It is also tightly connected to the call center for order taking.
- **Business intelligence:** identification of most-valuable customers, analysis of why customers leave, and evaluation of sales forecast accuracy.

Another integration software product is IBM's WebSphere architecture, which includes front office (WebSphere Portal), back office, and supportive infrastructure. (See Figure 4.1, page 111.)

Many other vendors offer complete enterprise packages. For example, Synco Software (syncosoft.com) offers ERP services, which include accounting, finance, marketing, production, and executive information system modules. SAP-AG, in its ERP R/3 product, offers more than 70 integrated modules, as will be shown in our next chapter.

➔ MANAGERIAL ISSUES

1. **Integration of functional information systems.** Integration of existing stand-alone functional information systems is a major problem for many organizations. Although client/server architecture (Chapter 2 and Technology



Guide 4) is more amenable to integration than legacy systems, there are still problems of integrating different types of data and procedures used by functional areas. Also, there is an issue of willingness to share information, which may challenge existing practices and cultures.

2. **Priority of transaction processing.** Transaction processing may not be an exotic application, but it deals with the core processes of organizations. It must receive top priority in resource allocation, balanced against innovative applications needed to sustain competitive advantage and profitability, because the TPS collects the information needed for most other applications.
3. **The customer is king/queen.** In implementing IT applications, management must remember the importance of the customer/end-user, whether external or internal. Some innovative applications intended to increase customers' satisfaction are difficult to justify in a traditional cost-benefit analysis. Empowering customers to enter into a corporate database can make customers happy since they can conduct self-service activities such as configuration and tracking and get quick answers to their queries. Self-services can save money for a company as well, but it may raise security and privacy concerns. Corporate culture is important here, too. Everyone in the organization must be concerned about customers. Management should consider installing a formal CRM program for this purpose.
4. **Finding innovative applications.** Tools such as Lotus Notes, corporate portals, and Web-based business intelligence enable the construction of many applications that can increase productivity and quality. Finding opportunities for such applications can best be accomplished cooperatively by end users and the IS department.
5. **Using the Web.** Web-based systems should be considered in all functional areas. They are effective, cost relatively little, and are user friendly. In addition to new applications, companies should consider conversion of existing applications to Web-based ones.
6. **System integration.** Although functional systems are necessary, they may not be sufficient if they work independently. It is difficult to integrate functional information systems, but there are several approaches to doing so. In the future, Web services could solve many integration problems, including connecting to a legacy system.
7. **Ethical issues.** Many ethical issues are associated with the various topics of this chapter. Professional organizations, either relating to the functional areas (e.g., marketing associations) or in topical areas such as CRM, have their own codes of ethics. These codes should be taken into account in developing functional systems. Likewise, organizations must consider privacy policies. Several organizations provide comparisons of privacy policies and other ethical-related topics. For an example, see socap.org.



In practicing CRM, companies may give priority to more valuable customers (e.g., frequent buyers). This may lead to perceived discrimination. For example, in one case, when a male customer found that Victoria's Secret charged him more than it did female buyers, he sued. In court it was shown that he was buying less frequently than the specific female he cited; the company was found not guilty of discrimination. Companies need to be very careful with CRM policies.

HRM applications are especially prone to ethical and legal considerations. For example, training activities that are part of HRM may involve ethical

issues in recruiting and selecting employees and in evaluating performance. Likewise, TPS data processing and storage deal with private information about people, their performance, etc. Care should be taken to protect this information and the privacy of employees and customers.

For more on business ethics as it applies to CRM and other topics in this chapter, see ethics.ubc.ca/resources/business.



ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; additional resources such as cases, tables, and figures; updates; additional exercises; links; and demos and activities can be found on the book's Web site.

KEY TERMS

Batch processing (p. ●●●)	Financial value chain management (FVCM) (p. ●●●)	Product lifecycle management (PLM) (p. ●●●)
Channel systems (p. ●●●)	Just-in-time (JIT) (p. ●●●)	Sales automation software (p. ●●●)
Computer-integrated manufacturing (CIM) (p. ●●●)	Manufacturing resource planning (MRP II) (p. ●●●)	Sales-force automation (p. ●●●)
Customer relationship management (CRM) (p. ●●●)	Material requirements planning (MRP) (p. ●●●)	Transaction processing systems (TPS) (p. ●●●)
eCRM (p. ●●●)	Online processing (p. ●●●)	Vendor-managed inventory (VMI) (p. ●●●)
Employee relationship management (ERM) (p. ●●●)	Online transaction processing (OLTP) (p. ●●●)	Virtual close (p. ●●●)
Expense Management Automation (EMA) (p. ●●●)	Process-centric integration (p. ●●●)	Work management systems (WMS) (p. ●●●)

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- Information systems applications can support many functional activities. Considerable software is readily available on the market for much of this support (for lease or to buy).
- The major business functional areas are production/operations management, marketing, accounting/finance, and human resources management.
- The backbone of most information systems applications is the transaction processing system (TPS), which keeps track of the routine, mission-central operations of the organization.
- The major area of IT support to production/operations management is in logistics and inventory management: MRP, MRP II, JIT, mass customization, PLM, and CIM.
- Channel systems deal with all activities related to customer orders, sales, advertising and promotion, market research, customer service, and product and service pricing. Using IT can increase sales, customers' satisfaction, and profitability.
- Financial information systems deal with topics such as investment management, financing operations, raising capital, risk analysis, and credit approval.
- Accounting information systems also cover many non-TPS applications in areas such as cost control, taxation, and auditing.
- All tasks related to human resources development can be supported by human resources information systems. These tasks include employee recruitment and selection, hiring, performance evaluation, salary and benefits administration, training and development, labor negotiations, and work planning.
- Web-based HR systems are extremely useful for recruiting and training.

- 8 CRM is a corporate-wide program that is composed of many activities aiming at fostering better relationships with customers. A Web-based call center is an example.
- 9 Integrated functional information systems are necessary to ensure effective and efficient execution of activities that cross functional lines or that require functional cooperation.
- 9 Integrating applications is difficult; it can be done in different ways, such as buying off-the-shelf applications or building custom systems. A promising new approach is that of Web services.

QUESTIONS FOR REVIEW

1. What is a functional information system?
2. List the major characteristics of a functional information system.
3. What are the objectives of a TPS?
4. List the major characteristics of a TPS.
5. Distinguish between batch and online TPS.
6. Explain how the Web enables mass customization.
7. Describe MRP.
8. Describe MRP II.
9. Describe VMI.
10. Define CIM, and list its major benefits.
11. Describe PLM and list its benefits.
12. Define channel systems.
13. Define JIT, and list some of its benefits.
14. Define sales force automation.
15. What is product/customer profitability?
16. Describe some tactical and strategic accounting/finance applications.
17. List some budgeting-related activities.
18. List some EC activities in finance.
19. List IT-supported recruitment activities.
20. How can training go online?
21. Explain human resources information systems.
22. Define CRM and eCRM.
23. Describe a Web-based call center.
24. Describe the need for application integration.

QUESTIONS FOR DISCUSSION

1. Why is it logical to organize IT applications by functional areas?
2. Describe the role of a TPS in a service organization.
3. Why are transaction processing systems a major target for restructuring?
4. Which functional areas are related to payroll, and how does the relevant information flow?
5. Discuss the benefits of Web-based TPS.
6. It is said that in order to be used successfully, MRP must be computerized. Why?
7. The Japanese implemented JIT for many years without computers. Discuss some elements of JIT, and comment on the potential benefits of computerization.
8. Describe the role of computers in CIM.
9. Explain how Web applications can make the customer king/queen.
10. Why are information systems critical to sales-order processing?
11. Describe how IT can enhance mass customization.
12. Marketing databases play a major role in channel systems. Why?
13. Geographical information systems are playing an important role in supporting marketing and sales. Provide some examples not discussed in the text.
14. What is the role of software in PLM? Can PLM be done manually?
15. Discuss how IT facilitates the budgeting process.
16. Why is risk management important, and how can it be enhanced by IT?
17. Compare bill presentment to check re-presentment. How are they facilitated by IT?
18. How can the Internet support investment decisions?
19. Describe the benefits of an accounting integrated software such as MAS 90; compare it to MAS 2000.
20. Discuss the role IT plays in support of auditing.
21. Investigate the role of the Web in human resources management.
22. Discuss the benefits of self-service online by employees and customers. How can these activities be facilitated by IT?
23. Geographical information systems are playing an important role in supporting marketing and sales.

Provide some examples not discussed in the text. (See Chapter 11.)

24. Discuss the justification issues of CRM. What are metrics for? (See Minicase 2 and Online File W7.17.)
25. Discuss why Web-based call centers are critical for a successful CRM.
26. Discuss the need for application integration and the difficulty of doing it.
27. Discuss the approaches and reasons for integrating front office with back office.

EXERCISES

1. Compare the way Dartmouth Medical integrates its applications with integration via ERP software such as SAP R3. Why might the latter not be appropriate for a medical center?
2. The chart shown in Figure 7.4 portrays the flow of routine activities in a typical manufacturing organization. Explain in what areas IT can be most valuable.
3. Argot International (a fictitious name) is a medium-sized company in Peoria, Illinois, with about 2,000 employees. The company manufactures special machines for farms and food-processing plants, buying materials and components from about 150 vendors in six different countries. It also buys special machines and tools from Japan. Products are sold either to wholesalers (about 70) or directly to clients (from a mailing list of about 2,000). The business is very competitive.

The company has the following information systems in place: financial/accounting, marketing (primarily information about sales), engineering, research and development, and inventory management. These systems are independent of each other although they all connected to the corporate intranet.

Argot is having profitability problems. Cash is in high demand and short supply, due to strong business competition from Germany and Japan. The company wants to investigate the possibility of using information technology to improve the situation. However, the vice president of finance objects to the idea, claiming that most of the tangible benefits of information technology are already being realized.

You are hired as a consultant to the president. Respond to the following:

- a. Prepare a list of ten potential applications of information technologies that you think could help the company.
- b. From the description of the case, would you recommend any portals? Be very specific. Remember, the company is in financial trouble.
- c. How can Web services help Argot?
4. Enter *resumix.com*. Take the demo. Prepare a list of all the product's capabilities.

GROUP ASSIGNMENTS

1. Each group should visit (or investigate) a large company in a different industry and identify its channel systems. Prepare a diagram that shows the seven components in Figure 7.7. Then find how IT supports each of those components. Finally, suggest improvements in the existing channel system that can be supported by IT technologies and that are not in use by the company today. Each group presents its findings.
2. The class is divided into groups of four. Each group member represents a major functional area: production/operations management, sales/marketing, accounting/finance, and human resources. Find and describe several examples of processes that require the integration of functional information systems in a company of your choice. Each group will also show the interfaces to the other functional areas.
3. Each group investigates an HRM software vendor (Oracle, Peoplesoft, SAP, Lawson Software). The group prepares a list of all HRM functionalities supported by the software. Then the groups make a presentation to convince the class that its vendor is the best.
4. Create groups to investigate the major CRM software vendors, their products, and the capabilities of those products in the following categories (each group represents a topical area or several companies):
 - Sales force automation (Oracle, Onyx, Siebel, Saleslogix, Pivotal)
 - Call centers (Clarify, LivePerson, NetEffect, Inference, Peoplesoft)
 - Marketing automation (Annuncio, Exchange Applications, MarketFirst, Nestor)

- Customer service (Brightware, Broadvision, Primus, Silknet)
- Sales configuration (Exactium, Newtonian)

Start with *searchcrm.com* and *crm guru.com* (to ask questions about CRM solutions). Each group must present arguments to the class to convince class members to use the product(s) they investigated.

INTERNET EXERCISES



1. Surf the Net and find free accounting software (try *shareware.cnet.com*, *clarisys.ca/free*, *rkom.com.free*, *tucows.com*, *passthe shareware.com*, and *freeware-guide.com*). Download the software and try it. Write a report on your findings.
2. Enter the site of Federal Express (*fedex.com*) and learn how to ship a package, track the status of a package, and calculate its cost. Comment on your experience.
3. Finding a job on the Internet is challenging; there are almost too many places to look. Visit the following sites: *headhunter.net*, *careermag.com*, *hotjobs.com*, *jobcenter.com*, and *monster.com*. What do these sites provide you as a job seeker?
4. Enter the Web sites *tps.com* and *nonstop.compaq.com*, and find information about software products available from those sites. Identify the software that allows Internet transaction processing. Prepare a report about the benefits of the products identified.
5. Enter the Web site *peoplesoft.com* and identify products and services in the area of integrated software. E-mail PeopleSoft to find out whether its product can fit the organization where you work or one with which you are familiar.
6. Examine the capabilities of the following financial software packages: Comshare MPC (from Comshare), Financial Analyzer (from Oracle), and CFO Vision (from SAS Institute). Prepare a report comparing the capabilities of the software packages.
7. Surf the Internet and find information from three vendors on sales-force automation (try *sybase.com* first). Prepare a report on the state of the art.
8. Enter *teknowledge.com* and review the products that help with online training. What are the most attractive features of these products?
9. Enter *salesforce.com* and take the quick tour. Review some of their products that support sale people in the field. What do they offer for CRM? Write a report.
10. Enter *siebel.com*. View the demo on e-business. Identify all e-business-related initiatives. Why is the company considered as the leader of CRM software?
11. Enter *anntaylor.com* and identify the customer services activities.
12. Enter *microsoft.com/businessSolutions/Solomon/default.mspix*. View three of the demos in different functional areas of your choice. Prepare a report on the capabilities.
13. Enter *sage.com/solutions/solutions.htm*. Identify functional software, CRM software, and e-business software products. Are these stand-alone, or integrated? Explain.



Minicase 1

Dollar General Uses Integrated Software

Dollar General (*dollargeneral.com*) operates more than 6,000 general stores in the United States, fiercely competing with Wal-Mart, Target, and thousands of other stores in the sale of food, apparel, home-cleaning products, health and beauty aids, and more. The chain doubled in size between 1996 and 2002 and has had some problems in addition to the stiff competition, due to its rapid expansion. For example, moving into new states means different sales taxes, and these need to be closely monitored for changes. Personnel management also became more difficult with the organization's growth. An increased number of purchasing orders exacerbated problems in the accounts payable department, which was using manual matching of purchasing orders, invoices, and what was actually received in "receiving" before bills were paid.

The IT department was flooded with requests to generate long reports on topics ranging from asset management to general ledgers. It became clear that a better information system was needed. Dollar General started by evaluating information requirements that would be able to solve the above and other problems that cut into the company's profit.

A major factor in deciding which software to buy was the integration requirement among the existing information systems of the various functional areas, especially the financial applications. This led to the selection of the Financials suite (from Lawson Software). The company started to implement applications one at a time. Before 1998, the company installed the suite's asset management, payroll, and some HR applications which allow the tens of thousands of employees to monitor and self-update their benefits, 401K contributions, and personal data (resulting in big savings to the HR department). After 1998, the accounts payable and general ledger modules of Lawson Software were activated. The accounting modules allow employees to route, extract, and analyze data in the accounting/finance area with little reliance on IT personnel. During 2001–2003, Dollar General moved into the sales and procurement areas, thus adding the marketing and operation activities to the integrated system.

Here are a few examples of how various parts of the new system work: All sales data from the point-of-sale scanners of some 6,000 stores are pulled each night, together with financial data, discounts, etc., into the business intelligence application for financial and marketing analysis. Employee payroll data, from each store, are pulled once a week. This provides synergy with the sales audit system (from STS Software). All sales data are processed nightly by the STS System, broken to hourly journal entries, processed and summarized, and then entered into the Lawson's general ledger module.

The original infrastructure was a mainframe-based (IBM AS 400). By 2002, the 800 largest suppliers of Dollar General were submitting their bills on the EDI. This allowed an instantaneous processing in the accounts payable module. By 2003, service providers, such as utilities, were added to the system. To do all this the systems was migrated in 2001 from the old legacy system to Unix operating system, and then to a Web-based infrastructure, mainly in order to add Web-based functionalities and tools.

A development tool embedded in Lawson's Financials allowed users to customize applications without touching the computer programming code. This included applications that are not included in the Lawson system. For example, an employee-bonus application was not available at Lawson, but was added to Financial's payroll module to accommodate Dollar General's bonus system. A customized application that allowed additions and changes in dozens of geographical areas also solved the organization's state sales-tax collection and reporting problem.

The system is very scalable, so there is no problem to add stores, vendors, applications, or functionalities. In 2003, the system was completely converted to Web-based, enabling authorized vendors, for example, to log on the Internet and view the status of their invoices by themselves. Also, the Internet/EDI enables small vendors to use the system. (An EDI is too expensive for small vendors, but the EDI/Internet is affordable.) Also, the employees can update personal data from any Web-enabled desktop in the store or at home. Future plans call for adding an e-purchasing (procurement) module using a desktop purchasing model (see Chapter 5).

Questions for Minicase 1

1. Explain why the old, nonintegrated functional system created problems for the company. Be specific.
2. The new system cost several million dollars. Why, in your opinion, was it necessary to install it?
3. Does it make sense to add a CRM module, or to keep CRM applications in a separate system?
4. Lawson Software Smart Notification Software (*lawson.com*) is being considered by Dollar General. Find information about the software and write an opinion for adoption or rejection.
5. Another new product of Lawson is Services Automation. Would you recommend it to Dollar General? Why or why not.

Sources: Compiled from Amato-McCoy (2002a) and *lawson.com* (site accessed May 17, 2003).



Minicase 2

QVC Moving CRM from TV to the Web

QVC (*qvc.com*) is known for its TV shopping channels. As a leading TV-based mail-order service, QVC is selling on the Web too. In 2000, QVC served more than 6 million customers, answered 125 million phone calls, shipped about 80 million packages, and handled more than a billion page views on its Web site. QVC's business strategy is to provide superb customer service in order to keep its customers loyal. QVC also appointed a senior vice president for customer service.

QVC's customer service strategy works very well for the TV business and is expected to work as well for the Web. For example, in December 1999, due to unexpected high demand, the company was unable to fulfill orders for gold NFL rings by Christmas Eve. When QVC learned about the potential delay, it sent an expensive NFL jacket, for free, and made sure the jacket would arrive before the holiday. This is only one example of the company's CRM activities.

To manage its huge business (about \$4 billion a year), QVC must use the latest IT support. For example, QVC operates four state-of-the-art call centers, one for overseas operations. Other state-of-the-art technologies are used as well. However, before using technology to boost loyalty and sales, QVC had to develop a strategy to put the customers at the core of the corporate decision making. "Exceeding the expectations of every customer" is a sign you can see all over QVC's premises. As a matter of fact, the acronym QVC stands for Quality, Value, and Convenience—all from the customers' perspective. QVC

created a superb service organization. Among other things, QVC provides education (demonstrating product features and functions), entertainment, and companionship. Viewers build a social relationship with show hosts, upon which the commercial relationship is built. Now QVC is attempting to build a social relationship with its customers on the Web (see *qvc.com*).

QVC knows that building trust on the TV screen is necessary, but not sufficient. So everyone in the company is helping. QVC's president checks customers' letters. All problems are fixed quickly. Everything is geared toward the long run. In addition, to make CRM work, QVC properly aligns senior executives, IT executives, and functional managers. They must collaborate, work toward the same goals, have plans that do not interfere with others' plans, and so forth. Also the company adopts the latest IT applications and offers training to its customer service reps in the new applications and in CRM continuously.

It is interesting to note that QVC is using metrics to measure customer service. (See Online File W7.17.) These metrics used to be calls per hour, sales per minute, and profitability per customer. Now, the metrics are:

- Friendliness of the call center reps
- How knowledgeable the reps are about the products
- Clarity of the instructions and invoices
- Number of people a customer has to speak with to get a satisfactory answer



Virtual Company Assignment

Transaction Processing at the Wireless

Your restaurant vocabulary is increasing. You've learned that a "cover" is a guest, the cover count is something that Jeremy keeps a very close watch on, and the per-person amount is critical to TWC's success. Running a diner is more than cooking and serving hamburgers, and you've

been able to identify activities and transactions at TWC that fit most of the categories discussed in this chapter. In fact, it seems to you that there are a lot more activities at the back of the house (kitchen and office) than at the front of the house (dining room).



- How often a customer has to call a second time to get a problem resolved

Data on customer service are collected in several ways, including tracking of telephone calls and Web-site movements. Cross-functional teams staff the call center, so complete knowledge is available in one place. Corrective actions are taken quickly with attempts to prevent repeat problems in the future.

To get the most out of the call center's employees, QVC strives to keep them very satisfied. They must enjoy the work in order to provide excellent customer service. The employees are called "customer advocates," and they are handsomely rewarded for innovative ideas.

In addition to call centers, QVC uses computer-telephony integration technology (CTI), which identifies the caller's phone number and matches it to customer information in the database. This information pops up on the rep's screen when a customer calls. The rep can greet the customer by saying: "Nice to have you at QVC again, David. I see that you have been with us twice this year, and we want you to know that you are important to us. Have you enjoyed the jacket you purchased last June?"

To know all about the customer history, QVC maintains a large data warehouse. Customers' buying history is correlated by zip code with psychodemographics data from Experian, a company that analyzes consumer information. This way, QVC can instantly know whether a new product is a hit with wealthy retirees or with young adults. The information is used for e-procurement, advertisement strategy, and more. QVC also uses *viral marketing*, meaning the word-of-mouth of its loyal customers. In order not to

bother its customers, QVC does not send any mail advertisements.

QVC is an extremely profitable business, growing at an annual double-digit rate since its start in 1986.

Questions for Minicase 2

1. Enter *qvc.com* and identify actions that the company does to increase trust in its e-business. Also, look at all customer-service activities. List as many as you can find.
2. Visit the CRM learning center at *darwinmag.com/learn/crm*, and identify some CRM activities not cited in this case that QVC may consider to further increase customer loyalty. Is any of the activities cited in this chapter applicable?
3. What is the advantage of having customers chat live online?
4. List the advantages of buying online vs. buying over the phone after watching QVC. What are the disadvantages?
5. Enter the chat room and the bulletin board. What is the general mood of the participants? Are they happy with QVC? Why or why not?
6. QVC said that the key for its success is customer trust. Explain why.
7. Examine the metrics that QVC uses to measure customer service. Can the company be successful by ignoring the productivity measures used before?

Sources: Compiled from *Darwin Magazine* (2000), and from *qvc.com* (accessed April 27, 2003).

1. Describe TWC's value chain. What are some transactions that take place along this value chain?
2. Describe in detail the information used in one back-of-the-house transaction.
3. The host/hostess is the first point of contact customers have upon coming to TWC. In addition to welcoming the customers, he/she manages the table assignments, making sure that there is adequate waitstaff coverage as well as efficient table turnover. The host/hostess is

a key figure in efficient dining room logistics. What automated tools might help the host/hostess in the job?

4. Barbara is interested in the potential of CRM to better understand customers' needs and serve repeat customers. You are unsure of the privacy and security issues and wonder if they outweigh the potential for personalization. Discuss the pros and cons of using CRM to better know TWC's customers.

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- 7. Transaction Processing, Functional Applications, CRM, and Integration
- ▶ 8. Supply Chain Management and Enterprise Resource Planning
- 9. IT Planning and Business Process Redesign

CHAPTER

8

Supply Chain Management and Enterprise Resource Planning

ChevronTexaco

8.1

Essentials of the Supply and Value Chains

8.2

Supply Chain Problems and Solutions

8.3

Computerized Systems: MRP, MRPII, SCM and E-Integration

8.4

Enterprise Resource Planning (ERP)

8.5

E-Commerce and Supply Chains

8.6

Partner Relationship Management

8.7

Global Supply Chains

Minicases: (1) Quantum Corporation / (2) Green Mountain Coffee Roasters

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Understand the concept of the supply chain, its importance, and management.
- 2 Describe the problems of managing the supply chain and some innovative solutions.
- 3 Trace the evolution of software that supports activities along the supply chain and describe the need for software integration.
- 4 Describe ERP and understand the relationships between ERP and SCM software.
- 5 Describe order fulfillment problems and solutions in e-commerce and how EC solves other supply chain problems.
- 6 Describe the process and activities of partner relationship management.
- 7 Understand the process and issues of global supply chain management.



CHEVRONTEXACO'S MODERNIZED SUPPLY CHAIN

➡ THE PROBLEM

ChevronTexaco (*chevrontexaco.com*) is the largest U.S. oil company and is multinational in nature. Its main business is drilling, refining, transporting, and selling petroleum products (oil and gasoline). In this competitive business a saving of even a quarter of penny for each gallon totals up to millions of dollars. Two problems have plagued the industry: running out of gasoline when needed at each pump, and a delivery that is aborted because a tank at the gas station is too full (called “retain”). Run-outs and retains, known as the industry’s “twin evils,” have been a target for improvements for years, with little success.

The causes of the twin evils have to do with the supply chain: Gasoline flows in the supply chain, starting with the upstream part of the chain (Chapter 2) which includes oil hunting, drilling, and extracting. Then the oil is processed, and finally it goes to the downstream, customer-facing part of the supply chain. The difficulty is to match the three parts of the chain. ChevronTexaco own oil fields and refineries, but it also buys both crude and refined oil to meet demand. Purchases are of two types: those that have long-term contracts and those that are purchased “as needed,” in the spot market, at prevailing prices (which usually are higher than contract prices).

In the past ChevronTexaco acted like a mass-production manufacturing company, just trying to make products and sell them (a supply-driven strategy). The problem with this strategy is that each time you make too much or too little, you are introducing extra cost into the supply chain.

➡ THE SOLUTION

The company decided to change its supply chain business model from *supply-driven* to *demand-driven*. Namely, instead of worrying about how much oil it would process and “push,” it started worrying about how much oil its customers wanted. This change necessitated a major transformation in the business and extensive support by information technologies.

To implement the IT support, the company is investing \$15 million (each year, in the U.S. alone), in proprietary supply chain software that can capture data in real time. Each tank in each gas station is equipped with an electronic monitor that conveys real-time information about the oil level, through a cable, to the station’s IT-based management system, and then via a satellite, to the main inventory system at the company’s main office. There, an advanced DSS-based planning system processes the data to help refining, marketing, and logistics decisions. This DSS include also information collected at trucking and airline companies. Using an enterprise resource planning (ERP) and the business planning system, ChevronTexaco determines how much to refine, how much to buy at spot markets, and when and how much to ship to each of its retail stations.

The system uses demand forecasting to determine how much oil it would refine on a monthly basis, with weekly and daily checks. This way production is matched to customer demand. It is necessary to integrate the supply and demand information systems, and this is where the ERP software is useful. Planners at

various points across the supply chain (e.g., refineries, terminals, stations, transportation, and production) have to share data constantly.

Recent corporate IT projects that support the ChevronTexaco supply chain and extend it to a global reach are NetReady (which enables 150 e-business initiatives), Global Information Link (GIL2, which enables connectivity throughout the company), e-Guest (which enables sharing of information with business partners), and the Human Resources Information System.

THE RESULTS

The integrated system, which allows data to be shared across the company, has improved decision making at every point in the customer-facing and processing parts of the supply chain. Better decision making has increased the company's profit by more than \$300 million in 1999 and by more than an additional \$100 million in 2000. Managers attribute the increase to various company initiatives, but mostly to the change in the supply chain.

According to Worthen, (2002), studies indicate that companies that belong to the top 20 percent in their industries operate their supply chains twice as efficiently as median companies. The successful companies carry half as much inventory, can respond to significant rise in demand (20 percent or higher) twice as fast, and know how to minimize the number of deliveries they must make to any retail outlets. ChevronTexaco belongs to this category.

Sources: Compiled from Worthen (2002) and from *chevrontexaco.com* (see "Information Technology"; site accessed May 2003).

LESSONS LEARNED FROM THIS CASE

The ChevronTexaco case illustrates the importance of supply chain management for the modern enterprise. It demonstrates the need to significantly improve the management of the supply chain (in this case from supply-driven to demand-driven). Such a drastic change was feasible only with the support of IT tools. In this case, IT is used to enable real-time communication between each tank at each gas station (many thousands) and the corporate management center, where DSS analysis can be done on a continuous basis. Also, knowing demand in real-time helps a company's acquisition of raw materials (in this case, oil) and drives its production (refinery) operations. Finally, all decision makers along the supply chain share information and collaborate.

Supply chain management is not a simple task, as will be seen in this chapter, but IT solutions enable even a large multinational company like ChevronTexaco to tame the supply chain, increasing both its profits and customer satisfaction. Finally, we see that the company is extending its supply chain improvement to its business partners. We also cover a related topic, order fulfillment in EC.

8.1 ESSENTIALS OF THE SUPPLY AND VALUE CHAINS

Initially, the concept of a *supply chain* referred only to the flow of materials from their sources (suppliers) to the company, and then inside the company to places where they were needed. There was also recognition of a *demand chain*, which

described the process of taking orders and delivering finished goods to customers. Soon it was realized that these two concepts are interrelated, so they were combined under the single concept named the *extended supply chain*, or just *supply chain*.

Concepts and Definitions

The following concepts and definitions are helpful for the study of this chapter.

SUPPLY CHAIN. As defined in Chapter 2, **supply chain** refers to the flow of materials, information, payments, and services from raw material suppliers, through factories and warehouses, to the end customers. A supply chain also includes the *organizations* and *processes* that create and deliver products, information, and services to the end customers. It includes many tasks such as purchasing, payment flow, materials handling, production planning and control, logistics and warehousing, inventory control, and distribution and delivery.

SUPPLY CHAIN MANAGEMENT. The function of **supply chain management (SCM)** is to plan, organize, and coordinate all the supply chain's activities. Today the concept of SCM refers to a total systems approach to managing the entire supply chain. SCM is usually supported by IT (see Kumar, 2001; Hugos, 2002; and Vakharia, 2002). The topic of supply chain management was found to be the number 1 priority of chief information officers (CIOs) in 2001, and their number 3 priority in 2002 (see Morgan Stanley, 2001, 2002).

SCM SOFTWARE. *SCM software* refers to software intended to support specific segments of the supply chain, especially in manufacturing, inventory control, scheduling, and transportation. This software concentrates on improving decision making, optimization, and analysis.

E-SUPPLY CHAIN. When a supply chain is managed electronically, usually with Web-based software, it is referred to as an **e-supply chain**. As will be shown in this chapter, improvements in supply chains frequently involve an attempt to convert an organization's supply chain to an e-supply chain—that is, to automate the information flow in the chain (see Poirier and Bauer, 2000).

SUPPLY CHAIN FLOWS. There are three flows in the supply chain: materials, information, and financial flows.

- **Materials flows.** These are all physical products, new materials, and supplies that flow along the chain. Included in the materials flows are returned products, recycled products, and materials or products for disposal.
- **Information flows.** All data related to demand, shipments, orders, returns, schedules, and changes in the above are information flows.
- **Financial flows.** Financial flows include all transfers of money, payments, credit card information and authorization, payment schedules, e-payments (Chapter 5), and credit-related data.

In service industries there may be no physical flow of materials, but frequently there is flow of documents (hard and/or soft copies). Service industries, according to the above definition, fit the definition of a supply chain, since the information flow and financial flow still exist. As a matter of fact the digitization of products (software, music, etc.) results in a supply chain without physical

flow. Notice however that in such a case, there are two types of information flows: one that replaces material flow (e.g., digitized software), and one that is the supporting information (orders, billing, etc).

In managing the supply chain it is necessary to coordinate all the above flows among all the parties involved in the supply chain (see Viswanadham, 2002).

BENEFITS. The goals of modern SCM are to reduce uncertainty and risks in the supply chain, thereby positively affecting inventory levels, cycle time, business processes, and customer service. All these benefits contribute to increased profitability and competitiveness, as demonstrated in the opening case. The benefits of supply chain management have long been recognized both in business and in the military.

In today's competitive business environment, the efficiency and effectiveness of supply chains in most organizations are critical for their survival and are greatly dependent upon the supporting information systems.

The Components of Supply Chains

The term *supply chain* comes from a picture of how the partnering organizations in a specific supply chain are linked together. A typical supply chain, which links a company with its suppliers and its distributors and customers was shown in Figure 2.6 (page •••). The supply chain involves three segments: (1) *upstream*, where sourcing or procurement from external suppliers occur, (2) *internal*, where packaging, assembly, or manufacturing take place, and (3) *downstream*, where distribution or dispersal take place, frequently by external distributors.

A supply chain also involves a *product life cycle* approach from “dirt to dust.” However, a supply chain is more than just the movement of tangible inputs, since it also includes the movement of information and money and the procedures that support the movement of a product or a service. Finally, the organizations and individuals involved are part of the chain as well. As a matter of fact, the supply chain of a service or of a digitizable product may not include *any* physical materials.

Supply chains come in all shapes and sizes and may be fairly complex, as shown in Figure 8.1. As can be seen in the figure, the supply chain for a car manufacturer includes hundreds of suppliers, dozens of manufacturing plants (for parts) and assembly plants (for cars), dealers, direct business customers (fleets), wholesalers (some of which are virtual), customers, and support functions such as product engineering and purchasing. For sake of simplicity we do not show here the flow of information and payments.

Notice that in this case the chain is not strictly linear as it was in Figure 2.6. Here we see some loops in the process. In addition, sometimes the flow of information and even goods can be bidirectional. For example, not shown in this figure is **reverse logistics**, which is the *return* of products. For the automaker, that would be cars returned to the dealers in cases of defects or recalls by the manufacturer.

Types of Supply Chains

The supply chains shown in Figures 2.6 and 8.1 are those of manufacturing companies. Such companies may have warehouses in different locations, making the chain even more complex. As a matter of fact there are several major types of supply chain. These types can be classified into four categories: integrated

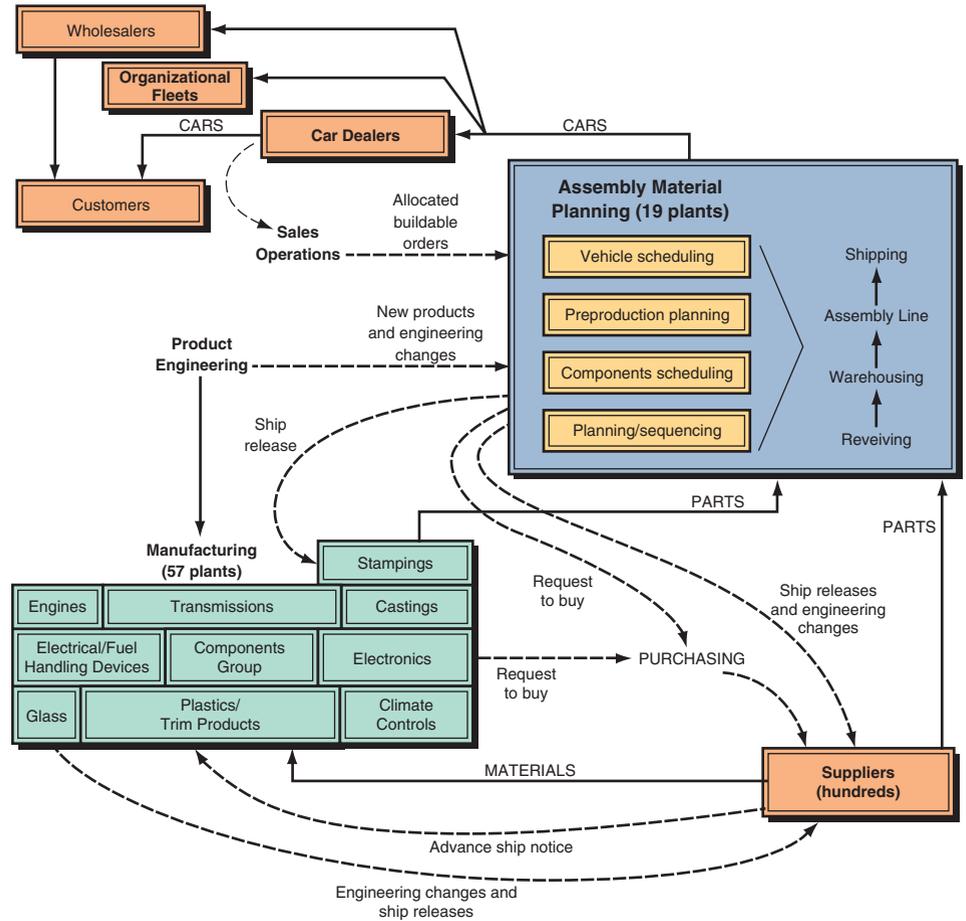


FIGURE 8.1 An auto-motive supply chain. (Source: Modified from *Introduction to Supply Chain Management* by Handfield and Nichols, 1999. Reprinted by permission of Pearson Education, Inc., Upper Saddle River, N.J.)



make-to-stock, continuous replenishment, build-to-order, and channel assembly. Details are provided in *Online File W8.1*.

The flow of goods, services, information, and financial resources is usually designed not only to effectively transform raw items to finished products and services, but also to do so in an efficient manner. Specifically, the flow must be followed with an increase in value, which can be analyzed by the *value chain*.

The Supply Chain and the Value Chain

In Chapter 3 we introduced the concepts of the *value chain* and the *value system*. A close examination of these two concepts shows that they are closely related to the supply chain. The *primary activities* of the value chain, corresponding to the internal part of the model are shown in Figure 2.6 (page ●●●). Some of the *support activities* of the value chains (such as moving materials, purchasing, and shipping) can be identified in Figure 8.1.

Porter’s value chain (1985) emphasized that value is added as one moves along the chain. One of the major goals of SCM is to maximize this value, and this is where IT in general and e-commerce in particular enter the picture, as will be shown in Sections 8.3 and 8.4. But let us first see why it is difficult to optimize the value and supply chains.

8.2 SUPPLY CHAIN PROBLEMS AND SOLUTIONS

Adding value along the supply chain is essential for competitiveness or even survival. Unfortunately, the addition of value is limited by many potential problems along the chain.

Background Supply chain problems have been recognized both in the military and in business operations for generations. Some even caused armies to lose wars and companies to go out of business. The problems are most evident in complex or long supply chains and in cases where many business partners are involved. For example, a well-known military case is the difficulties the German army in World War II encountered in the long supply chain to its troops in remote Russian territories, especially during the winter months. These difficulties resulted in a major turning point in the war and the beginning of the Germans' defeat. Note that during the 1991 and the 2003 wars in Iraq, the allied armies had superb supply chains that were managed by the latest computerized technologies (including DSS and intelligent applications). These chains were a major contributor to the swift victories.

In the business world there are numerous examples of companies that were unable to meet demand, had too large and expensive inventories, and so on. Some of these companies paid substantial penalties; others went out of business. On the other hand, some world-class companies such as Wal-Mart, Federal Express, and Dell have superb supply chains with innovative IT-enhanced applications (see *IT At Work 3.4*, page •••, on how Dell does it).

Problems Along the Supply Chain

An example of a supply chain problem was the difficulty of fulfilling orders received electronically for toys during the 1999 holiday season. During the last months of 1999, online toy retailers, including eToys (now kbkids.com), Amazon.com, and ToysRUs, conducted massive advertising campaigns to encourage Internet ordering. These campaigns included \$20 to \$30 discount vouchers for shopping online. Customer response was overwhelming, and the retailers that underestimated it were unable to get the necessary toys from the manufacturing plants and warehouses and deliver them to the customers' doors by Christmas Eve. The delivery problems cost the toy retailers dearly, in terms of both money and goodwill. ToysRUs, for example, ended up offering each of its unhappy customers a \$100 store coupon as compensation. Despite its generous gift, over 40 percent of the unhappy ToysRUs customers said they would not shop online at ToysRUs again (Conlin, 2000).

These and similar problems create the need for innovative solutions. For example, during the oil crises in the 1970s, Ryder Systems, a large trucking company, purchased a refinery to control the upstream of the supply chain and ensure availability of gasoline for its trucks. Such vertical integration is effective in some cases but ineffective in others. (Ryder later sold the refinery.) In the remaining portion of this section we will look closely at some of the major problems in managing supply chains and at some possible solutions, many of which are supported by IT.

SOURCES AND SYMPTOMS OF SUPPLY CHAIN PROBLEMS. Problems along the supply chain stem mainly from two sources: (1) from uncertainties, and (2) from the need to coordinate several activities, internal units, and business partners.

A major source of supply chain uncertainties is the *demand forecast*, as demonstrated by the 1999 toy season. The demand forecast may be influenced by several factors such as competition, prices, weather conditions, technological development, and customers' general confidence. Other supply chain uncertainties exist in *delivery times*, which depend on many factors, ranging from machine failures to road conditions and traffic jams that may interfere with shipments. *Quality problems* of materials and parts may also create production delays.

A major symptom of ineffective SCM is poor customer service, which hinders people or businesses from getting products or services when and where needed, or gives them poor-quality products. Other symptoms are high inventory costs, loss of revenues, extra cost of expediting shipments, and more. One of the most persistent SCM problems related to uncertainty is known as the *bullwhip effect*.

THE BULLWHIP EFFECT. The **bullwhip effect** refers to erratic shifts in orders up and down the supply chain (see Donovan, 2002/2003). This effect was initially observed by Procter & Gamble (P&G) with its disposable diapers product, Pampers. While actual sales in retail stores were fairly stable and predictable, orders from distributors to P&G (the manufacturer) had wild swings, creating production and inventory problems. An investigation revealed that distributors' orders were fluctuating because of poor demand forecasting, price fluctuation, order batching, and rationing within the supply chain. All this resulted in unnecessary and costly inventories in various areas along the supply chain, fluctuations of P&G orders to their suppliers, and flow of inaccurate information. Distorted information can lead to tremendous inefficiencies, excessive inventories, poor customer service, lost revenues, ineffective shipments, and missed production schedules (Donovan, 2002/2003).

The bullwhip effect is not unique to P&G. Firms ranging from Hewlett-Packard in the computer industry to Bristol-Myers Squibb in the pharmaceutical field, have experienced a similar phenomenon (see Shain and Robinson, 2002). Basically, even slight demand uncertainties and variabilities become magnified when viewed through the eyes of managers at each link in the supply chain. If each distinct entity makes ordering and inventory decisions with an eye to its own interest above those of the chain, stockpiling may be simultaneously occurring at as many as seven or eight places along the supply chain, leading in some cases to as many as 100 days of inventory—which is waiting, “just in case.” (versus 10–20 days' inventory in the normal case).

A 1998 industry study projected that \$30 billion in savings could materialize in the grocery industry supply chains alone through sharing information and collaborating. Thus, companies are trying to avoid the “sting of the bullwhip.” as well as to solve other SCM problems.

Solutions to Supply Chain Problems

SOLVING THE BULLWHIP PROBLEM. A common way to solve the bullwhip problem is by sharing information along the supply chain (e.g., see Reddy, 2001). Such sharing can be facilitated by EDI, extranets, and groupware technologies. Information sharing among supply chain partners is part of interorganizational EC or *c-commerce* (Chapters 4 and 5), and is sometimes referred to as the *collaboration supply chain* (see Simatupang and Sridharan, 2002).

One of the most notable examples of information sharing is between Procter & Gamble and Wal-Mart. Wal-Mart provides P&G access to sales information for every item P&G supplies to Wal-Mart, everyday in every store. With that



information, P&G is able to manage the inventory replenishment for Wal-Mart. By monitoring inventory levels, P&G knows when inventories fall below the threshold for each product at any Wal-Mart store. This automatically triggers an immediate shipment. All this is part of a **vendor-managed inventory (VMI) strategy**. The benefit of the strategy for P&G is accurate and timely demand information. P&G has similar agreements with other major retailers. Thus, P&G can plan production more accurately, minimizing the “bullwhip effect.” P&G deployed in 2000 a Web-based “Ultimate-Supply System,” which replaced 4,000 different EDI links to suppliers and retailers in a more cost-effective way. Later on we will show how Warner-Lambert and other manufacturers are doing similar information sharing with wholesalers and retailers in order to solve the bullwhip effect and other supply problems.

OPTIMIZING INVENTORY LEVELS. Over the years organizations have developed many solutions to the supply chain problems. Undoubtedly, the most common solution used by companies is *building inventories* as an “insurance” against supply chain uncertainties. This way products and parts flow smoothly through the production process.

The main problem with this approach is that it is very difficult to correctly determine inventory levels for each product and part. If inventory levels are set too high, the cost of keeping the inventory will be very large. If the inventory is too low, there is no insurance against high demand or slow delivery times, and revenues (and customers) may be lost. In either event the total cost, including cost of keeping inventories, cost of lost sales opportunities, and bad reputation, can be very high. Thus, companies make major attempts to control and optimize inventory levels, as shown in the *IT At Work 8.1*.

SUPPLY CHAIN COORDINATION AND COLLABORATION. Proper supply chain and inventory management requires coordination of all different activities and links of the supply chain. Successful coordination enables goods to move smoothly and on time from suppliers to manufacturers to customers, which enables a firm to keep inventories low and costs down. Such coordination is needed since companies depend on each other but do not always work together toward the same goal.

As part of the coordination effort, business partners must learn to *trust* each other. The lack of trust is a major inhibitor of collaboration. Gibbons-Paul (2003) reports that 75 percent of senior IT managers cited the lack of trust as number one barrier to electronic collaboration. To overcome this problem Gibbons-Paul offers six strategies. One strategy, for example, is that both suppliers and buyers must participate together in the design or redesign of the supply chain to achieve their shared goals.

To properly control the uncertainties mentioned earlier, it is necessary to identify and understand their causes, determine how uncertainties in some activities will affect other activities, up and down the supply chain, and then formulate specific ways to reduce or eliminate the uncertainties. Combined with this is the need for an effective and efficient communication and collaboration environments among all business partners (see Chapter 4). A rapid flow of information along the supply chains makes them very efficient. For example, computerized point-of-sale (POS) information can be transmitted once a day, or even in real time, to distribution centers, suppliers, and shippers. (Recall the Dell case, in Chapter 2.)



IT At Work 8.1

HOW LITTLEWOODS STORES IMPROVED ITS SCM



Littlewoods Stores (littlewoods.co.uk) is one of Britain's largest retailers of high-quality clothing. It has about 140 stores around the U.K. and Northern Ireland. The retail clothing business is very competitive, and every problem can be expensive. A serious supply chain problem for the company was *overstocking*. So in the late 1990s the company embarked on an IT-supported initiative to improve its supply chain efficiency.

In order to better manage the supply chain, the company introduced a Web-based performance reporting system, using SCM software. The new system analyzes, on a daily basis, inventory, marketing and finance data, space allocation, merchandising, and sales data. For example, merchandising personnel can now perform sophisticated sales, stock, and supplier analyses to make key operational decisions on pricing and inventory. Using the Web, analysts can view sales and stock data in virtually any grouping of levels and categories. Furthermore, users can easily drill down to detailed sales and to access other data.

The system also uses a data warehouse-based decision support system and other end-user-oriented software, to make better decisions. The savings have been dramatic: The cost of buying and holding backup inventory was cut by about \$4 million a year. For example, due to quicker

replenishment, stock went down by 80 percent. In addition, reducing the need for stock liquidations that resulted from too high inventories saved Littlewoods \$1.4 million each year. The ability to strategically price merchandise differently in different stores and improved communication and delivery abilities among stores saved another \$1.2 million each year. Marketing distribution expenses were cut by \$7 million a year, due to collaboration among sales, warehouses, suppliers and deliveries. And, finally, the company was able to reduce inventory and logistics-related staff from 84 to 49 people, a saving of about \$1 million annually.

Within a year the number of Web-based users of the system grew to 600, and the size of the data warehouse grew to over 1 gigabyte. In November 1999 the company launched its Online Home Shopping Channel (shop-i.co.uk) and other e-commerce projects. Further improvements in SCM were recorded as of fall 2000.

Sources: Compiled from microstrategy.com (site accessed January 2000, Customers' Success Stories), and from littlewoods.co.uk (site accessed March 25, 2003).

For Further Exploration: Explain how integrated software solved the excess inventory problem. Also, review the role of data warehouse decision support in this case.

SUPPLY CHAIN TEAMS. The change of the linear supply chain to a hub (Chapters 1 and 5) shows the need for the creation of **supply chain teams** at times. According to Epner (1999), a supply chain team is a group of tightly integrated businesses that work together to serve the customer. Each task is done by the member of the team who is best positioned, trained, and capable of doing that specific task. For example, the team member that deals with the delivery will handle a delivery problem even if he or she works for a delivery company rather than for the retailer whose product is being delivered. This way, redundancies will be minimized. If the customer contacts the delivery company about a delivery problem, that specific employee will be dealt with, rather than passing the problem along to the retailer, and the retailer will not have to spend valuable resources following up on the delivery. The task assignment to team members as well as the team's control is facilitated by IT tools such as workflow software and groupware (see Chapter 4).

PERFORMANCE MEASUREMENT AND METRICS. Measuring the supply chain performance is necessary for making decisions about supply chain improvements. IT provides for the data collection needed for such measurement. Some potential metrics for supply chain operations are: on-time delivery (%), quality



at unloading area (number of defects), cost performance, lead time for procurement, inventory levels (or days of turning an inventory), shrinkage (%), obsolescence (% of inventory), cost of maintaining inventory, speed of finding needed items in the storeroom, availability of items when needed (%), the percentage of rush orders, percentage of goods returned, and a customers' complaints rate.

Establishing such metrics and tracking them with business partners is critical to the success of one's business. Companies that use such measures have the needed data to minimize supply chain problems. For a comprehensive discussion of metrics see Sterne (2002) and Bayles (2001).

OTHER IT-ASSISTED SOLUTIONS TO SCM PROBLEMS. Here are some other generic IT-assisted solutions to solve SCM problems:

- Use wireless technology to expedite certain tasks in the supply chain (e.g., vehicle location and sales force automation; see Chapter 6).
- Configure optimal shipping plans. Use quantitative analysis, DSS, and intelligent systems for the configuration. (See Keskinocak and Tayur, 2001.)
- Create strategic partnerships with suppliers. Use DSS to determine which partnerships, and which suppliers to use.
- Use the just-in-time approach, in which suppliers deliver small quantities whenever supplies, materials, and parts are needed.
- Use outsourcing rather than do-it-yourself especially during demand peaks. Use DSS models to decide what and when to outsource.
- Similarly, buy rather than make production inputs whenever appropriate. Use DSS to make appropriate decisions.
- Reduce the lead time for buying and selling by proper planning. Use business intelligence models.
- Use fewer suppliers. Use business intelligence models to decide on how many and which suppliers.
- Improve supplier-buyer relationships by using CRM and PRM software solutions.
- Manufacture only after orders are in, as Dell does with its custom-made computers and servers.
- Achieve accurate demand by working closely with suppliers, using online collaboration tools (Chapter 4).
- Automate materials flow, information flow, and partner relationships (Viswanadham, 2002).

For more specific IT solutions, see Table 8.1 and Kumar (2001).

Large companies, such as Dell Computer, employ several methods to achieve supply-chain superiority (see *IT At Work 3.4* and Online Minicase W8.1). Wal-Mart is another company that is well-known for its ability to combine information from companies across its supply chain, with demand inventory data from its stores, to minimize operating cost and reduce prices. This requires lots of collaboration with business partners. Nestlé USA, for example, created a vice-president-level position exclusively to manage business with Wal-Mart (Worthen, 2002). For a comprehensive example of global

TABLE 8.1 IT Solutions to Supply Chain Problems

Supply Chain Problem	IT Solution
Linear sequence of processing is too slow. Waiting times between chain segments are excessive.	Parallel processing, using workflow software. Identify reason (DSS software) and expedite communication and collaboration (intranets, groupware).
Existence of non-value-added activities. Slow delivery of paper documents.	Value analysis (SCM software), simulation software. Electronic documents and communication system (e.g., EDI, e-mail).
Repeat process activities due to wrong shipments, poor quality, etc. Batching; accumulate work orders between supply chain processes to get economies of scale (e.g., save on delivery). Learn about delays after they occur, or learn too late.	Electronic verifications (software agents), automation; eliminating human errors, electronic control systems. SCM software analysis, digitize documents for online delivery. Tracking systems, anticipate delays, trend analysis, early detection (intelligent systems).
Excessive administrative controls such as approvals (signatures). Approvers are in different locations. Lack of information, or too-slow flow.	Parallel approvals (workflow), electronic approval system. Analysis of need. Internet/intranet, software agents for monitoring and alert. Bar codes, direct flow from POS terminals.
Lack of synchronization of moving materials.	Workflow and tracking systems. Synchronization by software agents.
Poor coordination, cooperation, and communication.	Groupware products, constant monitoring, alerts, collaboration tools.
Delays in shipments from warehouses.	Use robots in warehouses, use warehouse management software.
Redundancies in the supply chain. Too many purchasing orders, too much handling and packaging.	Information sharing via the Web, creating teams of collaborative partners supported by IT (see Epner, 1999).
Obsolescence of parts and components that stay too long in storage.	Reducing inventory levels by information sharing internally and externally, using intranets and groupware.
Scheduling problems, manufacturing lack of control.	Intelligent agents for B2B modeling (see <i>gensym.com</i>).

supply chain improvements at another large company, John Deere, see Nelson (2002).

8.3 COMPUTERIZED SYSTEMS: MRP, MRPII, SCM, AND INTEGRATION

The concept of the supply chain is interrelated with the computerization of its activities, which has evolved over 50 years.

The Evolution of Computerized Supply Chain Aids

Historically, many of the supply chain activities were managed with paper transactions, which can be very inefficient. Therefore, since the time when computers first began to be used for business, people have wanted to automate the processes along the supply chain.

The first software programs, which appeared in the 1950s and early 1960s, supported short segments along the supply chain. Typical examples are inventory management systems, scheduling, and billing. The supporting software

was called *supply chain management (SCM) software*. The major objectives were to reduce cost, expedite processing, and reduce errors. Such applications were developed in the functional areas, independent of each other, and they became more and more sophisticated with the passage of time (as was shown in Chapter 7). Of special interest were transaction processing systems and decision support procedures such as management science optimization and financial decision-making formulas (e.g., for loan amortization).

In a short time it became clear that interdependencies exist among some of the supply chain activities. One early realization was that production scheduling is related to inventory management and purchasing plans. As early as the 1960s, the **material requirements planning (MRP)** model was devised. This model essentially integrates production, purchasing, and inventory management of interrelated products (see Chapter 7). It became clear that computer support could greatly enhance use of this model, which may require daily updating. This resulted in commercial MRP software packages coming on the market.

While MRP packages were and still are useful in many cases, helping to drive inventory levels down and streamlining portions of the supply chain, they failed in as many (or even more) cases. One of the major reasons for the failure was the realization that schedule-inventory-purchasing operations are closely related to both financial and labor resources, which were not represented in MRP packages. This realization resulted in an enhanced MRP methodology (and software) called **manufacturing resource planning (MRP II)**, which adds labor requirements and financial planning to MRP (see Sheikh, 2002).

During this evolution there was more and more *integration* of functional information systems. This evolution continued, leading to the *enterprise resource planning (ERP)* concept, which integrates the transaction processing and other routine activities of all functional areas in the entire enterprise. ERP initially covered all routine transactions within a company, including internal suppliers and customers, but later it was expanded to incorporate external suppliers and customers in what is known as *extended ERP software*. A typical ERP includes dozens of integrated modules, in all functional areas; a listing of typical modules can be viewed in *Online File W8.2* at our Web site. We'll look at ERP, which is also known as an *enterprise software*, again in a bit more detail later in this section.

The next step in this evolution, which started in the late 1990s, is the inclusion of business intelligence and other application software (such as CRM software). At the beginning of the twenty-first century, the integration expanded to include entire industries and the general business community. (See *mySAP.com* for details.) This evolution of integrated systems is shown in Figure 8.2.

Notice that throughout this evolution there have been more and more integrations along several dimensions (more functional areas, combining transaction processing and decision support, inclusion of business partners). Therefore, before we describe the essentials of ERP and SCM software it may be beneficial to analyze the reasons for software and activities integration.

Systems Integration

Creating the twenty-first-century enterprise cannot be done effectively with twentieth-century computer technology, which is *functionally* oriented. Functional systems may not let different departments communicate with each other in the same language. Worse yet, crucial sales, inventory, and production data



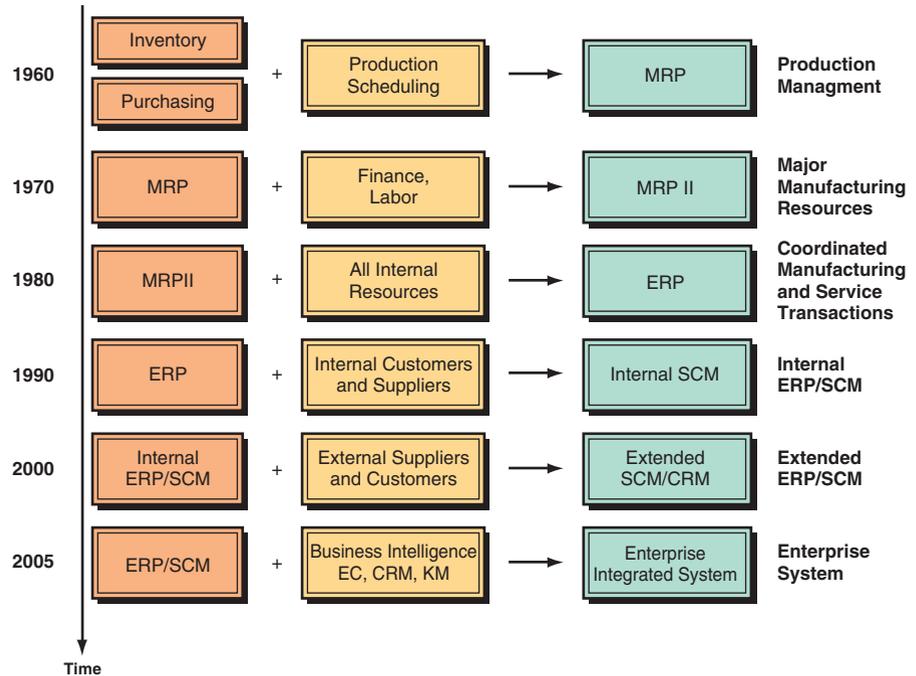


FIGURE 8.2 The evolution of integrated systems.

often have to be painstakingly entered manually into separate computer systems every time a person who is not a member of a specific department needs ad hoc information related to the specific department. In many cases employees simply do not get the information they need, or they get it too late.

Sandoe et al. (2001) list the following major benefits of systems integration (in declining order of importance):

- **Tangible benefits:** inventory reduction, personnel reduction, productivity improvement, order management improvement, financial-close cycle improvements, IT cost reduction, procurement cost reduction, cash management improvements, revenue/profit increases, transportation logistics cost reduction, maintenance reduction, and on-time delivery improvement.
- **Intangible benefits:** information visibility, new/improved processes, customer responsiveness, standardization, flexibility, globalization, and business performance.

Notice that many of both the tangible and intangible benefits cited above are directly related to improved supply chain management.

Integration of the links in the supply chain has been facilitated by the need to streamline operations in order to meet customer demands in the areas of product and service cost, quality, delivery, technology, and cycle time brought by increased global competition. Furthermore, new forms of organizational relationships and the information revolution, especially the Internet and e-commerce, have brought SCM to the forefront of management attention. Upper-level management has therefore been willing to invest money in hardware and software that are needed for seamless integration.

For further discussion of the improvements that integration provides to SCM, see Novell.com (look for Novell Nterprise).

TYPES OF INTEGRATION: FROM SUPPLY TO VALUE CHAIN. There are two basic types of systems integration: internal and external. *Internal integration* refers to integration between applications, and or between applications and databases, inside a company. For example, one may integrate the inventory control with an ordering system, or a CRM suite with the database of customers.

External integration refers to integration of applications and/or databases among business partners. An example of this is the suppliers' catalogs with the buyers' e-procurement system. External integration is especially needed for B2B and for partner relationship management (PRM) systems (Section 8.6). The most obvious external integration is that of linking the segments of the supply chain, and/or connecting the information that flows among the segments. We discussed this topic earlier and will discuss it further in this chapter.

But there is another type of integration, and this is the integration of the value chain. Traditionally, we thought of supply chain in terms of purchasing, transportation, warehousing, and logistics. The *integrated value chain* is a more encompassing concept. It is the process by which *multiple enterprises* within a shared market channel collaboratively plan, implement, and (electronically as well as physically) manage the flow of goods, services, and information along the entire chain in a manner that increases customer-perceived value. This process optimizes the efficiency of the chain, creating competitive advantage for all stakeholders in the value chain. Whereas the supply chain is basically a description of flows and activities, the value chain expresses the *contributions* made by various segments and activities both to the profit and to customers' satisfaction. (For a survey see Drickhamer, 2002.)

Another way of defining value chain integration is as a *process of collaboration* that optimizes all internal and external activities involved in delivering greater perceived value to the ultimate customer. A supply chain transforms into an integrated value chain when it does the following:

- Extends the chain all the way from subsuppliers (tier 2, 3, etc.) to customers
- Integrates back-office operations with those of the front office (see Figure 8.3)
- Becomes highly customer-centric, focusing on demand generation and customer service as well as demand fulfillment and logistics
- Seeks to optimize the value added by information and utility-enhancing services

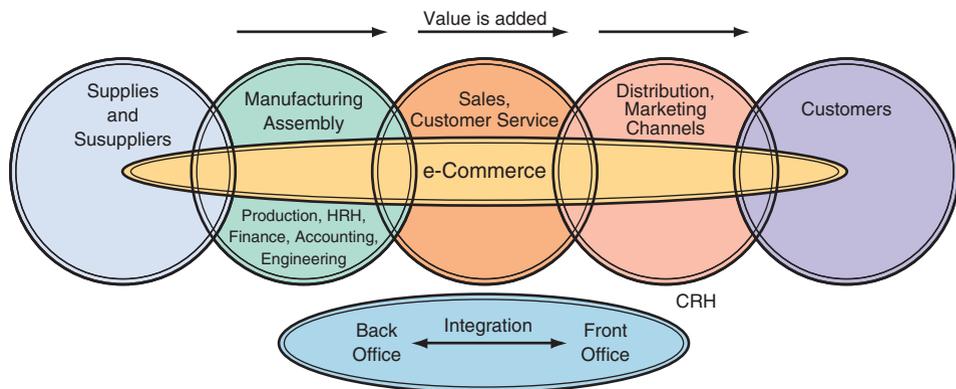


FIGURE 8.3 Back office and front office integration in a value chain.

- Is proactively designed by chain members to compete as an “extended enterprise,” creating and enhancing customer-perceived value by means of cross-enterprise collaboration

Collaboration Along the Supply Chain

Presently only a few large companies are successfully involved in a comprehensive collaboration to restructure the supply and value chains. One such effort is described in *IT At Work 8.2*.

For a special report on supply chain collaboration, see ASCET (2000), where such collaboration is called **collaborative commerce networks** or simply **collaborative commerce** (see Chapter 4 and 5).

Another example of supply chain collaboration that requires system integration is product-development systems that allow suppliers to dial into a client’s intranet, pull product specifications, and view illustrations and videos of a manufacturing process. (For further discussion, see Selland, 1999a and 1999b; and Hagel, 2002).

A popular solution to the integration problems in large companies is to use integrated application, in what is known as enterprise resource planning.

8.4 ENTERPRISE RESOURCE PLANNING (ERP)

One of the most successful tools for managing supply chains is enterprise resource planning (ERP). ERP systems are in use in thousands of large and medium companies worldwide. As this section will show, some ERP systems are producing dramatic results (see *erpassist.com*).

What Is ERP?

With the advance of enterprisewide client/server computing comes a new challenge: how to control all major business processes with a single software architecture in real time. Such an integrated software solution, known as **enterprise resource planning (ERP)** or just **enterprise systems**, is a process of planning and managing all resources and their use in the entire enterprise. It is a software comprised of a set of applications that automate routine back-end operations, such as financial, inventory management, and scheduling, to help enterprises handle jobs such as order fulfillment (see O’Leary, 2000). For example, in an ERP system there is a module for cost control, for accounts payable and receivable, for fixed assets and treasury management. ERP promises benefits ranging from increased efficiency to improved quality, productivity, and profitability. (See Ragowsky and Somers, 2002, for details.)

The term *enterprise resource planning* is misleading because the software does not concentrate on either planning or resources. ERP’s major objective is to *integrate all departments and functions across a company* onto a single computer system that can serve all of the enterprise’s needs (see Stratman and Roth, 2002). For example, improved order entry allows immediate access to inventory, product data, customer credit history, and prior order information. This availability of information raises productivity and increases customer satisfaction. ERP, for example, helped Master Product Company increase customers’ satisfaction and, consequently, sales by 20 percent and decrease inventory by 30 percent, thus increasing productivity (Caldwell, 1997).

For businesses that want to use ERP, one option is to self-develop an integrated system by using existing functional packages or by programming one’s own systems. The other option is to use commercially available integrated ERP



IT At Work 8.2

HOW WARNER-LAMBERT APPLIES AN INTEGRATED SUPPLY CHAIN



Warner-Lambert is a major U.S. pharmaceutical company that is now owned by Pfizer (*pfizer.com*). One of its major products is Listerine antiseptic mouthwash. The materials for making Listerine come mainly from eucalyptus trees in Australia and are shipped to the Warner-Lambert (WL) manufacturing plant in New Jersey. The major problem there is to *forecast the overall demand* in order to determine how much Listerine to produce. Then one can figure how much raw materials are needed and when. A wrong forecast will result either in high inventories of raw materials and/or of finished products, or in shortages. Inventories are expensive to keep, and shortages may result in loss of business.

Warner-Lambert forecasts demand with the help of Manugistic Inc.'s Demand Planning Information System (an SCM product). Used with other software in Manugistics' Supply Chain Planning suite, the system analyzes manufacturing, distribution, and sales data against expected demand and business climate information. Its goal is to help WL decide how much Listerine (and other products) to make and how much of each raw ingredient is needed, and when. For example, the model can anticipate the impact of seasonal promotion or of a production line being down.

The sales and marketing group of WL also meets monthly with WL employees in finance, procurement, and other departments. The group enters the expected demand

for Listerine into the Prism Capacity Planning system (now Invensys plc), which schedules the production of Listerine in the amounts needed and generates electronic purchase orders for WL's suppliers.

WL's supply chain excellence stems from the Collaborative Planning, Forecasting, and Replenishment (CPFR) program. This is a retailing industry project for which piloting was done at WL. In the pilot project, WL shared strategic plans, performance data, and market insight with Wal-Mart over private networks. The company realized that it could benefit from Wal-Mart's market knowledge, just as Wal-Mart could benefit from WL's product knowledge. In CPFR, trading partners collaborate on demand forecast using *collaborative e-commerce* (see attached figure). The project includes major SCM and ERP vendors such as SAP and Manugistics.

During the CPFR pilot, WL increased its products' shelf-fill rate—the extent to which a store's shelves are fully stocked—from 87 percent to 98 percent, earning the company about \$8 million a year in additional sales (the equivalent of a new product launch) for much less investment. WL is now using the Internet to expand the CPFR program to all its major suppliers and retail partners.

Warner-Lambert is involved in another collaborative retail industry project, the Supply-Chain Operations Reference (SCOR), an initiative of the Supply-Chain Council in the United States. SCOR divides supply chain operations

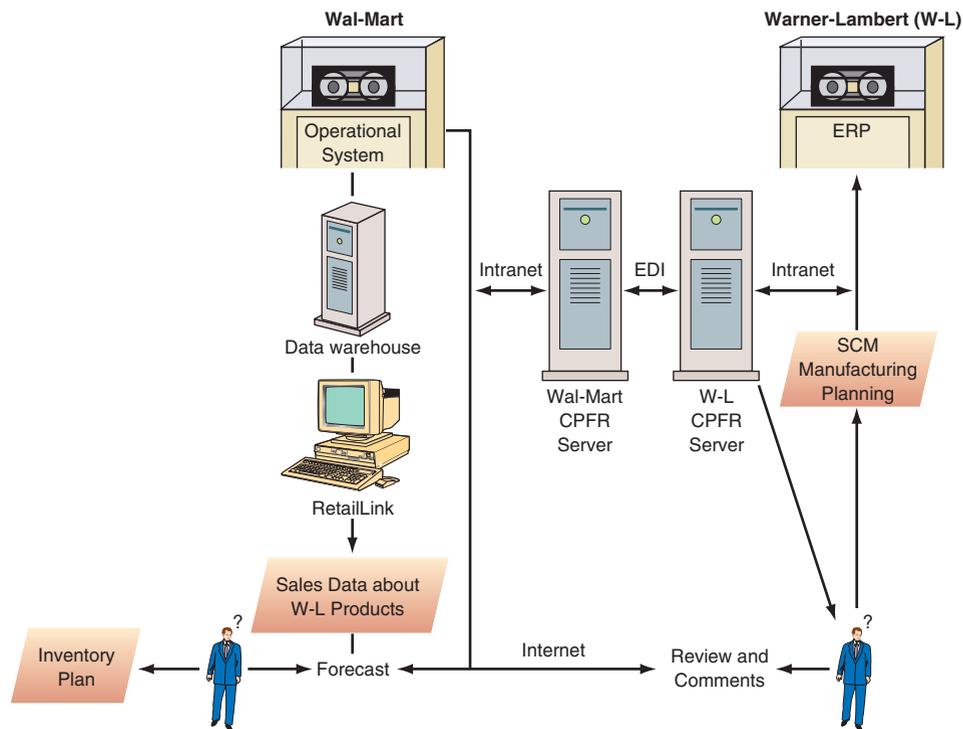
software. The leading ERP software is **SAP R/3**. Oracle, J.D. Edwards, Computer Associates, and PeopleSoft also make similar products. These products include Web modules.

Another alternative is to lease systems from *application service providers (ASPs)*. This option is described later in this chapter and at length in Chapters 13 and 14. A major advantage of this approach is that even a small company can enjoy ERP since users can lease only the modules they need, rather than buying the entire package. Some ERP vendors are willing now (2003) to sell only relevant modules.

The First- Generation ERP

An ERP suite provides a single interface for managing all the routine activities performed in manufacturing—from entering sales orders, to coordinating shipping, to after-sales customer service. As of the late 1990s, ERP systems were extended along the supply chain to suppliers and customers. They can incorporate functionality for customer interaction and for managing relationships with suppliers and vendors, making the system less inward-looking.

Large companies have been successful in integrating several hundred applications using ERP software, saving millions of dollars and significantly increasing



into parts, giving manufacturers, suppliers, distributors, and retailers a framework within which to evaluate the effectiveness of their processes along the same supply chains.

Sources: Compiled from Bresnahan (1998) and *Logistics Management and Distribution Report* (1998, 1999).

For Further Exploration: Why would Listerine have been a target for the pilot CPFR collaboration? For what industries, besides retailing, would such collaboration be beneficial?

customer satisfaction. For example, ExxonMobil consolidated 300 different information systems by implementing SAP R/3 in its U.S. petrochemical operations alone. ERP forces discipline and organization around business processes, making the alignment of IT and business goals more likely. Such change is related to business process reengineering (BPR) (Chapter 9). Also, by implementing ERP a company can discover all the “dusty corners” of its business.

However, ERP software can be extremely complex to implement; companies often need to change existing business processes to fit ERP’s format; and some companies require only some of the ERP’s software modules yet must purchase the entire package. For these reasons, ERP software may not be attractive to everyone. For example, Caldwell and Stein (1998) report that Inland Steel Industries, Inc., opted to write its own ERP system (containing 7 million lines of code), which supports 27 integrated applications, rather than use commercial ERP. Also, some companies, such as Starbucks, decided to use a *best of breed* approach, building their ERP with ready-made components from several vendors. As indicated earlier, the option of leasing individual modules from ASPs may lessen this problem.

In whatever form it is implemented, ERP has played a critical role in getting manufacturers to focus on business processes, thus facilitating business process changes across the enterprise. By tying together multiple plants and distribution facilities, ERP solutions have also facilitated a change in thinking that has its ultimate expression in an enterprise that is better able to expand operations and in better supply chain management. (For a comprehensive treatment of ERP, its cost, implementation problems, and payback, see Koch et al., 1999; James and Wolfe, 2000; Jacobs and Whybark, 2000; and Lucas and Bishop, 2001. Palaniswamy and Frank (2002) describe positive results of Oracle ERP and discuss its implementation process.

But ERP originally was never meant to fully support supply chains. ERP solutions are centered on *business transactions*. As such, they do not provide the computerized models needed to respond rapidly to real-time changes in supply, demand, labor, or capacity, nor to be effectively integrated with e-commerce. This deficiency has been overcome by the second generation of ERP.

Post-ERP (Second-Generation ERP)

First-generation ERP aimed at automating routine business transactions. And indeed ERP projects do save companies millions of dollars. A report by Merrill Lynch noted that nearly 40 percent of all U.S. companies with more than \$1 billion in annual revenues have implemented ERP systems. However, by the late 1990s the major benefits of ERP had been fully exploited. It became clear that with the completion of the Y2K projects that were an integral part of many ERP implementations, the first generation of ERP was nearing the end of its useful life.

But the ERP movement was far from over. A second, more powerful generation of ERP development started. Its objective is to leverage existing systems in order to increase efficiency in handling transactions, improve decision making, and further transform ways of doing business into e-commerce. (See James and Wolf, 2000.) Let's explain:

The first generation of ERP has traditionally excelled in its ability to manage administrative activities like payroll, inventory, and order processing. For example, an ERP system has the functionality of electronic ordering or the best way to bill the customer—but all it does is automate the transactions. Palaniswamy and Frank (2000) cite five case studies indicating that ERP significantly enhances the performance of manufacturing organizations *as a result of automating transactions*.

The reports generated by first-generation ERP systems gave planners statistics about what happened in the company, costs, and financial performance. However, the planning systems with ERP were rudimentary. Reports from first-generation ERP systems provided a snapshot of the business at a point in time. But they did not support the *continuous* planning that is central to supply chain planning, which continues to refine and enhance the plan as changes and events occur, up to the very last minute before executing the plan. Attempting to come up with an optimal plan using first-generation ERP-based systems has been compared to steering a car by looking in the rear-view mirror. Therefore, the need existed for planning systems oriented toward *decision making*. As discussed in *A Closer Look 8.1*, SCM software vendors set out to meet this need.

From the list of the solutions in *A Closer Look 8.1*, it is clear that SCM differs from ERP, and companies need both of them, as illustrated next.

COMBINING ERP WITH SCM-SOFTWARE. To illustrate how ERP and SCM may work together, despite their fundamentally different approaches, let's look at the



A CLOSER LOOK

8.1 SCM SOFTWARE VERSUS ERP SOFTWARE

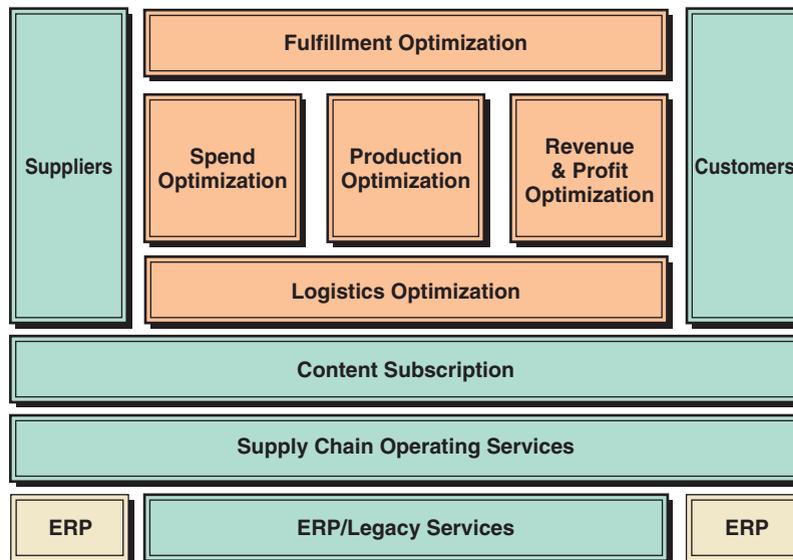
SCM software refers to software specifically designed to improve decision making along the supply chain, such as what is the best way to ship to your customer, or what is the optimal production plan inside your own manufacturing system. This decision-making focus is in contrast with ERP software, which streamlines the flow of routine information along the supply chain (such as order taking, inventory levels reporting, or sales data). Data collected by ERP system are frequently used as input data for analysis done with ERP software (Latamore, 2000).

To better understand the differences between SCM software and ERP software, let's look at the functionalities of products offered by two SCM vendors, i2 and Manugistics.

The optimization tools (each of which includes several applications; see i2.com/solutionareas/index.cfm) are supported by content subscription and supply chain services modules. The entire set of solutions can be connected to both ERP and legacy systems which provide the data for the analysis and optimization done by the optimization modules.

MANUGISTICS SUPPLY CHAIN MANAGEMENT SOLUTIONS. Manugistics offers the following integrated solution suites:

- Network design and optimization
- Manufacturing planning and scheduling
- Sales and operations planning



i2's Supply chain optimization.

i2's OPTIMIZATION SOLUTIONS. The i2 Corporation (i2.com) offers a set of five integrated optimization solutions, which are shown in the upper part of the attached figure (shown between "Suppliers" and "Customers"). Notice that all are SCM optimization tools, to help with decision making: For example, logistics optimization enables companies to procure, plan, execute, and monitor freight movements across multiple modes, borders, and enterprises. Optimization is usually built on DSS models, such as linear programming and simulation, as well on other analytical tools (see Chapter 11 and 12).

Order fulfillment management
 Collaborative VMI and CPFR
 Private Trading Intelligent Hub (for external integration)
 Service and parts management
 Logistics management
 Profitable Order Management
 Profitable Demand Management
 Enterprise Profit Optimization
 Each suite has several applications (see manugistics.com).



task of order processing: The ERP approach is, “How can I best take or fulfill your order?” In contrast, the question for SCM software is, “Should I take your order?” The SCM and ERP software are actually information systems and will be referred to as such.

Thus, the analytical SCM systems have emerged as a *complement* to ERP systems, to provide intelligent decision support or business intelligence capabilities (e.g., see Keskinocak and Tayur, 2001). An SCM system is designed to overlay existing systems and to pull data from every step of the supply chain. Thus it is able to provide a clear, global picture of where the enterprise is heading.

An example of a successful SCM effort is that of IBM. IBM has restructured its global supply chain in order to achieve quick responsiveness to customers and to do so with minimal inventory. To support this effort, IBM developed an extended-enterprise supply-chain analysis tool, called the Asset Management Tool (AMT). AMT integrates graphical process modeling, analytical performance optimization, simulation, activity-based costing, and enterprise database connectivity into a system that allows quantitative analysis of inter-enterprise supply chains. IBM has used AMT to analyze and improve such issues as inventory budgets, turnover objectives, customer-service targets, and new-product introductions. The system was implemented at a number of IBM business units and their channel partners. AMT benefits include savings of over \$750 million in materials costs and price-protection expenses each year. (For details, see Yao et al., 2000.) The system was also a prerequisite to a major e-procurement initiative at IBM.

Creating an ERP/SCM integration model allows companies to quickly assess the impact of their actions on the entire supply chain, including customer demand. Therefore, it makes sense to integrate ERP and SCM.

ALTERNATIVE WAYS TO INTEGRATE ERP WITH SCM. How is integration of ERP with SCM done? One approach is to work with different software products from different vendors. For example, a business might use SAP as an ERP and add to it Manugistics’ manufacturing-oriented SCM software, as shown in the Warner-Lambert (Pfizer) case. Such an approach requires fitting different software, which may be a complex task unless special interfaces known as “adapters” and provided by middleware vendors exist (see Linthicum, 1999).

The second integration approach is for ERP vendors to add decision support and analysis capabilities. Collectively, these capabilities are known as business intelligence. **Business intelligence** refers to analysis performed by DSS, ESS, data mining, and intelligent systems (see Chapters 2, 11, and 12). Using one vendor and a combined product solves the integration problem. However, most ERP vendors offer such functionalities for another reason: It is cheaper for the customers. The added functionalities, which create the *second-generation ERP*, include not only decision support but also CRM, electronic commerce (Section 8.5), and data warehousing and mining (Chapter 11). Some systems include a *knowledge management* component (Chapter 10) as well. In 2003, vendors started to add product life cycle management (PLM, Chapter 7) in an attempt to optimize the supply chain (Hill, 2003)

An example of an ERP application that includes an SCM module is provided in *IT At Work 8.3*.

Supply Chain Intelligence

The inclusion of business intelligence in supply chain software solutions is called by some **supply chain intelligence (SCI)**. SCI applications enable



IT At Work 8.3

COLGATE-PALMOLIVE USES ERP TO SMOOTH ITS SUPPLY CHAIN



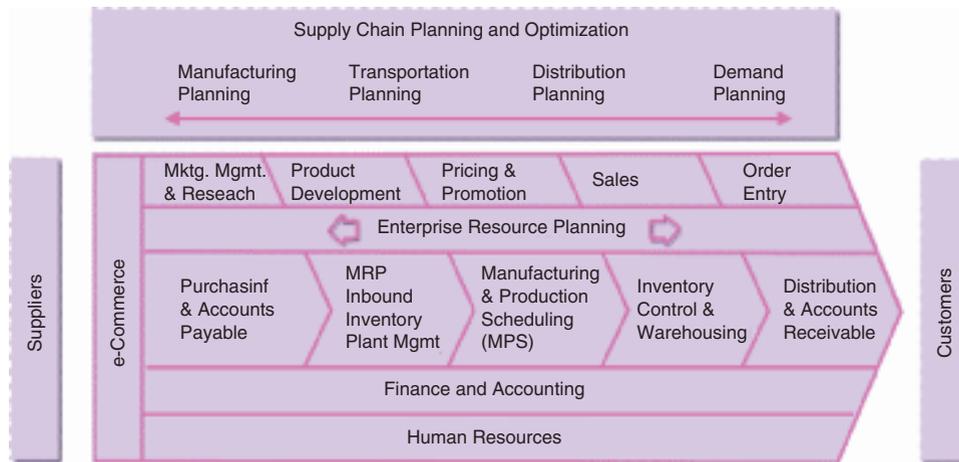
Colgate-Palmolive is the world leader in oral-care products (mouthwashes, toothpaste, and toothbrushes) and a major supplier of personal-care products (baby care, deodorants, shampoos, and soaps). In addition, the company's Hill's Health Science Diet is a leading pet-food brand worldwide. Foreign sales account for about 70 percent of Colgate's total revenues.

To stay competitive, Colgate continuously seeks to streamline its supply chain, where thousands of suppliers and customers interact with the company. At the same time, Colgate faces the challenges of new-product acceleration, which has been a factor in driving faster sales growth and improved market share. Also, Colgate is devis-

complexities in the manufacturing and the supply chains. To better manage and coordinate its business, Colgate embarked on an ERP implementation to allow the company to access more timely and accurate data and to reduce costs. The structure of the ERP is shown in the attached figure.

An important factor for Colgate was whether it could use the ERP software across the entire spectrum of the business. Colgate needed the ability to coordinate globally but to act locally. Colgate's U.S. division installed SAP R/3 for this purpose.

Source: Compiled from Kalakota and Robinson (2001).



Colgate-Palmolive ERP implementation.

ing ways to offer consumers a greater choice of better products at a lower cost to the company, which creates

For Further Exploration: What is the role of the ERP for Colgate-Palmolive? Who are the major beneficiaries?



strategic decision making by analyzing data along the entire supply chain. This so-called intelligence is provided by the tools and capabilities discussed in Chapters 11 and 12. A comparison of SCI with SCM is provided in *Online File W8.3*.

HOW ARE SCI CAPABILITIES PROVIDED? The following are common ways to provide SCI capabilities:

- Use an enhanced ERP package that includes business intelligence capabilities. For example, see Oracle and SAP products of 2001 or later.
- Integrate the ERP with business intelligence software from a specialized vendor, such as Brio, Cognus, or Information Builders, or Business Objects.



A CLOSER LOOK

8.2 EVEN THE BEST-PLANNED ERP SOMETIMES FAILS



The complexity of ERP projects causes some of them to fail. Here are several examples:

EXAMPLE 1. Hershey's chocolate bars and its other products were not selling well in late 1999. Hershey Foods Corporation (*hersheys.com*) reported a 19 percent drop in third-quarter net earnings, due to computer problems. The problems continued for several months, causing Hershey to lose market share and several hundred million dollars. The major problem, according to the company, was its new order-and-distribution system, which uses software from both SAP (the ERP) and Siebel Systems (the CRM). Since the integrated system went live in July 1999, Hershey had been unable to fill all orders and get products onto shelves on time. It took many months to fix the problem.

EXAMPLE 2. In November 1999, Whirlpool Corp. (*whirlpool.com*) reported major delays in shipment of appliances due to "bugs" in its new ERP. Orders for quantities smaller than one truckload met with snags in the areas of order processing, tracking, and invoicing. According to Collett (1999), SAP gave Whirlpool a red light twice prior to the date on which the project would go live, saying the supply chain was not ready, but Whirlpool ignored the signals.

EXAMPLE 3. FoxMeyer, a major distributor of prescription drugs to hospitals and pharmacies, which filed for bankruptcy in 1996. In August 2001, FoxMeyer sued both SAP and Accenture Consulting for \$500 million each, claiming that the ERP system they constructed led to its demise. Many customers sued FoxMeyer as well. All cases are still pending (May 2003). For the complete case, see *Online File W8.4* at the book's Web site.



EXAMPLE 4. W.L. Gore and Associates (*gore.com*), a multinational manufacturer of industrial products, filed a lawsuit against PeopleSoft and Deloitte & Touche, because the ERP project that the two companies developed for the company cost twice the original estimate.

Note: In both the FoxMeyer and the W.L. Gore cases, the ERP vendors and consultants blamed their clients' poor management teams for the ERP problems. Both cases were in court at the time this was written.

Sources: Compiled Davenport, (2000); *cnet.com*; *cio.com*; and *Business Courier* (miscellaneous dates).

- Use Web services (see Chapter 14).
- Create a best-of-breed system by using *components* from several vendors that will provide the required capabilities. (For component-based application development, see Chapter 14.)

ERP Failures and Justification

Despite improvements such as second-generation ERP and supply chain intelligence, ERP projects, especially large ones, may fail, as shown in the Nike case of Chapter 1. *A Closer Look 8.2* discusses some additional examples of ERP failures.

In order to avoid failures and ensure success, according to *thespot4sap.com*, it is necessary for the partners involved in ERP implementation to hold open and honest dialogue at the start of each project, and to nail down the critical success factors of the implementation. Included in this initial dialogue should be consideration of the following factors: the customer's expectations; the ERP product capabilities and limitations; the level of change the customer has to go through to make the system fit; the level of commitment within the customer's organization to see the project through to completion; the risks presented by politics within the organization, and (if applicable) the implementing consultant's capabilities, responsibilities, and role.

Various other considerations can affect the success or failure of an ERP project. For example, failures can be minimized if appropriate cost-benefit and cost justification is done in advance (Oliver and Romm, 2002; O'Brien, 2002; and

Murphy and Simon, 2002). Another way to avoid failures, or at least minimize their cost, is to use ASPs to lease rather than buy or build ERPs. ERP implementation may also be affected by cultural and global factors. For an analysis of some Asian experiences with ERPs, see Soh et al., 2000. Finally, Willcocks and Sykes (2000) tie the successful implementation of ERP to the need to identify and build key in-house IT capabilities before embarking on ERP.

Application Service Providers and ERP Outsourcing

As noted above, a popular option today for businesses that need ERP functions is to lease applications rather than to build systems. An *application service provider (ASP)* is a software vendor that offers to lease applications to businesses. In leasing applications, the vendor takes care of the functionalities and the internal integration problems. This approach is known as the “ASP alternative.” ASP is considered a risk-management strategy, and it best fits small- to midsize companies. (See Chapters 13 and 14 for further details.) The delivery of the software is usually done effectively via the Internet.

ASP offer ERP systems as well as ERP-added functions such as electronic commerce, CRM, desktop productivity, human resources information systems (HRISs), and other supply-chain-related applications.

The ASP concept is useful in ERP projects, which are expensive to install, take a long time to implement, and require additional staffing. Flexibility to the renter is a major benefit: you pay only for the ERP models used, and for a specific time period.

The use of an ASP has its downside. First, ASP vendors typically want a five-year commitment. Some companies may not want to lock themselves in for that long, reasoning that within five years ERP may be simplified and easier to implement in house. Second, organizations lose some flexibility with the use of an ASP. Rented systems are fairly standard and may not fit the organization’s specific needs. (For other benefits and limitations of ASPs, see Chapters 13 and 14 and Segev and Gebauer, 2001.)

8.5 E-COMMERCE AND SUPPLY CHAINS

E-commerce is emerging as a superb tool for providing solutions to problems along the supply chain. As seen earlier in this chapter and in Chapter 5, many supply chain activities, from taking customers’ orders to procurement, can be conducted as part of an EC initiative. In general, EC can make the following contributions to supply chain management:

1. EC can digitize some products, such as software, which expedites the flow of materials in the chain. It is also much cheaper to create and move electronic digits than physical products.
2. EC can replace all paper documents that move physically with electronic documents. This change improves speed and accuracy, and the cost of document transmission is much cheaper.
3. A single business transaction could involve many messages, totaling thousands of messages per week or even per day for a company. E-commerce can replace related faxes, telephone calls, and telegrams with an electronic messaging system at a minimal cost.
4. EC can change the nature and structure of the supply chain from linear to a hub (see the Orbis case in Chapter 1). Such restructuring enables faster, cheaper, and better communication, collaboration, and discovery of information.

5. EC enhances several of the activities discussed in the previous sections, such as collaboration and information sharing among the partners in the supply chain. These enhancements can improve cooperation, coordination, and demand forecasts.
6. EC typically shortens the supply chain and minimizes inventories. Production changes from mass production to build-to-order as a result of the “pull” nature of EC. The auto industry, for example, is expected to save billions of dollars annually in inventory reduction alone by moving to e-commerce-supported build-to-order strategy.
7. EC facilitates customer service. Of special interest is the reduced customer-service staffing needs due to innovations such as FAQs and self services such as self-tracking of shipments.
8. EC introduces efficiencies into buying and selling through the creation of e-marketplaces and e-procurement, as we saw in Chapter 5.

Let’s look now at some specific buying and selling activities along the supply chain.

Buying and Selling Electronically Along the Supply Chain

A major role of EC is to facilitate buying and selling along all segments of the supply chain. The major activities are: upstream, internal supply chain activities, downstream, and combined upstream/downstream activities.

UPSTREAM ACTIVITIES. There are many innovative EC models that improve the upstream supply chain activities. These models are generally described as *e-procurement*. Several were presented in Chapter 5: reverse auctions, aggregation of vendors’ catalogs at the buyer’s site, procurement via consortia and group purchasing. (For others, see Mitchell, 2000; Adamson, 2001; and Varley, 2000.)

INTERNAL SUPPLY ACTIVITIES. Internal SCM activities include several *intra-business EC* activities. These activities, from entering orders of materials, to recording sales, to tracking shipments, are usually conducted over a corporate intranet. The ChevronTexaco case illustrates several EC internal applications. Details and examples are provided in Chapters 5 and 7.

DOWNSTREAM ACTIVITIES. Typical EC models of downstream supply chain activities are provided in Chapters 5 and 7. Some examples follow.

Selling on Your Own Web Site. Large companies such as Intel, Dell, Cisco, and IBM use this model. At the selling company’s Web site, buyers review electronic catalogs from which they buy. Large buyers get their own pages and customized catalogs. Companies sell their standard products from their corporate site, and many (e.g., Cisco, National Semiconductor Corp.) allow customers to configure customized products.

Auctions. As discussed in Chapter 5, large companies such as Dell conduct auctions of products or obsolete equipment on their Web sites. Electronic auctions can shorten cycle time and sometimes save on logistics expenses.

For example, in the United States more than 2.5 million “pre-owned” cars are sold in auctions. Many of these auctions are offered online, supplied by car rental companies, government agencies, banks, and some large organizations that replace their fleets frequently. One pure online B2B auctioneer, for example, is *manheimauctions.com*. The buyers are car dealers who then resell the cars

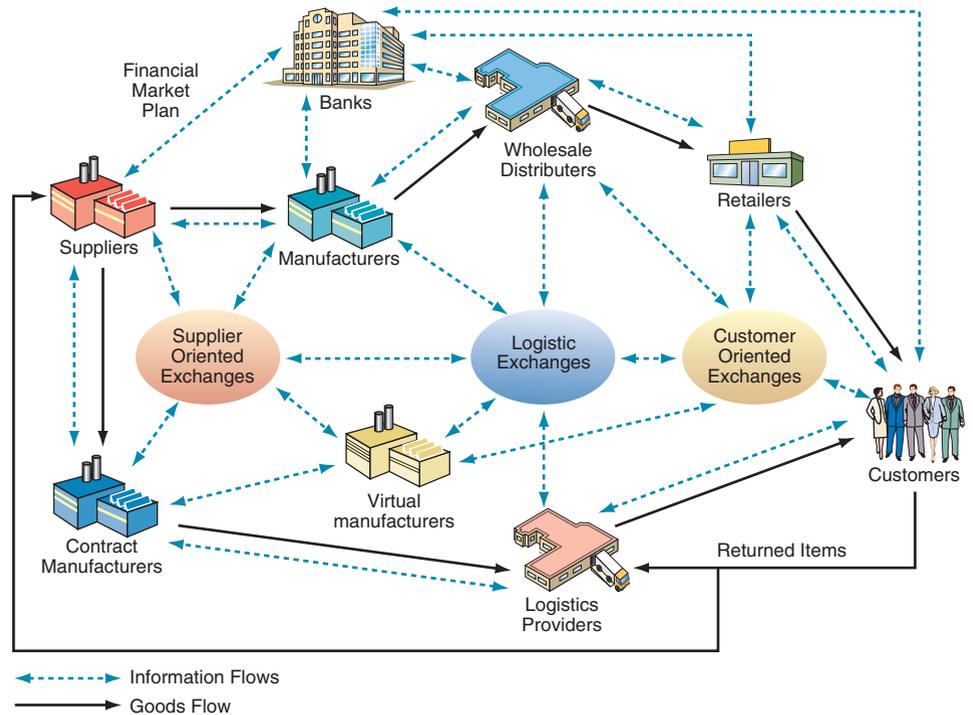


FIGURE 8.4 Web-based supply chain, involving trading exchanges.

to individuals. Traditional car auctions are done on large lots, where the cars are displayed and physically auctioned. In the electronic auction, the autos do not need to be transported to a physical auction site, nor do buyers have to travel to an auction site. Savings of up to \$500 per car are realized as a result.

Exchanges. Considerable support to B2B supply chains can be provided by electronic exchanges (Chapter 5). Such exchanges are shown in Figure 8.4. Notice that in this example there are three separate exchanges. In other cases there may be only one exchange for the entire industry.

UPSTREAM AND DOWNSTREAM ACTIVITIES COMBINED. It is sometimes advisable to combine upstream and downstream EC supply chain activities. These can be done in *B2B exchanges*, where many buyers and sellers meet, as discussed in Chapter 5. Most of these exchanges are centered one in each industry, so they are referred to as **vertical exchanges**. A typical vertical portal is the one organized by ChemConnect. Similar markets exist for metals, electricity (which is sold among electricity-generating companies), and many commodities. Some vertical exchanges use auctions and reverse auctions, as described in Chapter 5.

Supply Chains in E-Commerce: Characteristics, Problems, and Solutions

In previous sections of this chapter we described how e-commerce can solve some problems of non-EC companies that are selling and buying in a traditional way along the supply chain. However, some applications of EC, especially B2C and sometimes B2B, may have problems with their own supply chains. These problems usually occur in order fulfillment. Examining the characteristics of EC supply chains will help us understand the problems and the potential solutions.

THE CHARACTERISTICS OF EC SUPPLY CHAINS. EC supply chains need to deliver small quantities to a very large number of customers. Also, it is very difficult to forecast demand due to lack of experience and to the fact that many vendors sell some or mostly customized products. New dot-com companies do not have any existing supply chain operations; they are “starting from scratch.” (Click-and-mortar companies, in contrast, have existing supply chains and so have a bit of a head start.)

When a company sells online direct to customers it must take care of the following activities: quickly find the products to be shipped, and pack them; arrange for the packages to be delivered quickly to the customer’s door; collect the money from every customer, either in advance, COD (collect on delivery), or by billing the individual; and handle the return of unwanted or defective products. It may be difficult to fulfill these activities both effectively and efficiently. For this reason, both online companies and click-and-mortar companies have difficulties in their online-related supply chains. Let’s begin by looking at order fulfillment.

ORDER FULFILLMENT. **Order fulfillment** refers not only to providing what customers ordered and doing it on time, but also to providing all related customer service. For example, the customer must receive assembly and operating instructions for the appliance he or she just purchased. This can be done by including a paper document with the product or by providing the instructions on the Web. (A nice example is available at livemanuals.com.) In addition, if the customer is not happy with a product, an exchange or return must be arranged. Thus, while order fulfillment is basically a part of the *back-office* operations, it is strongly related to *front-office* operations as well.

When dot-com operations were still quite new, e-tailers faced continuous problems with order fulfillment, especially during the holiday season. The problems included inability to deliver on time, delivering wrong items, paying too much for deliveries, and heavily compensating unhappy customers. Taking orders over the Internet for some e-tailers proved to be the easy part of B2C e-commerce. Fulfillment to customers’ doors was the harder part. The e-tailers who have survived have proved that they have learned from past mistakes and are learning how to solve their order fulfillment problems.

As a matter of fact, many e-tailers have experienced fulfillment problems since they started EC. Amazon.com, for example, which initially operated as a totally online company, added physical warehouses in order to expedite deliveries and reduce its order fulfillment costs. Woolworths of Australia, a large supermarket that added online services, had serious difficulties with order fulfillment and delivery of fresh foods, and had to completely restructure its delivery system.

Several factors can be responsible for delays in deliveries. They range from inability to accurately forecast demand, to ineffective supply chains of the e-tailers. Similar problems exist also in off-line businesses. However, one EC is more typically based on the concept of “pull” operations, which begin with an order, frequently a customized one. (This is in contrast with traditional retailing that begins with a production to inventory, which is then “pushed” to customers.) In the pull case, it is more difficult to forecast demand, due to unique demands of customized orders and lack of sufficient years of experience (see Appendix 3.1).

Another order fulfillment problem in e-commerce is that the goods need be delivered to the customer’s door, with small quantities to each customer, whereas in brick-and-mortar retailing, the customers come to the stores to get

the products. The costs of shipping merchandise can quickly add up, and many customers do not like to pay them.

INNOVATIVE SOLUTIONS TO THE ORDER FULFILLMENT PROBLEM. In the last few years companies have developed interesting solutions to both B2C and B2B order fulfillment (e.g., see Robb, 2003). Here are two examples:

- Garden.com, a retailer of plants and flowers, developed proprietary software that allowed it to collaborate with its 70 suppliers efficiently and effectively. Orders were batched and organized in such a way that pullers were able to find, pack, and deliver the plants and flowers efficiently. Customers were able to track the status of their orders in real time (Kaplan, 2002). However, despite its efficient supply chain, the company went out of business in December 2000 due to an insufficient number of customers.
- SkyMall.com (now a subsidiary of Gem-Star TV Guide International) is a retailer selling from catalogs on board of airplanes, over the Internet, and by mail order. It relies on catalog partners to fill the orders. For small vendors that do not handle their own shipments, and for international shipments, SkyMall contracts distribution centers owned by fulfillment outsourcer Sykes Enterprise. To coordinate the logistics of sending orders to thousands of customers, SkyMall uses an EC order management integrator called Order Trust. As orders come in, SkyMall conveys the data to Order Trust, which disseminates it to the appropriate vendor, or to a Sykes distribution center. A report is then sent to SkyMall, and SkyMall pays Order Trust the transaction fees. This arrangement has allowed SkyMall to increase its online business by 3 percent annually (*skymall.com*).

Despite these and many other innovative solutions (e.g., see Bayles, 2001; Johnston et al., 2000; Rigney, 2000), most e-tailers are choosing to outsource order fulfillment to avoid problems.

OUTSOURCING ORDER FULFILLMENT. A most common solution in B2C is to outsource the delivery and possibly other logistics activities to companies such as FedEx and UPS. Especially if customers pay directly for the delivery, this is a viable solution to the selling company, as described in *IT At Work 8.4*.

SAME-DAY, EVEN SAME-HOUR DELIVERY. In the digital age, next-morning delivery may not be fast enough. Today we talk about same-day delivery, and even delivery within an hour. Quick delivery of pizza has been practiced for a long time (e.g., by Domino's Pizza). Today, pizza orders in many places are accepted online. Delivering groceries is another area where speed is important. An example is *groceryworks* (now part of *shop.safeway.com*).

Many restaurants also accept orders online, and approach known as "dine online." Some companies (e.g., *dialadinner.com.hk* in Hong Kong) offer aggregating services, which process orders for several restaurants and also make the deliveries.

Here is how dine online works: Customers click on the online menu to indicate dishes they want (which sometimes can be mixed and matched from two or more restaurants), and they then submit their request electronically. Order processors at the aggregating company receive the order, and forward the orders electronically to the participating restaurants (faxes orders to those that do not use computers). (A staff member phones first-time customers to check appropriate



IT At Work 8.4 HOW BIKEWORLD FULFILLS ORDERS



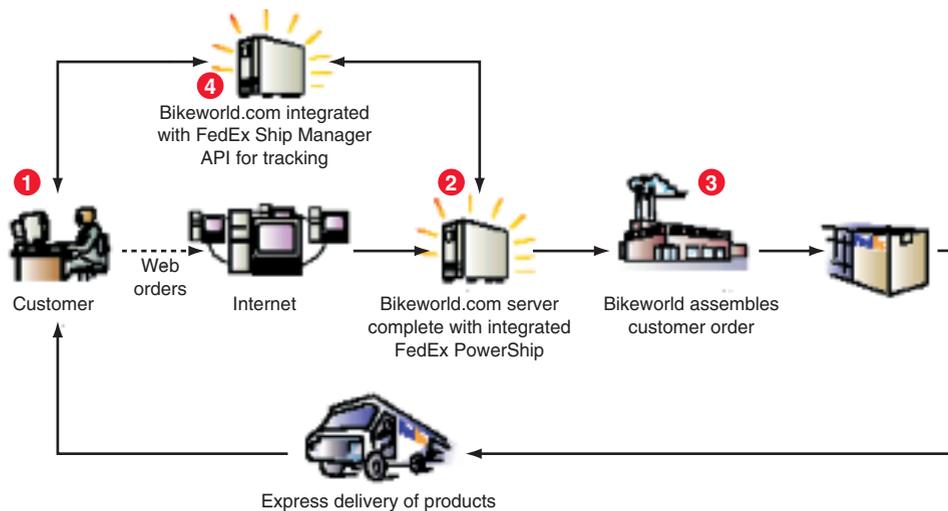
Bikeworld (San Antonio, Texas) is a small company (16 employees) known for its high-quality bicycles and components, expert advice, and personalized service. The company opened its Web site (*bikeworld.com*) in February 1996, using it as a way to keep customers from using out-of-state mail-order houses.

Bikeworld encountered one of Internet retailing's biggest problems: fulfillment. Sales of its high-value bike accessories over the Internet steadily increased, including global markets, but the time spent processing orders, man-

price. We set out to absolutely amaze our customers with unprecedented customer service. FedEx gave us the blinding speed we needed," says Whit Snell, Bikeworld's founder.

The nearby figure shows the five steps in the process. Explanations are provided in the figure.

Four years after venturing online, Bikeworld's sales volume has more than quadrupled, and the company was on track to surpass \$8 million in 2003. The company is consistently profitable; has a fully automated and scalable fulfillment system; has access to real-time order status, en-



How Orders are Fulfilled of Bikeworld.

ually shipping packages, and responding to customers' order status inquiries were overwhelming for the company.

In order to focus on its core competency, Bikeworld decided to outsource its order fulfillment to FedEx. FedEx offered reasonably priced quality express delivery, exceeding customer expectations while automating the fulfillment process. "To go from a complete unknown to a reputable worldwide retailer was going to require more than a fair

hancing customer service and leading to greater customer retention; and has the global capacity to service customers.

Source: Compiled from FedEx (2000).

For Further Exploration: Is outsourcing the only alternative for a small business like Bikeworld? Why or why not? Why is logistics a critical success factor?

delivery details, discuss payment method, and confirm that the order is genuine.) Delivery staff receives a copy of the order by SMS e-mail on their mobile phones, telling them which restaurant to go to. There they are handed the food and delivery details, which is delivered in small cars or on bicycles. Customers receive their meals and pay cash on delivery if needed. The average time from order to delivery is 30 to 40 minutes. (For another example of quick delivery, see *sameday.com*.)

AUTOMATED WAREHOUSES. Traditional warehouses are built to deliver *large quantities* to a *small number* of stores and plants. In B2C EC, companies need to send *small quantities* to a *large number* of individuals. The picking and packing process therefore is different, and usually more labor-intensive.

Large-volume EC fulfillment requires special warehouses. Automated warehouses, for example, may include robots and other devices that expedite the pickup of products. Several e-tailers, such as Amazon.com, operate their own warehouses. Most B2C is probably shipped via outsourcers, mainly UPS, FedEx, and the U.S. Post Office. One of the largest EC warehouses in the United States was operated by a mail-order company, Fingerhut (*fingerhut.com*). This company handled the logistics of all types of mail orders (including online orders) for Wal-Mart, Macy's, and many others. The company (now owned by Petters Group LLC) temporarily suspended warehousing operation but is now back in operation; the process they use is described in *Online File W8.5*. A similar warehouse is operated by L. L. Bean, which ships up to 150,000 packages a day (El Sawy, 2001).

Other companies (e.g., *submitorder.com*) provide similar services. The key for all such services is *speed* and *efficiency*. Plumbing wholesaler Davis & Warshaw uses several IT tools to enhance their newly constructed central warehouse as shown in *Online File W8.6*.



DEALING WITH RETURNS. Returning unwanted merchandise and providing for product exchanges or refunds are necessary activities for maintaining customers' trust and loyalty. The Boston Consulting Group found that the "absence of good return mechanism" was the second-biggest reason shoppers cited for refusing to buy on the Web frequently.

For their part, merchants face the major problem of how to deal with returns. Several options exist (e.g., see Trager, 2000):

- **Return an item to the place where it was purchased.** This is easy to do in a brick-and-mortar store, but not in a virtual one. To return an item to a virtual store, you need to get authorization, pack everything up, pay to ship it back, insure it, and wait up to two billing cycles for a credit to show up on your statement. The buyer is not happy, and neither is the seller, who must unpack the item, check the paperwork, and try to resell the item, usually at a loss. This solution is good only if the number of returns is small.
- **Separate the logistics of returns from the logistics of delivery.** Returns are shipped to an independent unit and handled there. This solution may be more efficient from the seller's point of view, but is no better for the buyer.
- **Allow the customer to physically drop the returned items at collection stations** (such as convenience stores or physical stores of the same company if they exist; e.g., ToyRUs or Staples), from which the returns can be picked up in bulks. This method is used at 7-Eleven stores in some countries, at BP Australia Ltd. (gasoline service stations), which teamed up with *wishlist.com.au*, and at Caltex Australia in their convenience stores. This solution requires good collaboration among retailers and the collection stations.
- **Completely outsource returns.** Several outsourcers, including FedEx and the United Postal Service (UPS), provide such services. The services they offer deal not only with shipments, but also with the entire logistics process of returns. This can be efficient and the customer may be happier, but the cost may be high.



IT At Work 8.5

INTEGRATING EC WITH ERP AT CYBEX



Cybox International, a global maker of fitness machines (*cybox.com*) was unable to meet the demand for its popular fitness machines, which increased dramatically in the late 1990s. To maintain its market share, the company had to work with rush orders from its close to 1,000 suppliers, at an extremely high cost. This was a result of a poor demand forecast for the machine's components. This forecast was done by using three different legacy systems that Cybox inherited from merger partners.

After examining the existing vendor's supply chain software, Cybox decided to install an ERP system (from PeopleSoft Inc.) for its supply chain planning and manufacturing applications. In conjunction with the software installation, Cybox analyzed its business processes and made some needed improvements. It also reduced the number of suppliers from 1,000 to 550.

Here is how Cybox's new system works: Customer orders are accepted at the corporate Web site and are instantly forwarded to the appropriate manufacturing plant (the company has two specialized plants). The ERP uses its *planning module* to calculate which parts are needed for each model. Then, the ERP's *product configurator* constructs, in just a few seconds, a component list and a bill-of-materials needed for each specific order.

The ERP system helps with other processes as well. For example: Cybox can e-mail a vendor detailed purchase orders with engineering changes clearly outlined. These changes are visible to everyone, so if one engineer is not at work, or has left the company, his or her knowledge is in the system and is easy to find. Furthermore, dealers now know that they will get deliveries in less than two weeks instead of the previous one to four weeks. They can also track the status of each order.

The system also helps Cybox to better manage its 550 suppliers. For example, the planning engine looks at price variations across product lines, detecting opportunities to negotiate price reductions by showing suppliers that their competitors offer the same products at lower prices. Also, by giving their suppliers projected long- and short-term production schedules, Cybox is making sure that all parts and materials are available when needed; it is also reducing the inventory level it must hold at Cybox. Furthermore, suppliers that cannot meet the required dates are replaced after quarterly reviews.

Despite intense industry price-cutting over the last year, Cybox remained very profitable, mainly due to its e-supply chain. Some of the most impressive results were: Cybox cut its bill-of-materials count (the number of items that might be included on a bill of materials) from 15,200 items to 200; reduced the number of vendors from 1,000 to 550; cut paperwork by two-thirds; and reduced build-to-order time from four to two weeks.

Introducing the system costs money of course. In addition to the cost of the software, the technology staff has increased from three to twelve. Yet, the company feels that the investment was more than justified, especially because it provided for much greater harmony between Cybox and its suppliers and customers.

Sources: Compiled from Sullivan et al. (2002); Paulson (2000); and *peoplesoft.com* (2003).

For Further Exploration: What are the relationships between Cybox's EC applications and ERP? What is the role of the planning module? What are the critical success factors for implementation?

Integration of EC with ERP

Since many middle-sized and large companies already have an ERP system, or are installing one, and since EC needs to *interface* with ERP, it makes sense to tightly integrate the two. Such interface is needed mainly for order fulfillment and for collaboration with business partners, as in the case of inventory managed by suppliers (the P&G-WalMart situation, cited earlier).

Efforts to integrate EC with ERP are still in their infancy in many organizations. ERP vendors started to integrate EC with ERP only since 1997 on a small scale and only since 2000 as a major initiative (see Siau and Messersmith, 2002). For example, SAP started building some EC interfaces in 1997, and in 1999 introduced *mySAP.com* as a major initiative. The mySAP initiative is a multifaceted Internet product that includes EC, online trading sites, an information portal, application hosting, and more user-friendly graphical interfaces (see *Online File W8.7*).

An example of EC/ERP integration is presented in *IT At Work 8.5*.



The logic behind integrating EC and ERP is that by extending the existing ERP system to support e-commerce, organizations not only leverage their investment in the ERP solution, but also speed up the development of EC applications.

The problem with this approach is that the ERP software is very complex and inflexible (difficult to change), so it is difficult to achieve easy, smooth, and effective integration. One other potential problem is that ERP systems deal more with back-office (e.g., accounting, inventory) applications, whereas EC deals with front-office applications such as sales and order taking, customer service, and other customer relationship management (CRM) activities. This problem may be solved by using Web services.

8.6 PARTNER RELATIONSHIP MANAGEMENT

Every company that has business partners has to manage the relationships with them. Partners need to be identified, recruited, and maintained. Communication needs to flow between the organizations. Information needs to be updated and shared. Actually, all that efforts are made to apply CRM to all types of business partners can be categorized as **partner-relationship management (PRM)**.

Before the spread of Internet technology, there were few automated processes to support partnerships. Organizations were limited to manual methods of phone, fax, and mail. EDI was used by large corporations, but usually only with their largest partners. Also, there were no systematic ways of conducting PRM. Internet technology changed the situation by offering a way to connect different organizations easily, quickly, and affordably.

PRM solutions connect vendors with their business (suppliers, customers, services) partners using Web technology to securely distribute and manage information. At its core, a PRM application facilitates partner relationships. According to *Business Wire* (2003), a Gartner Group survey conducted in late 2002 showed that of all sales-related applications, PRM programs had the highest return on investment.

Specific PRM functions include: partner profiles, partner communications, lead management (of clients), targeted information distribution, connecting the extended enterprise, partner planning, centralized forecasting, group planning, e-mail and Web-based alerts, messaging, price lists, and community bulletin boards. As described in Chapter 4, many large companies offer suppliers or partners customized portals for improved communication and collaboration. (For more on PRM, see *channelwave.com*, and *it-telecomsolutions.com*.)

One of the major categories of PRM is *supplier-relationship management (SRM)*. For many companies, such as retailers and manufacturers, working properly with suppliers is a major critical success factor.

PeopleSoft's SRM Model



PeopleSoft.Inc. (*peoplesoft.com*) developed a model for managing supplier relationships in real time. The model is generic and could be considered by any large company. It includes 13 steps, which are illustrated in Figure 8.5. The details of the steps are shown in *Online File W8.8*.

The core idea of this SRM model is that an e-supply chain is based on integration and collaboration (Sections 8.3–8.5). In this model, the supply chain process is connected, decisions are made collectively, performance metrics are based on common understanding of the partners, information flows in real time

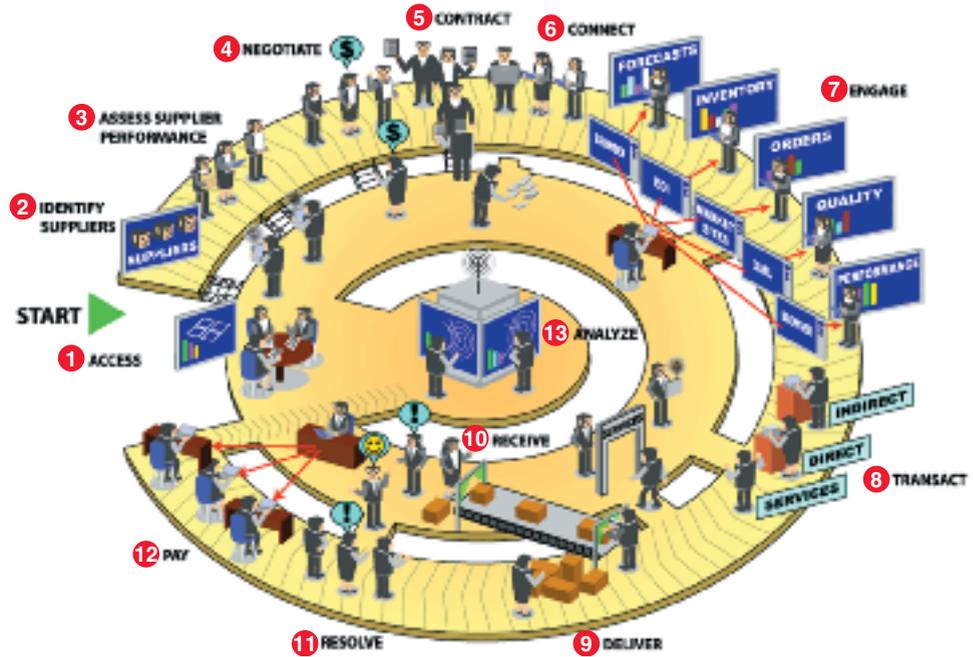


FIGURE 8.5 Managing Supplier Relationships in Real Time. (Source: Shecterle, 2003.)

(whenever possible). The only thing a new partner needs in order to join an SRM system is just a Web browser.

8.7 GLOBAL SUPPLY CHAIN

Supply chains that involve suppliers and/or customers or other business partners, are referred to as *Global Supply Chains*.

Characteristics and Problems along Global Supply Chains

Companies go global for a variety of reasons. The major reasons are: lower costs (of materials, products, services and labor); availability of products that are unavailable domestically; the firm's global strategy; technology available in other countries; high quality of products; intensification of global competition, which drives companies to cut costs; the need to develop a foreign presence to increase sales; and fulfillment of counter trade.

Supply chains that involve suppliers and/or customers in other countries are referred to as **global supply chains** (e.g., see Harrison, 2001, Handfield and Nichols, 1999) E-commerce has made it much easier to find suppliers in other countries (e.g., by using electronic bidding) as well as to find customers in other countries (see Handfield et al., 2002, and Turban et al., 2004).

Global supply chains are usually longer than domestic ones, and they may be complex. Therefore, additional uncertainties are likely. Some of the issues that may create difficulties in global supply chains are legal issues, customs fees and taxes, language and cultural differences, fast changes in currency exchange rates, and political instabilities. An example of difficulties in a global supply chain can be seen in *IT At Work 8.6*.

Information technologies are found to be extremely useful in supporting global supply chains (Harrison, 2001). For example, TradeNet in Singapore



IT At Work 8.6

LEGO STRUGGLES WITH GLOBAL ISSUES



Lego Company of Denmark (*lego.com*) is a major producer of toys, including electronic ones. It is the world's best-known toy manufacturer (voted as the "toy of the century") and has thousands of Web sites created by fans all over the world.

In 1999 the company decided to market its Lego Mindstorms on the Internet. This product is a unique innovation. Its users can build a Lego robot using more than 700 traditional Lego elements, program it on a PC, and transfer the program to the robot. Lego sells its products in many countries using several regional distribution centers. When the decision to do global e-commerce was made, the company had to face the following concerns and issues:

- It did not make sense to go to all countries, since the company's sales are very low in some countries and some countries offer no logistical support services. Lego had to choose where to market Mindstorms.
- A supportive distribution and service system would be needed, including software support and returns from around the globe.
- There was an issue of merging the offline and online operations versus creating a new centralized unit, which seemed to be a complex undertaking.
- Existing warehouses were optimized to handle distribution to commercial buyers, not to individual customers.
- Lego products were selling in different countries in different currencies and at different prices. Should the product be sold on the Net at a single price? In which currency? How would this price be related to the offline prices?
- How should the company handle the direct mail and track individual shipments?
- Invoicing had to comply with the regulations of many countries.
- Should Lego create a separate Web site for Mindstorms? What languages should be used there?
- Some countries have strict regulations regarding advertisement and sales to children. Also laws on consumer protection vary among countries.
- How to handle restrictions on electronic transfer of individuals' personal data.
- How to handle the tax and import duty payments in different countries.

In the rush to get its innovative product to market, Lego did not solve all of these issues before the direct marketing was introduced. The resulting problems forced Lego to close the Web site for business in 1998. It took about a year to solve all global trade-related issues and eventually reopen the site. By 2001 Lego was selling online many of its products, priced in U.S. dollars, but the online service was available in only 15 countries. By 2003 *lego.com* was operating as an independent unit. It offers many Web-only deals and allows online design of many products (e.g., see "Train Configurator"). The site is visited by over 4 million visitors each day.

Sources: Compiled from *lego.com*, from Damsguard and Horluck (2000), and from Stoll (2003).

For Further Exploration: Visit Lego's Web site (*lego.com*) and see the latest EC activities. Also, investigate what the competitors are doing. Do you think that the Web was a good way for Lego to go global?



connects sellers, buyers, and government agencies via electronic data interchange (EDI). (TradeNet is described in detail in *Online File W5.11* at the book's Web site.) A similar network, TradeLink, operates in Hong Kong, using both EDI and EDI/Internet attempting to connect about 70,000 trading partners. Promising as global supply chains are, one needs to design them carefully to optimize their functioning.

IT provides not only EDI and other communication options, but also online expertise in sometimes difficult and fast-changing regulations. IT also can be instrumental in helping businesses find trade partners (via electronic directories and search engines, as in the case of *alibaba.com* and *chemconnect.com*). IT also allows for automatic Web pages translation to many languages. Finally, IT facilitates outsourcing of products and services, especially computer programming, to countries with a plentiful supply of labor, at low cost.

MANAGERIAL ISSUES



1. **Ethical issues.** Conducting a supply chain management project may result in the need to lay off, retrain, or transfer employees. Should management notify the employees in advance regarding such possibilities? And what about those older employees who are difficult to retrain? Other ethical issues may involve sharing of personnel information, which may be required for a collaborative organizational culture.
2. **How much to integrate?** While companies should consider extreme integration projects, including ERP, SCM, and e-commerce, they should recognize that integrating long and complex supply chain segments may result in failure. Therefore, many times companies tightly integrate the upstream, inside-company, and downstream activities, each part by itself, and loosely connect the three.
3. **Role of IT.** Almost all major SCM projects use IT. However, it is important to remember that in most cases the technology plays a supportive role, and the primary role is organizational and managerial in nature. On the other hand, without IT, most SCM efforts do not succeed.
4. **Organizational adaptability.** To adopt ERP, organization processes must, unfortunately conform to the software, not the other way around. When the software is changed, in a later version for example, the organizational processes must change also. Some organizations are able and willing to do so; others are not.
5. **Going global.** EC provides an opportunity to expand markets globally. However, it may create long and complex supply chains. Therefore, it is necessary to first check the logistics along the supply chain as well regulations and payment issues.



ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; additional resources such as cases; tables and figures; updates; additional exercises; links; and demos and activities can be found on the book's Web site.

KEY TERMS

Application service provider (ASP) •••
 Bullwhip effect •••
 Business intelligence •••
 Collaborative commerce networks •••
 Collaborative commerce •••
 E-supply chain •••
 Enterprise resource planning (ERP) •••

Enterprise systems •••
 Global supply chain •••
 Material requirements planning (MRP) •••
 Manufacturing resource planning (MRP II) •••
 Order fulfillment •••
 Partner relationship management (PRM) •••
 Reverse logistics (returns) •••

SAP[®]3 •••
 Supply chain •••
 Supply chain intelligence (SCI) •••
 Supply chain management (SCM) •••
 Supply chain teams •••
 Vendor-managed inventory (VMI) •••
 Vertical exchanges •••

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 It is necessary to properly manage the supply chain to ensure superb customer service, low cost, and short cycle time.
- 1 The supply chain must be completely managed, from the raw materials to the end customers.
- 2 It is difficult to manage the supply chain due to the uncertainties in demand and supply and the need to coordinate several business partners' activities. A major inventory problem along the chain is known as the bullwhip effect.
- 2 Innovative approaches to SCM require cooperation and coordination of the business partners, facilitated by IT innovations such as inventory optimization and VMI over extranets, which allow suppliers to view companies' inventories in real time and manage them for their customers.
- 3 Software support for supply chain management has increased both in coverage and scope, from MRP to MRP II, to ERP, to enhanced ERP (with business partners), and to an ERP/SCM software integration.
- 4 ERP is an integrated software (known also as an enterprise software) that manages all transformation-type information processing in the enterprise.
- 4 Today, ERP software, which is designed to improve standard business transactions, is enhanced with business intelligence and decision-support capabilities as well as Web interfaces.
- 5 Electronic commerce is able to provide new solutions to problems along the supply chain by integrating the company's major business activities with both upstream and downstream entities via an electronic infrastructure.
- 5 E-commerce tools, such as e-procurement and collaborative commerce, are used to solve supply chain problems.
- 5 Order fulfillment in EC is difficult due to the need to ship many small packages to customers' doors. Outsourcing the logistics and delivery jobs is common, but it can be expensive.
- 5 Special large and automated warehouses help in improving the EC order fulfillment, but they can be expensive to build and operate.
- 6 PRM should be approached as a comprehensive topic, like the life cycle approach of PeopleSoft (see Figure 8.5). While supply chain interactions are a major part of PRM, collaboration and joint venture should be nourished as well.
- 7 Global supply chains are usually long and can be complex. Therefore they must be carefully analyzed before a decision to go global is finalized.

QUESTIONS FOR REVIEW

1. Define supply chain and supply chain management (SCM).
2. Describe the components of a supply chain.
3. What is an e-supply chain?
4. Describe the bullwhip effect.
5. Describe some solutions to supply chain problems.
6. Define MRP and MRP II.
7. Describe SCM software
8. Define ERP and describe its major characteristics.
9. How can integration can solve supply chain problems?
10. Define order fulfillment in EC.
11. List the major difficulties of order fulfillment in EC.
12. Define reverse logistics.
13. Describe some solutions to the order fulfillment problem.
14. Define PRM and SRM.
15. Describe the major SRM activities according to the PeopleSoft model.
16. Describe a global supply chain and some difficulties in going global.

QUESTIONS FOR DISCUSSION

1. Identify the supply chain(s) and the flow of information described in the opening case.
2. Relate the concepts of supply chain and its management to Porter's value chain and value system model.
3. Discuss the Warner-Lambert (Pfizer) Listerine case, and prepare a chart of the product's supply chain.
4. Distinguish between ERP and SCM software. In what ways do they complement each other?

5. It is said that SCM software created more changes in logistics than 100 years of continuous improvement did. Discuss.
6. Discuss what it would be like if the registration process and class scheduling process at your college or university were restructured to an online, real-time, seamless basis with good connectivity and good empowerment in the organization. (If your registration is already online, find another manual process that can be automated.) Explain the supply chain in this situation.
7. Relate ERP to software integration.
8. Compare MRP to MRP II to ERP.
9. Discuss how cooperation between a company that you are familiar with and its suppliers can reduce inventory cost.
10. Find examples of how organizations improve their supply chains in two of the following: manufacturing, hospitals, retailing, education, construction, agribusiness, shipping.
11. The normal way to collect fees from travelers on expressways is to use tollbooths. Automatic coin-collecting baskets can expedite the process, but do not eliminate the long waiting lines during rush hours. About 80 percent of the travelers are frequent users of the expressways near their homes. The money collection process on some highways has been reengineered by using smart cards that can be scanned. Lately, further improvement has been made. The smart ID cards can be read wirelessly from 30–40 feet, so cars do not have to stop. Fees are charge to travelers' accounts, which reduces travelers' waiting time by 90 percent and money processing cost by 80 percent. (See details in Chapter 6.)
 - a. Identify the supply chain.
 - b. Several new information technologies including smart cards are used in the process. Find information on how this is accomplished.
12. Discuss the problem of reverse logistics in EC. What kind of companies may suffer the most? (View some solutions offered by FedEx.)
13. Explain why UPS defines itself as a "technology company with trucks" rather than a "trucking company with technology."
14. Discuss the meaning of the word *intelligence* in the term *supply chain intelligence*.
15. It is said that supply chains are essentially "a series of linked suppliers and customers; every customer is in turn a supplier to the next downstream organization, until the ultimate end-user." Explain. Use a diagram to make your point.
16. Explain the bullwhip effect. In which type of business it is likely to occur most? How can the effect be controlled?

EXERCISES

1. Draw the supply chain of the Davis & Warshow plumbing parts business (*Online File W8.6*). Show the use of IT in various places of the chain.
2. Draw the supply chains of Warner-Lambert (Pfizer) and Dell Computer (see Online Minicase 8.1). What are the similarities? The differences?
3. Draw the supply chain of Lego (see additional description at *lego.com*). Include at least two countries.
4. Enter *supplychain.aberdeen.com* and observe its "online supply chain community". Most of the information there is free. Prepare an outline of the major resources available in the site.
5. Automated warehouses play a major role in B2C and mail order fulfillment. Find material on how they operate. (Use *google.com* and *findarticles.com* for more information.) Try to find information about Lands' End's warehouse.
6. Examine the functionalities of ERP software from SAP or other vendors.
7. *Kozmo.com* was a company that rented videos and delivered them to customers within 30 to 60 minutes. Find out what you can about why it failed. Was there a problem with the company's order-fulfillment promises? Were there any drawbacks in Kozmo's alliances with Starbucks and Amazon.com? Explain.
8. Read the opening case and answer the following
 - a. The company business is not to make the product, but "to sell the product." Explain this statement,
 - b. Why was it necessary to use IT to support the change?
 - c. Identify all the segments of the supply chain.
 - d. Identity all supporting information systems in this case.

GROUP ASSIGNMENTS

1. Each group in the class will be assigned to a major ERP/SCM vendor such as SAP, PeopleSoft, Oracle, J. D. Edwards, etc. Members of the groups will investigate topics such as: (a) Web connections, (b) use of business intelligence tools, (c) relationship to CRM and to EC, (d) major capabilities, and (e) availability of ASP services by the specific vendor.

Each group will prepare a presentation for the class, trying to convince the class why the group's software is best for a local company known to the students (e.g., a supermarket chain).

2. Each team should investigate the order fulfillment process of an e-tailer, such as *amazon.com*, *staples.com*, or *landsend.com*. Contact the company, if necessary, and examine related business partnerships if they exist. Based on the content of this chapter, prepare a report with suggestions for how the company can improve its order ful-

fillment process. All the groups' findings will be discussed in class. Based on the class's findings, draw some conclusions about how order fulfillment can be improved.

3. FedEx, UPS, the U.S. Postal Service, and others are competing in the EC logistics market. Each team should examine one such company and investigate the services it provides. Contact the company, if necessary, and aggregate the findings into a report that will convince classmates or readers that the company in question is the best. (What are its best features?)

INTERNET EXERCISES



1. Enter *ups.com*. Examine some of the IT-supported customer services and tools provided by the company. Write a report on how UPS contributes to supply chain improvements.
2. Enter *supply-chain.org*; *cio.com*, *findarticles.com*, and *google.com* and search for recent information on supply chain management integration.
3. Enter *logictool.com*. Find information on the bullwhip effect and on the strategies and tools used to lessen the effect.
4. Enter *coca-colastore.com*. Examine the delivery and the return options available there.
5. The U.S. Post Office provides EC logistics. Examine its services and tracking systems at *uspsprioritymail.com*. What are the potential advantages for EC shippers?
6. Enter *brio.com* and identify Brio's solution to SCM integration as it relates to decision making for EC. View the demo.
7. Enter *rawmart.com* and find what information they provide that supports logistics. Also find what shipment services they provide online.
8. Visit *ups.com* and find its recent EC initiatives. Compare them with those of *fedex.com*. Then go to *onlinestore.ups.com* and simulate a purchase. Report your experiences.
9. Enter *efulfillmantservice.com*. Review the products you find there. How does the company organize the network? How is it related to companies such as FedEx? How does this company make money?
10. Enter *KeWill.com*. Find the innovations they offer that facilitate order fulfillment. Compare it to *meloworlwide.com*. Write a report on your findings.
11. Enter *submitorder.com* and find out what they offer. Comment on the uniqueness of the services.



Minicase 1

Quantum Corporation Streamlined Its Supply Chain

Quantum Corporation (*quantum.com*) is a major U.S. manufacturer of hard-disk drives and other high-technology storage components. Quantum faced two key challenges in its manufacturing process.

The first challenge was streamlining its component supply process in order to reduce on-hand inventory. Quantum's traditional ordering process was labor-intensive, involving numerous phone calls and manual inventory checks. To ensure that production would not be interrupted, the process required high levels of inventory. Quantum needed a solution that would automate the ordering process to increase accuracy and efficiency, reduce needed inventory to 3 days' supply, and provide the company's purchasing agents with more time for non-transactional tasks.

Quantum's second challenge was to improve the quality of the components' data in its material requirements planning (MRP) system. Incomplete and inaccurate data caused delays in production. Quantum's solution of manually reviewing reports to identify errors was labor intensive and occurred too late; problems in production were experienced before the reports were even reviewed. Quantum needed a technology solution that would enable it to operate *proactively* to catch problems before they caused production delays.

The solution that Quantum chose to automate its component supply process was an interenterprise system that automatically e-mails reorders to suppliers. Initiated in 1999, the system uses an innovative event detection and notification solution from Categoric Software (*categoric.com*). It scans Quantum's databases twice daily, assessing material requirements from one application module against inventory levels tracked in another. Orders are automatically initiated and sent to suppliers as needed, allowing suppliers to make regular deliveries that match Quantum's production schedule. The system not only notifies suppliers of the quantity of components required in the immediate orders, but also gives the supplier a valuable window into the amount of inventory on hand and future weekly requirements.

The system also provided other improvements. It enabled Quantum to tap into multiple data sources to identify critical business events. To elevate data quality, Quantum implemented Categoric Alerts to proactively catch any data errors or omissions in its MRP database. The systems' notifications are now sent whenever any critical MRP data fall outside the existing operational parameters.

The system has produced the desired results. For example, the estimated value of the improved ordering process using the new system is millions of dollars in inventory reductions each year. The buyers have reduced transaction tasks and costs, and both Quantum and its buyers get a lot more information with a lot less work. Before the implementation of Categoric Alerts, Quantum's analysts would search massive reports for MRP data errors. Now that the new system is implemented, exceptions are identified as they occur. This new process has freed the analysts from the drudgery of scanning reports and has greatly increased employee satisfaction.

Data integrity of the MRP increased from 10 percent to almost 100 percent, and Quantum is now able to quickly respond to changing customer demand. The system paid for itself in the first year.

Sources: Compiled from an advertising supplement in *CIO Magazine* (November 1, 1999), from information at *categoric.com* (accessed May 28, 2000), and from *quantum.com* (accessed June 10, 2003).

Questions for Minicase 1

1. Identify the internal and external parts of the supply chain that were enhanced with the system.
2. Enter *categoric.com* and find information about Categoric Alerts. Describe the capability of the product.
3. Explain how purchasing was improved.
4. Describe how Quantum's customers are being better served now.
5. Identify the EC solutions used in this case.



Minicase 2

Green Mountain Coffee Roasters Integrates Electronic Commerce and Supply Chain Management

Green Mountain Coffee Roasters (GMCR) (*gmc.com*), a medium-sized distributor of quality coffee in the United States, experienced a high growth rate in recent years (from \$34 million in 1996 to about \$100 million in 2002). Sales are made through over 5,000 wholesalers and resellers, including supermarkets, restaurants, and airlines. In addition, mail-order shipments are made to over 40,000 loyal individual customers.

The rapid expansion of the business made it necessary to provide all employees access to the latest data so they could make better decisions regarding demand forecast, inventory management, and profitability analysis. To meet this need the company decided to install an ERP software.

In 1997, GMCR replaced its custom legacy information system with an ERP from PeopleSoft. The ERP includes functional modules such as production and inventory control, financial management, and human resources management. GMCR decided in 1998 to hook the ERP to the Internet for the following reasons:

- The company expected to double its online sales to individual customers. This was going to be done by displaying the culture and image of the company, allowing customers to learn more about coffee, and creating a “GMCR coffee community.” This goal was not reached.
- The existing coffee tours and coffee club were well adapted to the Internet.
- The company estimated that at least 30 percent of its 5,000 business partners prefer to do business online.
- The company needed a better mechanism for CRM and PRM. The company wanted to get quick feedback, be able to solve customer and partners’ problems quickly, and provide an efficient and easy order-taking facility.

The integration of the Web with ERP provided the following capabilities:

- Many of the business customers are small proprietor-managed shops. They are busy during the day, so they prefer to place orders in the evenings when GMCR’s call center is closed.
- The customers like to know, immediately, if a product is in stock and when it will be shipped.

- Customers want to see their order histories, including summaries such as a most-frequently ordered product list.
- Customers want to track the status of their orders.

All of the above capabilities can be done by customers themselves, any time and from anywhere. In addition, the system can support the requests of GMCR’s sales force for instant information about customers, inventory levels, prices, competition, overnight delivery services, and so forth.

PeopleSoft’s eStore, an Internet storefront that is tightly integrated with the ERP suite (from order fulfillment to the rest of the supply chain management), was implemented in 1999. GMCR benefited not only from improved customer service and efficient online marketing, but also from providing access to the latest data to all employees. Some of the results so far: Forecasts have improved, inventory is minimized (using the just-in-time concept), and profitability analysis by product and/or customer is done in minutes.

Sources: Condensed from customer success stories at *peoplesoft.com* (January 2000); from *gmc.com* (December 2000); from *Business Wire* Aug. 22, 2002, March 20, 2003, and May 6, 2003.

Questions for Minicase 2

1. Enter *gmc.com* and identify the major customer-related activities. How are such activities supported by information technology?
2. Coffee club members make up about 90 percent of all the company’s direct mail business. Why? (Check the Web site.)
3. How can the ERP system improve GMCR’s inventory system?
4. It is said that “Internet sales data must be taken into account by enterprise planning, forecast demand, and profitability studies.” Explain why.
5. It is said that “Because the customer’s account and pricing information are linked to the order, accurate invoicing will flow automatically from the Internet transaction.” Explain, and relate to the concept of the supply chain.



Virtual Company Assignment Integrated Restaurant Software

You've reached the halfway point in your internship at The Wireless Cafe (TWC), and you feel pretty confident you understand the processes at the front of the house and the back of the house. You had just read about ERP systems when Jeremy mentioned to you the problems he has getting information from the point-of-sale (POS) systems to his inventory, financial, and kitchen management systems. You are excited about the possibility of applying some ERP principles to TWC, and so you suggest to Jeremy an investigation of integrated restaurant applications.

1. Review the capabilities of restaurant management software such as RestaurantPlus (restaurantplus.com/), Micros

(micros.com/), NextPOS (nextpos.com/), Aloha (alohapos.com) or others you can find on the Web.

2. Describe some similarities and differences between the systems you reviewed in Question 1 and the ERP systems you read about in Chapter 8.
3. Many restaurants establish a relationship with a single restaurant purveyor (Sysco, for example) to provide nearly everything the restaurant needs for daily operations. What are the issues in this type of relationship in light of SCM?

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PART III
Organizational Applications



- 7. Transaction Processing, Functional Applications, CRM, and Integration
- 8. Supply Chain Management and Enterprise Resource Planning
- ▶ 9. IT Planning and Business Process Redesign

CHAPTER

9

IT Planning and Business Process Redesign

TruServe

9.1

IT Planning—A Critical Issue for Organizations

9.2

Strategic IT Planning

9.3

Information Requirements Analysis, Resource Allocation, Project Planning

9.4

Planning IT Architectures

9.5

Some Issues in IT Planning

9.6

Planning for Web-based Systems and E-Commerce

9.7

Business Process Redesign

9.8

The Role of IT in Business Process Redesign

9.9

Restructuring Processes and Organizations

9.10

Organization Transformation and Change Management

Minicases: (1) Oregon's GIS Plan /
(2) National City Bank

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Discuss the importance, evaluation, and approaches to IT planning.
- 2 Explain the four-stage model of information systems planning, and discuss the importance of aligning information systems plans with business plans.
- 3 Describe several different methodologies for conducting strategic information systems planning.
- 4 Describe information requirement analysis, project payoff and portfolios, resource allocation, and project planning.
- 5 Identify the different types of information technology architectures and outline the processes necessary to establish an information architecture.
- 6 Discuss the major issues addressed by information systems planning.
- 7 Distinguish the major Web-related IT planning issues and understand application portfolio selection.
- 8 Describe the need for business process redesign and the methodologies for doing it.
- 9 Explain the IT support for processes redesign and BPR, and describe redesign efforts, successes, and failures.
- 10 Describe organizational transformation and change management related to business processes redesign.



HOW TRUSERV PLANNED ITS INFORMATION TECHNOLOGY

➡ THE PROBLEM

TruServ Corp. (*truserv.com*) was created in 1997 by the merger of Cotter & Co. and Servistar Corp. TruServ, one of the largest hardware suppliers in the United States, has annual wholesale sales of about \$5 billion, which supports sales of some \$15 billion retail. A major challenge was to merge the information systems of the two companies. The two systems were completely different, so their integration was a major problem for TruServ.

➡ THE SOLUTION

To do the integration, Paul Lemerise, CIO of TruServ, relied on a *strategic IT plan*. Lemerise turned first to Ernst & Young, a major CPA/IT consultant with which he had worked before on external auditing. He created a planning team that included the consultants and executives from the two merging companies. Lemerise did not include IT executives because he wanted strong input from the business side. He felt that he and the consultants knew enough about IT to represent the interest of the IT managers.

The team decided to include both a short-term tactical plan and a long-term strategic plan. The short-term plan was aimed at supporting the immediate needs of TruServ. It ensured that projects such as the corporate intranet would be on track. It also established a help desk. The long-term plan examined such issues as e-procurement and other e-commerce applications.

The team examined the merger plans and the business plan of the new corporation. It conducted interviews with 30 top executives regarding business goals and technology wish lists. Of special importance were long meetings with the CEO, who got very excited about the possibilities the new system could offer, in particular, e-business.

Once the interviews were completed, Lemerise met with all the executives together, in an attempt to reach a consensus about the priorities of IT projects and the entire strategic plan. The formal IT strategic plan was completed in July 1997. It included all major initiatives for three years, such as the move to one common retail system, and delineated how the company would use the intranet and e-commerce. The topics ranged from the use of wireless technologies in the warehouses to collaboration with business partners.

➡ THE RESULTS

The plan has remained fluid. It has been reevaluated and updated with new business goals every six months since its inception. This flexibility has enabled TruServ to introduce new initiatives as needed. For example, in 2000 and 2001 the company embarked on several Web-based projects, including a Web-centric collaborative technology to streamline its supply chain and transportation networks. An e-commerce linkage with midmarket suppliers was announced in December 2000. TruServ decided not to plan for more than three years in the future (“anything beyond planning for three years often doesn’t happen”), but

every year the planning horizon is extended one year. The plan includes a return on investment (ROI) section, which takes into account such intangible items as improving communication with customers.

Sources: Condensed from Blodgett (1998) and from *truserv.com* (2001).



LESSONS LEARNED FROM THIS CASE

The case of TruServ demonstrates the benefits of a formal IT plan, especially for large corporations. It also demonstrates that there are different types of plans (e.g., tactical and strategic), and that end users as well as the CEO must be involved in the planning.

One of the major concerns of organizations today is how to transform yesterday's organization to a successful one in the digital economy. Many times, before e-commerce is undertaken, processes such as procurement must be redesigned or reengineered. Therefore IT planning frequently involves planning to redesign business processes as well (see El Sawy, 2001).

This chapter first describes the evolution and issues of IT systems planning. Then it presents a four-stage model of information systems planning: strategic planning, requirements analysis, resource allocation, and project planning. Next, it discusses methodologies for operationalizing the model, with primary emphasis on the stages of strategic planning and requirements analysis. (Planning for developing individual applications is discussed in Chapter 14.) Moving to business process redesign and to organizational transformation, the chapter describes the value and method of redesign and BPR and how IT supports them. Finally, the chapter deals with transforming organizations to e-business and managing change.

9.1 IT PLANNING—A CRITICAL ISSUE FOR ORGANIZATIONS

IT planning is the organized planning of IT infrastructure and applications portfolios done at various levels of the organization. The topic of IT planning is very important for both planners and end users: End-users often do IT planning for their own units, and they also frequently participate in the corporate IT planning. Therefore end-users must understand the planning process. Corporate IT planning determines how the IT infrastructure will look. This in turn determines what applications end users can deploy. Thus the future of every unit in the organization could be impacted by the IT infrastructure.

Business Importance and Content

A survey of more than 500 IT executives, conducted in 2003, by *cio.com.*, revealed that *strategic thinking and planning* was the number-one concern for CIOs (*cio.com*, 2003). It was also among the top issues in 2000 and 2001. Why does strategic planning continuously rank high as an issue of concern among IT executives? Simply put, because IT has to work closely with an organization's business side to make sure the company stays competitive. Aligning the goals of the organization and the ability of IT to contribute to those goals can deliver great gains in productivity to the organization. According to Blodgett (1998), as the demands of an increasingly competitive workplace call for closer integration of IT goals and the business mission, strategic plans for the whole enterprise become more important. In addition, with advances in Web-based supply chain collaborations

and integration of e-marketplaces with buyers, sellers, and service providers, a good business strategy involves an IT strategy that keeps in mind the internal customers as well as the external customers and vendors. Aligning IT with the business is a process rather than an event, and IT strategy should be based on adding value to the organization's activities.

The Evolution of IT Planning

During the early years of information technology, in the late 1950s and 1960s, developing new applications and then revising existing systems were the focal points for the first planning and control systems. Organizations adopted methodologies for developing systems, and they installed project management systems to assist with implementing new applications. These initial mechanisms addressed *operational* planning. As organizations became more sophisticated in their use of information systems, emphasis shifted to *managerial* planning, or resource-allocation control. In the 1990s, the role of IT evolved to helping organizations to reach their business goals and to create competitive advantage. Currently the particular focus of IT strategy is on how IT creates business value.

Typically, annual planning cycles are established to identify potentially beneficial IT services, to perform cost-benefit analyses, and to subject the list of potential projects to resource-allocation analysis. Often the entire process is conducted by an IT *steering committee* (see Chapter 15). The steering committee reviews the list of potential projects, approves the ones considered to be beneficial, and assigns them relative priorities. The approved projects are then mapped onto a development schedule, usually encompassing a one- to three-year time frame. This schedule becomes the basis for determining IT resources requirements such as long-range hardware, software, personnel, facilities, and financial requirements.

Some organizations extend this planning process by developing additional plans for longer time horizons. They have a *long-range IT plan*, sometimes referred to as the *strategic IT plan* (see Ward and Peppard, 2002, and Boar, 2000). This plan typically does not refer to specific projects; instead it sets the overall directions in terms of infrastructure and resource requirements for IT activities for five to ten years in the future.

The next level down is a *medium-term IT plan*. It identifies the **applications portfolio**, a list of major, approved IS projects that are consistent with the long-range plan. Since some of these projects will take more than a year to complete, and others will not start in the current year, this plan extends over several years.

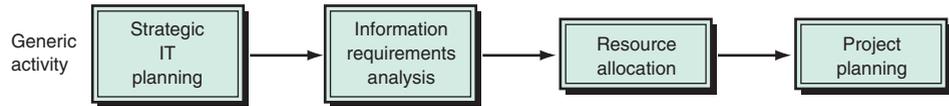
The third level is a *tactical plan*, which has budgets and schedules for current-year projects and activities. In reality, because of the rapid pace of change in technology and the environment, short-term plans may include major items not anticipated in the other plans.

The planning process just described is currently practiced by many organizations. Specifics of the IT planning process, of course, vary among organizations. For example, not all organizations have a high-level IT steering committee. Project priorities may be determined by the IT director, by his or her superior, by company politics, or even on a first-come, first-served basis.

Executing IT Planning

IT planning is a lengthy and complex process, and it can be done by several alternative approaches.

FIGURE 9.1 Basic four-stage model of IS planning.



IT PLANNING APPROACHES. In the IT planning process, organizations need to first determine whether the use of IT is to achieve a competitive advantage or to support an operational role. Earl (1989) identified five types of planning approaches in response to the changing focus and increasing maturity of the IT strategy process. The five different approaches, which are still valid, are:

- **Business-led approach.** The IT investment plan is defined on the basis of the current business strategy. This approach emphasizes that business strategy should lead IT strategy.
- **Method-driven approach.** The IS needs are identified with the use of techniques and tools (often used or prescribed by consultants).
- **Technological approach.** Analytical modeling (e.g., computer-aided software engineering, CASE) and other tools are used to execute the IT plans.
- **Administrative approach.** The IT plan is established by the steering committee or management to implement an approved IS initiative.
- **Organizational approach.** The IT investment plan is derived from a business-consensus view of all stakeholders in the organization (management and end users) of how IT/IS fits the organization's overall business objectives.

Organizations may use one or more of these approaches, or some combination or variant of them. They may also use some formal model of planning.

A FOUR-STAGE MODEL OF IT PLANNING. Several models have been developed to facilitate IT planning (e.g., see Ward and Peppard, 2002; Cassidy, 1998; and Papp, 2001). Of special interest is Wetherbe's (1993) **four-stage model of planning**. The model (depicted in Figure 9.1) consists of four major activities—*strategic planning*, *requirements analysis*, *resource allocation*, and *project planning*—and it is valid today. The stages involve the following activities:

- **Strategic IT planning:** establishes the relationship between the overall organizational plan and the IT plan
- **Information requirements analysis:** identifies broad, organizational information requirements to establish a strategic information architecture that can be used to direct specific application development
- **Resource allocation:** allocates both IT application development resources and operational resources
- **Project planning:** develops a plan that outlines schedules and resource requirements for specific information systems projects

Most organizations engage in all four stages, but their involvement in the specific stages tends to be sporadic and prompted by problems as they occur, instead of reflecting a systematic, stage-by-stage process. The four-stage model can be expanded to include major activities and outputs of the four stages. The model moves from a high level of abstraction to a more concrete formulation



FIGURE 9.2 Applications portfolio matrix. (Sources: Ward and Peppard 2002, Figure 1.7, p. 42.)

of IT planning activities. Some useful methodologies for conducting each planning stage are discussed later in this chapter.

The four-stage planning model is the foundation for the development of a portfolio of applications that is both highly aligned with the corporate goals and has the ability to create an advantage over competitors. There is also a relationship between the four-stage planning model and the various versions of the system development life cycle (SDLC) described in Chapter 14. The four-stage planning model identifies projects and general resource requirements necessary to achieve organizational objectives. In Sections 9.2 and 9.3, we describe the four stages in more detail.

A major issues in IT planning is to determine what specific applications an organization needs to have during the period covered by the plan. For this purpose, organizations use an applications portfolio.

APPLICATIONS PORTFOLIO. An **applications portfolio** is the mix of computer applications that the information system department has installed or is the process of developing on behalf of the company. Building upon the “McFarlan grid” (see *Online File W3.2*), the applications portfolio categorizes existing, planned, and potential information systems based on their business contributions. This 2×2 matrix is a powerful IT planning tool (as shown in Figure 9.2), which is very easy to grasp and understand.

Let’s now begin at Stage 1 in the four-stage model of IT planning.



9.2 STAGE 1: STRATEGIC INFORMATION TECHNOLOGY PLANNING

The first stage of the IT planning model is **strategic information technology planning (SITP)**. It includes several somewhat different types of activities. On the one hand, it refers to identifying the *applications portfolio* through

which an organization will conduct its business. These applications make it possible for an organization to implement its business strategies in a competitive environment.

On the other hand, SITP can also refer to a process of searching for *strategic information systems (SIS)* applications that enable an organization to develop a competitive advantage, as discussed in Chapter 3, rather than just maintaining its position. To accomplish this goal, the organization must do some creative thinking: This involves assessing the current business environment and the organization's objectives and strategies, understanding the capabilities of existing systems, and looking ahead to how new IT systems could produce future advantages for the organization.

The output from the SITP process should include the following: a new or revised IT charter and assessment of the state of the information systems department; an accurate evaluation of the strategic goals and directions of the organization; and a statement of the objectives, strategies, and policies for the IT effort.

Ward and Peppard (2002) provided a more in-depth analysis on the strategic planning and proposed a framework for IT strategy formulation and planning. Details are found in *Online File W9.1*.



IT Alignment with Organizational Plans

Improving the planning process for information systems has long been one of the top concerns of information systems department management. The Society for Information Management (SIM) (*simnet.org*, 2002) found this to be the number-one issue in surveys of senior IT executives in 1997/1998. A survey of 420 organizations, conducted by NCC in 2003 (*ncc.co.uk*, 2003), found that keeping IT strategy aligned with business strategy was their number-one strategic concern.

Strategic information technology planning (SITP) must be aligned with overall organizational planning, whenever relevant, so that the IT unit and other organizational personnel are working toward the same goals, using their respective competencies (Chan, 2002; Pickering, 2000; Ward and Peppard, 2002). The primary task of IT planning is therefore to identify information systems applications that fit the objectives and priorities established by the organization. Figure 9.3 graphically illustrates the alignment of IS strategy, business strategy, and IT strategy and deployment. *IT At Work 9.1* demonstrates how alignment was done at Hewlett-Packard. For another example of alignment of business strategy and IT strategy, see Cale and Kanter (1998).

CHALLENGES FOR IT ALIGNMENT. Despite the theoretical importance of IT alignment, organizations continue to demonstrate limited actual alignment. People 3 Inc. (2003) reported that about 65 percent of companies have either a negative or neutral view of the ability of IT and business managers to work together in supporting corporate goals and objectives. Alignment is a complex management activity (Hackney et al., 2000), and its complexity increases in accordance with the increasing complexity of organizations (For the IS complexity framework, see Hackney et al., 1999, and Hackney et al., 2000). A study conducted by Chan (2002) also found that informal organizational structure results in better IT alignment and performance. (For a listing of the fundamentals assumptions upon which the SITP process is grounded, and the challenges to those assumptions, see *Online File W9.2* and Hackney et al., 2000.)



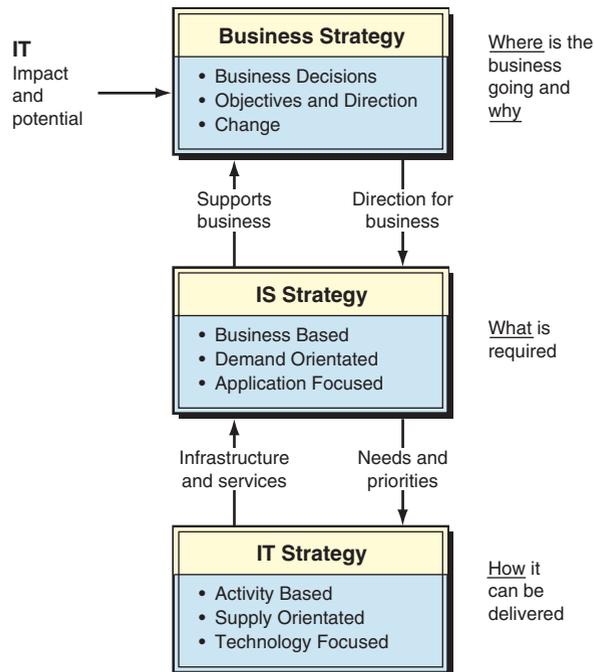


FIGURE 9.3 The relationship among business, IS, and IT strategies (Source: Ward and Peppard 2002, Figure 1.6, p. 41.)



IT At Work 9.1 HEWLETT-PACKARD ALIGNS BUSINESS AND IT STRATEGIES

Hewlett-Packard (*hp.com*) developed a planning methodology in which business processes strategies and technologies are defined and aligned concurrently. This methodology was designed to allow the company to make process changes regardless of the limitations of the existing technology, and it gives visibility to the impacts that new technologies and processes have on each other.

In the past, Hewlett-Packard had used a sequential process. First, it defined the business strategy and the operations and supporting strategies, including technologies. Then, all these functions were aligned and replanned, taking into consideration the technologies available. In the new methodology, the planning is performed for all areas *concurrently*. Furthermore, the entire approach is complemented by a strong focus on teamwork, specialized and objective-driven functional areas and business units, and a commitment to quality and customer satisfaction. The approach links strategy and action. The business alignment framework takes into account the necessary process changes resulting

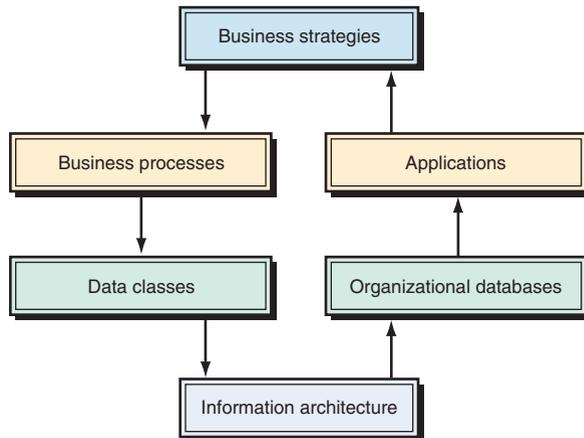
from changes in the business environment, as well as potential technological developments. But, because major changes may result in a change in value systems as well as culture and team structures of the organization, H-P includes these factors within the planning methodology.

Target processes, technologies, and standards drive the selection of potential solutions. The participative management approach ensures effective implementation. According to the framework, business processes and information requirements are defined in parallel with technology enablers and models, which are then linked throughout the alignment process. Adjustments and refinements are made continuously.

Sources: Compiled from Feurer et al. (2000) and from *hp.com* (2001).

For Further Exploration: Why is concurrent planning superior? What communication and collaboration support is needed?

FIGURE 9.4 Business systems planning (BSP) approach. (Source: Derived from *Business Systems Planning—Information Systems Planning Guide*, Application Manual GE20-0527-3, 3rd ed., IBM Corporation, July 1981. Courtesy of the International Business Machines Corporation.)



Tools and Methodologies of IT Planning



Several tools and methodologies exist to facilitate IT planning. These methods are used to help organizations to align their business IT/IS strategies with the organizational strategies, to identify opportunities to utilize IT for competitive advantage, and to analyze internal processes. Most of these methodologies start with some investigation of strategy that checks the industry, competition, and competitiveness, and relates them to technology (*alignment*). Others help create and justify new uses of IT (*impact*). Ward and Peppard (2002) further categorized these methods with respect to their nature (see *Online File W9.3*). In the next section, we look briefly at some of these methodologies.



THE BUSINESS SYSTEMS PLANNING (BSP) MODEL. The **business systems planning (BSP) model** was developed by IBM, and it has influenced other planning efforts such as Andersen Consulting's (now Accenture's) *method/1* and Martin and Finkelstein's *information engineering* (Martin and Finkelstein, 1981). BSP is a top-down approach that starts with business strategies. It deals with two main building blocks—*business processes* and *data classes*—which become the basis of an information architecture. From this architecture, planners can define organizational databases and identify applications that support business strategies, as illustrated in Figure 9.4. BSP relies heavily on the use of metrics in the analysis of processes and data, with the ultimate goal of developing the information architecture. (For details see *Business Systems Planning*, 1981, and *Online File W9.4*.)



THE STAGES OF IT GROWTH MODEL. Nolan (1979) indicated that organizations go through six **stages of IT growth** (called “IS growth” at that time). *A Closer Look 9.1* describes these six stages. In each stage, four processes are active to varying degrees. These are the applications portfolio, users’ role and awareness, IT resources, and management planning and control techniques. The *y* axis in the figure in *A Closer Look 9.1* (p. ●●●) refers to IT expenditures. Note that the growth rate of IT expenses is low during data administration, medium during initiation and maturity, and high during expansion (contagion) and integration. In addition to serving as a guide for expenditure, the model helps in determining the seriousness of problems. (For more on Nolan’s stages of IT growth, see *Online File W9.5*.)



A CLOSER LOOK

9.1 NOLAN'S SIX STAGES OF IS GROWTH MODEL

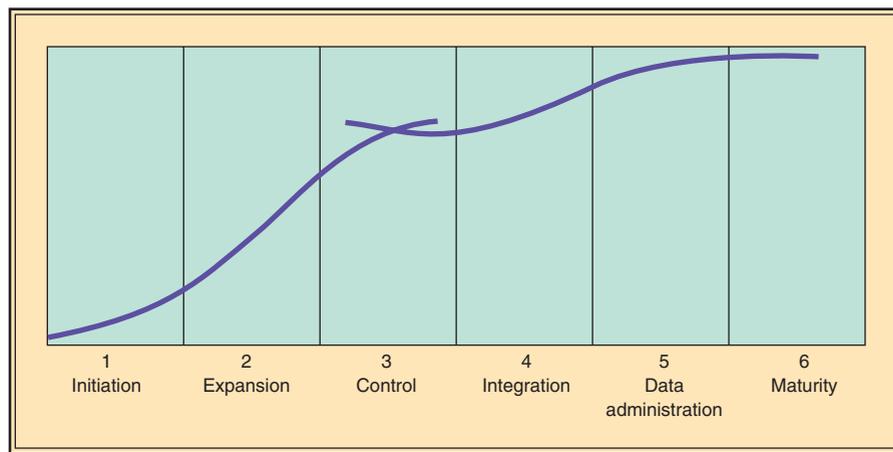
The six stages of IS growth (see attached figure) are:

1. **Initiation.** When computers are initially introduced to the organization, batch processing is used to automate clerical operations in order to achieve cost reduction. There is an operational systems focus, lack of management interest, and a centralized information systems department (ISD).
2. **Expansion (Contagion).** Centralized rapid growth takes place as users demand more applications based on high expectations of benefits. There is a move to online systems as ISD tries to satisfy all user demands and little, if any, control. IT expenses increase rapidly.
3. **Control.** In response to management concern about cost versus benefits, systems projects are expected to show a return, plans are produced, and methodologies/standards are enforced. The control stage often produces a backlog of applications and dissatisfied users. Planning and controls are introduced.
4. **Integration.** There is considerable expenditure on integrating (via telecommunications and databases)

existing systems. User accountability for systems is established, and ISD provides a service to users, not just solutions to problems. At this time there is a transition in computer use and an approach from data processing to information and knowledge processing (transition between the two curves).

5. **Data administration.** Information requirements rather than processing drive the applications portfolio, and information is shared within the organization. Database capability is exploited as users understand the value of the information and are willing to share it.
6. **Maturity.** The planning and development of IT in the organization are closely coordinated with business development. Corporatewide systems are in place. The ISD and the users share accountability regarding the allocation of computing resources. IT has truly become a strategic partner.

Source: Compiled from R. L. Nolan, "Managing the Crises in Data Processing," *Harvard Business Review*, March–April 1979. Reprinted with permission of the *Harvard Business Review*.



Nolan's six stages of IT Growth

CRITICAL SUCCESS FACTORS. Critical success factors (CSFs) are those few things that must go right in order to ensure the organizations' survival and success. The *CSF approach* to IT planning was developed to help identify the information needs of managers. The fundamental assumption is that in every organization there are three to six key factors that, if done well, will result in

the organization's success. Therefore organizations should continuously measure performance in these areas, taking corrective action whenever necessary. CSFs also exist in business units, departments, and other organizational units.

Critical success factors vary by broad industry categories—manufacturing, service, or government—and by specific industries within these categories. For organizations in the same industry, CSFs will vary depending on whether the firms are market leaders or weaker competitors, where they are located, and what competitive strategies they follow. Environmental issues, such as the degree of regulation or amount of technology used, influence CSFs. In addition, CSFs change over time based on temporary conditions, such as high interest rates or long-term trends.

IT planners identify CSFs by interviewing managers in an initial session, and then refine these CSFs in one or two additional sessions. Sample questions asked in the CSF approach are:

- What objectives are central to your organization?
- What are the critical factors that are essential to meeting these objectives?
- What decisions or actions are key to these critical factors?
- What variables underlie these decisions, and how are they measured?
- What information systems can supply these measures?

The first step following the interviews is to determine the organizational objectives for which the manager is responsible, and then the factors that are critical to attaining these objectives. The second step is to select a small number of CSFs. Then, one needs to determine the information requirements for those CSFs and measure to see whether the CSFs are met. If they are not met it is necessary to build appropriate applications (see Figure 9.5).

The critical success factors approach encourages managers to identify what is most important to their performance and then develop good indicators of

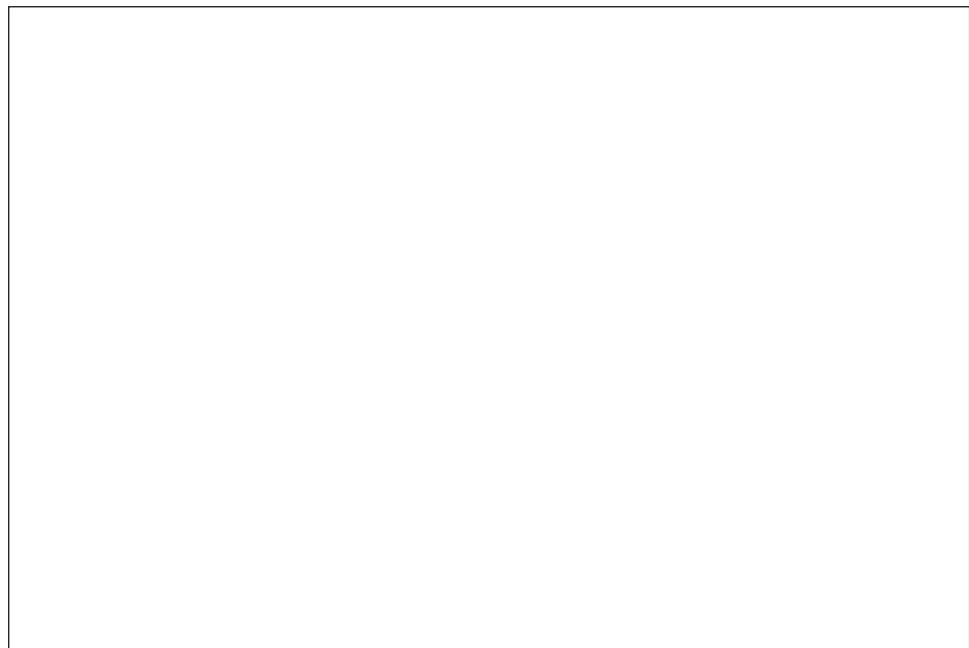


FIGURE 9.5 Critical success factors basic processes. (Source: Ward and Peppard, 2002, Figure 4.7, p. 211.)



performance in these areas. Conducting interviews with all key people makes it less likely that key items will be overlooked. On the other hand, the emphasis on critical factors avoids the problem of collecting too much data, or including some data just because they are easy to collect.

SCENARIO PLANNING. **Scenario planning** is a methodology in which planners first create several scenarios, then a team compiles as many as possible future events that may influence the outcome of each scenario. This approach is used in planning situations that involve much uncertainty, like that of IT in general and e-commerce in particular. With the rapid changes of technologies and business environment, Stauffer (2002) emphasized the need for scenario planning. Five reasons to do scenario planning are: (1) to ensure that you are not focusing on catastrophe to the exclusion of opportunity, (2) to help you allocate resources more prudently, (3) to preserve your options, (4) to ensure that you are not still “fighting the last war,” and (5) to give you the opportunity to rehearse testing and training of people to go through the process. Scenario planning follows a rigorous process; the essential steps are summarized in Table 9.1.

Scenario planning has been widely used by major corporations to facilitate IT planning (e.g., *ncr.com* and *gbn.com*). It also has been particularly important to e-commerce planning. For instance, creating customer scenarios helps the company better fit the products and services into the real lives of the customers, resulting in sales expansion and customer loyalty. Seybold (2001) described three cases (National Semiconductor, Tesco, Buzzsaw.com) that used customer scenarios to strengthen customer relationships, to guide business strategy, and to deliver business value.

Although EC proliferation would certainly allow any combination or variation of business scenarios, each company has to select the most appropriate model for its needs. The use of this model can help EC planners to determine the EC initiatives that best fit their organization. (See Minicase 2 for an example of implementation.)

TABLE 9.1 Essential Steps of Scenario Planning

- Determine the scope and time frame of the scenario you are fleshing out.
- Identify the current assumptions and mental models of individuals who influence these decisions.
- Create a manageable number of divergent, yet plausible, scenarios. Spell out the underlying assumptions of how each of these imagined futures might evolve.
- Test the impact of key variables in each scenario.
- Develop action plans based on either (a) the solutions that play most robustly across scenarios, or (b) The most desirable outcome toward which a company can direct its efforts.
- Monitor events as they unfold to test the corporate direction, be prepared to modify it as required.

The educational experience that results from this process includes:

- Stretching your mind beyond the groupthink that can slowly and imperceptibly produce a sameness of minds among top team members in any organization.
- Learning the ways in which seemingly remote potential developments may have repercussions that hit close to home.
- Learning how you and your colleagues might respond under both adverse and favorable circumstances.

Source: Compiled from Stauffer (2002).

9.3 STAGES 2–4: INFORMATION REQUIREMENTS ANALYSIS, RESOURCE ALLOCATION, AND PROJECT PLANNING

The next three stages of the four-stage planning model are inter-related; they start with information requirements.

Information Requirements Analysis: Stage 2 of the 4-Stage Model

The second stage of the model is the **information requirements analysis**, which is an analysis of the information needs of users and how that information relates to their work. The goal of this second stage is to ensure that the various information systems, databases, and networks can be integrated to support the requirements identified in stage 1 to enable decision making.

In the first step of information requirements analysis, IT planners assess what information is needed to support current and projected decision making and operations in the organization. This is different from the detailed information requirements analysis associated with developing *individual* application systems (i.e., identifying required outputs and the inputs necessary to generate them, which we describe in Chapter 14). Rather, the stage 2 information requirements analysis is at a more comprehensive level of analysis. It encompasses infrastructures such as the data needed in a large number of applications (e.g., in a data warehouse or a data center) for the whole organization. Similarly, requirements for the intranet, extranet, and corporate part are established.

There are several alternative approaches for conducting the requirements analysis. One of them is presented as a five-step model in Table 9.2. Also, some of the methods described in Chapter 14, such as JAD, can be used here.

The results of the requirements analysis exercise are threefold. It identifies high-payoff information categories, it provides a basis for the architecture of IT, and it guides in resource allocation.

IDENTIFYING HIGH PAYOFFS. To determine which IT projects will produce the highest organizational payoff, the organization can identify categories with high

TABLE 9.2 The Five-Step Requirements-Analysis Model

Step 1: Define underlying organizational subsystems. The first step is to identify the underlying organizational processes, such as order fulfillment or product analysis.

Step 2: Develop subsystem matrix. The next phase is to relate specific managers to organizational processes. This relationship can be represented by a matrix. The matrix is developed by reviewing the major decision responsibilities of each middle-to-top manager and relating them to specific processes.

Step 3: Define and evaluate information requirements for organizational subsystems. In this phase, managers with major decision-making responsibility for each process are interviewed in groups by information analysts in order to obtain the information requirements of each organizational process.

Step 4: Define major information categories and map interview results into them. The process of defining information categories is similar to the process of defining data items for individual application into entities and attributes.

Step 5: Develop information/subsystem matrix. Mapping information categories against organizational subsystems creates an information-categories-by-organizational-process matrix. Information categories can be accounts receivable, customers' demographics, or products' warranties. In each cell of the matrix an important information category value is inserted.



importance-value scores, and should consider them first for feasibility. In order to identify high payoff, planners use a matrix that relates information—categories to organizational processes to identify high payoff. But this matrix does not indicate whether it is technically, economically, or operationally feasible to develop systems for each information category. The matrix merely indicates the relative importance of information. Feasibility studies and other project-related tasks must still be performed, as described in Chapter 14. This step requires substantial creativity (e.g., see Ruohonen and Higgins, 1998). In Section 9.6, we demonstrate how this is done for Web-based systems. An example of identifying high-payoff projects is provided at *IT At Work 9.2*.

PROVIDING AN ARCHITECTURE. Clearly defining the intersection of information and processes helps an organization avoid separate, redundant information systems for different organizational processes. When an organization decides to improve information for one process, other processes that need such information can be taken into consideration. By completing the conceptual work first, an organization can identify information systems projects that offer the most benefit and lead to cohesive, integrated systems. The resulting systems are far better than the fragmented, piecemeal systems that are continually being reworked or abandoned because they do not mesh with the organization's general requirements. To develop such integrated systems requires systematic planning from the top down, rather than randomly from the bottom up, and this is done in the architecture phase. In Chapter 13, we describe how this has been done in the State of Iowa (see the opening case there).

GUIDANCE IN RESOURCE ALLOCATION. Once high-payoff areas of IT have been identified it is reasonable to give those areas high priority when the organization allocates resources. Such an allocation is described next.

**Resource Allocation:
Stage 3 of the
4-Stage Model**

Resource allocation, the third stage of the IT planning model, consists of developing the hardware, software, data communications and networks, facilities, personnel, and financial plans needed to execute the master development plan as defined in the requirements analysis. This stage provides the framework for technology and labor procurement, and it identifies the financial resources needed to provide appropriate service levels to users. The financial aspect will be discussed briefly here (with a more in-depth discussion in Chapter 13).

Resource allocation is a contentious process in most organizations because opportunities and requests for spending far exceed the available funds. (See the opening case in Chapter 13.) This can lead to intense, highly political competition between organizational units, which makes it difficult to objectively identify the most desirable investments.

Requests for funding approval from the steering committee fall into two categories. Some projects and infrastructure are necessary in order for the organization to stay in business. For example, it may be imperative to purchase or upgrade hardware if the network, or disk drives, or the processor on the main computer are approaching capacity limits. Obtaining approval for this type of spending is largely a matter of communicating the gravity of the problems to decision makers.

On the other hand, the IT planning process identifies an information architecture that usually requires additional funding for less critical items: new projects,



IT At Work 9.2

IDENTIFYING HIGH PAYOFF PROJECTS



Wing Fat Foods (WFF) is a wholesaler, delivering perishable and nonperishable foodstuffs, as well as hardware, kitchenware, and household goods, to restaurants, groceries, and similar businesses along the Atlantic Coast of the United States. WFF is famous for its quality and service, which is accomplished with a relatively low level of IS investment. WFF hopes that its additional IT investment will help it to sustain its edge over competitors.

In response to the need of identifying potential new IT projects, Pefferess and Gengler (2003) proposed to WFF a new method, the *critical success chain (CSC) method*, for IT planning. The CSC method includes four steps:

Step 1: Pre-study preparation: Determine scope and participants and collect project idea stimuli. The analyst invited 25 IS users (6 senior managers, 11 middle managers, 5 journeyman employees, and 3 WFF customers) to participate in an in-depth interview. At the same time, she collected project ideas to serve as stimuli. For example, she asked each participant to describe the functionality of a system that would benefit WFF.

Step 2: Participant interviews: Elicit personal constructs from organization members. The analyst then conducted 25–50 minute interviews with each participant, showing the participant three system descriptions and asking them

to rank the system attributes and explain their importance to the organization. A line of questions was asked until the participants suggested a concrete feature or attribute that would become part of the project idea. This line of questions was designed to produce specific features of the system idea, expected performance, and related organizational values or objectives. In this study, the analyst collected about 8 chains of suggestions per participant.

Step 3: Analysis: Aggregate personal constructs into CSC models. The analyst first clustered the interview statements into constructs and mapped the constructs into a matrix. She then clustered the chains using the Ward and Peppard strategic planning framework (found in *Online File W9.1*). Mapping each cluster into a CSC map, she represented the constructs as nodes and the links in the chains as lines connecting the nodes. The figure below depicts an organization-specific CSC model consisting of, from left to right, descriptions of desired system attributes, resulting expected performance outcomes (CSF), and associated organizational goals.

Step 4: Idea workshops: Elicit feasible strategic IS from technical and business experts and customers. The CSC maps were used by both IS professionals from within WFF and non-IS customers as a starting

maintenance or upgrades of existing systems, and infrastructure to support these systems and future needs. Approval for projects in this category may become more difficult to obtain because the ISD is already receiving limited funding for mandatory projects.

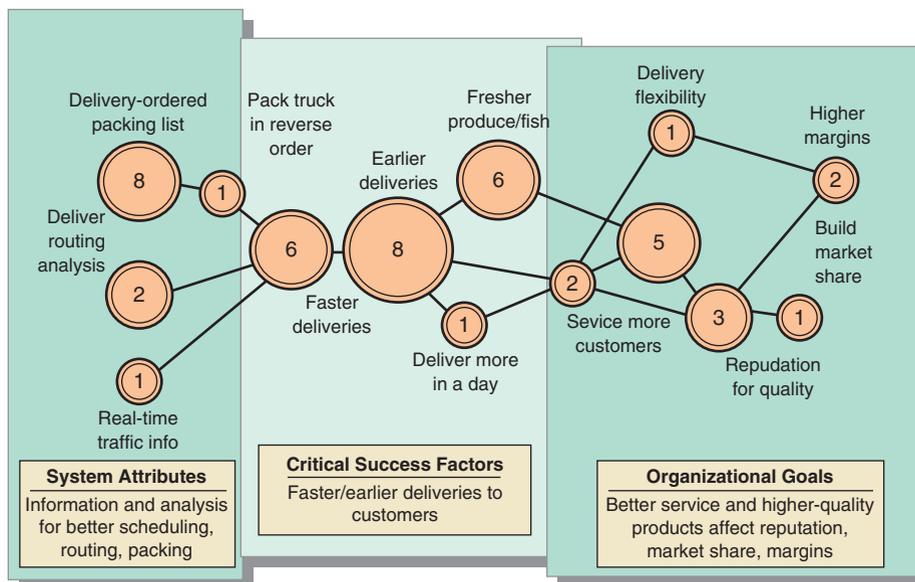
After setting aside funds for the first category, the organization can use the remainder of the IT budget for projects related mainly to the improved information architecture. The organization can prioritize spending among items in the architecture developed by using information requirements analysis. In addition to formally allocating resources through budgeting decisions, an organization can use chargeback mechanisms to fund corporate-level projects. In a *chargeback system*, some or all of a system's cost is charged to users. In addition, management may encourage individual units to make their own decisions about IT expenses. Chapter 13 discusses chargeback, cost-benefit analysis, and other, more sophisticated analyses that can also be used to assess investments in individual IT projects as well as infrastructure.

Another major factor in resource allocation is the *outsourcing strategy* (Chapter 13). The more that is outsourced, the less capital investment and internal resources are needed.

point for developing a portfolio of IS proposals. Providing the technical and business experts at WFF with the CSC maps, the workshop finally yielded 14 project ideas, including a decision support system for scheduling, routing, and loading trucks for delivery, as well as the support activities for existing systems, including training and updated equipment and maintenance support.

Sources: Compiled from Peffers and Gengler, (2003).

For Further Exploration: Why is the method called the CS chain? Why is such a lengthy process, with so many participants, needed?



Critical success chain network map. (Source: Peffers and Gengler (2003).)

Project Planning: Stage 4 of the 4-Stage Model

The fourth and final stage of the model for IT planning is **project planning**. It provides an overall framework within which specific applications can be planned, scheduled, and controlled. Since this stage is associated with systems development, it will be covered in Chapter 14. Also, this stage depends on the outsourcing strategy. The more an organization outsources, the more vendor management and control will need to be included in project planning.

9.4 PLANNING INFORMATION TECHNOLOGY ARCHITECTURES

The term **information technology architecture** refers to the overall (high-level) structure of all information systems in an organization. This structure consists of applications for various managerial levels (operational control, management planning and control, and strategic planning) and applications oriented to various functional-operational activities (such as marketing, R&D, production, and distribution). The information architecture also includes infrastructure (e.g., the databases, supporting software, and networks needed to connect applications together). In the simplest view, an IT architecture consists of a description of the combination of hardware, software, data, personnel, and



telecommunications elements within an organization, along with procedures to employ them. An information architecture for an organization should guide the long-range development as well as allow for responsiveness to diverse, short-range information systems demands. (The configuration of these architectures is discussed in Technology Guide 4.)

An **information architecture** is a high-level, logical plan of the information requirements and the structures or integration of information resources needed to meet those requirements. An information technology architecture specifies the technological and organizational infrastructure that physically implements an information architecture.

Three types of technology architectures are described in Technology Guide 4: *centralized*, *noncentralized*, and *client/server*. In this section we discuss the general considerations relating to IT infrastructure and provide some guidelines for choosing among architecture options. We conclude the section with a look at the issue of reengineering *legacy systems* (holdover systems from earlier architectures).

IT Infrastructure Considerations

Different organizations have different IT infrastructure requirements. Broadbent et al. (1996) looked at how the characteristics and environments of organizations influenced their IT infrastructure. They identified several core *infrastructure services* provided in all of the firms, plus others provided by some of the firms. They also found the following four *infrastructure relationships* in a sample of 26 large firms:

1. **Industry.** Manufacturing firms use fewer IT infrastructure services than retail or financial firms.
2. **Market volatility.** Firms that need to change products quickly use more IT infrastructure services.
3. **Business unit synergy.** Firms that emphasize synergies (e.g., cross-selling) use more IT infrastructure services.
4. **Strategy and planning.** Firms that integrate IT and organizational planning, and track or monitor the achievement of strategic goals, use more IT infrastructure services.



Based on analysis of their data, Broadbent et al. developed a model of the relationship between firm context and IT infrastructure (shown in *Online File W9.6*). This model indicates that two general factors influence infrastructure levels: The first factor is *information intensity*, the extent to which products or processes incorporate information. The second factor is *strategic focus*, the level of emphasis on strategy and planning. Firms with higher levels of these two factors use more IT infrastructure services, and they have greater reach and range in their use of these services.

Choosing Among Architecture Options

A poorly organized IT architecture can disrupt a business by hindering or misdirecting information flows. Each organization—even within the same industry—has its own particular needs and preferences for information. Therefore each organization requires an IT architecture specifically designed and deployed for its use.

In today's computing environment, IT architectures are becoming increasingly complex, yet they still must be responsive to changing business needs. Actually, today's IT architecture is designed around *business processes* rather than

around the traditional application hierarchy of the functional departments. These requirements call for tough decisions about a number of architectural issues. The choices among *centralized computing*, *distributed computing*, and *blended computing* architectures are discussed below.

IN FAVOR OF CENTRALIZED COMPUTING. Centralized computing has been the foundation of corporate computing for over 30 years. **Centralized computing** puts all processing and control authority within one computer to which all other computing devices respond.

There are a number of benefits of centralized computing: Centralized computing can exploit the economies of scale that arise whenever there are a large number of IT applications and users in an organization. It may be more cost-effective to have one large-scale computing resource that is used by many than it is to have many small-scale computing resources. The cost of a centralized facility can be divided among many users, usually reducing duplication of effort and more efficiently managing an operation (housing the computer, providing support services, etc.). Centralized approaches can also offer easier control from an enterprise perspective. If important corporate data are stored on a centralized computing platform, a company is able to impose strict physical access controls to protect the data. When data are spread throughout an organization, securing and preserving data becomes much more difficult (See Chapter 15).

However, with increasing use of *client/server* systems, the role of the mainframe computer has shifted toward a more collaborative relationship with other computing resources within an organization. A few proponents of PCs go so far as to claim that the mainframe is dead. Many experts, though, agree that the mainframe is likely to exist for many years, particularly as a repository for data that can be centrally maintained for enterprisewide use (the data center, see Technology Guide 3). Providing access to and analyzing very large quantities of data are uses for which mainframes are still very appropriate. This is especially important in banking, insurance, airlines, and large retailing. The Internet and intranets can be extremely useful in distributing information stored on mainframe (and smaller) computers.

IN FAVOR OF DISTRIBUTED COMPUTING. **Distributed computing** gives users direct control over their own computing. This approach argues that choices for computing are best handled at the point of the computing need—that individual needs are best met with individualized computing. The rise in popularity of PCs, with their decreasing costs and increasing performance, has led many organizations to embrace distributed computing. Applications data can be entered, verified, and maintained closer to its source.

Distributed computing can also offer a high degree of flexibility and desirable system redundancy. When an organization expands, it may be much easier and less expensive to add another local, distributed processor than to replace a centralized mainframe with an even larger mainframe. Also, a computer in a decentralized environment may be noticeably faster than a centralized computer very far away from a user.

Moreover, a malfunctioning distributed computer ordinarily does not prevent other distributed computers from working, especially if data are partially or fully duplicated around the system, such as in the case of Lotus Notes/Domino or some intranets. (In contrast, a centralized approach has a single point of failure—the



central computer. When it goes down, no one computes.) Consider an organization that sells online; if its order processing system goes down for a day in the holiday season, it could lose hundreds of thousands of dollars in sales.

IN FAVOR OF BLENDING CENTRALIZED AND DISTRIBUTED COMPUTING. As noted earlier, computing does not have to be entirely centralized or entirely distributed—it can be a blending of the two models. Many distributed systems are based on client/server architecture. In some circumstances, the mainframe (centralized resource) is viewed as a kind of peripheral device for other (distributed) computing resources. The mainframe can be a large file server that offers the economies of scale and data control that are desirable in most organizations, and yet still allows processing and handling of local needs via distributed computing resources. *What to distribute where* (and what *not to distribute*) then become key issues.

INFORMATION ARCHITECTURES AND END-USER COMPUTING. Like an automobile, a personal computer gives its user great flexibility, power, and freedom. But just as the user of an automobile needs access to an infrastructure of highways, the user of a personal computer needs access to an infrastructure of databases and communication networks, including the Internet corporate portal and intranets. Creating such an architecture for end-users invariably involves PC linkage issues.

There are five basic configurations of PCs for end users:

1. Centralized computing with the PC functioning as a “dumb terminal” (or sometimes “not-so-dumb,” yet not smart)—the thin PCs.
2. A single-user PC that is not connected to any other device.
3. A single-user PC that is connected to other PCs or systems, using ad hoc telecommunications (such as dial-up telephone connections).
4. Workgroup PCs connected to each other in a small *peer-to-peer network* (see Technology Guide 4).
5. Distributed computing with many PCs fully connected by LANs via wireline or Wi-Fi.

End-user computing with interconnected desktop PCs or network computers appears inevitable. Given this inevitability, it is important that organizations maximize corporate business benefits and, at the same time, minimize risks and undue constraints on user initiative, business knowledge, and organizational unity. (For more on the development of end-user computing, see Chapter 14.)

THE IMPACT OF OUTSOURCING AND UTILITY COMPUTING. As the amount of IT that is outsourced increases, and with the development of utility computing (the purchase of computing services, much as one today purchases electricity and water services; see Chapters 2 and 14), the amount of infrastructure needed by organizations will decline. Theoretically, there will be no need even for a data center. The architecture then will be comprised of LANs and PCs, intranets, corporate portals, and extranets. While outsourcing is spreading rapidly, it is mostly *selected outsourcing* (Chapter 13), namely, only some of the IT operations are outsourced. However, within about 5 to 10 years the impact of both outsourcing and utility computing are expected to be significant.

Reengineering Legacy Systems

Holdovers of earlier architectures that are still in use after an organization migrates to a new architecture are described as **legacy systems**. These systems may continue in use even after an organization switches to an architecture that is different from, and possibly incompatible with, the architectures on which they are based. They may still be capable of meeting business needs, and so might not require any immediate changes. Or they may be in need of reengineering to meet some current business needs, requiring significant changes.

Each legacy system has to be examined on its own merits, and a judgment made regarding the current and future value of the system to the organization. This type of decision—to keep, improve, or replace—can present management with agonizing alternatives. On one hand, keeping a legacy system active offers stability and return on previous investments (“If it ain’t broke, don’t fix it”). On the other hand, increasing processing demands and high operational costs make replacement attractive if not imperative. Newer systems, however, may be more risky and less robust.

Reverse engineering is the process of examining systems to determine their present status, and to identify what changes are necessary to allow the system to meet current and future business needs. The results of this process can then guide the redesign and redevelopment of the system. Some reverse engineering tools, when applied to legacy systems, automatically generate up-to-date documentation. Other tools in this category help programmers convert code in older programs into a more efficient form.

Legacy systems are not just mainframe systems. A legacy system might consist of PC programs that need to be reengineered and “ported” to a mainframe, a process that is called *upsizing* the system. Or a legacy system might be a mainframe application that needs to be reengineered and “rehosted” onto PCs, an example of *downsizing* a system. In each instance, a business is trying to effectively “rightsize” a legacy system to meet evolving business requirements. An important area is in the *integration* of legacy systems with enterprise systems (such as ERP, CRM, and KM) and with e-commerce systems.

Finally, organizations should reengineer legacy systems in concert with business process redesign (refer to the “retooling” discussion in Section 9.8). Changes to the computerized or automated side of a business should synchronize with changes in other business processes. While reengineering legacy systems might be justified solely on a cost or efficiency basis, significant business gains can also be made when this effort is a coordinated part of restructuring business processes to improve efficiency and effectiveness.

9.5 SOME ISSUES IN IT PLANNING

IT planning is a complex process. Of the many special topics in this category, we have elected to focus on IT planning in interorganizational and international systems. Information technology planning may get more complicated when several organizations are involved, as well as when we deal with multinational corporations. In this section, we also address the problems and challenges for IT planning.

Planning for Interorganizational Systems

Internal information systems of business partners must “talk” with each other effectively and do it efficiently. In Chapters 4 and 5, we introduced IT technologies such as EDI, e-mail, and extranets that facilitate communication and



collaboration between companies. IT planning that involves several organizations may be complex. The problem is that some information systems may involve hundreds or even thousands of business partners. IT planners in such a case could use focus groups of customers, suppliers, and other business partners, especially during the strategic information planning as well as during the information requirements analysis.

Planning for project management of interorganization systems (IOSs) can be fairly complex. IT planners may create virtual planning teams that will work together on projects such as extranets or EDI. Such collaboration is especially important in strategic planning that involves infrastructure. Questions such as who is going to pay for what can become critical factors in cost/benefit analysis and justification of information systems applications.

A comprehensive study of global IT strategic planning was conducted by Curry and Ferguson (2000). In order to increase the success of such planning, they suggest that organizations reduce the planning horizon to two to three years (from three to five years) and that they increase the collaboration between the IT planners and end users.

Examples of joint planning for interorganizational systems can include using an extended supply chain approach and adopting the same enterprise software. If company A will use software from SAP and company B will use Oracle software, there could be additional expenses for connecting these softwares to each other. Web services (Chapters 2 and 15) may provide the solution for such an integration.

IT Planning for Multinational Corporations



Multinational corporations face a complex legal, political, and social environment, which complicates corporate IT planning. Therefore, many multinational companies prefer to decentralize their IT planning and operations, empowering their local IT managers. An illustrative example is shown in *IT At Work 9.3*. However, such a policy may be self-defeating since communication, coordination, and collaboration among decentralized business units may require large expenses. ExxonMobil Corporation, for example, was forced to centralize its IT operations because of such high expenditures (see *Online File W9.7*).

Problems for IT Planning

IT planning can be an expensive and time-consuming process. A study of five large-scale planning projects found that such projects may involve ten or more employees, on a half-time or full-time basis, for periods lasting from ten weeks to a year. The estimated costs of these projects ranged from \$450,000 to \$1.9 million. In addition, a survey reported by King (2000) disclosed that more than 50 percent of the companies surveyed were conducting IS planning using obsolete methodologies.

Teo and Ang (2001) emphasized the importance of understanding IT planning problems. They argued that these problems may result in wasted resources, lost opportunities, duplicated efforts, and incompatible systems. They studied 138 companies and identified IT planning problems at the three phases of IS planning: the launching phase, the plan development phase, and the implementation phase. In all three phases, failing to get top management support for the IS planning was the most serious problem. Other major IS planning problems included: not having free communication flow and not being able to obtain sufficiently qualified personnel in the planning phase; ignoring business goals and failing to translate goals and strategies into action plans in the plan development phase;



IT At Work 9.3

IT PLANNING AT AN INTERNATIONAL LAW FIRM



Rouse & Co. International is a U.K.-based law firm with 15 offices worldwide. Kamran Hussain joined the firm in 1998 as the global head of IT operations and development. His first task was to look closely at office locations, in particular, those located in Asia, including Jakarta, Beijing, Hong Kong, Bangkok, and Vietnam.

At that time, Hussain's biggest challenge was to convince the company about good technology. Each office had its own culture that he had to adapt to. For example, the Chinese in the Beijing office are loyal to their local people; they had their own way of developing the regional office's strategy and did not want to integrate globally. The Jarkarta office, on the other hand, was more confident about integrating new technologies.

The law firm employs a wide range of professionals, including lawyers, patent and trademark attorneys, investigators, linguists, and researchers. With so many employees sharing information, it was important to get all offices connected. Since not all offices had the same level of IT

sophistication, Hussain chose a Windows 2000 network running on TCP/IP, with a Watchguard firebox (a security appliance designed to provide mid-sized organizations with firewall and virtual private network functions). This network lets the company maintain the IT systems remotely, but allows Hussain to hire IT staff in each office locally, as local staff tend to have better insight into the local information. The networking project now helps the firm manage its knowledge management strategy, allows the company to save resources, and enables it to group the database by countries, as the criteria set by the client tend to be country-specific.

Source: Condensed from Zakaria (2002).

For Further Exploration: Why is it important to integrate the systems from different countries? Apart from cultural differences, what are other challenges for IT planning in an international firm?



neglecting to adjust the IS plan to reflect major environmental changes; and ignoring the IS plan once it has been developed in the implementation phase. (Details of these planning problems are shown in *Online File W9.8*.)

In response to the rapid change of technology and the business environment, IT strategies have to be more flexible and more responsive in order to take advantage of opportunities quickly and in the most cost-effective way. Details in planning for Web-based system and e-commerce are described in the following section.

9.6 PLANNING FOR WEB-BASED SYSTEMS AND E-COMMERCE (E-PLANNING)

Strategic planning for Web-based systems can be viewed as a subset of IT strategic planning. However, in many cases it is done independently of IT planning. Here, we will refer to this specialized process as *e-planning* and will examine some of its features.

E-Planning IT planning in this chapter refers mostly to corporate planning of IT infrastructure rather than to applications planning. In contrast, **e-planning** is electronically supported IT planning that touches on EC infrastructure and mostly deals with uncovering business opportunities and deciding on an applications portfolio that will exploit those opportunities (see *IT At Work 9.2*).

Some of the infrastructure needed for e-commerce and Web-based systems may be already in place, as part of the organization's overall IT infrastructure.



Nevertheless, e-planning may be conducted as a separate planning exercise. In such a case, ISD people will participate in the steering committee together with end users. Of course, alignment between the two processes is needed. One reason for such separation is that technology is an enabler of e-commerce, but the major objective of e-commerce is to rejuvenate organizations. If the process is controlled by IT people, the success of e-commerce may be constrained. Another reason for the separation is that e-planning is usually less formal, and it must be done quickly. Furthermore, due to rapid changes the e-planning must be more flexible.

Planning for Web-based individual applications is very similar to the planning of any IT application. However, at the macro level of planning, the emphasis is different. The areas where more attention is given in e-planning are the applications portfolio, risk analysis, and strategic planning issues such as the use of metrics. Let's elaborate.

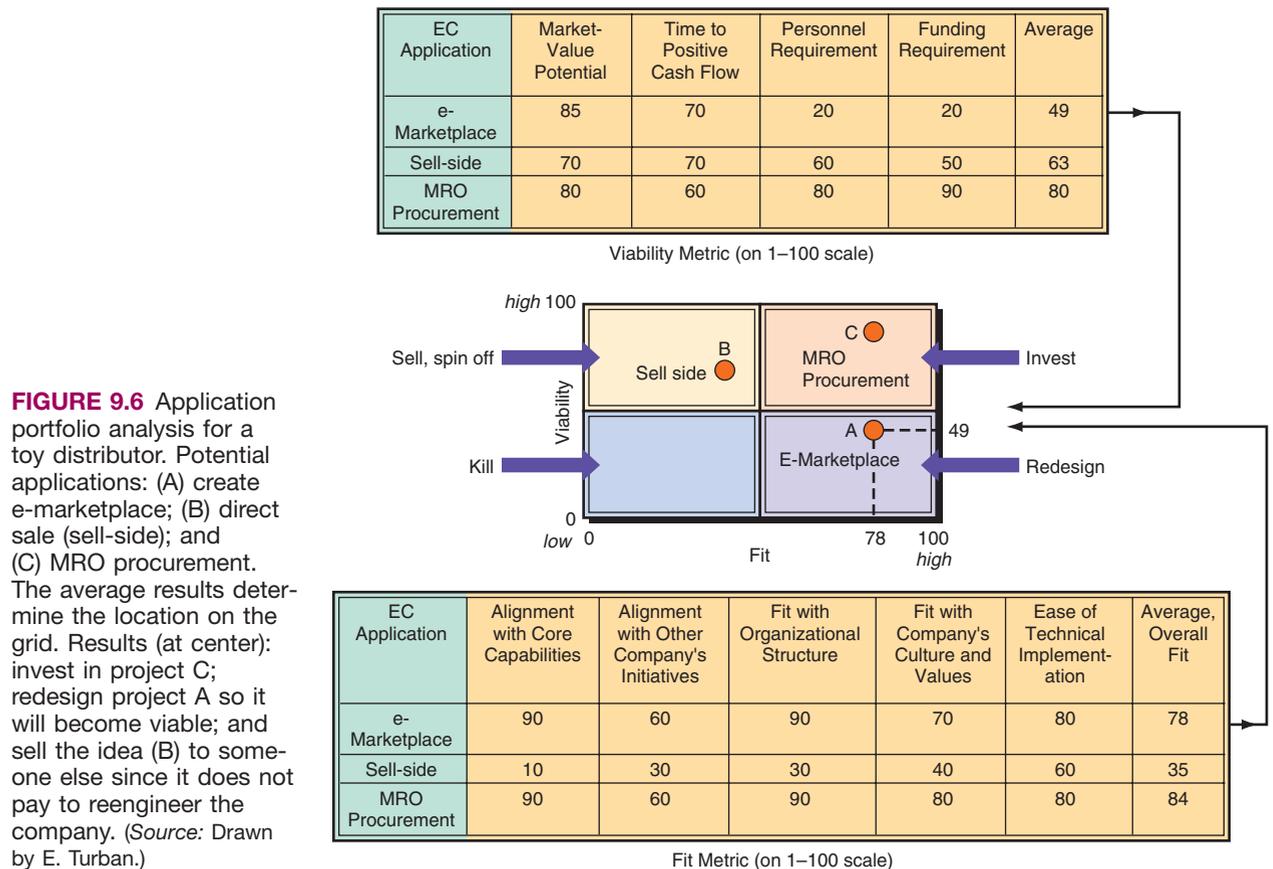
APPLICATIONS PORTFOLIO FOR E-COMMERCE. The importance of the applications portfolio in regular IT planning may be declining. Most organizations have their mission-critical systems already in place, and IT activities are fairly distributed. In e-commerce, however, most organizations are starting from scratch. The cost of building systems is high, and so is the risk. Therefore, it is advisable to conduct centralized EC planning and to select appropriate applications and prioritize them, as was shown in *IT At Work 9.2*. Another methodology for planning an applications portfolio was proposed by Tjan (2001).

Tjan's Portfolio Strategy. Tjan (2001) adopted a business project portfolio applications approach to create an Internet portfolio planning matrix. (Also see Boar, 2000.) However, instead of trading off industry growth and market position, here the strategy is based on *company fit*, which can be either low or high, and the *project's viability*, which can also be low or high. Together these create an *Internet portfolio map (matrix)*.

A project's viability can be assessed by four criteria: market-value potential, time to positive cash flow, personnel requirements, and funding requirements. EC initiatives such as a B2B procurement site, a B2C store, or a portal for kids, for example, can be evaluated on a scale of 1 to 100, for each of the four metrics. Then, an average score (simple average) for each metric is computed. For *fit*, the following criteria are used: alignment with core capabilities, alignment with other company initiatives, fit with organizational structure, fit with company's culture and values, and ease of technical implementation. Again, each EC initiative is assessed on a scale of 1 to 100 (or on a qualitative scale of high, medium, low), and an average is computed.

The various applications initiatives are then mapped on the *Internet portfolio matrix*, based on the average scores for viability and fit. The Internet matrix is divided into four cells, as shown in Figure 9.6. If both *viability* and *fit* are low, the project is killed. If both are high, then the project is adopted. If *fit* is high, but *viability* is low, the project is sent to redesign. Finally, if the *fit* is low but the *viability* is high, the project may be sold or spun off. The figure shows how several applications were rated for an e-marketplace company for a toy company in Hong Kong.

Tjan's portfolio strategy introduces a systematic approach to EC project selection. The assessment of the points per criterion can be done by several experts to ensure quality. Cases where there is more agreement can be considered with more confidence. Organizations can add their own criteria to the methodology.



RISK ANALYSIS. The degree of risk of some Web-based systems is very high, and such risk often leads to failure. For example, Disney Inc. aborted two major EC initiatives in 2000: First, Disney closed its e-toy company (*smartkid.com*), and second, it closed its company (*go.com*) that was managing all of Disney's EC initiatives. The loss was many millions of dollars. Failures of IT applications do not usually cost so much money, especially if they are not enterprisewide in nature. Conducting an appropriate risk analysis could reduce the chance of failures. However, this was difficult to do at that time due to lack of historical data.



STRATEGIC PLANNING ISSUES. Several strategic planning issues are unique to the Web environment. Each of these may involve IT infrastructure, but the market and organizational implications may be more important. Here are some examples:

- **Who and where?** Should the EC initiatives be conducted in a completely independent division or even a separate company?
- **Use of metrics.** EC planning is difficult because the field is evolving, the history is brief, and few planners have experience. Therefore it is desirable to use industry standards, also known as **metrics**, for executing various steps of the planning process (see Plant, 2000). (Metrics are discussed in Chapters 5 and 13.)

- **Learn from failures.** During 2000/2001 there were many EC failures, both major initiatives and whole companies. Planners should study such failures, to learn what went wrong in the hope of avoiding such problems in the future. (For lessons for planners, see Useem, 2000; Agrawal et al., 2001; and Chapter 5 of this book.)
- **Use a different planning process.** The Web environment requires a different planning process, as illustrated by Turban et al. (2004).
- **Integration.** Information systems strategic planning must integrate, in many cases, e-business and knowledge management (see Galliers, 1999, for details).

Planning in a Turbulent Web Environment



The Web environment is very turbulent. Some people question the validity of formal planning in such an environment. Others insist that the turbulence makes formal planning a necessity. Samela et al. (2000) investigated the issue of planning in a turbulent environment in two organizations and concluded that a formal comprehensive approach may be more beneficial than not having a formal plan. Of course, generalizing from only two organizations may not tell the whole story. Samela and Spil (2002) recently suggested a continuous e-business planning process, with four basic planning cycles: (1) agreeing on planning objectives, (2) aligning business objectives and information objectives, (3) analyzing IS resources and IT infrastructure, and (4) authorizing actions. The four cycles are repeated each period in order to ensure continuous review and improvement of the strategies. (Details are shown in *Online File W9.9*).

Whether an organization uses formal planning for the Web environment or not, the planning of Web systems frequently requires redesign of business processes, our next topic.

9.7 BUSINESS PROCESS REDESIGN

Of the major environmental pressures described in Chapter 1, three are considered most important by Hammer and Champy (1993)—customers, competition, and change, known as the *three C's*. *Customers* today know what they want, what they are willing to pay, and how to get products and services on their own terms. Their considerable influence puts pressure on organizations to meet their terms, or lose their business. In addition, *competition* is generally increasing with respect to price, quality, selection, service, and promptness of delivery. The introduction of e-commerce has caused competition to intensify through removal of trade barriers, increased international cooperation, and the creation of technological innovations. Finally, *change* continues to occur. Markets, products, services, technology, the business environment, and people keep changing, frequently in an unpredictable and significant manner.

These pressures can be very strong in certain industries or countries, and they tend to be even stronger as time passes. Some of the conventional methods of organizational responses do not always work in this environment. Therefore, a more comprehensive response—called *business process redesign*—is sometimes called for. Of the organizational responses to environmental pressures, business process redesign and its variants have received lots of management attention (e.g., see Evangelista and Burke, 2003, and Rajaram and Corbett, 2002). (One variant, and predecessor, of business process redesign is *business process reengineering*, or BPR.) These approaches encompass several of the responses described in Chapter 1. In this section we will explore the topic of business process redesign. Let's begin by looking at some of the drivers of redesign and BPR.

The Drivers of Process Redesign

A **business process** is a collection of activities that take one or more kinds of inputs and create an output. As indicated earlier, business processes may need to be redesigned in response to business pressures and/or to enable transformation to e-businesses. Here are some representative drivers behind the need to business process redesign:

- **Fitting commercial software.** It is frequently more economic to *buy* or *lease* software than to develop custom software. However, to reap the best benefit of buying or leasing software, it is best to use the software as it is. (Remember the Nike disaster discussed in Chapter 1.) But what if the software does not fit your business processes, and it is not possible or advisable to change the software? The best solution sometimes is to redesign the affected business processes. Typical software in this category is the functional information systems, ERP, business intelligence (Chapter 11), and profitability software.
- **Streamlining the supply chain.** As seen in Chapter 8, it is frequently necessary to change segments in the supply chain to streamline its operations and to better collaborate with business partners. Redesign is frequently done on small segments of the chain, but sometimes the entire chain is redesigned (e.g., the Orbis case of Chapter 1, where a linear chain was changed to a hub).
- **Participating in private or public e-marketplaces.** With the increased trend to use e-marketplaces (Chapter 5) comes the need to get connected to them, as well as to the organization's back-end processes. To enable such integration it is frequently necessary to redesign internal as well as external processes. The same is true with participating in auction sites. Not changing the processes results in manual operations (e.g., data entry) which may be expensive, slow, and error-prone.
- **Improving customer service.** To properly introduce CRM, it is often necessary to change business processes. As will be seen later in this chapter, centralizing 800 numbers and empowering frontline employees involve process restructuring.
- **Conducting e-procurement.** Introduction of e-procurement methods (Chapter 5) frequently requires complete redesign of the purchasing process (requisition, approval, control, and payment for purchases).
- **Enabling direct online marketing.** Many manufactures as well as wholesalers are using direct marketing to consumers, mostly via the Internet. Moving to such a business model requires design or redesign of order taking and order fulfillment.
- **Reducing cost and improving productivity.** For generations companies have sought to reduce costs and increase productivity. An example is industrial engineering methods. Many of these are part of continuous small improvements, while others require radical changes in business processes (e.g., see Barua et al., 2001, and Selladurai, 2002).
- **Automating old processes.** Many organizations believe that the solution to their problem is to automate business processes. While in some cases it make sense to do it, in many other it does not. Automating ineffective processes can result in only small savings, whereas restructuring can result in a much larger savings.

Several other drivers may contribute to the need for redesign. In the following sections we will describe some of them: reducing cycle time, need for customization, and empowering employees. Another of these drivers, the problem of the stovepipe, is described in *A Closer Look 9.2*.



A CLOSER LOOK

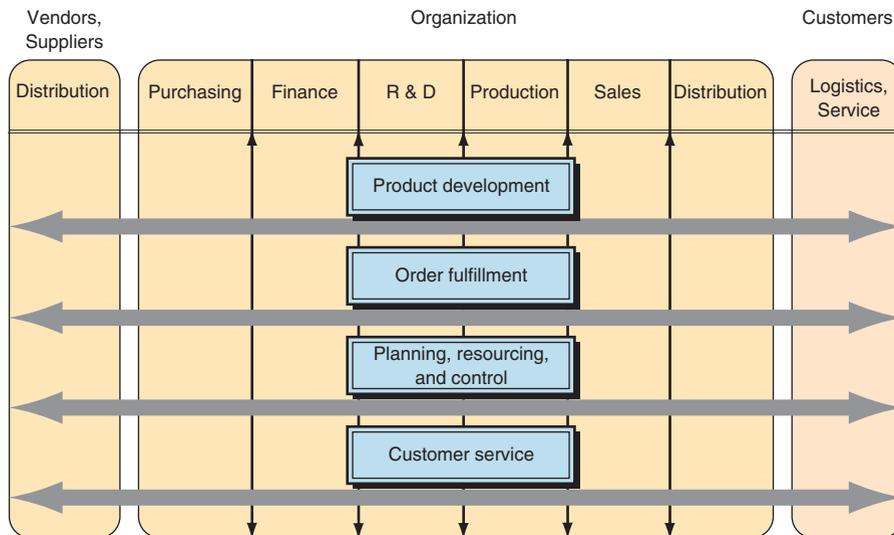
9.2 THE PROBLEM OF THE STOVEPIPE

All organizations have both horizontal and vertical dimensions. The organization's layers—usually top, middle, and low (supervisory) management—define the *horizontal* dimensions; the organization's functional departments define the *vertical* dimensions.

The vertical dimension of the organization, primarily focused on functional specialization, has caused many problems in organizations as they have tried to move into the information-based economy. One recurring problem is sometimes referred to as “stovepipes,” in recognition of its vertical nature. Because of the vertical structure of organizations, there is a lack of effective collaboration between

quality, control, and customer service are processes that can transcend the functional boundaries of several departments such as distribution, purchasing, research and development, manufacturing, and sales.

Here is an example of a stovepipe problem: A customer places an order with Sales. After a few days, she calls Sales to find out the status of the order. Sales calls various departments. Frequently, it is difficult to trace the order. People push the order from place to place and feel only a small sense of responsibility and accountability, so Sales may not be able to give the customer an answer in time, or may even give an incorrect answer. The problem



Business processes across functional areas and organizational boundaries

functional areas. Interaction among vertical functions—that is, across the “stovepipes”—turns out to be crucial in order for organizations to operate efficiently and effectively.

Often, the difference between duties of functional units and business processes in an organization is confused. The figure below illustrates how an organization can have vertical functions (the stovepipes) but also have processes, sometimes referred to as **cross-functional activities**, that transcend departmental boundaries. Product development, order processing, planning, sourcing,

of the stovepipe can intensify if the supporting information systems are improperly structured.

Focusing on vertical functions and their corresponding information systems to support the business has resulted in fragmented, piecemeal information systems that operate in a way in which the “left hand doesn’t know what the right hand is doing.” Integration of information is required for good decision making (see Chapter 7). Achieving it is one of the goals of business process redesign.

Methodologies for Restructuring

As indicated earlier, business process redesign was preceded by **business process reengineering (BPR)**, a methodology in which an organization *fundamentally* and *radically* redesigns its business processes to achieve *dramatic improvement*. Initially, attention in BPR was given to *complete restructuring* of organizations (Hammer and Champy, 1993). Later on, the concept was changed to include only one of a few processes (rather than an entire organization) due to numerous failures of BPR projects (e.g., Sarker and Lee, 1999) and the emergence of Web-based applications that solved many of the problems that BPR was supposed to solve.

Today, the concept of BPR has been modified to *business process redesign*, which can focus on anything from the redesign of an individual process, to redesign of a group of processes (e.g., all the processes involved in e-procurement), to redesign of the entire enterprise (see El Sawy, 2001). The redesign of several processes became a necessity for many companies aspiring to transform themselves to e-businesses. For principles of redesign, see *Online File W9.10*. For a table showing how BPR has changed with time and with technology development, see *Online File W9.11*. And finally, for a tutorial on the first wave of BPR (many of whose features exist in the second wave), see *Online File W9.12*.



BUSINESS PROCESS MANAGEMENT. **Business process management (BPM)** is a new method for restructuring that combines workflow systems (Chapter 4) and redesign methods. This emerging methodology covers three process categories—people-to-people, systems-to-systems, and systems-to-people interactions—all from a process-centered perspective. In other words, BPM is a blending of workflow, process management, and applications integration. Le Blond (2003) describes the use of BPM in McDonald's Singapore operations. One area of redesign there was the scheduling of crews at McDonald's restaurants; several other successful applications related to performance improvements. (Staffware Inc., a BPM software vendor and consultant, provides a free online demo as well as case studies at *staffware.com*. For comprehensive coverage see also Smith and Fingar, 2002).

The conduct of a comprehensive business process redesign, or even of the redesign of only one process, is almost always enabled by IT, which we address in the next section.

9.8 THE ROLE OF IT IN BUSINESS PROCESS REDESIGN

IT has been used for several decades to improve productivity and quality by automating existing processes. However, when it comes to restructuring or redesign, the traditional process of looking at problems first and then seeking technology solutions for them may need to be reversed. A new approach is first to recognize powerful redesign solutions that restructuring and BPR make possible, and then to seek the processes that can be helped by such solutions. This approach requires *inductive* rather than *deductive* thinking. It also requires innovation, since a company may be looking for problems it does not even know exist.

IT can break old rules that limit the manner in which work is performed. Some typical rules are given in Table 9.3. IT-supported redesign and BPR examples can be found in any industry, private or public (e.g., MacIntosh, 2003 and

TABLE 9.3 Changes in Business Processes Brought by IT

Old Rule	Intervening Technology	New Rule
Information appears in only one place at one time.	Shared databases, client/server architecture, Internet, intranets	Information appears simultaneously wherever needed.
Only an expert can perform complex work.	Expert systems, neural computing	Novices can perform complex work.
Business must be either centralized or distributed.	Telecommunications and networks: client/server, intranet	Business can be both centralized and distributed.
Only managers make decisions.	Decision support systems, enterprise support systems, expert systems	Decision making is part of everyone's job.
Field personnel need offices to receive, send, store, and process information.	Wireless communication and portable computers, the Web, electronic mail	Field personnel can manage information from any location.
The best contact with potential buyers is a personal contact.	Interactive videodisk, desktop teleconferencing, electronic mail	The best contact is the one that is most cost-effective.
You have to locate items manually.	Tracking technology, groupware, workflow software, search engines	Items are located automatically.
Plans get revised periodically.	High-performance computing systems, intelligent agents	Plans get revised instantaneously whenever needed.
People must come to one place to work together.	Groupware and group support systems, telecommunications, electronic mail, client/server	People can work together while at different locations.
Customized products and services are expensive and take a long time to develop.	CAD/CAM, CASE tools, online systems for JIT decision making, expert systems	Customized products can be made quickly and inexpensively (mass customization).
A long period of time is spanned between the inception of an idea and its implementation (time-to-market).	CAD/CAM, electronic data interchange, groupware, imaging (document) processing	Time-to-market can be reduced by 90 percent.
Organizations and processes are information-based.	Artificial intelligence, expert systems	Organizations and processes are knowledge-based.
Move labor to countries where labor is inexpensive (off-shore production).	Robots, imaging technologies, object-oriented programming, expert systems, geographical information systems (GIS)	Work can be done in countries with high wages and salaries.

Source: Compiled from M. Hammer and J. Champy, *Re-engineering the Corporation* (New York: Harper Business, 1993).

Khan, 2000). The role of IT in redesigning business processes can be very critical and is increasing due to the Internet and intranets. For example, Geoffrey (1996) provides several examples of how intranets have *rescued* BPR projects (Salladurai, 2002).

Need for Information Integration

One objective of redesign is to overcome problems such as that of the stovepipe, by *integrating* the fragmented information systems. (Some integration solutions were described in Chapters 4, 7, and 8.) Besides creating inefficient redundancies, information systems developed along departmental or functional boundaries cause difficulties in generating the information that is required for effective decision making. For instance, consider a case where the management of a bank wants to offer more mortgage loans to better utilize large savings deposits. Management decides to send letters encouraging specific customers to consider buying homes, using



IT At Work 9.4

VW OF MEXICO SHIFTED TO E-PROCUREMENT



Facing strong competition and the North American Free Trade Agreement (NAFTA) environment, Volkswagen of Mexico (*vw.com.mex*) turned to IT. In 1996, VW implemented an ERP system, using SAP R/3 software. By 1998, the company integrated its enterprise system, which was used to cut inventory and production costs, with an extranet, which streamlined spare-parts ordering by its dealers in Mexico. The major reason for the project was the increased demand that resulted from NAFTA and from VW's decision to market the Beetle (called the "New Beetle") in the United States and Canada. These cars are manufactured in Mexico, where labor and services are cheaper.

The integrated system allows people at every level of the company, from manufacturing to car servicing at the dealership, to take advantage of the SAP system. The SAP system integrates the manufacturing, finance, marketing, and other departments among themselves and, thanks to the extranet, now also links these departments with the dealers and business partners. In order to implement SAP, VW had to redesign many of its production, accounting, and sales processes. This was done using some of the methods we describe later in this chapter.

The R/3 system orchestrates all the different areas of the manufacturing and parts-ordering tasks, such as supplier orders, reception, warehousing, client orders, packing, and billing. By tapping into R/3 modules, the dealers can cut the turnaround time for ordering spare parts from 10 days to fewer than 5—a very important competitive advantage. The dealers can check the status of their orders on the computer.

One problem with the integrated system is that some of the dealers in Mexico were not ready to buy, install, and use computers. However, the fact that the new system means a low inventory level, which can save the dealers considerable money, motivated them to join in. The company projected that the application will result in \$50 million in cost savings over three years for the dealers.

Sources: Compiled from *PC Week* (1998), and from press releases of *vw.com.mex* (1999–2002).

For Further Exploration: Can VW's suppliers be added to the system? What competitive advantage could be realized with such an addition?

convenient financing available through the bank. Management also decides that the best customers to whom to send such letters are: customers who do not currently have mortgage loans or who have loans for a very small percentage of the value of their homes; customers who have good checking account records (e.g., few or no overdrafts); customers with sufficient funds in their savings accounts to make a down payment on a home; and customers with good payment records on installment loans with the bank.

Because the data necessary to identify such customers may be available in different files of different information systems, there may be no convenient or economical way to integrate them. Using innovations such as *data warehouses* and special integrated software can be helpful, but expensive. Therefore, extensive programming and clerical work are required to satisfy such an information request. The scenario of the bank can be translated into other organizational settings.

Integration should cross not only departmental boundaries but also organizational ones, reaching suppliers and customers. Namely, it should work along the *extended supply chain*. This is especially important in company-centric B2B e-marketplaces and in B2B exchanges (see Chapter 5). An example of an internal integration followed by integration with dealers is provided in *IT At Work 9.4*.

The integration of an organization's information systems enables redesign innovations such as the introduction of a single point of contact for customers,



called a *case manager* or a *deal structurer*. We can see how this single point of contact works by looking at a credit-approval process at IBM. The old process took seven days and eight steps. It involved creation of a paper folder that was routed, sequentially, through four departments (sales, credit check, business practices, finance, and back to sales). In the redesigned process, one person, the deal structurer, conducts all the necessary tasks. This one generalist replaced four specialists. To enable one person to execute the above steps, an intelligent DSS (Chapter 12) provides the deal structurer with the guidance needed. The program guides the generalist in finding information in the databases, plugging numbers into an evaluation model, and pulling standardized clauses—“boilerplates”—from a file. For difficult situations, the generalist can get help from a specialist. As a result, the turnaround time has been slashed from seven days to four hours.

Retooling of IT for Business Process Redesign

Redesign of business processes often means a need to change some or all of the organizational information systems. The reason for this is that information systems designed along hierarchical lines may be ineffective in supporting the redesigned organization. Therefore, it is often necessary to redesign the information systems. This process is referred to as *retooling*.

Retooling focuses on making sure the information systems are responsive to the processes-redesign effort and to the use of e-business. Many organizations found that once they realized they had a business problem and wanted to do something about it, their information systems function could not accommodate the desired changes. For example, a government agency in Singapore decided to defer a badly needed BPR project when it discovered that it would cost over \$15 million just to rewrite the applicable computer programs.

To retool for redesign, a key issue is getting a good understanding of the current installed base of IT applications and databases. It is also important to understand the existing infrastructure in terms of computing devices, networks, and the like, and their relationships to the current available software, procedures, and data. Another key issue is an assessment of what the ideal IT architecture would be for the organization in terms of hardware and software, as well as an appropriate information architecture.

In planning a retooling, it is very important to *benchmark* the technology being used in the organization against what the best competitors are using. It is also imperative to find out what the latest technologies are and to determine in what direction the organization needs to go. For an example of a massive IT retooling in a public agency, in which the technology enabled the company to restructure all its major business processes, see Tung and Turban (1996).

IT INFRASTRUCTURE AND DEVELOPMENT SOFTWARE FOR BUSINESS PROCESS REDESIGN.

Information technology can either enable or constrain successful redesign and BPR. The links between enterprise IT infrastructure and business-process change were explored by Broadbent et al. (1999). Exploratory case analysis of four firms was used to understand the ways IT infrastructure contributes to success in implementing redesign and BPR. The researchers found that all firms needed a basic level of IT infrastructure capability in order to implement process redesign and especially BPR. The firms that had developed a higher level of IT infrastructure capabilities, before or concurrent with undertaking business process redesign, were able to implement extensive changes to their business processes over relatively short time frames.

IT TOOLS FOR BUSINESS PROCESS REDESIGN AND BPR. A large variety of IT tools can be used to support redesign and BPR. Some of these tools are generic and can be used for other purposes, while others are specifically designed for redesign and BPR. Let's elaborate.

Special BPR and process redesign software. According to El Sawy (2001), special BPR software enables the capture of the key elements of a business process in a visual representation made up of interconnected objects on a time line. The elements of this visual representation usually include activities, sequencing, resources, times, and rules. BPR software is much more than drawing or flowcharting software in that the objects on the screen are intelligent and have process and organizational data and rules associated with them. The software is also interactive, in real time. BPR software may incorporate some aspects of project management in terms of allocating resources and costs to work activities and their time sequencing. BPR software also has "what-if" capabilities in that it enables process simulation and performance comparison of alternative process designs. The better BPR software packages are quite intuitive and relatively easy to learn. The 10 major reasons why special BPR software is of value for business process redesign are summarized in *Online File W9.13*.

The most comprehensive special BPR suite, which includes many functionalities, was BPR Workflow from Holosofx (now a part of IBM's WebSphere). For a detailed description of this package and usable software, see El Sawy, 2001. In addition to BPR Workflow one can find integrated BPR tool kits in some ERP software (e.g., see Oracle 9i and SAP R/3).

Some people believe that BPR can be done with CASE tools (Chapter 14). This is not the case, since CASE tools can be used to execute only a few BPR activities, and they are difficult to use. Other believe that workflow tools can be used. Again, this is true only for some redesign activities. Furthermore, the workflow capabilities in custom-designed BPR software are usually superior to those of generic tools. However, for many projects there is no need for a comprehensive suite; in those situations, generic tools or special tools designed to be used for only one or two BPR activities are both efficient and effective. For a listing of some generic and single-activity tools that may be of use in business process redesign, see *Online File W9.14*.



9.9 RESTRUCTURING PROCESSES AND ORGANIZATIONS

Redesign, restructuring, and reengineering efforts involve many activities, four of which are described in this section: redesign of processes, mass customization, cycle time reduction, and restructuring the entire organization. In this section we also look at some BPR failures.

Redesign of One or a Few Processes

Redesign efforts frequently involve only one or a few processes. One of the most publicized examples of business process redesign is the accounts payable process at Ford Motor Company described in *IT At Work 9.5*. The Ford example demonstrates changes in a simple process. Khan (2000) describes the restructure of an air cargo process that was much more complicated and involved several IT tools.

Mass Customization

One of the most successful models of e-commerce is build-to-order, which is implemented via mass customization. (See Appendix 3.1.) The concept of *mass*



IT At Work 9.5 REENGINEERING PROCESSES AT FORD MOTOR COMPANY



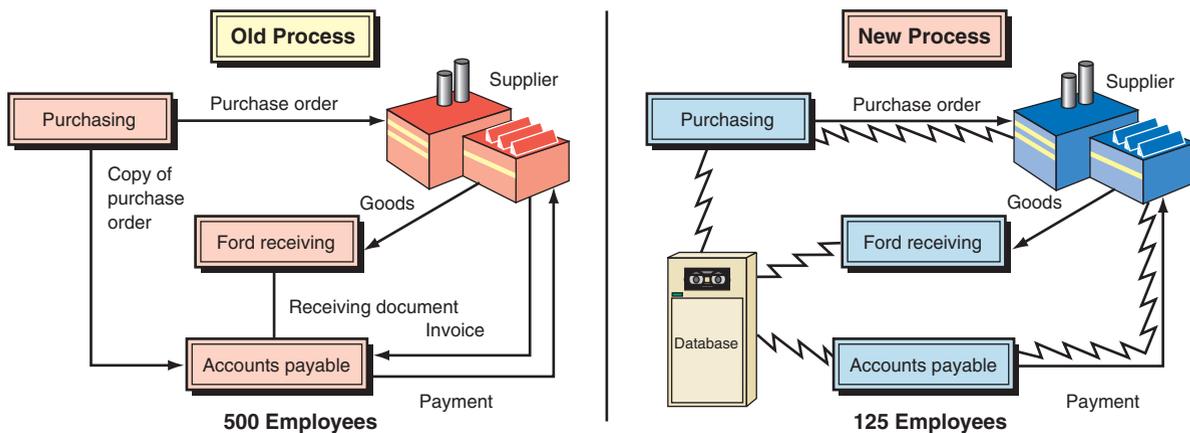
As part of its productivity improvement efforts, the management of Ford Motor Company (*ford.com*) put its North American Accounts Payable Department under the microscope in search of ways to cut costs. Management thought that by streamlining processes and installing new computer systems, it could reduce the head count by some 20 percent, to 400 people.

But after visiting Mazda's account payables department (Ford is part owner of Mazda), Ford managers increased their goal: perform accounts payable with only 100 clerks. Analysis of Ford's old system revealed that when the purchasing department wrote a purchase order, it sent a copy to accounts payable. Later, when material control received the goods, it sent a copy of the receiving document to accounts payable. Meanwhile, the vendor also sent an invoice to accounts payable. If the purchase order, receiving document, and invoice all matched, then accounts payable issued a payment. Unfortunately, the department spent most of its time on many mismatches. To prevent them, Ford instituted "invoiceless processing." Now, when the purchasing department initiates an order, it enters the

system. (If there is no database entry for the received goods, or if there is a mismatch, the clerk returns the goods.)

Under the old procedures, the accounting department had to match 14 data items among the receipt record, the purchase order, and the invoice before it could issue payment to the vendor. The new approach requires matching only four items—part number, amount, unit of measure, and supplier code—between the purchase order and the receipt record. The matching is done automatically, and the computer prepares the check, which accounts payable sends to the vendor (or an electronic transfer is made). There are no invoices to worry about since Ford has asked its vendors not to send them. The restructured system as compared to the old one is shown in the figure below.

Ford did not settle for the modest increases it first envisioned. Instead it opted for a radical change, and it achieved dramatic improvement: a 75 percent reduction in head count, not the 20 percent it would have achieved with a conventional improvement program. And since there are no discrepancies between the financial record and physical record, material control is simpler, receipts are



Reengineering processes at Ford Motor Company

information into an online database. It does not send a copy of the purchase order to anyone. The vendor receives notification through an EDI.

When the goods arrive at the receiving dock, the receiving clerk checks the database to see whether the goods correspond to an outstanding purchase order. If so, he or she accepts them and enters the transaction into the computer

more likely to be correct, and financial information is more accurate.

Source: Condensed from Hammer and Champy (1993).

For Further Exploration: How did the EDI help attain the reduction? What other support was provided by IT?

customization involves production of large quantities of customized items, as Dell is doing with personal computers (e.g., see Pine and Davis, 1999, and Gilmore and Pine, 2000). Mass customization enables a company to provide flexible and quick responsiveness to a customer's needs, as expressed in their self-configured orders, at a low cost and with high quality. A build-to-order strategy is made possible by allowing fast and inexpensive production changes, by reducing the ordering and sales cycle time using e-commerce, and by shortening the production time (e.g., by using prefabricated parts and sub-assemblies). Often, such a mass customization strategy must be preceded and/or supported by a business process redesign.

Cycle Time Reduction

Cycle time refers to the time it takes to complete a process from beginning to end. As discussed earlier, competition today focuses not only on cost and quality, but also on speed. Time is recognized as a major element that provides competitive advantage, and therefore **cycle time reduction** is a major business objective.

The success of Federal Express, for example, is clearly attributable to its ability to reduce the delivery time of packages. It does this by using complex computer-supported systems that allow flexible planning, organization, and control (see Wetherbe, 1996). The comeback of Chrysler Corporation and its success in the 1990s can be attributed largely to its "technology center," which brought about a more than 30 percent reduction in its time to market (the time from beginning the design of a new model to the delivery of the car). General Motors achieved even larger reduction of delivery times in recent years (see case in Chapter 8). Boeing Corporation reengineered its design of airplanes by moving to total computerization. In a fundamental change to Boeing's processes, a physical prototype was never built. In addition to reducing the cycle time, Boeing was able to improve quality and reduce costs. Because of these changes, Boeing was able to compete better with Airbus Industries.

Notice that in Boeing's, GM's, and Chrysler's cases the change was *fundamental* and *dramatic*. First, the role of the computer was changed from a tool to a platform for the total design. Second, it was not just a process change, but a *cultural change* relative to the role of the computer and the design engineers. According to Callon (1996), the engineers are now a part of a computer-based design system. Computing also played a major communications role during the entire design process. As was shown in the Ford case (*IT At Work 9.5*), IT makes a major contribution in shortening cycle times by allowing the combination or elimination of steps and the expediting of various activities in the process. In Chapter 2 we demonstrated a significant reduction in cycle time achieved by Dell due to introduction of Web Services and redesigning the communication processes between the manufacturing plants and the suppliers.

There is an old saying that "time is money," so saving time saves money. But cycle time reduction does more than save money. If you beat your competitors with a new product, a product improvement, or a new service, you can gain a substantial market share. Pharmaceutical companies, for example, are desperately trying to reduce the cycle time of new drugs. If successful, they will be the first on the market, they may receive a patent on the innovation, and revenues will begin flowing sooner to repay their huge investments.

Additionally, the Internet, extranets, and intranets provide a means of economically reducing cycle time by cutting communications time through the use

of e-mail and EDI (also Internet/EDI) and by allowing collaboration in design and operations of products and services (see Chapter 8).

Restructuring the Whole Organization

We've seen that one problem in many current organizations is vertical structures. How should a contemporary organization be organized? There are several suggestions of how to do it. Let's look at how it is done with business process redesign.

The fundamental problem with the hierarchical organizational structure is that any time a decision needs to be made, it must climb up and down the hierarchy. If one person says "no" to a pending decision, everything comes to a screeching halt. Also, if information is required from several "functional sources," getting all the right information coordinated can be a time-consuming and frustrating process for employees and customers alike.

So, how is organizational redesign done? It varies, depending on the organization and the circumstances. For example, providing each customer with a single point of contact can solve the stovepipe problem described earlier. In the traditional bank, for example, each department views the same customer as a separate customer. Figure 9.7 depicts a redesigned bank in which the customer deals with a single point of contact, the account manager. The account manager is responsible for all bank services and provides all services to the customer, who receives a single statement for all of his or her accounts and can access all accounts on the same Web page. Notice that the role of IT is to back up the account manager by providing her with expert advice on specialized topics, such as loans. Also, by having easy access to the different databases, the account manager can answer queries, plan, and organize the work with customers.

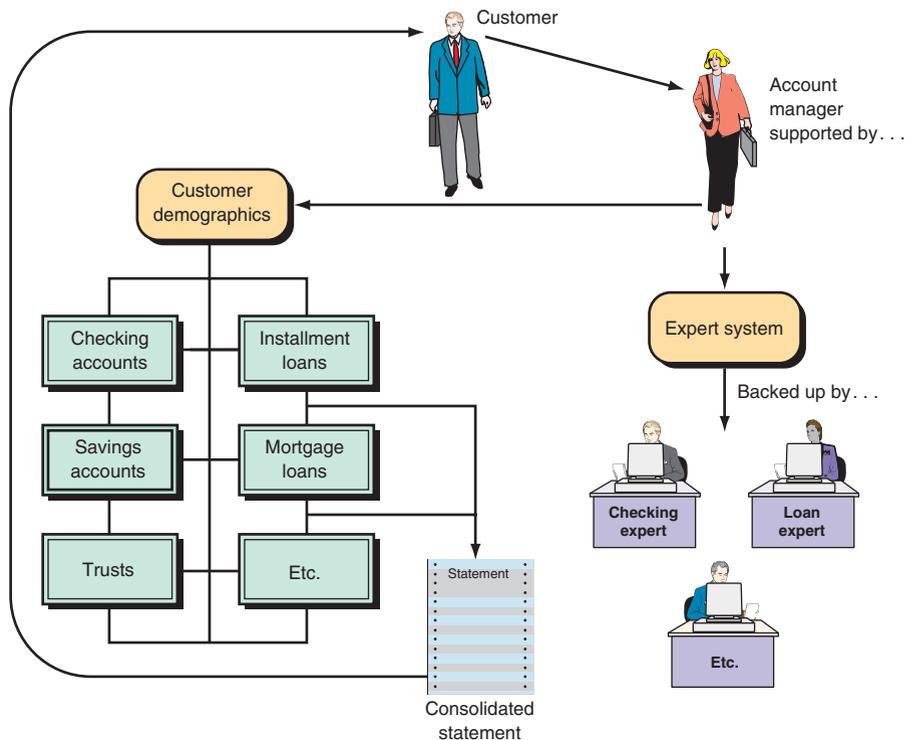


FIGURE 9.7
Reengineered bank with integrated system.

An alternative to the single-point contact is a networked structure, usually supported by a call center. In this structure, regardless of where and when a client contacts the company, the networked agents would have access to all customer data, so that *any* employee can provide excellent customer service. Companies such as USAA, Otis Elevator, and others have all agents located in one city and give customers all over the country the same toll-free number and a centralized Web address. In this model, the company also can install a computer-based call-center technology, which brings up complete customer information (or information about a customer's elevator in the case of Otis) on the computer screen, whenever a customer calls. This means that anyone who answers the call would know all the information necessary to make a quick, frontline decision (see Chapter 12). There is no need to ask questions of the customer, and any agent can give personalized and customized service. This is especially important in services such as reservation systems for hotels or airlines, as well as for utility companies, financial services, universities and health care services.

Reengineering and restructuring is not limited to a specific type of organization. Studies indicate that 70 percent of all large U.S. corporations are reengineering or considering some major redesign projects. In addition, the public sector, including the U.S. federal government, is continuously implementing restructuring projects. See *IT At Work 9.6*, which describes one such project by the U.S. federal government.



IT At Work 9.6

INFORMATION TECHNOLOGY IN RESTRUCTURING THE FEDERAL GOVERNMENT



The U.S. federal government is using IT to streamline its bureaucracy and improve public services. The plan is to create an “electronic government,” moving from the Industrial Age into the Information Age. It is also part of e-government, where processes are being redesigned to enable e-purchasing and other EC activities. For detail of the plan see E-Government Strategy (2003).

Information technology is playing a key role in such restructuring of government operations and services. The document cited above describes the new e-government systems as a “virtual agency” in which information is shared throughout the government. The U.S. Department of Agriculture already distributes food stamps electronically. Medicare payments may be integrated into that system (expected in 2004). Other e-government services being proposed include a national network serving law enforcement and public safety agencies; electronic linkage of tax files at federal, state, and local agencies; an interna-

tional trade data system; a national environmental data index; government wide electronic mail; and an integrated information infrastructure, including consolidated data centers. Various IT teams are also looking at client/server networks and intranets to eliminate the need for large mainframe data centers. Tens of millions of U.S. citizens receive Social Security and other payments periodically. The distribution of these services is also moving to the Internet for greater savings and shorter cycle times. Smaller countries such as Hong Kong and Singapore already restructured many of their services to go online (e.g., see *ecitizen.gov.sg* and *cnfo.gov.hk*).

Sources: Compiled from *npa.gov* (1998), *fcw.com*, *govexec.com* and *e-Government Strategy* (2003).

For Further Exploration: Why are these systems referred to as a virtual agency? Is so much computerization of the government beneficial? Why or why not?



Virtual Organizations

One of the most interesting organizational structures is the *virtual organization*, also referred to as a *virtual corporation (VC)*. The creation, operation, and management of a virtual organization is heavily dependent on IT and is especially facilitated by the Internet and e-commerce (see Venkatraman and Henderson, 1998).

DEFINITION AND CHARACTERISTICS. A **virtual organization (virtual corporation, VC)** is an organization composed of several business partners sharing costs and resources for the purpose of producing a product or service. In a virtual organization the resources of the business partners remain in their original locations but are integrated. The virtual organization can be temporary, with a onetime mission such as launching a satellite, or it can be permanent. According to Goldman et al. (1995), permanent virtual corporations are designed to: (1) create or assemble productive resources rapidly, (2) create or assemble productive resources frequently and concurrently, and (3) create or assemble a broad range of productive resources. They are considered permanent in that they expect to continue their activities indefinitely.

The virtual organization is usually composed of several business units, each in a different location. Each partner contributes complementary resources that reflect its strengths and determine its role in the virtual enterprise. VCs are not necessarily organized directly along the supply chain. For example, a virtual business partnership may include several partners, each creating a portion of a product or service, in an area in which each has special advantage such as expertise or low cost.

The concept of virtual organizations is not new, but recent developments in IT allow new implementations that exploit its capabilities (see Suhas, 2000). The modern virtual organization can be viewed as a *network* of creative people, resources, and ideas connected via online services and/or the Internet, who band together to produce products or services. The major attributes of virtual organizations are:

- **Excellence.** Each partner brings its core competency, so an all-star winning team is created. No single company can match what the virtual corporation can achieve.
- **Utilization.** Resources of the business partners are frequently underutilized, or utilized in a merely satisfactory manner. In the virtual corporation, resources can be put to use more profitably, thus providing a competitive advantage.
- **Opportunism.** The partnership is opportunistic. A virtual organization is organized to meet a market opportunity.
- **Lack of borders.** It is difficult to identify the boundaries of a virtual corporation; it redefines traditional boundaries. For example, more cooperation among competitors, suppliers, and customers makes it difficult to determine where one company ends and another begins in the virtual corporation partnership.
- **Trust.** Business partners in a VC must be far more reliant on each other and require more trust than ever before. They share a sense of destiny.
- **Adaptability to change.** The virtual corporation can adapt quickly to the environmental changes discussed in Chapter 1 because its structure is relatively simple or fluid.



- **Technology.** Information technology makes the virtual organization possible. A networked information architecture is a must.

For an analysis of why virtual organizations work, see Markus et al. (2000). For strategies used by virtual organizations, see Venkatraman and Henderson (1998).

HOW IT SUPPORTS VIRTUAL ORGANIZATIONS. There are several ways for IT to support virtual organizations. The most obvious are those that allow communication and collaboration among the dispersed business partners. For example, e-mail, desktop videoconferencing, screen sharing, and several other groupware technologies described in Chapter 4 are frequently used to support virtual corporations.

Since the partners in a virtual organization are in different locations, they need information systems for supporting communication and collaboration. Such systems are a special case of interorganizational information systems (IOSs)—information systems that cross organizational lines to one or more business partners (see Chapter 8). Standard transactions in the interorganizational information systems are supported by extranets, Internet/EDI, and EFT (see Chapter 5).

The Internet is the infrastructure for these and other technologies used by VCs. Virtual office systems, for example, can be supported by intelligent agents. Modern database technologies and networking permit business partners to access each other's databases. Lotus Notes and similar integrated groupware tools permit diversified interorganizational collaboration. Turban et al. (2004) provide numerous examples of collaborative applications. ERP software is extensively used to support standard transactions among business partners. In general, most virtual organizations cannot exist without IT. (For a survey of other tools see Boudreau et al., 1999; for the effect of IT on VCs, see Peng and Chang, 2000.)

9.10 ORGANIZATION TRANSFORMATION AND CHANGE MANAGEMENT

The examples in the previous sections demonstrated restructuring and BPR approaches that can be helpful in solving problems and exploiting opportunities created by the changing business environment. Such approaches need to be introduced into an organization and accepted by its members. Major organizational changes such as transformation to e-business (Siemens case, Chapter 1) are referred to as *organization transformation*; such major transformation usually requires *change management*. In this section we also address the topics of empowerment and BPR failures and successes.

Organization Transformation

Introducing a corporate wide e-business or other major business process redesign is likely to result in transforming an old organization to a new one. Generally speaking, **organization transformation** refers to an organization with a "new face," whose business processes, structure, strategy, and procedures are completely different from the old one. Taking an organization through a radical transformation can be a lengthy, expensive, and complex process, which may involve organizational learning, changes in management and personnel, creation of a new structure, and employee retraining.

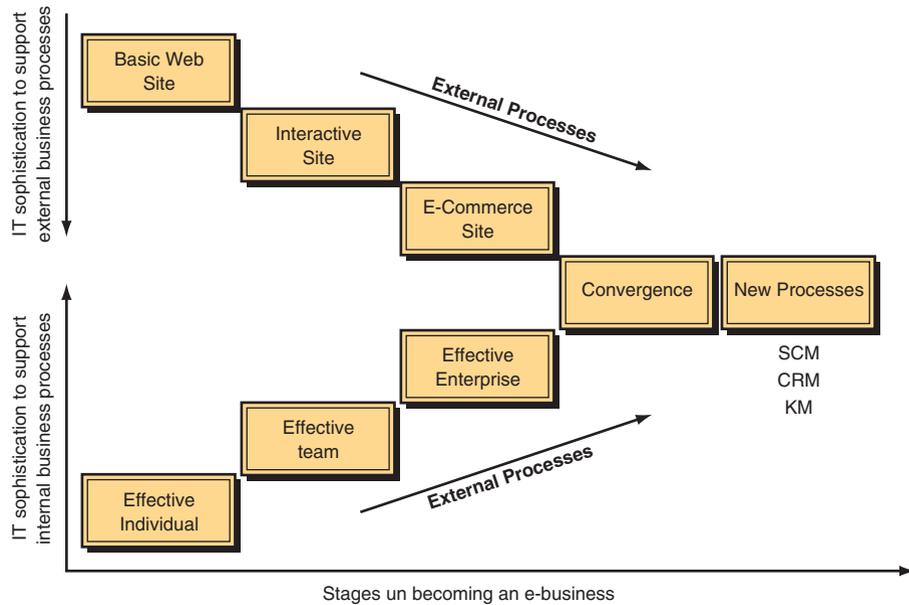


FIGURE 9.8 Roadmap to becoming e-Business. (Source: Ginige et al., (2001), Figure 2, p. 43.)

A major organization transformation, which many companies have had to face recently, is transformation to an e-business.

TRANSFORMATION TO AN E-BUSINESS. Transforming an organization to e-business, especially for a large company, can be very complex endeavor. (Recall the Siemens case, Chapter 1). To do so, the organization needs to transform several major processes, such as procurement, sale, CRM, and manufacturing.

Such a transformation involves several strategic issues. Lasry (2002) raises several of these issues when investigating the rate at which “brick-and-mortar” retail firms adopt the Web as an additional sales channel. He examined organizational strategies such as internal restructuring, forming a joint venture, or outsourcing. He concluded that implementing EC requires a disruptive and potentially hazardous change in core features, and therefore he suggested that companies spin off the EC activities as part of the transformation process.

Ginige et al. (2001) provide a comprehensive description of the transformation to e-business, describing both the internal and external processes supported by IT, as shown in Figure 9.8. They then showed the support of IT to each stage, as shown in *Online File W9.15*. Finally they describe the necessary change management activities.

Several other studies are dedicated to the transformation to e-business. For example, Chen and Ching (2002) explored the relationship of BPR and e-business and investigated the change process both for individuals and organizations. They proposed a process of redesigning an organization for e-business, providing several research propositions. Bosilj-Vuksic et al. (2002) explored the use of simulation modeling for enabling transformation to e-business. They examined the process of BPR and suggested how to use simulation and process maps to support the process. Lee (2003) described the use of business intelligence (Chapter 11) and

intelligent systems (Chapter 12) to facilitate the transformation of process and data to e-business.

An organization transformation process is facilitated by change management.

Change Management

Changing business processes, organizational structure, operating procedures, and so forth are interrelated, as shown by the classic Scott-Morton framework (see *Online File W1.4*). Major changes in business processes and/or in technology move organizations out of equilibrium, creating changes in structure, strategy, and in people and their roles. When the magnitude of the changes is significant, the changes may be resisted by employees. Change is a learning process that need to be properly managed. Management scholars have developed guidelines for how to introduce change into organizations (e.g., see Mintzberg and Westley, 1992, and Anderson, 2001) and how to diffuse innovations into organizations (e.g., see Rogers, 1983).

The faster the speed of change, the more difficult and stressful it is to manage it. Moving to e-business is very rapid, and so are many redesign projects. The classic change management approaches, such as use of benchmarking (Clarke and Manton, 1997), were adapted for IT changes. For example, Burn and Ash (2001) developed a model for introducing e-business changes in an ERP environment.

Of the many topics related to organization transformation and change management, we will deal here only with two: changing organizational structures, and empowerment of employees. The related topics are also important but are outside the scope of this textbook.

Changing Organizational Structure



A major issue in organization transformation, including transformation to e-business, is the change in organizational structure. One common potential change is to a networked organization.

Many experts have advocated the concept of networked organizations (e.g., see Majcharzak and Wang, 1996). The term **networked organizations** refers to organizational structures that resemble computer networks and are supported by information systems. This structure is promising, but it is difficult to implement. (See *Online File W9.16*.)

The tendency in recent years has been for organizations to become somewhat “flatter” in terms of management layers, and managerial roles and organizational processes have been changing to follow this trend. Although the basic hierarchical structure is still most common, many organizations use temporary and/or permanent teams that are assigned to specific processes. For the use of teams as they related to business process and work redesign, see Choudrie et al. (2002) and Launonen and Kess (2002). Team-based structure requires empowerment of employees.

Empowerment Using IT

Empowerment is the vesting of decision-making or approval authority in employees in situations in which such authority was traditionally a managerial prerogative. Empowered employees are allowed to make operational and managerial decisions. Empowerment frequently accompanies redesign efforts. As a philosophy and set of behavioral practices, empowerment means allowing self-managing autonomous teams (e.g., see Hinks, 2002) or individuals to be in



charge of their own career destinies, as they work toward company and personal goals through a shared company vision (see Murrell and Meredith, 2000).

EMPOWERMENT'S RELATIONSHIP TO INFORMATION TECHNOLOGY. Empowerment can be enhanced through IT. Perhaps IT's most important contribution is the provision of the right information, at the right time, at the right quality, and at the right cost. Information is necessary, but it may not be sufficient. To be fully empowered means to be *able to make decisions*, and these require *knowledge*. Knowledge is scarce in organizations, and specialists usually hold it. To empower employees means to increase the availability of such knowledge. Expert systems and other intelligent systems can play a major role in knowledge sharing, as can the Internet and intranets.

Empowered employees are expected to perform better, and to do so, they may need new tools. Information technology can provide, for example, tools that will enhance the creativity and productivity of employees, as well as the quality of their work. These tools can be special applications for increasing creativity (Chapter 12), spreadsheets for increasing productivity, and hand-held computers to improve communication. Examples are provided in Chapters 4 and 7.

Finally, empowerment may require training. Self-directed teams, for example, may need more skills and higher levels of skills. Once organized, teams will require training, which can be provided by IT. For example, many companies provide online training, use multimedia, and even apply intelligent computer-aided instruction.

EMPOWERMENT OF CUSTOMERS, SUPPLIERS, AND BUSINESS PARTNERS. In addition to empowering employees, companies are empowering their customers, suppliers, and other business partners. For example, Levi Strauss & Company allows its textile suppliers to access its database, so they know exactly what Levi Strauss is producing and selling and can ship supplies just in time. The company is using a similar approach with all its suppliers. Federal Express is using the Internet to empower its customers to check prices, prepare shipping labels, find the location of the nearest drop box, and trace the status of packages. Finally, Dell empowers its customers to configure and track orders and troubleshoot problems.

The topics we have considered in this section—organization transformation, change management, and empowerment—can have a significant impact in determining success or failure in business process redesign.

BPR Failures and Successes

During the 1990s, there were many success stories of BPR (Grant, 2002, El Sawy, 2001) and just as many cases of failures.



FAILURES. The PROSCI organization conducted a survey of several hundred companies to learn the best BPR practices and the reasons for BPR failures, which can be found at the organization's Web site (prosci.com). Another summary of research into business process redesign failure is available at managingchange.com/bpr/bprcult/4bprcult.htm. The summary indicates a failure rate of 50 to 80 percent. According to Grant (2002) at least 70 percent of all BPR projects fail. Some of the reasons cited for failure are high risk, inappropriate change management, failure to plan, internal politics, high cost of retooling, lack of participation and leadership, inflexible software, lack of motivation, and lack of top management

support. A highly detailed case study on BPR failures is provided by Sarker and Lee (1999). For more on BPR failures and suggestions on how to avoid them, see El Sawy (2001).

BPR SUCCESSES. Despite the high failure rate of business process redesign, there are many cases of success, especially when less than the entire organization is restructured. While BPR failures tend to get more widespread publicity, success stories are published mostly by vendors and in academic and trade journals. For example, there is evidence of the success of BPR in the public sector (MacIntosh, 2003). Khong and Richardson (2003) report on extensive BPR activities and successes in banking and finance companies in Malaysia, and Mohanty and Deshmukh (2001) found successful BPR initiatives in a large cement manufacturing plant in India. (For details, see *Online File W9.17*). Organizations should consider restructuring their business processes or sometimes the entire businesses (see opening case, Chapter 1). When successful, redesign has great potential to improve an organization's competitive position.



➔ MANAGERIAL ISSUES

- 1. Importance.** Getting IT ready for the future—that is, planning—is one of the most challenging and difficult tasks facing all of management, including IS management. Each of the four steps of the IT strategic planning process—strategic planning, information requirements analysis, resource allocation, and project planning—presents its own unique problems. Yet, without planning, or with poor planning, the organization may be doomed.
- 2. Organizing for planning.** Many issues are involved in planning: What *should* be the role of the ISD? How should IT be organized? Staffed? Funded? How should human resources issues, such as training, benefits, and career paths for IS personnel, be handled? What about the environment? The competition? The economy? Governmental regulations? Emerging technologies? What is the strategic direction of the host organization? What are its key objectives? Are they agreed upon and clearly stated? Finally, with these strategies and objectives and the larger environment, what strategies and objectives should IS pursue? What policies should it establish? What type of information architecture should the organization have: centralized or not centralized? How should investments in IT be justified? The answer to each of these questions must be tailored to the particular circumstances of the ISD and the larger organization of which it is a part.
- 3. Fitting the IT architecture to the organization.** Management of an organization may become concerned that its IT architecture is not suited to the needs of the organization. In such a case, there has likely been a failure on the part of the IT technicians to determine properly the requirements of the organization. Perhaps there has also been a failure on the part of management to understand the type and manner of IT architecture that they have allowed to develop or that they need.
- 4. IT architecture planning.** IT specialists versed in the technology of IT must meet with business users and jointly determine the present and future needs for the IT architecture. In some cases, IT should lead (e.g., when business

users do not understand the technical implications of a new technology). In other cases, users should lead (e.g., when technology is to be applied to a new business opportunity). Plans should be written and published as part of the organizational strategic plan and as part of the IT strategic plan. Plans should also deal with training, career implications, and other secondary infrastructure issues.

5. **IT policy.** IT architectures should be based on corporate guidelines or principles laid out in policies. These policies should include the roles and responsibilities of IT personnel and users, security issues, cost-benefit analyses for evaluating IT, and IT architectural goals. Policies should be communicated to all personnel who are managing or directly affected by IT.
6. **Ethical and legal issues.** Conducting interviews for finding managers' needs and requirements must be done with full cooperation. Measures to protect privacy must be taken.



In designing systems one should consider the people in the system. Reengineering IT means that some employees will have to completely reengineer themselves. Some may feel too old to do so. Conducting a supply chain or business process reorganization may result in the need to lay off, retrain, or transfer employees. Should management notify the employees in advance regarding such possibilities? And what about those older employees who are difficult to retrain?

Other ethical issues may involve sharing of computing resources (in a client/server environment, for example) or of personal information, which may be part of the new organizational culture. Finally, individuals may have to share computer programs that they designed for their departmental use, and may resist doing so because they consider such programs their intellectual property. Appropriate planning must take these and other issues into consideration.

Implementing organizational transformation by the use of IT may tempt some to take unethical or even illegal actions. Companies may need to use IT to monitor the activities of their employees and customers, and in so doing may invade the privacy of individuals. When using business intelligence to find out what competitors are doing, companies may be engaged in unethical tactics such as pressuring competitors' employees to reveal information, or using software that is the intellectual property of other companies (frequently without the knowledge of these other companies).

7. **IT strategy.** In planning IT it is necessary to examine three basic strategies:
 - (1) *Be a leader in technology.* Companies such as FedEx, Dell, and Wal-Mart are known for their leading strategy. The advantages of being a leader are the ability to attract customers, to provide unique services and products, and to be a cost leader. However, there is a high development cost of new technologies and high probability of failures.
 - (2) *Be a follower.* This is a risky strategy because you may be left behind. However, you do not risk failures, and so you usually are able to implement new technologies at a fraction of the cost.
 - (3) *Be an experimenter, on a small scale.* This way you minimize your research and development investment and the cost of failure. When new technologies prove to be successful you can move fairly quickly for full implementation.



8. Integration: The role of IT in redesign and BPR. Almost all major supply chain management (SCM) and/or BPR projects use IT. However, it is important to remember that in most cases the technology plays a *supportive* role. The primary role is organizational and managerial in nature. On the other hand, without IT, most SCM and BPR efforts do not succeed.

9. Failures. A word of caution: One of the lessons from the history of IT is that very big projects have a tendency to fail when expectations exceed real capabilities. For example, many of the early material requirements planning (MRP) systems, artificial intelligence, and complex transaction processing systems never worked. BPR and some ERP projects also have failed, for many reasons. One of the reasons for failure is a miscalculation of the required amount of IT. It simply may be too expensive to rebuild and retool the IT infrastructure and adjust applications that are necessary for BPR. The solution may be instead to defer the BPR and use incremental improvements, or to reengineer only the most critical processes.



ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; additional resources such as cases, tables, and figures; updates; additional exercises; links; and demos and activities can be found on the book's Web site.

KEY TERMS

Applications portfolio •••	Cycle time reduction •••	Legacy systems •••
Business process •••	Distributed computing •••	Metrics •••
Business process management (BPM) •••	E-planning •••	Networked organizations •••
Business process reengineering (BPR) •••	Empowerment •••	Organization transformation •••
Business systems planning (BSP) •••	Flattened organization •••	Project planning •••
Centralized computing •••	Four-stage model of planning •••	Resource allocation •••
Change management •••	Information architecture •••	Reverse engineering •••
Critical success factors (CSFs) •••	Information requirements analysis •••	Scenario planning •••
Cross-functional activities •••	Information technology architecture •••	Stages of IT growth •••
	IT planning •••	Strategic information technology planning (SITP) •••
		Virtual organization (virtual corporation, VC) •••

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- Information technology planning can help organizations meet the challenges of a rapidly changing business and competitive environment. There are several approaches to IT planning (e.g., method driven, technological approach).
- IT planning methods have evolved over time. Today they are centered around e-planning.
- Aligning IT plans with business plans makes it possible to prioritize IS projects on the basis of contribution to organizational goals and strategies.

- 2 The four-stage IT planning model includes strategic planning, requirements analysis, resource allocation, and project planning.
- 3 Strategic information systems planning involves methodologies such as business systems planning (BSP), stages of IT growth, and critical success factors (CSFs).
- 4 IS planning requires analysis of the information needed by the organization. Several methods exist for doing it. Also, implementing the planning requires planning-including resource allocation, cost-benefit analysis, and project management (using software).
- 5 Information technology architecture can be centralized or distributed. When it is distributed, it often follows the client/server architecture model.
- 5 Organizations can use enterprise architecture principles to develop an information technology architecture.
- 6 The major information systems planning issues are strategic alignment, architecture, resource allocation, and time and budget considerations.
- 7 To prioritize an e-commerce applications portfolio, IT planners can use the validity of the application and its fit with the organization, plotting it on a grid that indicates company fit and project viability and suggests one of four strategies.
- 8 BPR is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements.
- 9 IT helps not only to automate existing processes, but also to introduce innovations which change structure (e.g., create case managers and interdisciplinary teams), reduce the number of processes, combine tasks, enable economical customization, and reduce cycle time.
- 9 Mass customization, which is facilitated by IT, enables production of customized goods by methods of mass production at a low cost.
- 9 Cycle time reduction is an essential part of many BPR projects and is usually attainable only by IT support.
- 10 One of the most innovative BPR strategies is the creation of business alliances and virtual corporations.
- 10 Process redesign and/or BPR result in transforming organizations to new structures and operations, such as e-business.
- 10 Transforming organizations means change that may be resisted or poorly done. Therefore, change management is needed.

QUESTIONS FOR REVIEW

1. Briefly discuss the evolution of IT planning.
2. What are some of the problems associated with IT planning?
3. Define and discuss the four-stage model of IT planning.
4. Identify the methods used for strategic planning and review their characteristics.
5. What is information technology architecture and why is it important? List the major types.
6. What are the advantages and disadvantages of centralized computing architectures?
7. What is a legacy system? Why do companies have legacy systems?
8. Define scenario planning.
9. What is an applications portfolio?
10. Define business process and BPR.
11. List the drivers of process redesign.
12. Describe the stovepipe problem.
13. Define BPM.
14. Describe the enabling role of IT in BPR.
15. What is meant by mass customization? Give examples.
16. Define cycle time reduction.
17. Define a virtual corporation.
18. Describe the major characteristics of empowerment and describe its benefits.
19. Define organization transformation and change management.

QUESTIONS FOR DISCUSSION

1. Discuss how strategic planning, as described in this chapter, could help an electric utility plan its future.
2. How might an organization with a good strategic idea be limited in its ability to implement that idea if it has



an inferior or inappropriate information architecture? Provide an example.

3. What type of problems might an organization encounter if it focuses only on resource allocation planning and project planning?
4. Why is it so important to align the IT plan with organizational strategies? What could happen if the plan is not aligned with these strategies?
5. Discuss the advantages of using Tjan's approach to an applications portfolio.
6. Some organizations feel that IT planning is a waste of time, because the competitive environment and technologies are changing so rapidly. They argue that their plans will be obsolete before they are completed. Discuss.
7. Should there be a correlation between a firm's architecture structure (and chart) and its IT architecture (e.g., centralized IT for a centralized structure)?
8. Review the opening case. What approach was used to develop an information systems plan?
9. Relate the concepts of supply chain and its management to BPR and IT.
10. Explain why IT is an important BPR enabler.
11. Some people say that BPR is a special case of a strategic information system, whereas others say that the opposite is true. Comment.
12. Relate virtual corporations to networked organizations. Why is a VC considered to be a BPR activity?
13. What are some of the reasons for maintaining a functional structure of an organization?
14. Explain the role intranets can play in lessening the stovepipe problem.

EXERCISES

1. Using the CSF method of strategic planning, identify new strategic initiatives that a university might take using information technology.
2. Examine *IT At Work* 9.2 and Tjan's applications portfolio method. Compare the two, showing the advantages and limitations of each.
3. What kind of IT planning is done in your university or place of work to ensure that the Internet demand in the future will be met? Does the university have a CIO? Why or why not?
4. Examine some business processes in your university, city, or company. Identify two processes that need to be redesigned. Employ some of El-Sawy's 10 principles to plan the redesign. Be innovative.

GROUP ASSIGNMENTS

1. Divide the class into groups of six people or less. Each group will be entrepreneurs attempting to start some kind of nationwide company. Each group should describe the IT architecture it would build, as well as the expected benefits from, and potential problems with, the IT architecture it has chosen.
2. Have teams from the class visit IT project development efforts at local companies. The team members should interview members of the project team to ascertain the following information.
 - a. How does the project contribute to the goals and objectives of the company?
 - b. Is there an information architecture in place? If so, how does this project fit into that architecture?
 - c. How was the project justified?
 - d. What planning approach, if any, was used?
 - e. How is the project being managed?
3. Assign groups to the following industries: banking, airlines, health care, insurance, and large retailing. Each group will investigate the use of the mainframe in one industry and prepare a report on the future of the mainframe. Also, include information on how client/server architecture is used in the industry.
4. Each group in the class will be assigned to a major ERP/SCM vendor such as SAP, PeopleSoft, Oracle, etc. Members of the groups will investigate topics such as:
 - a. Web connections.
 - b. Use of business intelligence tools.
 - c. Relationship to BPR.
 - d. Major capabilities.
 - e. Use of ASPs.
 - f. Low cost approaches.
 Each group will prepare a presentation for the class.

INTERNET EXERCISES

1. Go to dwinc.com/strat.htm and read the content. Compare and contrast the approach on this page to other approaches to strategic information systems planning.
2. Enter cio.com. Review the latest IT planning surveys and reviews reported. Start with the October 1997 survey conducted by CIO Communications Inc.
3. Find 10 to 15 examples of mass customization not cited in this book. Look for shoes, clothing, industrial products, etc.
4. There is an increased use of the Internet/intranets to enable employees to make their own travel arrangements. Several Internet travel companies provide opportunities for companies to reengineer their travel processes. Surf the Internet to find some vendors that provide such services. Prepare a report that summarizes all the vari-



Minicase 1 Oregon Geographic Information System Plan

Geographic information systems (GISs) are becoming increasingly important to governmental agencies in conducting their business and serving the public. Such systems use spatial data such as digitized maps and can combine these data with other text, graphics, icons, and symbols (see Chapter 11). The state government in Oregon (sscgis.state.or.us) recognized the increasing importance of GISs as a tool to support decisions that are related to data represented by maps. GISs also offer the potential benefit of coordination among agencies, to avoid duplicated efforts and incompatible data.

The state therefore created a Geographic Information Council, consisting of 22 people from agencies at the federal, state, and local levels, to develop a strategic plan to promote the effective use of GISs in Oregon. The planning process commenced in 1995 and produced a comprehensive plan dated March 1996. The plan identified and prioritized goals and strategies, including leadership responsibilities and time frames for each major item. The Council circulated the draft plan to GIS personnel in different organizations, to obtain a peer review before finalizing the document.

The plan starts with a “vision for GIS,” a scenario for potential types and levels of usage. This vision incorporates potential advances in technology such as multimedia,

organizational structures including a statewide centralized GIS data administration function, a high-bandwidth telecommunications infrastructure, and adequate funding for GIS activities.

Benchmarks for Success

The plan identified criteria for evaluating its own validity:

- GIS integrated into governmental processes (“as common as word processing”)
- Geographic data gathered and managed cooperatively and made available to the public
- Statewide standards for spatial data
- A centralized catalog of statewide GIS data
- GIS as an integral part of curriculum for K-12 and higher education throughout the state

Goals and Strategies

The plan also established specific goals, strategies for achieving them, agencies with lead responsibilities, and target dates. The goals include data requirements such as:

- ous activities. Also discuss the potential impact on the travel agency industry.
5. Enter *truserv.com* and find “news” in the media relations section. Identify all IT-related plans announced by the company in the last six months. Comment on your findings.
 6. Surf the Internet to find some recent material on the role IT plays in supporting BPR. Search for products and vendors and download an available demo.
 7. Identify some newsgroups that are interested in BPR. Initiate a discussion on the role of IT in BPR.
 8. Enter *gensym.com* and find their modeling products. Explain how they support BPR and redesign.
 9. Enter *xelus.com/index.asp* and find how Xelus Corporation software can facilitate planning (e.g., see the Cisco case).

(1) currency and completeness; (2) security; (3) ease of use and accessibility; (4) incorporation of metadata indicating applicability; (5) coordination of collection and maintenance; and (6) standardization.

For technology, the goals include: (1) network access for agencies and public; (2) compatible data exchange formats; (3) real-time update capability; (4) master contracts for hardware/software/training; (5) integration with global positioning system (GPS) technology; and (6) a centralized data repository.

For people and organizations, the goals include: (1) stable funding and resources; (2) recruitment and retention of GIS employees; (3) definition of a model GIS organizational structure; (4) development of an educational program; (5) effective marketing of Oregon’s GIS program.

Follow-Up

The planning group recognized that this plan would lose its value if not maintained, or if there were no follow-up on its recommendations. Therefore the plan included the following ongoing strategies: (1) monthly meetings of the planning group; (2) workgroups to address specific recommendations; (3) development of GIS plans at other state agencies; (4) distribution of supplements and updates four times a year; and (5) measurement against

benchmarks and revision of the plan for the next two-year period.

Source: Compiled from *sscgis.state.or.us/coord/orisplan.htm*. Adapted and reprinted with permission from Oregon Department of Administration and PlanGraphics, Inc.

Questions for Minicase 1

1. Which stage(s) and activities of the four-stage planning model is/are included in the Oregon GIS planning effort?
2. Based on material presented in this chapter and your own personal evaluation, identify things that the planners did well in this project.
3. Can you see any problems or weaknesses with this planning effort?
4. Discuss possible differences in IT planning for governmental agencies, as discussed in this minicase, versus planning in business organizations.
5. Identify businesses and other private organizations that might want to use GIS data created and maintained by public agencies in Oregon. Discuss how (and whether) public agencies should charge private organizations for such data.



Minicase 2

Scenario Planning at National City Bank Aligns IT with Business Planning

The Problem. The banking industry is very competitive. National City Corp. of Cleveland (*national-city.com*) was confronting three challenges: (1) it needed new ways to generate earnings; (2) it faced increasing competition for market share; and (3) the bank was losing customers who wanted to do banking using the Internet.

National City saw the customer information system it was developing with IBM as a solution to these problems. The bank hoped to use this system to develop new, high-revenue products, tailor programs for customers, and cross-sell products to appropriate customers. But to design it, the bank had to know what kind of information the system would be aggregating. Would it track information about the products the bank offered or the people who bought them? If it was product-focused, it would have to include detailed descriptions of each financial service, whether credit cards or mortgages. If the system was customer-focused, it would track whether they used ATMs, branch offices, or call centers, and would indicate demographics in order to build customer profiles. Furthermore, the bank would need to set up business rules to determine customer profitability.

Management quickly realized that they simply could not answer these questions because the answers were linked to a larger issue: Management didn't have a clear sense of the bank's strategic direction. The required investment in technology was \$40 million, so planning to invest it properly was critical.

The Solution. To clarify the business direction, the bank hired a consulting company, *ncri.com*, to employ scenario planning. The planning process involved six phases used by an implementation team:

Phase I: Alternative Visions (Scenarios)

In this phase, a few possible visions of the future are selected. In the case of National City, the scenarios were:

- **Utilize a CRM-based strategy.** This was a major industry trend in which everything would be geared to individual customer need. This business model is complex and expensive to pursue.
- **Specialize solely in certain financial services.** This is a low-cost option, but may not bring new customers and may even result in losing existing customers.
- **Create a separate online bank.**

Phase II: Events Generation

Next, a list of 150 internal and external events that might influence any of the outcomes was generated by the team. Events included new regulations and technological developments (e.g., wireless). These events were simulated as newspaper headlines (e.g., "Demand for real-time banking information via cell phones is skyrocketing"). These events were used later to create scenarios.



Virtual Company Assignment

IT Planning at The Wireless Café

During your internship at TWC, you've uncovered many opportunities for IT to offer more effective management, better information, and improved customer care. You've got everybody's heads spinning with the possibilities, but you realize that it takes careful planning, alignment, and integration to make the best use of information technologies at the diner. While you and Jeremy were recently talking about the potential of wireless waitstaff software, you

realized he's quite excited about it and may just go out and buy the system. You decide you really need to talk with Barbara and Jeremy about the importance of IT planning, so you start to set out your plan to plan.

1. Discuss the long-range planning approach you'd recommend that TWC undertake. Include issues such as the planning approach, who you'd include (and how you'd



Phase III: The Workshop

A three-day workshop with the 24 top executives was conducted. The participants were divided into three groups. The first task was to rank all 150 events by the *chance that they will occur*. Once done, all participants met to discuss the rankings and, after appropriate discussion, reach a consensus. This process can be lengthy, but it is essential.

Then, each team was assigned one of the bank's three scenarios and was asked to analyze the impact of the most-likely-to-occur events on that scenario, within a five-year planning horizon.

Phase IV: Presentation

Each group made an oral presentation, in which their goal was to convince the other groups that their vision was the most feasible. This was a difficult task since some team members, who had to play the role of supporters, actually did not like the scenario they were suppose to "sell."

Phase V: Deliberation and Attempt to Reach a Consensus

The entire group of participants needed to agree on which alternative was the best for the bank. After long deliberation, the group decided to support alternative #1, the CRM-based strategy.

Phase VI: IT Support

To facilitate the IT planning, an IS plan was devised in which a data warehouse was planned, so that customers'

profiles could be built. Data mining was planned for identifying the bank's most profitable customers, and a Web-based call center was designed to provide personalized services.

All in all, the scenario planning process was an exercise in contingency thinking that resulted in prosperity. Compiled the bank when the system was eventually deployed.

Sources: Condensed from Levinson, 2000; *ncri.com*; and *national-city.com*.

Questions for Minicase 2

1. One critique of this approach is that some members who are asked to "sell" a specific scenario may not be enthusiastic to do so. Find information in the scenario planning literature on this issue, or e-mail to a scenario consultant (*ncri.com* or *gbn.com*). Write a report on your findings.
2. Can group decision support systems (Chapter 10) be used in this case? Why and what for, or why not?
3. How can the end users learn about technology in scenario planning?
4. What IT tools can be used to facilitate this scenario planning process, which was done manually?
5. How did the scenario planning help the IT people to better understand the business?
6. Why is scenario planning considered a risk-management tool?

get the staff together in a 24/7 operation), the planning activities you'd use to get started, and the proposed results of the IT strategic planning effort.

2. As the senior cook, Marie-Christine works closely with Barbara and Jeremy in menu planning, meal costing, and food ordering. At the French Culinary Institute where she was trained, Marie-Christine learned how to cost meals manually. Many automated menu costing programs are now available, such as RestaurantPlus (<http://www.restaurantplus.com/>), Micros (<http://www.micros.com/>) NextPos (<http://www.nextpos.com/>), and Aloha (<http://www.alohapos.com/>).

You sense that Marie-Christine is very proud of her background and training and has a strong reluctance to use the computer. What steps would you take to overcome this reluctance?

3. It is beginning to look like IT may drive the business decisions at TWC. After reviewing TWC's mission and considering the myriad possibilities for reengineering many front-of-the-house and back-of-the-house processes, what advice do you have for Barbara and Jeremy, who seem very enthusiastic about adopting many new technologies?

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PART IV
**Managerial and Decision
Support Systems**



- ▶ 10. Knowledge Management
- 11. Data Management: Warehousing, Analyzing, Mining, and Visualization
- 12. Management Decision Support and Intelligent Systems

CHAPTER

10

Knowledge Management

Siemens AG

10.1

Introduction to Knowledge Management

10.2

Knowledge Management Initiatives

10.3

Approaches to Knowledge Management

10.4

Information Technology in Knowledge Management

10.5

Knowledge Management Systems Implementation

10.6

Roles of People in Knowledge Management

10.7

Ensuring Success of KM Efforts

Minicases: (1) DaimlerChrysler /
(2) Chevron

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Define knowledge and describe the different types of knowledge.
- 2 Describe the activities involved in knowledge management.
- 3 Describe different approaches to knowledge management.
- 4 Describe the issues associated with implementing knowledge management in organizations.
- 5 Describe the technologies that can be utilized in a knowledge management system.
- 6 Describe the activities of the chief knowledge officer and others involved in knowledge management.
- 7 Describe benefits as well as drawbacks to knowledge management initiatives.



SIEMENS LEARNS WHAT IT KNOWS THROUGH KNOWLEDGE MANAGEMENT

➔ THE PROBLEM

Siemens AG, a \$73 billion electronics and electrical-engineering conglomerate, produces everything from lightbulbs to X-Ray machines, from power generation equipment to high-speed trains. During its 156-year history, Siemens (*siemens.com*) developed into one of the world's largest and most successful corporations. Siemens is well known for the technical brilliance of its engineers; however, much of their knowledge was locked and unavailable to other employees. Facing competitive pressure (see opening case, Chapter 1), Siemens is trying to maximize the contributions of each business unit. One way to do it was to learn to leverage the knowledge and expertise of its 460,000 employees worldwide.

➔ THE SOLUTION

The roots of knowledge management (KM) at Siemens go back to 1996 when a number of people within the corporation with an interest in KM formed a "community of interest." They researched the subject, learned what was being done by other companies, and looked for ways that knowledge management could benefit Siemens. Without any suggestion or encouragement from senior executives, mid-level employees in Siemens business units began creating knowledge repositories, communities of practice, and informal techniques of sharing knowledge. By 1999, the senior management of Siemens AG confirmed the importance of knowledge management to the entire company by creating an organizational unit that would be responsible for the worldwide deployment of KM.

At the heart of Siemens' technical solution to knowledge management is a Web site called ShareNet, which combines elements of a database repository, a chat room, and a search engine. Online entry forms allow employees to store information they think might be useful to colleagues. Other Siemens employees are able to search the repository or browse by topic, and then contact the authors for more information using one of the available communication channels. In addition, the system lets employees post an alert when they have an urgent question.

Although KM implementation at Siemens involved establishing a network to collect, categorize, and share information using databases and intranets, Siemens realized that IT was only the tool that enabled knowledge management. Randall Sellers, Director of Knowledge Management for the Americas Region of Siemens stated, "In my opinion, the technology or IT role is a small one. I think it's 20 percent IT and 80 percent change management—dealing with cultural change and human interfaces."

The movement toward knowledge management by Siemens has presented several challenges to the company, some of which are cultural. Siemens used a three-pronged effort to convince employees that it is important to participate in the exchange of ideas and experiences and to share what they know. It has assigned 100 internal KM "evangelists" throughout the globe who are responsible for training, answering questions, and monitoring the system. Siemens' top management has shown its full support for the knowledge management projects. And the company is providing incentives to overcome employees' resistance to change.



In exchange for employees posting documents to the system and for using the knowledge, Siemens rewards its employees with “Shares,” much like frequent-flyer miles. Once collected and accumulated, these shares can be exchanged for things like consumer electronics or discounted trips to other countries.

However, the real incentive of the system is much more basic. Commission-driven salespeople have already learned that knowledge and expertise of their colleagues available through ShareNet can be indispensable in winning lucrative contracts. Employees in marketing, service, R&D, and other departments are also willing to participate and contribute as long as they realize that the system provides them with useful information in a convenient way.

The ShareNet has undergone tremendous growth, which resulted in several challenges for Siemens. The company strives to maintain balance between global and local knowledge initiatives as well as between knowledge management efforts that support the entire company or individual business units. Furthermore, Siemens works to prevent ShareNet from becoming so overloaded with information that it becomes useless. It employs a group of people who monitor the system and remove trivial and irrelevant content.

THE RESULTS

The ShareNet has evolved into a state-of-the-art Web-based knowledge management system that stores and catalogues volumes of valuable knowledge, makes it available to every employee, and enhances global collaboration. Numerous companies, including Intel and Volkswagen, studied ShareNet before setting up their own knowledge management systems. Furthermore, Teleos, an independent knowledge management research company, acknowledged Siemens as being one of the Most Admired Knowledge Enterprises worldwide for five years in a row.

Siemens also has realized a variety of quantifiable benefits afforded by knowledge management. For example, in April 1999, the company developed a portion of ShareNet to support its Information & Communications Networks Group at the cost of \$7.8 million. Within 2 years, the tool had helped to generate \$122 million in additional sales.

Ultimately, knowledge management may be one of the major tools that will help Siemens prove that large diversified conglomerates can work and that being big might even be an advantage in the Information Age.

Sources: Adapted from Vasilash (2002), *The Economist* (2001), and Williams (2001).

LESSONS LEARNED FROM THIS CASE

This case illustrates the importance and value of identifying an organization’s knowledge and sharing it throughout the organization. In a major initiative, Siemens AG developed ShareNet and other knowledge management systems to the valuable knowledge of the employees. Siemens transformed its culture as the knowledge management system was deployed, leading to significantly lower operating costs and more collaboration throughout the global enterprise. Organizations recognize the value of their intellectual assets, though they may be hard to measure. Fierce global competition drives companies to better utilize their intellectual assets by transforming themselves into organizations that foster the development and sharing of knowledge.



In this chapter we describe the characteristics and concepts of knowledge management. In addition, we will explain how firms are using information technology to implement knowledge management systems and how these systems are transforming modern organizations.

10.1 INTRODUCTION TO KNOWLEDGE MANAGEMENT

Concepts and Definitions

With roots in expert systems, organizational learning, and innovation, the idea of knowledge management is itself not new (e.g., see Cahill, 1996). Successful managers have always used intellectual assets and recognized their value. But these efforts were not systematic, nor did they ensure that knowledge gained was shared and dispersed appropriately for maximum organizational benefit. Moreover, sources such as Forrester Research, IBM, and Merrill Lynch estimate that 85 percent of a company's knowledge assets are not housed in relational databases, but are dispersed in e-mail, Word documents, spreadsheets, and presentations on individual computers (Editors of Ziff Davis Smart Business, 2002). The application of information technology tools to facilitate the creation, storage, transfer, and application of previously uncodifiable organizational knowledge is a new and major initiative in organizations.

Knowledge management (KM) is a process that helps organizations identify, select, organize, disseminate, and transfer important information and expertise that are part of the organization's memory and that typically reside within the organization in an unstructured manner. This structuring of knowledge enables effective and efficient problem solving, dynamic learning, strategic planning, and decision making. Knowledge management initiatives focus on identifying knowledge, explicating it in such a way that it can be shared in a formal manner, and leveraging its value through reuse.

Through a supportive organizational climate and modern information technology, an organization can bring its entire organizational memory and knowledge to bear upon any problem anywhere in the world and at any time. For organizational success, *knowledge, as a form of capital, must be exchangeable among persons, and it must be able to grow.* Knowledge about how problems are solved can be captured, so that knowledge management can promote organizational learning, leading to further knowledge creation.

KNOWLEDGE. In the information technology context, knowledge is very distinct from data and information (see Figure 10.1). Whereas *data* are a collection of facts, measurements, and statistics, *information* is organized or processed data that are timely (i.e., inferences from the data are drawn within the time frame

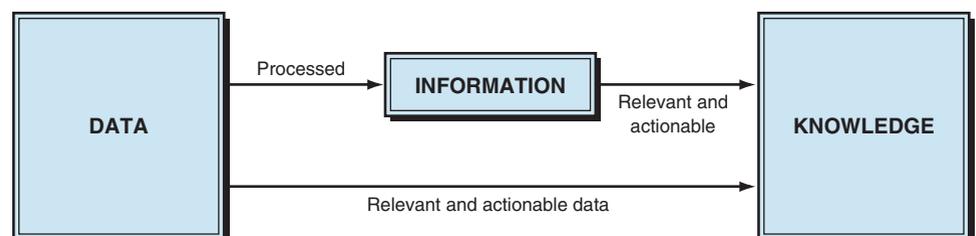


FIGURE 10.1 Data, Information, and Knowledge.



of applicability) and accurate (i.e., with regard to the original data) (Holsapple, 2003). *Knowledge* is information that is *contextual, relevant, and actionable*.

For example, a map giving detailed driving directions from one location to another could be considered data. An up-to-the-minute traffic bulletin along the freeway that indicates a traffic slowdown due to construction several miles ahead could be considered information. Awareness of an alternative, back-roads route could be considered as knowledge. In this case, the map is considered data because it does not contain current relevant information that affects the driving time and conditions from one location to the other. However, having the current conditions as information is only useful if the individual has knowledge that will enable him to avert the construction zone. The implication is that knowledge has strong experiential and reflective elements that distinguish it from information in a given context. Having knowledge implies that it can be exercised to solve a problem, whereas having information does not carry the same connotation.

An *ability to act* is an integral part of being knowledgeable. For example, two people in the same context with the same information may not have the same ability to use the information to the same degree of success. Hence there is a difference in the human capability to add value. The differences in ability may be due to different experiences, different training, different perspectives, and so on. While data, information, and knowledge may all be viewed as assets of an organization, knowledge provides a higher level of meaning about data and information. It conveys *meaning*, and hence tends to be much more valuable, yet more ephemeral.

Knowledge has the following characteristics that differentiates it from an organization's other assets (Gray, 1999; Holsapple, 2003):

- **Extraordinary leverage and increasing returns.** Knowledge is not subject to diminishing returns. When it is used, it is not consumed. Its consumers can add to it, thus increasing its value.
- **Fragmentation, leakage, and the need to refresh.** As knowledge grows, it branches and fragments. Knowledge is dynamic; it is information in action. Thus, an organization must continually refresh its knowledge base to maintain it as a source of competitive advantage.
- **Uncertain value.** It is difficult to estimate the impact of an investment in knowledge. There are too many intangible aspects.
- **Uncertain value of sharing.** Similarly, it is difficult to estimate the value of sharing the knowledge, or even who will benefit most.
- **Rooted in time.** The utility and validity of knowledge may vary with time; hence, the immediacy, age, perishability, and volatility of knowledge are important attributes.

There is a vast amount of literature about what knowledge and knowing means in epistemology (study of the nature of knowledge), the social sciences, philosophy, and psychology (Polanyi, 1958, 1966). Though there is no single definition of what knowledge and knowledge management specifically mean, the business perspective on them is fairly pragmatic. Information as a resource is not always valuable (i.e., information overload can distract from the important); knowledge is a resource when it is clear, relevant, and important to an individual processing the knowledge (Holsapple, 2003). Knowledge implies an



implicit understanding and experience that can discriminate between its use and misuse. Over time, information accumulates and decays, while knowledge evolves. The word knowledge tends to carry positive connotations (Schultze and Leidner, 2002). However, because *knowledge is dynamic in nature*, today's knowledge may well become tomorrow's ignorance if an individual or organization fails to update knowledge as environmental conditions change. For more on the potential drawbacks of managing and reusing knowledge, see Section 10.7.

Intellectual capital (or **intellectual assets**) is another term often used for knowledge, and it implies that there is a financial value to knowledge (Edvinsson, 2003). Though intellectual capital is difficult to measure, some industries have tried. For example, the value of the intellectual capital of the property-casualty insurance industry has been estimated to be between \$270 billion to \$330 billion (Mooney, 2000). The Organization for Economic Co-operation and Development (OCED) has scored its 30 member nations according to their investments in intellectual capital such as R&D, education, and patents. According to OCED, those countries with the most intellectual capital activities will be the winners of future wealth (Edvinsson, 2003).

Knowledge evolves over time with experience, which puts connections among new situations and events in context. Given the breadth of the types and applications of knowledge, we adopt the simple and elegant definition that **knowledge** is *information in action* (O'Dell et al., 1998).

TACIT AND EXPLICIT KNOWLEDGE. Polanyi (1958) first conceptualized and distinguished between an organization's tacit and explicit knowledge. **Explicit knowledge** deals with more objective, rational, and technical knowledge (data, policies, procedures, software, documents, etc.). **Tacit knowledge** is usually in the domain of subjective, cognitive, and experiential learning; it is highly personal and difficult to formalize (Nonaka and Takeuchi, 1995).

Explicit knowledge is the policies, procedural guides, white papers, reports, designs, products, strategies, goals, mission, and core competencies of the enterprise and the information technology infrastructure. It is the knowledge that has been codified (documented) in a form that can be distributed to others or transformed into a process or strategy without requiring interpersonal interaction. For example, a description of how to process a job application would be documented in a firm's human resources policy manual. Explicit knowledge has also been called **leaky knowledge** because of the ease with which it can leave an individual, document, or the organization, after it has been documented (Alavi, 2000). Moreover, there is a simple relationship between the codification of knowledge and the costs of its transfer: the more than knowledge is made explicit, the more economically it can be transferred (Teece, 2003).

Tacit knowledge is the cumulative store of the experiences, mental maps, insights, acumen, expertise, know-how, trade secrets, skill sets, understanding, and learning that an organization has, as well as the organizational culture that has embedded in it the past and present experiences of the organization's people, processes, and values. Tacit knowledge, also referred to as *embedded knowledge* (Madhavan and Grover, 1998), is usually either localized within the brain of an individual or embedded in the group interactions within a department or a branch office. Tacit knowledge typically involves expertise or high skill levels. It is generally slow and costly to transfer and can be plagued by ambiguity (Teece, 2003).



Sometimes tacit knowledge is easily documentable but has remained tacit simply because the individual housing the knowledge does not recognize its potential value to other individuals. Other times, tacit knowledge is unstructured, without tangible form, and therefore difficult to codify. Polanyi (1966) suggests that it is difficult to put some tacit knowledge into words. For example, an explanation of how to ride a bicycle would be difficult to document explicitly, and thus is tacit. Tacit knowledge has been called **sticky knowledge** because it may be relatively difficult to pull it away from its source.

Successful transfer or sharing of tacit knowledge usually takes place through associations, internships, apprenticeship, conversations, other means of social and interpersonal interactions, or even through simulations (e.g., see Robin, 2000). Nonaka and Takeuchi (1995) claim that intangibles like insights, intuitions, hunches, gut feelings, values, images, metaphors, and analogies are the often-overlooked assets of organizations. Harvesting this intangible asset can be critical to a firm's bottom line and its ability to meet its goals.

The Need for Knowledge Management Systems

The goal of knowledge management is for an organization to be aware of individual and collective knowledge so that it may make the most effective use of the knowledge it has (Bennet and Bennet, 2003). Historically, MIS has focused on capturing, storing, managing, and reporting explicit knowledge. Organizations now recognize the need to integrate both explicit and tacit knowledge in formal information systems. **Knowledge management systems (KMSs)** refer to the use of modern information technologies (e.g. the Internet, intranets, extranets, Lotus-Notes, Software filters, Agents, Data Warehouses) to systematize, enhance, and expedite intra- and inter-firm knowledge management (Alavi and Leidner, 1999). KMSs are intended to help an organization cope with turnover, rapid change, and downsizing by making the expertise of the organization's human capital widely accessible. They are being built in part from increased pressure to maintain a well-informed, productive workforce. Moreover, they are built to help large organizations provide a consistent level of customer service, as illustrated in *IT At Work 10.1*.

Knowledge Management System Cycle

A functioning knowledge management system follows six steps in a cycle (see Figure 10.2). The reason the system is cyclical is that knowledge is dynamically refined over time. The knowledge in a good KM system is never finished because, over time, the environment changes, and the knowledge must be updated to reflect the changes. The cycle works as follows:

1. **Create knowledge.** Knowledge is created as people determine new ways of doing things or develop know-how. Sometimes external knowledge is brought in.
2. **Capture knowledge.** New knowledge must be identified as valuable and be represented in a reasonable way.
3. **Refine knowledge.** New knowledge must be placed in context so that it is actionable. This is where human insights (tacit qualities) must be captured along with explicit facts.
4. **Store knowledge.** Useful knowledge must then be stored in a reasonable format in a knowledge repository so that others in the organization can access it.
5. **Manage knowledge.** Like a library, the knowledge must be kept current. It must be reviewed to verify that it is relevant and accurate.
6. **Disseminate knowledge.** Knowledge must be made available in a useful format to anyone in the organization who needs it, anywhere and anytime.



IT At Work 10.1

CINGULAR CALLS ON KNOWLEDGE



How do you make sure that each of your customer service agents at 22 call centers nationwide can answer virtually any question asked by one of your 22 million clients? That was the challenge faced by Cingular Wireless (*cingular.com*), a major mobile communications provider based in Atlanta, Georgia.

To accomplish this Herculean task, Cingular Wireless turned to knowledge management. Cingular benchmarked knowledge management solutions of technology-oriented companies, such as Dell and Microsoft. Steve Mullins, vice president of customer experience for Cingular Wireless and Monica Browning, Cingular's director of knowledge management, met with several knowledge management software vendors to learn how their tools operate. Following a review of knowledge management solutions used by other companies, Cingular chose eService Suite by ServiceWare of Edison, New Jersey.

To ensure successful implementation of the system, Cingular embarked on a campaign to obtain support of everyone involved, from senior executives to each call center agent who would use the system. A pilot program was initiated at technical support departments at three call centers. In addition, to help manage organizational changes that accompany a shift to knowledge management, Cingular enlisted the help of leading consulting firms Cap Gemini, Ernst and Young, and Innovative Management Solutions.

A major issue in developing the knowledge management system involved capturing the knowledge and storing it in the system. Cingular accomplished it by combining the efforts of its employees and an external authoring group from Innovative Management Solutions. Cingular divided the process into phases, which allowed the company to populate the knowledge base with technical support information, common topics, information on rate plans, and so on. It took about four months before the knowledge base was ready for the first group of users.

The knowledge management system uses complex algorithms to process natural language queries and provide customer service agents with lists of most likely answers to

their questions. Furthermore the software determines the relevance of possible answers by ranking them partly on exact text and phrase matching. In addition, the system can match synonyms and assign additional weight to certain things. The system attempts to provide even more focused solutions by retrieving answers from the pool of knowledge that is relevant to a particular user and his or her profile.

Understanding that knowledge must grow and evolve, Cingular encourages users to contribute their expertise to the system. The software can automatically record a sequence of steps that an agent took to find a correct solution to a certain problem and give the agent an option to provide additional feedback.

Cingular realized that ensuring validity and integrity of the knowledge stored and distributed by the knowledge management system is one of the key factors of the system's success. To that end, the company employs a knowledge management team that is responsible for monitoring, maintaining, and expanding the knowledge management system. The team consists of about 25 full-time employees based in Cingular's Atlanta headquarters. The KM team works closely with various departments of the company and subject matter experts to ensure that the knowledge base has the right answers in a user-friendly format at the right time. In addition, the team reviews contributions to the knowledge base made by the agents and makes appropriate changes or additions to the knowledge base.

Cingular's clients are often the ultimate beneficiaries of the company's knowledge. That is why Cingular plans to bring its knowledge closer to its customers by extending the knowledge management system online and to retail stores. Customers will be able to access instructions on using wireless services and features, handsets, and other devices that Cingular carries, as well as troubleshooting tips.

Source: Adapted from O'Herron (2003).

For Further Exploration: Explain the advantages and disadvantages of a professional knowledge management team administering the content of organization's knowledge base.

As knowledge is disseminated, individuals develop, create, and identify new knowledge or update old knowledge, which they replenish into the system. Knowledge is a resource that is not consumed when used, though it can age. (For example, driving a car in 1900 was different from driving one now, but many of the basic principles still apply.) Knowledge must be updated. Thus, the amount of knowledge grows over time.

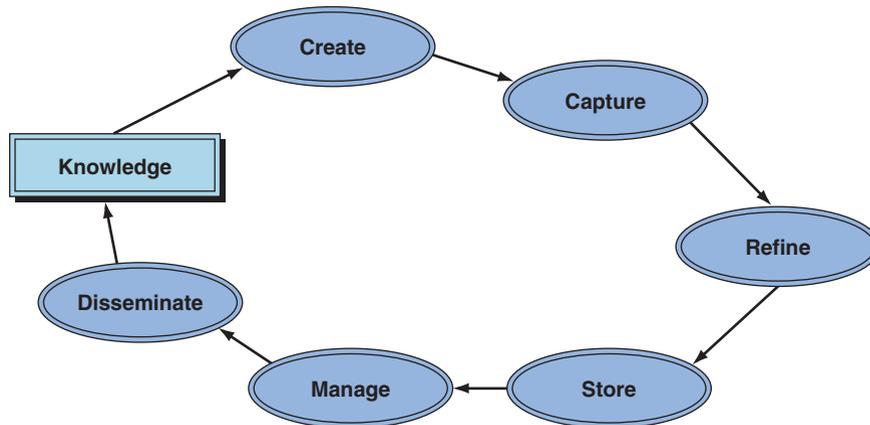


FIGURE 10.2 The knowledge management cycle.

10.2 KNOWLEDGE MANAGEMENT INITIATIVES

When asked why the organization was building a worldwide knowledge management system, the Chief Knowledge Officer (CKO) of a large multinational consulting firm replied, “We have 80,000 people scattered around the world that need information to do their jobs effectively. The information they needed was too difficult to find and, even if they did find it, often inaccurate. Our Intranet is meant to solve this problem.” (Leidner, 2003). A survey of European firms by KPMG Peat Marwick in 1998 found that almost half of the companies reported having suffered a significant setback from losing key staff (KPMG, 1998). Similarly, a survey conducted in the same year by Cranfield University found that the majority of responding firms believed that much of the knowledge they needed existed inside the organization, but that finding and leveraging it were ongoing challenges. It is precisely these types of difficulties that have led to the systematic attempt to manage knowledge.

Most knowledge management initiatives have one of three aims: (1) to make knowledge visible mainly through maps, yellow pages, and hypertext, (2) to develop a knowledge-intensive culture, or to (3) build a knowledge infrastructure (Davenport and Prusak, 1998). These aims are not mutually exclusive, and indeed, firms may attempt all three as part of a knowledge management initiative.

There are several activities or processes that surround the management of knowledge. These include the creation of knowledge, the sharing of knowledge, and the seeking and use of knowledge. Various terms have been used to describe these processes. What is important is an understanding of how knowledge flows through an organization, rather than any particular label assigned to a knowledge activity.

Knowledge Creation

Knowledge creation is the generation of new insights, ideas, or routines. It may also be referred to as *knowledge acquisition* (Holsapple and Joshi, 2003). It is helpful to distinguish between the creation of fundamentally new knowledge versus the acquisition of existing knowledge (Ford, 2003). Nonaka (1994) describes knowledge creation as interplay between tacit and explicit knowledge and as a growing spiral as knowledge moves among the individual, group, and organizational levels.



There are four modes of knowledge creation: socialization, externalization, internalization, and combination. The *socialization* mode refers to the conversion of tacit knowledge to new tacit knowledge through social interactions and shared experience among organizational members (e.g., mentoring). The *combination* mode refers to the creation of new explicit knowledge by merging, categorizing, reclassifying, and synthesizing existing explicit knowledge (e.g., statistical analyses of market data). The other two modes involve interactions and conversion between tacit and explicit knowledge. *Externalization* refers to converting tacit knowledge to new explicit knowledge (e.g., producing a written document describing the procedures used in solving a particular client's problem). *Internalization* refers to the creation of new tacit knowledge from explicit knowledge (e.g., obtaining a novel insight through reading a document). These final two modes of knowledge creation deal less with the creation of new knowledge than with the conversion of existing knowledge to a new mode.

Holsapple and Joshi (2003) suggest that there are two important dimensions to the acquisition of knowledge: one is the identification of existing knowledge from external sources and the other, the selection of needed knowledge from an organization's existing knowledge resources. These two activities require different skills, levels of effort, and costs.

Knowledge Sharing

Knowledge sharing is the willful explication of one's ideas, insights, solutions, experiences (i.e., knowledge) to another individual either via an intermediary, such as a computer-based system, or directly. However, in many organizations, information and knowledge are not considered organizational resources to be shared, but individual competitive weapons to be kept private (Davenport et al., 1998). Organizational members may share personal knowledge with a certain trepidation—the perceived threat that they are of less value if their knowledge is part of the organizational public domain. Also, a primary constraint on individual's knowledge sharing behaviors might simply be time. Moreover, sharing knowledge is a risky proposition since one does not know how that knowledge might be reused (Ford, 2003).

Research in organizational learning and knowledge management suggests that some facilitating conditions include trust, interest, and shared language (Hanssen-Bauer and Snow, 1996), fostering access to knowledgeable members (Brown and Duguid, 2000), and a culture marked by autonomy, redundancy, requisite variety, intention, and fluctuation (Nonaka, 1994). Several organizations have made knowledge sharing a guiding principal for the organization (Liebowitz and Chen, 2003). Johnson & Johnson has knowledge fairs designed to promote new relationships among colleagues in order to facilitate knowledge transfer. The World Bank includes such factors as openness to new ideas, continual learning, and sharing of knowledge as part of their annual performance evaluation of employees (Liebowitz and Chen, 2003).

Knowledge Seeking

Knowledge seeking, also referred to as *knowledge sourcing* (Gray and Meister, 2003), is the search for and use of internal organizational knowledge. While the lack of time or the lack of reward may hinder the sharing of knowledge, the same can be said of knowledge seeking. Individuals may sometimes feel compelled to come up with new ideas, rather than use tried-and-true knowledge, if they feel that their own performance review is based on the originality or creativity of their ideas. Such was the case for marketing employees in a global consumer goods organization described in Alavi et al. (2003).

Individuals may engage in knowledge creation, sharing, and seeking with or without the use of information technology tools. We next describe two common approaches to knowledge management.

10.3 APPROACHES TO KNOWLEDGE MANAGEMENT

There are two fundamental approaches to knowledge management: the process and the practice approaches.

The Process Approach

The **process approach** attempts to codify organizational knowledge through formalized controls, processes, and technologies (Hansen et al., 1999). Organizations adopting the process approach may implement explicit policies governing how knowledge is to be collected, stored, and disseminated throughout the organization. The process approach frequently involves the use of information technologies to enhance the quality and speed of knowledge creation and distribution in the organizations. These technologies may include intranets, data warehousing, knowledge repositories, decision support tools, and groupware (Ruggles, 1998).

There are several different levels of the process approach (van der Spek et al., 2003). At the most rudimentary, knowledge may be codified in project descriptions, stories, or other forms of documentation, but limited filtering has been done. At the next level, knowledge may be codified into structured concepts, frameworks, and theories. At the highest level, knowledge is embedded into work practices that give direction to employees (van der Spek et al., 2003).

The main criticisms of the process approach are that it fails to capture much of the tacit knowledge embedded in firms and that it forces individuals into fixed patterns of thinking (DeLong & Fahey, 2000; Brown & Duguid, 2000; Von Krogh, 2000; Hargadon, 1998). The process approach is favored by firms that sell relatively standardized products that fill common needs. Most of the valuable knowledge in these firms is fairly explicit because of the standardized nature of the products and services. For example, a kazoo manufacturer has minimal product changes or service needs over the years, and yet there is steady demand and a need to produce the item. In these cases, the knowledge is typically static in nature.

Even large firms that utilize tacit knowledge, such as Ernst & Young, have invested heavily to ensure that the process approach works efficiently. The 250 people at Ernst & Young's Center for Business Knowledge manage an electronic repository and help consultants find and use information. Specialists write reports and analyses that many teams can use. And each of Ernst & Young's more than 40 practice areas has a staff member who helps codify and store documents. The resulting area databases are linked through a network (Hansen et al., 1999). Naturally, people-to-documents is not the only way consultants in firms like Ernst & Young and Accenture share knowledge; they talk with one another as well. But they do place a high degree of emphasis on the codification strategy (Hansen et al., 1999).

The Practice Approach

In contrast, the **practice approach** to knowledge management assumes that a great deal of organizational knowledge is tacit in nature and that formal controls, processes, and technologies are not suitable for transmitting this type of understanding. Rather than building formal systems to manage knowledge, the

focus of this approach is to build the social environments or communities of practice necessary to facilitate the sharing of tacit understanding (Brown and Duguid, 2000; DeLong and Fahey, 2000; Gupta and Govindarajan, 2000; Wenger and Snyder, 2000; Hansen et al., 1999). Communities of practice are groups of individuals with a common interest who work together informally (Smith and McKee, 2003). Within such a community, individuals collaborate directly, teach each other, and share experiences (Smith and McKee, 2003).

The practice approach is typically adopted by companies that provide highly customized solutions to unique problems. The valuable knowledge for these firms is tacit in nature, which is difficult to express, capture, and manage. In this case, the environment and the nature of the problems being encountered are extremely dynamic. For these firms, knowledge is shared mostly through person-to-person contacts. Collaborative computing methods (for example, Lotus Notes/Domino Server or e-mail) help people communicate. Because tacit knowledge is difficult to extract, store, and manage, the explicit knowledge that points to *how* to find the appropriate tacit knowledge (people contacts, consulting reports) is made available to an appropriate set of individuals who might need it.

To make their practice approach work, firms like Bain invest heavily in building networks of people and communications technology such as telephone, e-mail, and videoconferencing. Also they commonly have face-to-face meetings (Hansen et al., 1999).

Table 10.1 summarizes the process and practice approaches.

TABLE 10.1 Process and Practice Approaches to Knowledge Management

	Process Approach	Practice Approach
Type of knowledge supported	Explicit knowledge—codified in rules, tools, and processes (DeLong and Fahey, 2000)	Mostly tacit knowledge—unarticulated knowledge not easily captured or codified (Leonard and Sensiper, 1998)
Means of transmission	Formal controls, procedures, and standard operating procedures with heavy emphasis on information technologies to support knowledge creation, codification, and transfer of knowledge (Ruggles, 1998).	Informal social groups that engage in story telling and improvisation (Wenger and Snyder, 2000).
Benefits	Provides structure to harness generated ideas and knowledge (Brown and Duguid, 2000). Achieves scale in knowledge reuse (Hansen et al., 1999).	Provides an environment to generate and transfer high value tacit knowledge (Brown and Duguid, 2000; Wenger & Snyder, 2000). Provides spark for fresh ideas and responsiveness to changing environment (Brown and Duguid, 2000).
Disadvantages	Fails to tap into tacit knowledge. May limit innovation and forces participants into fixed patterns of thinking.	Can result in inefficiency. Abundance of ideas with no structure to implement them.
Role of information technology	Heavy investment in IT to connect people with reusable codified knowledge (Hansen et al., 1999).	Moderate investment in IT to facilitate conversations and transfer of tacit knowledge (Hansen et al., 1999).

Source: Alavi et al. (2003), p. 3.



IT At Work 10.2

TEXACO DRILLS FOR KNOWLEDGE



Texaco (*texaco.com*), a company that pumps over a million barrels of oil a day, has discovered a new source of power—the collective knowledge and expertise of its 18,000 employees in 150 countries around the world. Texaco believes that connecting people who have questions with people who have answers gives it the power to work faster and more efficiently.

At Texaco, managing knowledge is a critical business challenge. John Old, Texaco's knowledge guru, approaches this challenge with a strategy that leverages human connections. Old states that knowledge by its nature is contextual; thus, systems that simply allow people to record what they know are ineffective. He strongly believes that a successful knowledge management solution must recognize the importance of human connections.

Texaco uses technology to help people build personal relationships and share knowledge. One of the systems at work at Texaco is PeopleNet, a search engine for employees on the company's intranet. Employees who have questions can use PeopleNet to review profiles of their colleagues who might have the right answers. Texaco discovered that having biographies and pictures of its employees online makes it possible to establish credibility and trust between people who have not met each other. And it is trust that makes effective knowledge transfer possible.

Another tool that Texaco uses to connect its employees is a software system called Knowledge Mail (from Tacit Knowledge Systems). This software analyzes e-mail sent and received by employees to help them make good contacts with colleagues who work on the same issues.

John Old speaks of several important lessons that Texaco learned while managing knowledge. He points out that people are more eager to share knowledge when they are united by a clear, specific, and measurable business purpose. Knowledge sharing becomes even more successful when they trust each other and see direct benefits that can be derived from the knowledge exchange. In addition, it is important to give people enough time to reflect on what they know and what they need to learn.

Texaco's approach to knowledge management has provided many positive results. The knowledge management efforts help Texaco's employees successfully resolve numerous issues that range from adjusting oil well pumps to deciding whether or not to enter into new lines of business.

Source: Adapted from Warner (2001).

For Further Exploration: Texaco relies primarily on the practice approach to knowledge management. Why was this approach effective for Texaco? Would this approach be optimal for your college or place of work?

In reality, a knowledge management initiative can, and probably will, involve both process and practice approaches. The two are not mutually exclusive. Alavi et al. (2003) describe the case of an organization that began its KM effort with a large repository but evolved the knowledge management initiative into a community-of-practice approach that existed side by side with the repository. In fact, community members would pass information from the community forum to the organizational repository when they felt that the knowledge was valuable outside their community. *IT At Work 10.2* illustrates how Texaco successfully manages its knowledge using the practice approach.

10.4 INFORMATION TECHNOLOGY IN KNOWLEDGE MANAGEMENT

Knowledge management is more a methodology applied to business practices than a technology or product. Nevertheless, information technology is *crucial* to the success of every knowledge management system. Information technology enables KM by providing the enterprise architecture upon which it is built.



Components of Knowledge Management Systems

Knowledge management systems are developed using three sets of technologies: *communication*, *collaboration*, and *storage and retrieval*.

Communication technologies allow users to access needed knowledge, and to communicate with each other—especially with experts. E-mail, the Internet, corporate intranets, and other Web-based tools provide communication capabilities. Even fax machines and the telephone are used for communication, especially when the practice approach to knowledge management is adopted.

Collaboration technologies provide the means to perform group work. Groups can work together on common documents at the same time (synchronous) or at different times (asynchronous); in the same place, or in different places. This is especially important for members of a community of practice working on knowledge contributions. Collaborative computing capabilities such as electronic brainstorming enhance group work, especially for knowledge contribution. Additional forms of group work involve experts working with individuals trying to apply their knowledge. This requires collaboration at a fairly high level. Other collaborative computing systems allow an organization to create a virtual space so that individuals can work online anywhere and at any time.

Storage and retrieval technologies originally meant using a database management system to store and manage knowledge. This worked reasonably well in the early days for storing and managing most explicit knowledge, and even explicit knowledge about tacit knowledge. However, capturing, storing, and managing tacit knowledge usually requires a different set of tools. Electronic document management systems and specialized storage systems that are part of collaborative computing systems fill this void.

Technologies Supporting Knowledge Management

Several technologies have contributed to significant advances in knowledge management tools. Artificial intelligence, intelligent agents, knowledge discovery in databases, and Extensible Markup Language (XML) are examples of technologies that enable advanced functionality of modern knowledge management systems and form the base for future innovations in the KM field.

ARTIFICIAL INTELLIGENCE. In the definition of knowledge management, *artificial intelligence* (Chapter 11) is rarely mentioned. However, practically speaking, AI methods and tools are embedded in a number of knowledge management systems, either by vendors or by system developers.

AI methods can assist in identifying expertise, eliciting knowledge automatically and semiautomatically, interfacing through natural language processing, and in intelligent search through intelligent agents. AI methods, notably expert systems, neural networks, fuzzy logic, and intelligent agents, are used in knowledge management systems to perform various functions: They assist in and enhance searching knowledge (e.g., intelligent agents in Web searches), including scanning e-mail, documents, and databases and helping establish knowledge profiles of individuals and groups. They forecast future results using existing knowledge. AI methods help determine the relative importance of knowledge, when knowledge is both contributed to and accessed from the knowledge repository, and help determine meaningful relationships in the knowledge. They identify patterns in data (usually through neural networks), induce rules for expert systems, and provide advice directly from knowledge by using neural networks



or expert systems. Finally, they provide a natural language or voice command-driven user interface for a knowledge management system.

INTELLIGENT AGENTS. *Intelligent agents* are software systems that learn how users work and provide assistance in their daily tasks. For example, when these software programs are told what the user wants to retrieve, passive agents can monitor incoming information for matches with user interests and active agents can seek out information relevant to user preferences (Gray and Tehrani, 2003). Intelligent agents of various kinds are discussed in Chapter 12.

There are a number of ways that intelligent agents can help in knowledge management systems. Typically they are used to elicit and identify knowledge. Examples are:

- IBM (*ibm.com*) offers an intelligent data mining family, including Intelligent Decision Server (IDS), for finding and analyzing massive amounts of enterprise data.
- Gentia (Planning Sciences International, *gentia.com*) uses intelligent agents to facilitate data mining with Web access and data warehouse facilities.
- Convectis (HNC Software Inc.) uses neural networks to search text data and images, to discern the meaning of documents for an intelligent agent. This tool is used by InfoSeek, an Internet search engine, to speed up the creation of hierarchical directories of Web topics.

Combining intelligent agents with enterprise knowledge portals is a powerful technique that can deliver to a user exactly what he or she needs to perform his or her tasks. The intelligent agent learns what the user prefers to see, and how he or she organizes it. Then, the intelligent agent takes over to provide it at the desktop like a good administrative assistant would (King and Jones, 1995).

KNOWLEDGE DISCOVERY IN DATABASES. **Knowledge discovery in databases (KDD)** is a process used to search for and extract useful information from volumes of documents and data. It includes tasks known as knowledge extraction, data archaeology, data exploration, data pattern processing, data dredging, and information harvesting. All of these activities are conducted automatically and allow quick discovery, even by nonprogrammers. Data are often buried deep within very large databases, data warehouses, text documents, or knowledge repositories, all of which may contain data, information, and knowledge gathered over many years. **Data mining**, the process of searching for previously unknown information or relationships in large databases, is ideal for eliciting knowledge from databases, documents, e-mail, and so on. (For more on data mining, see Chapter 12.)

AI methods are useful data mining tools that include automated knowledge elicitation from other sources. Intelligent data mining discovers information within databases and other repositories that queries and reports cannot effectively reveal. Data mining tools find patterns in data and may even (automatically) infer rules from them. Patterns and rules can be used to guide decision making and forecast the effect of these decisions. KDD can also be used to identify the meaning of data or text, using KM tools that scan documents and e-mail to build an expertise profile of a firm's employees. Data mining can speed up analysis by providing needed knowledge.

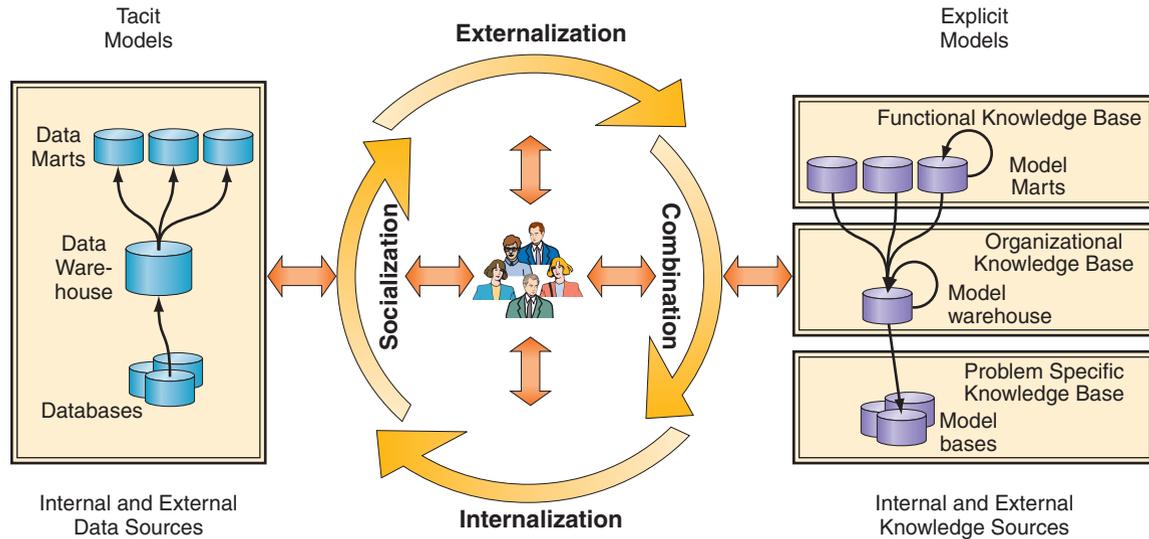


FIGURE 10.3 Framework for integrating decision support and knowledge management systems. (Source: Bolloju et al., 2001.)

Extending the role of data mining and knowledge discovery techniques for knowledge externalization, Bolloju et al. (2002) propose a framework for integrating knowledge management into enterprise environments for next-generation decision support systems. Their framework, shown in Figure 10.3, includes **model marts** and **model warehouses**. Both of these act as repositories of knowledge created by employing knowledge-discovery techniques on past decision instances stored in data repositories. (Model marts are small versions of model warehouses.) The model marts and model warehouses capture operational and historical decision models. For example, a model mart can store decision rules corresponding to problem-solving knowledge of different decision makers in a particular domain, such as loan approvals in a banking environment. (As you will discover in Chapter 12, model marts and model warehouses are analogous for models to data marts and data warehouses for data.)

This integrated decision support–knowledge management framework accommodates different types of knowledge transformations proposed by Nonaka and Takeuchi (1995). Systems built around this framework are expected to enhance the quality of support provided to decision makers; to support knowledge management functions such as acquisition, creation, exploitation, and accumulation; to facilitate discovery of trends and patterns in the accumulated knowledge; and to provide means for building up organizational memory.

EXTENSIBLE MARKUP LANGUAGE (XML). Extensible Markup Language (XML) enables standardized representations of data structures, so that data can be processed appropriately by heterogeneous systems without case-by-case programming. This method suits e-commerce applications and supply chain management systems that operate across enterprise boundaries. XML not only can automate processes and reduce paperwork, but also can unite business partners and supply chains for better collaboration and knowledge transfer. XML-based messages can be taken from back-end repositories and fed out through the portal interface and back again. A portal that uses XML allows the company to



communicate better with its customers, linking them in a virtual demand chain, where changes in customer requirements are immediately reflected in production plans. Due to its potential to tremendously simplify systems integration, XML may become the universal language that all portal vendors embrace (see Ruber, 2001). (For more technical detail on XML, see Technology Guide 2.)

Vendors are quickly moving to integrate the advantages offered by XML standards. For example, Interwoven's content management software, Teamsite, now fully supports XML, enabling organizations to provide content available in any format across the enterprise. Sequoia Software's XML Portal Server (XPS) and Hummingbird's Enterprise Portal Suite also support the XML standard for data exchange.

10.5 KNOWLEDGE MANAGEMENT SYSTEMS IMPLEMENTATION

The KMS challenge is to identify and integrate the three essential components—communication technologies, collaboration technologies, and storage and retrieval technologies—to meet the knowledge management needs of an organization. The earliest knowledge management systems were developed with networked technology (intranets), collaborative computing tools (groupware), and databases (for the knowledge repository). They were constructed from a variety of off-the-shelf IT components (e.g., see Ruggles, 1998). Many organizations, especially large management consulting firms like Accenture and J.D. Edwards, developed their knowledge architecture with a set of tools that provided the three technology types. Collaborative computing suites such as Lotus Notes/Domino Server provide many KMS capabilities. Other systems were developed by integrating a set of tools from a single or multiple vendors. For example, J.D. Edwards used a set of loosely integrated Microsoft tools and products to implement its Knowledge Garden KMS, as did KPMG. In the early 2000s, KMS technology has evolved to integrate the three components into a single package. These include enterprise knowledge portals and knowledge management suites.

Knowledge Management Products and Vendors

Technology tools that support knowledge management are called **knowware**. Most knowledge management software packages include one or more of the following seven tools: collaborative computing tools, knowledge servers, enterprise knowledge portals, electronic document management systems, knowledge harvesting tools, search engines, and knowledge management suites. Many packages provide several tools because several are necessary in an effective knowledge management system. For example, most electronic document management systems also include collaborative computing capabilities.

Knowledge management systems can be purchased in whole or in part from one of numerous software development companies and enterprise information systems vendors, they can be acquired through major consulting firms, or can be outsourced to the application service providers (ASPs). All three alternatives will be discussed in the later part of this chapter.

SOFTWARE DEVELOPMENT COMPANIES AND ENTERPRISE INFORMATION SYSTEMS VENDORS. Software development companies and enterprise information systems vendors offer numerous knowledge management packages: from individual tools to comprehensive knowledge management suites. The variety of

knowware that is readily available on the market allows companies to find the tools that will meet their unique knowledge management needs. Following is a review of some software packages and their vendors in each of the seven knowware categories cited earlier.

Collaborative Computing Tools. Collaboration tools, or groupware, were the first used to enhance tacit knowledge transfer within an organization. One of the earliest collaborative computing systems, GroupSystems, provides many of the tools that support group work, including electronic brainstorming and idea categorization. Lotus Notes/Domino Server provides an enterprisewide collaborative environment. Other collaboration tools include MeetingPlace (Latitude), QuickPlace (Lotus Development Corp.), eRoom Documentum (Documentum), and PlaceWare (PlaceWare Inc.). For a discussion, details and examples of collaborative computing, see Chapter 4.

Knowledge Servers. A knowledge server contains the main knowledge management software, including the knowledge repository, and provides access to other knowledge, information, and data. Examples of knowledge servers include the Hummingbird Knowledge Server, the Intraspect Software Knowledge Server, the Hyperwave Information Server, the Sequoia Software XML Portal Server, and Autonomy's Intelligent Data Operating Layer (IDOL) Server. Autonomy's IDOL Server connects people to content, content to content, and people to people through modules that enable organizations to integrate various personalization, collaboration and retrieval features. The server provides a **knowledge repository**, a central location for searching and accessing information from many sources, such as the Internet, corporate intranets, databases, and file systems, thereby enabling the efficient distribution of time-sensitive information. The server seamlessly extends and integrates with the company's e-business suite, allowing rapid deployment applications that span the enterprise and leverage AI-assisted technology to harvest knowledge assets.

Enterprise Knowledge Portals. Enterprise knowledge portals (EKPs) are the doorways into many knowledge management systems. They have evolved from the concepts underlying executive information systems, group support systems, Web-browsers, and database management systems. According to an IDC report, individuals may spend as much as 30 percent of their time looking for information (Ziff Davis, 2002). An enterprise knowledge portal presents a single access point for a vast body of explicit information, such as project plans, functional requirements, technical specifications, white papers, training materials, and customer feedback survey data (Kesner, 2003).

Enterprise knowledge portals are a means of organizing the many sources of unstructured information in an organization. Most combine data integration, reporting mechanisms, and collaboration, while document and knowledge management is handled by a server. The portal aggregates each user's total information needs: data and documents, e-mail, Web links and queries, dynamic feeds from the network, and shared calendars and task lists. The personal information portal has evolved into an enterprise knowledge portal (Silver, 2000).

One highly successful portal is Cisco's Employee Connection. The portal provides anytime, anywhere access to the company's intranet; it has been credited with helping save the company \$551 million, thanks primarily to improved self-service (Anderson, 2002). The intent of the system is to connect as many systems and applications as possible so that the user has a single entree into all of Cisco's information systems (Anderson, 2002).



When enterprise information portals first entered the market, they did not contain knowledge management features. Now, most do. Leading portal vendors include Autonomy, Brio, Corechange, Dataware, Vignette, Intraspect, Hummingbird, InXight, IBM/Lotus, Knowmadic, OpenText, Plumtree, Verity, and Viador. Database vendors such as Microsoft, Oracle, and Sybase are also selling knowledge portals. Portals can range in cost from less than \$500,000 to \$8 million (Steinberg, 2002).

The Knowledge Center (from KnowledgeTrack) offers integrated business-to-business (B2B) functions and can scale from dot-coms to large enterprises. Knowledge Center can be built into the enterprise architecture instead of simply sitting on top, the way most intranet portals do. The Knowledge Center integrates with external data sources including ERP, online analytical processing (OLAP) (see Chapter 11), and CRM systems (see Chapter 7). Knowledge Center supports communities of practice and enables them for large project management, allowing information to be shared among all of the extended enterprise value chains.

Hyperwave's Hyperwave Information Portal (HIP) aggregates information from disparate sources and features dynamic link management, which verifies the quality of the link and hides links to unauthorized content. HIP manages connections between information sources and makes structured and unstructured corporate information searchable via a standard browser. See *IT At Work 10.3* about how the Canadian law firm Smith Lyons developed a successful enterprise knowledge portal. For more on such portals, see Collins (2001), Liautaud and Hammond (2000), and *InfoWorld* (2000).

Electronic Document Management. Electronic document management (EDM) systems focus on the document in electronic form as the collaborative focus of work. EDM systems allow users to access needed documents, generally via a Web-browser over a corporate intranet. EDM systems enable organizations to better manage documents and workflow for smoother operations. They also allow collaboration on document creation and revision.

Many knowledge management systems use an EDM system as the knowledge repository (see Minicase 2). There is a natural fit in terms of the purpose and benefits of the two. For example, Pfizer uses a large-scale document management system to handle the equivalent of truckloads of paper documents of drug approval applications passed between Pfizer and the FDA, its regulating agency. This EDM system dramatically cut the time required for FDA submission and review, making Pfizer more competitive in getting new and effective drugs to market (Blodgett, 2000).

Systems like DocuShare (Xerox Corporation) and Lotus Notes (Lotus Development Corporation) allow direct collaboration on a common document. Some other EDM systems include Documentum (Documentum Inc.), ViewStar (eiStream), FYI (Identitech), FileNet Content Manager (FileNet Corporation), Livelink (Open Text Corporation), PaperPort (ScanSoft Inc.), and CaseCentral.com (Document Repository Inc.).

Knowledge Harvesting Tools. Tools for capturing knowledge unobtrusively are helpful since they allow a knowledge contributor to be minimally (or not at all) involved in the knowledge-harvesting efforts. Embedding this type of tool in a KMS is an ideal approach to knowledge capture.

For example, Tacit Knowledge Systems' KnowledgeMail is an expertise-location software package that analyzes users' outgoing e-mail to parse subject



IT At Work 10.3

PORTAL OPENS THE DOOR TO LEGAL KNOWLEDGE



Richard Van Dyk, CIO of Smith Lyons, a Toronto-based international law firm, knew exactly what kind of system he was looking for to manage the firm's documents and knowledge. He had spent a year defining his requirements and had composed a complex flowchart on his whiteboard. Smith Lyons (*smithlyons.com*) wanted to take thousands of pieces of information, give people different views into that information, and have a high level of link management. Van Dyk considered document management tools to be too inflexible for the way lawyers practice law. "We needed a flexible environment that we could massage and manipulate and that would allow people to continue working as they have," says Van Dyk.

"Lawyers are basically document generators," he says. "Due to time constraints, they spend more time collecting documents than organizing them." Because the firm's 550 attorneys and support specialists each had a distinct working methodology, often reflecting the requirements of a specific area of practice, Van Dyk knew they would resent having a rigid system they could not easily personalize.

The profusion of document management, knowledge management, and portal systems makes finding the right product difficult. Each has its strengths and weaknesses. Organizations coming from a document-centric perspective, like Smith Lyons, need to organize and manage content at the back end while developing highly customized individual user interfaces at the front end.

The solution that best met Van Dyk's criteria was the Hyperwave Information Portal from Hyperwave Information Management of Westford, Massachusetts. "What I

liked about Hyperwave's portal environment was that as soon as we installed it, we had a framework to begin knowledge mapping—tagging and indexing documents by subject and key words and phrases—and for building the database structures in our repositories," says Van Dyk. The firm had definite ideas on how to structure templates and specific pieces of information that are unique to a legal practice. These issues included myriad legal forms and documents generated by the proprietary software applications used for different practice areas.

Once the portal was set up, Smith Lyons' developers began to customize the views for each desktop PC by creating wizards that connect users to their own secure information areas and to intranet pages containing company activity information. In development, too, is an extranet on which lawyers will be able to post status reports to clients and deliver confidential documents and contracts.

"That flexibility in building our DM portal allows our lawyers and specialists to be incredibly specific in their searches," says Van Dyk. Lawyers also can share their accumulated knowledge more easily with colleagues in the same practice areas, by referencing legal citations, court decisions, and winning strategies that have worked in the past.

Source: Adapted from Ruber (2000).

For Further Exploration: How is the practice of law different from the operations of other businesses? How can enterprise knowledge portals benefit the entire legal system (courts, and so on)?

expertise. It maintains a directory of expertise and offers ways to contact experts, while maintaining privacy controls for those experts. Autonomy's Active-Knowledge performs a similar analysis on e-mail and other standard document types. Intraspect Software's Intraspect platform monitors an organization's group memory, captures the context of its use, such as who used it, when, for what, how it was combined with other information, and what people said about it, and then makes the information available for sharing and reuse.

Search Engines. Search engines perform one of the essential functions of knowledge management—locating and retrieving necessary documents from vast collections accumulated in corporate repositories. Companies like Google, Verity, and Inktomi are offering a wide selection of search engines that are capable of indexing and cataloging files in various formats as well as retrieving and prioritizing relevant documents in response to user queries.



Knowledge Management Suites. Knowledge management suites are complete knowledge management solutions out-of-the-box. They integrate the communications, collaboration, and storage technologies into a single convenient package. A knowledge management suite must still access internal databases and other external knowledge sources, so some integration is required to make the software truly functional. Knowledge management suites are powerful approaches to developing a KMS because they offer one user interface, one data repository, and one vendor.

IBM/Lotus offers an extensive range of knowledge management products: the Domino platform, QuickPlace and Sametime, Discovery Server and Learning Space, as well as the WebSphere portal. See *IT At Work 10.4* to learn how Commerce Bank implemented a knowledge management system based on the IBM/Lotus platform.

Several vendors also provide fairly comprehensive sets of tools for KM initiatives, which include Dataware Knowledge Management Suite, KnowledgeX by KnowledgeX, Inc., and many others. Autonomy Knowledge Management Suite offers document categorization and workflow integration. Microsoft provides central components of knowledge management solutions, and is working on developing an encompassing KM framework. Some enterprise information systems vendors, such as SAP, PeopleSoft, and Oracle are developing knowledge-management-related technologies as a platform for business applications. Siebel Systems is repositioning itself as a business-to-employee knowledge management platform.

CONSULTING FIRMS. All of the major consulting firms (Accenture, Ernst & Young, and so on) have massive internal knowledge management initiatives. Usually these become products after they succeed internally and provide assistance in establishing knowledge management systems and measuring their effectiveness. Consulting firms also provide some direct, out-of-the-box proprietary systems for vertical markets. Most of the major consulting firms define their knowledge management offerings as a *service*. For more on consulting firm activities and products, see McDonald and Shand (2000).

KNOWLEDGE MANAGEMENT APPLICATION SERVICE PROVIDERS. Application service providers (ASPs) have evolved as a form of KMS outsourcing on the Web. There are many ASPs for e-commerce on the market.

For example, Communispace is a high-level ASP collaboration system that focuses on connecting people to people (not just people to documents) to achieve specific objectives, regardless of geographic, time, and organizational barriers. As a hosted ASP solution, it is easy to rapidly deploy within organizations. Unlike conventional KM systems that organize data and documents, or chat rooms where people simply swap information, Communispace contains a rich assortment of interactions, activities, and tools that connect people to the colleagues who can best help them make decisions, solve problems, and learn quickly. Communispace is designed to build trust online. It attempts to make a community self-conscious about taking responsibility for its actions and knowledge. Its Climate component helps participants to measure and understand how people are feeling about the community. The Virtual Café gives dispersed employees a way to meet and learn about each other through pictures and profiles.



IT At Work 10.4

FINDING THE RIGHT ANSWERS WITH KNOWLEDGE MANAGEMENT



Commerce Bank (*commerceonline.com*) is a \$15.4 billion financial institution that is quickly growing to become a dominant player in the financial services market of Philadelphia and southern New Jersey. During 30 years of its existence, it has developed a network of 214 branches and made ambitious plans for continuous growth. Commerce Bank names itself “America’s Most Convenient Bank.” It lives up to that name by maintaining a strong banking network and by empowering each branch to make business decisions in an effort to better meet the needs of its customers.

While undergoing explosive growth, Commerce Bank encouraged its associates to learn all about the customers and the right ways to service them. However, the company realized that its most important asset, knowledge, was locked away in the file cabinets and in the heads of its associates. In order to support this initiative, Commerce Bank needed to tap into that knowledge and find a way to train employees consistently and conveniently across the entire branch network.

The first step for new employees is Commerce University, a boot camp where they are instilled with the fundamentals of customer service. But the program covers only a few of the range of issues that an associate might encounter.

The need for knowledge management at Commerce Bank was apparent. Jack Allison, VP of Systems Development, says, “We had folks in administration that could spend 70 percent of their time answering calls and clarifying answers for branches. At times, we could wait weeks or months for the right answer to certain questions. Knowing that training may not give answers for every scenario, we needed to give associates a tool that could help them find any answer to any topic at any time.”

Commerce Bank envisioned a solution—a workflow-based knowledge management system that could provide instant answers to questions for the bank’s employees and online customers. To make this vision a reality, Commerce chose to develop a system based on IBM’s Lotus Notes, which the bank had been using since 1995. Using IBM’s Domino server, the Lotus Notes client, and an application development toolkit, Commerce Bank created a full-fledged knowledge management system, called Wow Answer Guide.

Introduced in 2000, Wow Answer Guide provides a central repository of knowledge about all bank transactions, helps employees learn a process and respond to customer inquiries, and stores information electronically. In addition, the system allows employees to register for the bank’s continuing education courses.

The complete Wow Answer Guide contains more than 400 applications, and Commerce plans to add even more, such as a customer relationship management system. The flexibility of the platform simplifies application development process and allows adding new features and expanding functionality with minimal investments of time and effort. By drawing on the power of the Domino platform, Commerce Bank created workflow-based applications that streamline internal knowledge sharing and that route data and information to the appropriate employees within the organization. This dramatically reduces the completion time for approval-intensive transactions, improves the bank’s capacity, and minimizes labor costs.

“[Wow Answer Guide] is especially good for the green associate, or the veteran, who is still learning how to process a new product,” says Allison. “We don’t want our associates on a scavenger hunt to get the correct information.”

Commerce Bank realized that knowledge management would be beneficial not only to the bank’s employees, but also to the bank’s clients. “We wanted to put information in our customers’ hands so they could conduct [online] transactions with confidence,” said Allison. In the summer of 2000, Commerce Bank deployed a new version of Wow Answer Guide that empowered the bank’s online customers.

Knowledge management at Commerce Bank proved to be an effective investment. According to Allison, the application has saved the bank \$20,000 per week, or approximately \$1 million a year. In fact, the bank achieved a return on investment within a month of launching Wow Answer Guide.

Source: Adapted from Amato-McCoy (2003).

For Further Exploration: How do knowledge requirements of bank employees differ from those of bank customers? How would these differences influence the functionality of knowledge management systems designed to serve these two groups of users?



A recent trend among application service providers is to offer a complete knowledge management solution, including a KM suite and the consulting to set it up.

Integration of KM Systems with Other Business Information Systems

Since a knowledge management system is an enterprise system, it must be integrated with other enterprise and other information systems in an organization. Obviously, when it is designed and developed, it cannot be perceived as an add-on application. It must be truly integrated into other systems. Through the structure of the organizational culture (changed if necessary), a knowledge management system and its activities can be directly integrated into a firm's business processes. For example, a group involved in customer support can capture its knowledge to provide help on customers' difficult problems. In this case, help-desk software would be one type of package to integrate into a KMS, especially into the knowledge repository.

Since a KMS can be developed on a knowledge platform consisting of communication, collaboration, and storage technologies, and most firms already have many such tools and technologies in place, it is often possible to develop a KMS in the organization's existing tools (e.g., Lotus Notes/Domino Server). Or, an enterprise knowledge portal can provide universal access and an interface into all of an individual's relevant corporate information and knowledge. In this case, the KMS effort would provide the linkage for everyone into the entire enterprise information system.

In the remainder of this section, we look at how KM systems can be integrated with other types of business information systems.

INTEGRATION WITH DECISION SUPPORT SYSTEMS (DSS). Knowledge management systems typically do not involve running models to solve problems, which is an activity typically done in decision support systems. However, since a knowledge management system provides help in solving problems by applying knowledge, part of the solution may involve running models. A KMS could integrate into an appropriate set of models and data and activate them, when a specific problem may call for it.

INTEGRATION WITH ARTIFICIAL INTELLIGENCE. Knowledge management has a natural relationship with artificial intelligence (AI) methods and software, though knowledge management, strictly speaking, is not an artificial intelligence method. There are a number of ways in which knowledge management and artificial intelligence can integrate. For example, if the knowledge stored in a KMS is to be represented and used as a sequence of if-then-else rules, then an expert system becomes part of the KMS (see Rasmus, 2000). An expert system could also assist a user in identifying how to apply a chunk of knowledge in the KMS.

Much work is being done in the field of artificial intelligence relating to knowledge engineering, tacit-to-explicit knowledge transfer, knowledge identification, understanding, and dissemination, and so on. Companies are attempting to realign these technologies and resultant products with knowledge management. The AI technologies most often integrated with knowledge management are intelligent agents, expert systems, neural networks, and fuzzy logic. Several specific methods and tools were described earlier.



INTEGRATION WITH DATABASES AND INFORMATION SYSTEMS. Since a KMS utilizes a knowledge repository, sometimes constructed out of a database system or an electronic document management system, it can automatically integrate to this part of the firm's information system. As data and information updates are made, the KMS can utilize them. Knowledge management systems also attempt to glean knowledge from documents and databases (knowledge discovery in databases) through artificial intelligence methods, as was described earlier.

INTEGRATION WITH CUSTOMER RELATIONSHIP MANAGEMENT SYSTEMS. Customer relationship management (CRM) systems help users in dealing with customers. One aspect is the help-desk notion described earlier. But CRM goes much deeper. It can develop usable profiles of customers, and predict their needs, so that an organization can increase sales and better serve its clients. A KMS can certainly provide tacit knowledge to people who use CRM directly in working with customers.

INTEGRATION WITH SUPPLY CHAIN MANAGEMENT SYSTEMS. The supply chain is often considered to be the logistics end of the business. If products do not move through the organization and go out the door, the firm will fail. So it is important to optimize the supply chain and manage it properly. As discussed in Chapter 8, supply chain management (SCM) systems attempts to do so. SCM can benefit through integration with KMS because there are many issues and problems in the supply chain that require the company to combine both tacit and explicit knowledge. Accessing such knowledge will directly improve supply chain performance.

INTEGRATION WITH CORPORATE INTRANETS AND EXTRANETS. Communication and collaboration tools and technologies are necessary for KMS to function. KMS is not simply integrated with the technology of intranets and extranets, but is typically developed on them as the communications platform. Extranets are specifically designed to enhance the collaboration of a firm with its suppliers and sometimes with customers. If a firm can integrate its KMS into its intranets and extranets, not only will knowledge flow more freely, both from a contributor and to a user (either directly or through a knowledge repository), the firm can also capture knowledge directly with little user involvement, and can deliver it when the system "thinks" that a user needs knowledge.

10.6 ROLES OF PEOPLE IN KNOWLEDGE MANAGEMENT

Managing a knowledge management system requires great effort. Like any other information technology, getting it started, implemented, and deployed requires a champion's effort. Many issues of management, people, and culture must be considered to make a knowledge management system a success. In this section, we address those issues.

Managing the knowledge repository typically requires a full-time staff, similar to a reference-library staff. This staff examines, structures, filters, catalogues, and stores knowledge so that it is meaningful and can be accessed by the people who



need it. The staff assists individuals in searching for knowledge, and performs “environmental scanning”: If they identify specific knowledge that an employee or client might need, they send it directly to them, thus adding value to the organization. (This is standard procedure for Accenture knowledge management personnel.) Finally, the knowledge repository staff may create communities of practice (see Minicase 1) to gather individuals with common knowledge areas to identify, filter, extract, and contribute knowledge to a knowledge repository.

Most of the issues concerning the success, implementation, and effective use of a knowledge management system are people issues. And since a knowledge management system is an enterprisewide effort, many people need to be involved in it (Robb, 2003). They include the chief knowledge officer (CKO), the CEO, the other officers and managers of the organization, members and leaders of communities of practice, KMS developers, and KMS staff. Each person or group has an important role in either the development, management, or use of a KMS. By far, the CKO has the most visible role in a KMS effort, but the system cannot succeed unless the roles of all the players are established and understood. Ensuring that a KM team is properly constituted is therefore an essential factor in the success of any KM initiative (Robb, 2003).

The Chief Knowledge Officer

Knowledge management projects that involve establishing a knowledge environment conducive to the transfer, creation, or use of knowledge attempt to build *cultural receptivity*. These attempts are centered on changing the behavior of the firm to embrace the use of knowledge management. Behavioral-centric projects require a high degree of support and participation from the senior management of the organization to facilitate their implementation. Most firms developing knowledge management systems have created a knowledge management officer, a **chief knowledge officer (CKO)**, at the senior level. The objectives of the CKO’s role are to maximize the firm’s knowledge assets, design and implement knowledge management strategies, effectively exchange knowledge assets internally and externally, and promote system use.

A chief knowledge officer must do the following (adapted from Duffy, 1998):

- Set strategic priorities for knowledge management.
- Establish a knowledge repository of best practices.
- Gain a commitment from senior executives to support a learning environment.
- Teach information seekers how to ask better and smarter questions.
- Establish a process for managing intellectual assets.
- Obtain customer satisfaction information in near real time.
- Globalize knowledge management.

The CKO is responsible for defining the area of knowledge within the firm that will be the focal point, based on the mission and objectives of the firm (Davis, 1998). The CKO is responsible for standardizing the enterprisewide vocabulary and for controlling the knowledge directory. This is critical in areas that must share knowledge across departments, to ensure uniformity. CKOs must get a handle on the company’s repositories of research, resources, and expertise, including where they are stored and who manages and accesses them. (That is, the CKO must perform a *knowledge audit*.) Then the CKO must encourage “pollination” (sharing of knowledge) among disparate workgroups with complementary resources.



The CKO is responsible for creating an infrastructure and cultural environment for knowledge sharing. He or she must assign or identify the *knowledge champions* within the business units. The CKO's job is to manage the content their group produces (e.g., the Chrysler Tech Clubs in Minicase 1), continually add to the knowledge base, and encourage their colleagues to do the same. Successful CKOs should have the full and enthusiastic support of their managers and of top management. Ultimately, the CKO is responsible for the entire knowledge management project while it is under development, and then for management of the system and the knowledge once it is deployed.

CEO, Officers, and Managers of the Organization

Briefly, vis a vis knowledge management, the CEO is responsible for championing the KM effort. He or she must ensure that a competent and capable CKO is found and that the CKO can obtain all the resources (including access to people with knowledge sources) needed to make the project a success. The CEO must also gain organization-wide support for the contribution to and use of the KMS. The CEO must also prepare the organization for the cultural changes that are expected to occur when the KMS is implemented. Support for the KMS and the CKO is the critical responsibility of the CEO.

The various other officers in the organization generally must make resources available to the CKO so that he or she can get the job done. The chief financial officer (CFO) must ensure that the financial resources are available. The chief operating officer (COO) must ensure that people begin to embed knowledge management practices into their daily work processes. There is a special relationship between the CKO and chief information officer (CIO). Usually the CIO is responsible for the IT vision of the organization and for the IT architecture, including databases and other potential knowledge sources. The CIO must cooperate with the CKO in making these resources available. KMSs are expensive propositions, and it is wise to use existing systems if they are available and capable.

Managers must also support the KM effort and provide access to sources of knowledge. In many KMSs, managers are an integral part of the communities of practice.

Communities of Practice

The success of many KM systems has been attributed to the active involvement of the people who contribute to and benefit from using the knowledge. Consequently, communities of practice have appeared within organizations that are serious about their knowledge management efforts. As discussed earlier, a **community of practice (COP)** is a group of people in an organization with a common professional interest. Ideally, all the KMS users should each be in at least one COP. Creating and nurturing COPs properly is one key to KMS success.

In a sense, a community of practice "owns" the knowledge that it contributes, because it manages the knowledge on its way into the system, and as owner, must approve modifications to it. The community is responsible for the accuracy and timeliness of the knowledge it contributes and for identifying its potential use.

A number of researchers have investigated how successful COPs form and function. One study, by Storck and Hill (2000), investigated one of the earliest communities of practice, at Xerox. When established at Xerox, the COP was a new organizational form. The word *community* captured the sense of responsible, independent action that characterized the group, which continued to function

within the standard boundaries of the large organization. Management sponsored the community, but did not mandate it. Community members were volunteers. For more on communities of practice, see Barth (2000a), Cothrel and Williams (1999a, 1999b), Eisenhart (2000), and Smith and McKeen (2003).

KMS Developers KMS developers are the team members who actually develop the system. They work for the CKO. Some are organizational experts who develop strategies to promote and manage the organizational culture shift. Others are involved in system software and hardware selection, programming, testing, deploying, and maintaining the system. Still others initially are involved in training users. Eventually the training function moves to the KMS staff.

KMS Staff Enterprisewide KM systems require a full-time staff to catalogue and manage the knowledge. This staff is either located at the firm's headquarters or dispersed throughout the organization in the knowledge centers. Most large consulting firms have more than one knowledge center.

Earlier we described the function of the staff to be similar to that of reference librarians. They actually do much more. Some members are functional-area experts who are now cataloguing and approving knowledge contributions, and pushing the knowledge out to clients and employees who they believe can use the knowledge. These functional experts may also work in a liaison role with the functional areas of the communities of practice. Others work with users to train them on the system or help them with their searches. Still others work on improving the system's performance by identifying better methods with which to manage knowledge. For example, Ernst & Young has 250 people managing the knowledge repository and assisting people in finding knowledge at its Center for Business Knowledge. Some staff members disseminate knowledge, while others are liaisons with the forty practice areas. They codify and store documents in their areas of expertise (see Hansen et al., 1999).

10.7 ENSURING SUCCESS OF KM EFFORTS

Organizations can gain several benefits from implementing a knowledge management strategy. Tactically, they can accomplish some or all of the following: reduce loss of intellectual capital due to people leaving the company; reduce costs by decreasing the number of times the company must repeatedly solve the same problem, and by achieving economies of scale in obtaining information from external providers; reduce redundancy of knowledge-based activities; increase productivity by making knowledge available more quickly and easily; and increase employee satisfaction by enabling greater personal development and empowerment. The best reason of all may be a strategic need to gain a *competitive advantage* in the marketplace (Knapp, 1998).

Knowledge Management Valuation In general, companies take either an asset-based approach to knowledge management valuation or one that links knowledge to its applications and business benefits (Skyrme and Amidon, 1998). The former approach starts with the identification of intellectual assets and then focuses management's attention on increasing their value. The second uses variants of a *balanced scorecard*, where financial measures are balanced against customer, process, and innovation



measures. Among the best-developed financial measurement methods in use are the balanced-scorecard approach, Skandia's Navigator, Stern Stewart's economic value added (EVA), M'Pherson's inclusive valuation methodology, the return on management ratio, and Levin's knowledge capital measure. See Skyrme and Amidon (1998) for details on how these measures work in practice.

Another method of measuring the value of knowledge is to estimate its price if it was offered for sale. Most firms are reluctant to sell knowledge, unless they are expressly in the business of doing so. Generally a firm's knowledge is an asset that has competitive value, and if it leaves the organization, the firm loses its competitive advantage. However, it is possible to price the knowledge and the access to the knowledge in order to make it worth a firm's while to sell it. For example, American Airlines' Decision Technologies Corp. grew from a small internal analysis team in the 1970s. Initially the team was created to solve problems and provide decision support to American Airlines only. As it grew, it became an independent corporation within AMR Corp., and it began to provide consulting and systems to other airlines, including American's competitors. AMR evidently had decided that the revenue it could obtain by selling some knowledge overrode any competitive advantage it would lose by doing so. The major consulting firms are in the business of selling expertise. Their knowledge management efforts, which often began as internal systems, evolved into quite valuable systems that their clients use on a regular basis.

Success indicators with respect to knowledge management are similar to those for assessing the effectiveness of other business-change projects. They include growth in the resources attached to the project, growth in the volume of knowledge content and usage, the likelihood that the project will survive without the support of a particular individual or individuals, and some evidence of financial return either for the knowledge management activity itself or for the entire organization (Davenport et al., 1998).

There are in general two types of measures that can be used to assess the effectiveness of a KM initiative: results-oriented and activity-oriented (O'Dell et al., 2003). The results-oriented measures are financial in nature and might include such things as increase in goods sold. The activities-based measures consider how frequently users are accessing knowledge or contributing to knowledge (O'Dell et al., 2003).

FINANCIAL METRICS. Even though traditional accounting measures are incomplete for measuring KM, they are often used as a quick justification for a knowledge management initiative. Returns on investment (ROIs) are reported to range from 20:1 for chemical firms to 4:1 for transportation firms, with an average of 12:1, based on the knowledge management projects assisted on by one consulting firm (Abramson, 1998). In order to measure the impact of knowledge management, experts recommend focusing KM projects on specific business problems that can be easily quantified. When the problems are solved, the value and benefits of the system become apparent and often can be measured (MacSweeney, 2002).

At Royal Dutch/Shell group, the return on investment was explicitly documented: The company had invested \$6 million in a Knowledge Management System in 1999 and within two years obtained \$235 million in reduced costs and new revenues (King, 2001). Hewlett-Packard offers another example of documented financial returns. Within six months of launching its @HP



companywide portal in October 2000, Hewlett-Packard realized a \$50 million return on its initial investment of \$20 million. This was largely due to a reduction in volume of calls to internal call centers and to the new paperless processes (Roberts-Witt, 2002).

The financial benefit might be perceptual, rather than absolute, but it need not be documented in order for the KM system to be considered a success.

NONFINANCIAL METRICS. Traditional ways of financial measurement may fall short when measuring the value of a KMS, because *they do not consider intellectual capital an asset*. Therefore there is a need to develop procedures for valuing the *intangible* assets of an organization, as well as to incorporate models of intellectual capital that in some way quantify innovation and the development and implementation of core competencies.

When evaluating intangibles, there are a number of new ways to view capital. In the past, only customer goodwill was valued as an asset. Now the following are also included (adapted from Allee, 1999):

- **External relationship capital:** how an organization links with its partners, suppliers, customers, regulators, and so on
- **Structural capital:** systems and work processes that leverage competitiveness, such as information systems, and so on
- **Human capital:** the individual capabilities, knowledge, skills, and so on, that people have
- **Social capital:** the quality and value of relationships with the larger society
- **Environmental capital:** the value of relationships with the environment

For example, a knowledge management initiative undertaken by Partners HealthCare System, Inc. has not resulted in quantifiable financial benefits, but has greatly increased the social capital of the company. The knowledge management system for physicians implemented by Partners reduced the number of serious medication errors by 55 percent at some of Boston's most prestigious teaching hospitals. Calculating return on investment for such a system turns out to be an extremely difficult proposition, which is why only a small fraction of hospitals use similar systems. While the company is unable to determine how the system affects its bottom line, it is willing to justify the costs based on the system's benefits to the society (Melymuka, 2002).

Causes of KM Failure



No system is infallible. There are many cases of knowledge management failing. Estimates of KM failure rates range from 50 percent to 70 percent, where a failure is interpreted to mean that *all* of the major objectives were not met by the effort (Ambrosio, 2000).

Some reasons for failure include having too much information that is not easily searchable (Steinberg, 2002) and having inadequate or incomplete information in the system so that identifying the real expertise in an organization becomes foggy (Desouza, 2003). Failure may also result from an inability to capture and categorize knowledge as well as from the over management of the KM process such that creativity and communities of practice are stifled (Desouza, 2003). Other issues include lack of commitment (this occurred at a large Washington, D.C., constituent lobbying organization), not providing incentive for people to use the system (as occurred at Pillsbury Co.; see Barth, 2000b, and Silver, 2000), and an



IT At Work 10.5

ESCAPING A KNOWLEDGE MANAGEMENT FAILURE



In late 1990s, Frito-Lay Inc., a Plano, Texas-based snack foods division of PepsiCo Inc., realized that its sales teams had difficulties collaborating and finding pertinent information. These difficulties led to frustration, declining performance, and rising turnover rates. To alleviate these problems and boost performance, Frito-Lay (*fritolay.com*) envisioned a Web-based portal that would combine tools for knowledge management and collaboration. The company engaged Dallas-based consulting firm, Navigator Systems Inc., to develop the portal.

Frito-Lay selected a pilot sales team to describe the kinds of knowledge they needed. The requests ranged from simple information, such as why Frito-Lay merchandises Lays and Ruffles products in one part of a store and Doritos in another, to more complex questions on what motivates shoppers as they move through a store. To collect the required knowledge, developers searched Frito-Lay's databases in departments such as marketing, sales, and operations. They also referenced external sources such as trade publications and industry organizations, and identified in-house subject matter experts.

In October 1999, a working prototype of the system was presented to the pilot sales team. Only then did Frito-Lay discover that in the quest for speed, a classic and crippling mistake had been made: The development team had failed to obtain sufficient input from the sales team and did not involve users in the design process. The prototype had the potential to be marginally useful to any sales team, but it was not specific enough to offer fundamental benefits for the pilot team. Therefore, the pilot team was reluctant to accept the system. "Conceptually, it was a great idea," said Frito-Lay sales team leader Joe Ackerman. "But when folks

are not on the front line, their view of what is valuable is different from those running 100 miles an hour in the field."

Frito-Lay learned valuable lessons from that mistake and chose to redesign the system. However, at this stage, it not only needed to add the missing features, but also had to win back the sales force and convince them that the redesigned system would indeed streamline their work by facilitating knowledge exchange. The team of developers spent the following four months working with salespeople to transform the prototype into a system they would embrace.

The redesigned portal has been a big success. Better collaboration has helped to significantly reduce turnover, while improved access to knowledge-base resources has enabled salespeople to present themselves as consultants with important knowledge to share. Today, the knowledge management portal is used for daily communication, call reporting, weekly cross-country meetings, training, document sharing, and access to data and industry news. The pilot team exceeded its sales plan for 2000 and grew its business at a rate almost twice that of Frito-Lay's other customer teams. The KMS concept is now being tailored to three other Frito-Lay sales teams and departments, and other divisions of PepsiCo have expressed interest in it as well.

Source: Adapted from Melymuka (2001).

For Further Exploration: Why did Frito-Lay find it difficult to correct the mistake identified in a late stage of the development cycle? If you were responsible for the development of a knowledge management system, what specific actions would you take to ensure that it satisfies the needs of end users?

over-emphasis on technology at the expense of larger knowledge and people issues (Hislop, 2002).

IT At Work 10.5 illustrates how Frito-Lay narrowly avoided failure of its KMS.

Factors Leading to KM Success

To increase the probability of success of knowledge management projects, companies must assess whether there is a strategic need for knowledge management in the first place. The next step is to determine whether the current process of dealing with organizational knowledge is adequate and whether the organization's culture is ready for procedural changes. Only when these issues are resolved, should the company consider technology infrastructure and decide if a new system is needed. When the right technological solution is chosen, it

**TABLE 10.2 Major Factors that Lead to KM Project Success**

- A link to a firm's economic value, to demonstrate financial viability and maintain executive sponsorship.
- A technical and organizational infrastructure on which to build.
- A standard, flexible knowledge structure to match the way the organization performs work and uses knowledge. Usually, the organizational culture must change to effectively create a knowledge-sharing environment.
- A knowledge-friendly culture leading directly to user support.
- A clear purpose and language, to encourage users to buy into the system. Sometimes simple, useful knowledge applications need to be implemented first.
- A change in motivational practices, to create a culture of sharing.
- Multiple channels for knowledge transfer—because individuals have different ways of working and expressing themselves. The multiple channels should reinforce one another. Knowledge transfer should be easily accomplished and be as unobtrusive as possible.
- A level of process orientation to make a knowledge management effort worthwhile. In other words, new, improved work methods can be developed.
- Nontrivial motivational methods, such as rewards and recognition, to encourage users to contribute and use knowledge.
- Senior management support. This is critical to initiate the project, to provide resources, to help identify important knowledge on which the success of the organization relies, and to market the project.

Source: Adapted from Davenport et al., 1998.

becomes necessary to properly introduce the system to the entire organization and to gain participation of every employee (Kaplan, 2002).

A case study of Nortel Network's KM initiative indicated that there were three major issues that influenced the success of KM: (1) having effective managerial influence in terms of coordination, control and measurement, project management, and leadership; (2) having key resources such as financial resources and cross-functional expertise, and (3) taking advantage of technological opportunities. Together, these enabled a well-defined process, the understanding of people issues, and the successful incorporation of technology (Massay et al., 2002). Other factors that may lead to knowledge management project success are shown in Table 10.2.

Effective knowledge sharing and learning requires cultural change within the organization, new management practices, senior management commitment, and technological support. We recognize that organizational culture must shift to a culture of sharing. This should be handled through strong leadership at the top, and by providing knowledge management tools that truly make people's jobs better. As far as encouraging system use and knowledge sharing goes, people must be *properly* motivated to contribute knowledge. The mechanism for doing so should be part of their jobs, and their salaries should reflect this. People must also be motivated to utilize the knowledge that is in the KMS. Again, this should be part of their jobs and their reward structures.

As more companies develop their knowledge management capabilities, some of the ground rules are becoming apparent. Success depends on a clear strategic logic for knowledge sharing, the choice of appropriate infrastructure (technical or non-technical), and an implementation approach that addresses the typical barriers: motivation to share knowledge, resources to capture and synthesize organizational learning, and ability to navigate the knowledge network to find the right people and data.



A CLOSER LOOK

10.1 ADAPTABILITY—A MISSING INGREDIENT

Mrs. Fields Cookies, a national chain of cookie stores, grew remarkably fast and successfully during the early 1980s. A key aspect of the company's strategy was to provide expertise directly from the headquarters to every store. As the number of stores increased, the only feasible way to achieve such direct control was through the use of information systems that were designed to mimic the decision making of Mrs. Fields herself. Decision-making systems were placed in each store. The system would take input (such as the temperature, the day of the week, the date, and so forth), would process the data, and would provide, as output, information to each store manager about how many cookies of each type to bake each hour. In essence, the software provided each store manager with explicit directions for planning each day's production, sales, and labor scheduling, along with inventory

control and ordering. Because of the well functioning computer systems, which in principle were systems designed to make Mrs. Fields tacit knowledge available to all stores, the company was able to successfully function with few managerial levels.

However, as the market began to change and consumers became more health conscious, Mrs. Fields was very slow to respond. In a sense, by embedding so much knowledge into systems that were incapable of adaptation, the organization tied itself to a certain way of doing things and failed to engage in knowledge creation. That is, it failed to pick up the signals in the environment, which might have suggested a change in strategy or product focus. By the early 1990s, the company had fallen into bankruptcy.

Source: Adapted from Henfridsson and Söderholm (2000).

Potential Drawbacks to Knowledge Management Systems

While there are many positive outcomes of managing knowledge, as discussed in examples throughout this chapter, it would be short-sighted to not consider the potential negative outcomes associated with reusing knowledge. As an example, Henfridsson and Söderholm (2000) analyzed the situation that faced Mrs. Fields cookies, as described in *A Closer Look 10.1*.

The case of Mrs. Fields illustrates that while organizations might achieve significant short-term gains through knowledge management systems, they must not neglect to allow for the creative process of new knowledge creation, lest they eventually find themselves applying yesterday's solutions to tomorrow's problems.

Closing Remarks

For millennia we have known about the effective use of knowledge and how to store and reuse it. Intelligent organizations recognize that knowledge is an intellectual asset, perhaps the only one that grows over time, and when harnessed effectively can sustain competition and innovation. Organizations can use information technology to perform true knowledge management. Leveraging an entire organization's intellectual resources can have tremendous financial impact.

With knowledge management, the definition is clear, the concepts are clear, the methodology is clear, the challenges are clear and surmountable, the benefits are clear and can be substantial, and the tools and technology—though incomplete and somewhat expensive—are viable. Key issues are executive sponsorship and measuring success. Technological issues are minimal compared to these. Knowledge management is not just another expensive management fad. Knowledge management is a new paradigm for how organizations work.

 **MANAGERIAL ISSUES**

1. **Organizational culture change.** This issue is how can we change organizational culture so that people are willing both to contribute knowledge to and use knowledge from a KMS? There must be strong executive leadership, clearly expressed goals, user involvement in the system, and deployment of an easy-to-use system that provides real value to employees. A viable reward structure for contributing and using knowledge must also be developed.
2. **How to store tacit knowledge.** This is extremely difficult. Most KMSs (based on the network storage model) store explicit knowledge about the tacit knowledge that people possess. When the knowledgeable people leave an organization, they take their knowledge with them. Since knowledge requires active use by the recipient, it is important for the person generating knowledge to articulate it in a way that another, appropriately educated person can understand it.
3. **How to measure the tangible and intangible benefits of KMS.** There are a number of ways to measure the value of intellectual assets and of providing them to the organization, as discussed in Section 10.7.
4. **Determining the roles of the various personnel in a KM effort.** This issue is described in Section 10.6.
5. **The lasting importance of knowledge management.** Knowledge management is extremely important. It is not another management fad. If it is correctly done, it can have massive impact by leveraging know-how throughout the organization. If it is not done, or is not correctly done, the company will not be able to effectively compete against another major player in the industry that does KM correctly.
6. **Implementation in the face of quickly changing technology.** This is an important issue to address regarding the development of many IT systems. Technology has to be carefully examined, and experiments done, to determine what makes sense. By starting now, an organization can get past the managerial and behavioral issues, which have greater impact on the eventual success (or not) of a KMS. As better and cheaper technology is developed, the KMS can be migrated over to it, just as legacy systems have migrated to the PC.



ON THE WEB SITE... Additional resources, including quizzes; online files of additional text, tables, figures, and cases; and frequently updated Web links to current articles and information can be found on the book's Web site. (wiley.com/college/turban).

KEY TERMS

Chief knowledge officer (CKO) •••

Community of practice (COP) •••

Data mining •••

Explicit knowledge •••

Intellectual capital (intellectual assets) •••

Knowledge •••

Knowledge discovery in databases (KDD) •••

Knowledge management (KM) •••



Knowledge management system (KMS) •••
 Knowledge repository •••
 Knowware •••

Leaky knowledge •••
 Model marts •••
 Model warehouses •••
 Practice approach •••

Process approach •••
 Sticky knowledge •••
 Tacit knowledge •••

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 Knowledge is different from information and data. Knowledge is information that is contextual, relevant, and actionable. It is dynamic in nature.
- 1 Tacit (unstructured, sticky) knowledge is usually in the domain of subjective, cognitive, and experiential learning. Explicit (structured, leaky) knowledge deals with more objective, rational, and technical knowledge, and is highly personal and hard to formalize.
- 2 Knowledge management is a process that helps organizations identify, select, organize, disseminate, and transfer important information and expertise that typically reside within the organization in an unstructured manner.
- 2 Knowledge management requires a major transformation in organizational culture to create a desire to share (give and receive) knowledge, plus a commitment to KM at all levels of a firm.
- 2 The knowledge management model involves the following cyclical steps: create, capture, refine, store, manage, and disseminate knowledge.
- 2 Standard knowledge management initiatives involve the creation of knowledge bases, active process management, knowledge centers, and collaborative technologies.
- 2 Knowledge management is an effective way for an organization to leverage its intellectual assets.
- 3 The two strategies used for knowledge management initiatives are process approach and the practice approach.
- 3 Communities of practice (COPs) provide pressure to break down the cultural barriers that hinder knowledge management efforts.
- 4 A knowledge management system is generally developed using three sets of technologies: communication, collaboration, and storage.
- 4 A variety of technologies can make up a knowledge management system: the Internet, intranets, data warehousing, decision-support tools, groupware, and so on. Intranets are the primary means of displaying and distributing knowledge in organizations.
- 5 The chief knowledge office (CKO) is primarily responsible for changing the behavior of the firm to embrace the use of knowledge management and then managing the development operation of a knowledge management system.
- 5 Knowledge management typically involves the cooperation of managers, developers, KM staff, and users.
- 6 Knowledge management systems can be purchased in whole or in part from one of numerous software development companies and enterprise information systems vendors, they can be acquired through major consulting firms, or can be outsourced to the application service providers (ASPs).
- 6 Knowledge portals can be used to provide a central location from which various KM applications are searched.
- 6 It is difficult to measure the success of a KMS. Traditional methods of financial measurement fall short, as they do not consider intellectual capital an asset. Non-financial metrics are typically used to measure the success of a KM, yet some firms have been able to determine financial payoffs.

QUESTIONS FOR REVIEW

- 1. Discuss what is meant by an intellectual asset.
- 2. Define knowledge and knowledge management.
- 3. Define explicit knowledge. Why is it also called leaky?
- 4. Define tacit knowledge. Why is it also called sticky?
- 5. How can tacit knowledge be transferred or shared?
- 6. List some ways in which organizational culture can impact on a knowledge management effort.
- 7. What is the primary goal of knowledge management?
- 8. Describe the process approach to knowledge management.
- 9. Describe the practice approach to knowledge management.
- 10. Describe the roles and responsibilities of the people involved in a knowledge management system, especially the CKO.



11. What is a community of practice?
12. List the steps in the cyclical model of knowledge management. Why is it a cycle?
13. List the major knowledge management success factors.
14. Describe the role of IT in knowledge management.

QUESTIONS FOR DISCUSSION

1. Why is the term knowledge so hard to define?
2. Describe and relate the different characteristics of knowledge.
3. Explain why it is important to capture and manage knowledge.
4. Compare and contrast tacit knowledge and explicit knowledge.
5. Explain why organizational culture must sometimes change before knowledge management is introduced.
6. How does knowledge management attain its primary objective?
7. How can employees be motivated to contribute to and use knowledge management systems?
8. What is the role of a knowledge repository in knowledge management?
9. Explain the importance of communication and collaboration technologies to the processes of knowledge management.
10. Explain why firms adopt knowledge management initiatives.
11. Explain the role of the CKO in developing a knowledge management system. What major responsibilities does he or she have?
12. Discuss some knowledge management success factors.
13. Why is it hard to evaluate the impacts of knowledge management?
14. Explain how the Internet and its related technologies (Web browsers, intranets, and so on) enable knowledge management.
15. Explain the roles of a community of practice.
16. Describe an enterprise knowledge portal and explain its significance.

EXERCISES

1. Make a list of all the knowledge management methods you use during your day (work and personal). Which are the most effective? Which are the least effective? What kinds of work or activities does each knowledge management method enable?
2. Investigate the literature for information on the position of CKO. Find out what percentage of firms with KM initiatives have CKOs and what their responsibilities are.
3. Investigate the literature for new measures of success (metrics) for knowledge management and intellectual capital. Write a report on your findings.
4. Describe how each of the key elements of a knowledge management infrastructure can contribute to its success.
5. Based on your own experience or on the vendor's information, list the major capabilities of a particular knowledge management product, and explain how it can be used in practice.
6. Describe how to ride a bicycle, drive a car, or make a peanut butter and jelly sandwich. Now, have someone else try to do it based solely on your explanation. How can you best convert this knowledge from tacit to explicit (or can't you)?
7. Consider why knowledge-management systems would be so important to a modern organization that firms would initiate such systems.

GROUP ASSIGNMENTS

1. Compare and contrast the capabilities and features of electronic document management with those of collaborative computing and those of knowledge management systems. Each team represents one type of system. Present the ways in which these capabilities and features can create improvements for an organization.
2. Search the Internet for knowledge management products and systems and create categories for them. Assign one vendor to each team. Describe the categories you created and justify them.
3. If you are working on a decision-making project in industry for this course (or if not, use one from another

class or from work), examine some typical decisions in the related project. How would you extract the knowledge you need? Can you use that knowledge in practice? Why or why not?

4. Read the article by A. Genusa titled “Rx for Learning,” available at *cio.com* (February 1, 2001), which describes

Tufts University Medical School’s experience with knowledge management. Determine how these concepts and such a system could be implemented and used at your college or university. Explain how each aspect would work, or if not, explain why not.

INTERNET EXERCISES



1. How does knowledge management support decision making? Identify products or systems on the Web that help organizations accomplish knowledge management. Start with *brint.com*, *decision-support.net*, and *knowledgemanagement.ittoolbox.com*. Try one out and report your findings to the class.
2. Try the KPMG Knowledge Management Framework Assessment Exercise at *kmsurvey.londonweb.net* and assess how well your organization (company or university) is doing with knowledge management. Are the results accurate? Why or why not?
3. Search the Internet to identify sites dealing with knowledge management. Start with *google.com*, *kmworld.com*, and *km-forum.org*. How many did you find? Categorize the sites based on whether they are academic, consulting firms, vendors, and so on. Sample one of each and describe the main focus of the site.
4. Identify five real-world knowledge management success stories by searching vendor Web sites (use at least three different vendors). Describe them. How did knowledge-management systems and methods contribute to their success? What features do they share? What different features do individual successes have?
5. Search the Internet for vendors of knowledge management suites, enterprise knowledge portals, and out-of-the-box knowledge management solutions. Identify the major features of each product (use three from each), and compare and contrast their capabilities.
6. J. D. Edwards (*jedwards.com*) developed a knowledge management intranet initiative called the Knowledge Garden. Access both the J. D. Edwards and Microsoft Web sites and investigate its current capabilities.



Minicase 1

DaimlerChrysler EBOKs with Knowledge Management

In 1980 Chrysler Corporation came back from near bankruptcy with innovative designs and a view of a shared culture in design, development, and manufacturing. The company began new ways of looking at its business, its suppliers, and its workers. After the acquisition of American Motors Corporation (AMC) in 1987, executives developed and deployed advanced, dedicated platform design and production methods, which showed enormous potential. Jack Thompson, the technology center development director, worked closely with Chairman Lee Iacocca on the development of a new, modern engineering and design facility. Thompson designed the center around knowledge-sharing and productivity principles: open air, natural light, and escalators (people don't talk on elevators).

In 1994 the tech center opened, providing a home for a transformed engineering culture. Two years later, the corporate headquarters was moved next to the tech center so executives could be nearby. By 2000, over 11,000 people were working at the Auburn Hills, Michigan, center. In November 1998, Daimler-Benz became the majority owner of Chrysler Corporation, renaming the company DaimlerChrysler (*daimlerchrysler.com*). Chrysler's fast, efficient, and innovative nature, as a result of the extremely successful platform approach to design and engineering, led to the buy-in—the largest merger in manufacturing history.

Platform production at DaimlerChrysler has teams of engineers focused on a single type of car platform (small car, minivan, and so on), working on new models as a system from concept to production. Cars are designed by a single team considering customer needs and preferences, as opposed to the standard practice of organizing the new designs by organizational functions (silos). Platform teams of employees work and learn together focused on the product, with a payoff in market responsiveness, reduced cost, and increased quality. The Chrysler LH, the first model developed with the platform approach, took 39 months to produce; typically the time to market exceeds 50 months.

While the benefits were clear, Chrysler executives noticed that unexplained errors were popping up in the new

platforms (like leaving a moisture barrier out of car doors). *There was an organizational memory problem:* Mentoring and peer support became limited. Informal and formal professional collaboration had stopped. The same mistakes were being made, corrected, and repeated. People were not learning about new developments in their core areas. The typical collaboration found among groups doing similar work was sharply reduced, and so problems and solutions were not being documented or shared.

Collaboration and communication needed to be reestablished within groups with common training, interests, and responsibilities (design, engineering, body, engine, manufacturing, and so on). The goal was to reestablish these links while becoming more competitive with even faster product-cycle times. Chrysler needed to institutionalize knowledge sharing and collaboration. In 1996 Chrysler Corporation made *knowledge management* a vital condition for design and engineering, leading to dramatic improvements in productivity.

First, engineers mapped out where the knowledge was within the organization (a knowledge audit). There were many categories, or “buckets of knowledge,” ranging from product databases to CAD/CAM systems to manufacturing, procurement, and supply vehicle test data. Within each category, details were identified and codified. Sharing knowledge meant integrating these knowledge buckets, while resolving cultural issues that impeded sharing across platform boundaries. Chrysler created informal cross-platform *Tech Clubs*, functionally organized communities of practice to reunite designers and engineers with peers from other platform groups. Each community would then codify its knowledge and provide mentoring and apprenticeship opportunities for learning.

The *Engineering Book of Knowledge (EBOK)* is Chrysler's intranet supporting a knowledge repository of process *best practices* and technical know-how to be shared and maintained. It was initially developed by two engineering managers but continues through encouraged employee participation in grassroots (i.e., supported at the lower

levels of the organization) Tech Clubs. EBOK is written in GrapeVine (GrapeVine Technologies), running as a Lotus Notes application, and is accessed with the Netscape browser and NewsEdge.

Knowledge is explored and entered into the EBOK through an iterative team approach: the Tech Clubs. Best practices are identified, refined, confirmed, and finally entered into the EBOK in a secure interactive electronic repository. When an author proposes a best practice, users in the Tech Club responsible for that area of knowledge react by commenting on the knowledge through a discussion list. One manager, the *Book Owner*, is ultimately responsible for approving new entries and changes to the book. The Book Owner joins the conversation. The author can respond to the comments by either building a better case or going along with the discussion. Ultimately the Tech Club decides, and the Book Owner enters the new knowledge. The Book Owner is the individual who is ultimately responsible for the accuracy of the book, and therefore approves entries to, modifications to, and deletions from the book.

The EBOK is DaimlerChrysler's official design review process. The EBOK even contains best practices information about DaimlerChrysler's competitors. DaimlerChrysler has determined that EBOK is both a best practices tool (the process approach) and a collaboration tool (the practice approach). DaimlerChrysler officials recognize that because the environment changes and new methods are being continually developed, the EBOK will never be fully complete. The EBOK is a *living book*. The EBOK *leverages* technology knowledge.

The EBOK is central to DaimlerChrysler's new way of working. The plan is to have more than 5,000 users with access to 3,800 chapters, of which just over half were completed by early 1999. Through the EBOK, DaimlerChrysler reconciled its platform problems and developed a technical memory while tracking competitive information, quality information, and outside standards. Even though there is no central budget for books of knowledge and associated processes, DaimlerChrysler is deploying knowledge in other departments such as manufacturing, finance, and sales and marketing.

The EBOK is only one of several initiatives that promote and facilitate knowledge sharing at DaimlerChrysler. In

early 1999, soon after the merger, the company began an information-sharing project called ProBench. The objective of ProBench was to help Chrysler and Mercedes determine how to best use each other's manufacturing expertise. Extensive collaboration enabled Chrysler to benefit from the engineering strengths of Mercedes, while Mercedes was able to learn from Chrysler's know-how in launching new vehicle models. One of the biggest accomplishments of ProBench was Chrysler's decision to use a Mercedes' superior rear-wheel-drive automatic transmission on future vehicles. "We are able to save [\$600 million in] investment money, get variable costs down, and gain many other advantages by not inventing the wheel twice," says Dieter Zetsche, DaimlerChrysler's Chief Executive Officer. Zetsche concludes: "[Collaboration] has been a real value to us, and it is a very positive result of the merger."

Sources: Adapted from Karlenzig (1999), Maynard (2001), and *daimlerchrysler.com*.

Questions for Minicase 1

1. Platform design at DaimlerChrysler led directly to a reduction in the time to market and in costs for new vehicles. Explain how it caused new problems.
2. What is meant by a community of practice? How did DaimlerChrysler leverage the knowledge within such a community?
3. Describe the Engineering Book of Knowledge (EBOK). Explain how it is updated by adding new knowledge of practice.
4. It has been said that "the proper role for all knowledge management tools is to leverage technology in service to human thinking." Explain this statement.
5. How successful was the knowledge management initiative at DaimlerChrysler?
6. Consider how a book of knowledge could impact another organization, ideally one with which you are affiliated (e.g., your university, job, part-time job, family business). Describe the potential impacts, and list the benefits. Would there be any organizational culture issues to deal with? Why or why not?



Minicase 2

Chevron's Knowledge Management Initiatives Cook with Gas

Chevron (*chevron.com*) wanted to explore, develop, adapt, and adopt knowledge management methods to leverage its expertise throughout the enterprise to maintain a competitive position in the marketplace. The improvements gained from identifying, sharing, and managing intellectual assets can impact positively on drilling, office work, safety, and refineries. Improvements were generated by focusing on process, culture, best practices, and technology, including Internet technology.

Chevron uses knowledge management in drilling, refinery maintenance and safety management, capital project management, and other areas. The electronic document-management system impacts on several different areas at Chevron.

Drilling

Chevron adopted an *organizational learning system (OLS)* that improves drilling performance by sharing information globally. The system uses a simple software tool to capture lessons from the first wells in a new area, and then uses that knowledge to drill the rest of the wells faster and cheaper. Well costs have dropped by 12 to 20 percent and cycle time has been reduced as much as 40 percent in some cases (offshore drilling vessels can cost up to \$250,000 a day). Oil & Gas Consultants International

developed the OLS for Amoco. Chevron found it through a best-practices survey.

Refineries

The company uses knowledge management IS to maintain six refineries. Sam Preckett, reliability-focused maintenance-system manager, is developing a process to improve information and knowledge sharing. Preckett and others realized that they were not effectively using the data and information already stored in Chevron's enterprise information systems. Preckett has been developing an informal best-practices methodology for maintenance by "trying to learn how we do things." Getting knowledge to users is only part of the system; another part captures the tacit knowledge and experiences of workers. Chevron is trying to motivate workers to participate. Preckett said that at Chevron creative thinking is promoted from the executive level, which "allows him to do interesting things" to achieve efficiency gains through knowledge sharing.

Electronic Document Management

Another specific need under the knowledge management umbrella was addressed by the DocMan system, initiated in December 1994 to improve the timeliness of document



Virtual Company Assignment

Knowledge Management at The Wireless Café

You've noticed that Barbara and Jeremy spend quite a bit of time interviewing potential employees, and some quick Web research reveals that average turnover of restaurant employees for the past few years has been running over 100 percent. This news is alarming to you, as you think of all of the new information systems and technologies that

could help The Wireless Café run more efficiently. How will the staff ever develop system expertise if they stay less than a year?

1. What kinds of knowledge is The Wireless Café losing with such a high turnover? Consider both tacit and ex-
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access, management, and integration, and sharing of information among individual divisions to meet regulatory compliances. A long-standing application, DocMan works for the Warren Petroleum Limited Partnership Mont Belvieu complex in Texas (of which Chevron is a joint owner).

To handle cultural resistance to change, management emphasized the benefits of the DocMan system: faster access to documents, elimination of wasted effort searching for documents, and assets protection. DocMan delivered a 95 percent return on investment over its 5-year project life. The investment payout period was 1.1 years based on an annual savings of \$480,000.

Capital Project Management

Through knowledge management, Chevron implemented a new standard methodology for capital project management. In one case, 60 companies shared data and practices, and so it was possible to compare performance to determine which companies were best and why.

These remarkable achievements did not take place overnight, but were a part of a continuous process that started in 1985 with a focus on Total Quality Management training and benchmarking. By 2000, knowledge management was established as a corporate value, virtual collaboration among groups was practiced worldwide, and knowledge management became an important part of performance appraisals.

What have been the overall results? Improved management of knowledge was instrumental in reducing operat-

ing costs from \$9.4 billion to \$7.4 billion from 1992 to 1998 and in reducing energy costs by \$200 million a year. During the 1990s, efforts like this were essential in reducing costs, achieving productivity gains of over 50 percent (in barrels of output per employee), and improving employee safety performance more than 50 percent. Chevron now calls itself a *learning organization* (an organization capable of learning from its past experiences sure that's a good idea). Some gains from knowledge management at Chevron are qualitative: Employees' work is more interesting and challenging when it involves finding and applying new knowledge. Jobs are potentially more fulfilling and more personally rewarding.

Sources: Adapted from Velker (1999), *CIO.com* (1999), and Silverman et al. 2000).

Questions for Minicase 2

1. What is meant by a learning organization?
2. Describe the gains that Chevron experienced through its knowledge management programs.
3. To what different areas did Chevron apply knowledge management, and how successful were they?
4. Why is it important to document cost savings of knowledge management systems?
5. If dramatic payoffs can be achieved through knowledge management (as with the DocMan system), why don't more companies do so?

pllicit knowledge accumulated by employees in the different positions. How important is this knowledge to the well-being and long-term success of The Wireless Café? What can Barbara and Jeremy do about capturing it?

2. Using The Wireless Café's Web site, match the jobs with information systems that The Wireless Café might adopt. Try to rank the level of training or expertise you think an employee needs to have before using the system on the job and determine whether online training would be beneficial.
3. Discuss the problems of retaining organizational knowledge in an industry with high turnover. Is a knowledge management effort cost-effective for The Wireless Café? What are some guidelines to help management decide on the level of knowledge capture and management they should practice?

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PART IV
**Managerial and Decision
Support Systems**



10. Knowledge Management

▶ 11. Data Management: Warehousing, Analyzing, Mining, and Visualization

12. Management Decision Support and Intelligent Systems

CHAPTER

11

Data Management: Warehousing, Analyzing, Mining, and Visualization

Harrah's Entertainment

11.1

Data Management: A Critical
Success Factor

11.2

Data Warehousing

11.3

Information and Knowledge
Discovery with Business
Intelligence

11.4

Data Mining Concepts and
applications

11.5

Data Visualization
Technologies

11.6

Marketing Databases in
Action

11.7

Web-based Data Management
Systems

Minicases: (1) Sears /
(2) Dallas Area Rapid Transit

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Recognize the importance of data, their managerial issues, and their life cycle.
- 2 Describe the sources of data, their collection, and quality issues.
- 3 Describe document management systems.
- 4 Explain the operation of data warehousing and its role in decision support.
- 5 Describe information and knowledge discovery and business intelligence.
- 6 Understand the power and benefits of data mining.
- 7 Describe data presentation methods and explain geographical information systems, visual simulations, and virtual reality as decision support tools.
- 8 Discuss the role of marketing databases and provide examples.
- 9 Recognize the role of the Web in data management.



FINDING DIAMONDS BY DATA MINING AT HARRAH'S

➔ THE PROBLEM

Harrah's Entertainment (*harrahs.com*) is a very profitable casino chain. With 26 casinos in 13 states, it had \$4 billion sales in 2002 and net income of \$235 million. One of Harrah's casinos is located on the Las Vegas strip, which typifies the marketing issues that casino owners face. The problem is very simple, how to attract visitors to come and spend money in your casino, and to do it again and again. There is no other place like the Las Vegas strip, where dozens of mega casinos and hundreds of small ones lure visitors by operating attractions ranging from fiery volcanoes to pirate ships.

Most casino operators use intuition to plan inducements for customers. Almost all have loyalty cards, provide free rooms to frequent members, give you free shows, and more. The problem is that there is only little differentiation among the casinos. Casinos believe they must give those incentives to survive, but do they help casinos to excel? Harrah's is doing better than most competing casinos by using management and marketing theories facilitated by information technology, under the leadership of Gary Loveman, a former Harvard Business School professor.

➔ THE SOLUTION

Harrah's strategy is based on technology-based CRM and the use of customer database marketing to test promotions. This combination enables the company to fine-tune marketing efforts and service-delivery strategies that keep customers coming back. Noting that 82.7 percent of its revenue comes from slot machines, Harrah's started by giving each player a loyalty smart card. A smart-card reader on each slot machine in all 26 of its casinos records each customer's activities. (Readers are also available in Harrah's restaurants, gift shops, etc., to record any spending.)

Logging your activities, you earn credit, as in other loyalty programs, for which you get free hotel rooms, dinners, etc. Such programs are run by most competitors, but Harrah's goes a step further: It uses a 300-gigabyte transactional database, known as a data warehouse, to analyze the data recorded by the card readers. By tracking millions of individual transactions, the IT systems assemble a vast amount of data on customer habits and preferences. These data are fed into the enterprise data warehouse, which contains not only millions of transactional data points about customers (such as names, addresses, ages, genders) but also details about their gambling, spending, and preferences. This database has become a very rich repository of customer information, and it is mined for decision support.

The information found in Harrah's database indicated that a loyalty strategy based on same-store (same casino, in this case) sales growth could be very beneficial. The goal is to get a customer to visit your establishment regularly. For example, analysis discovered that the company's best customers were middle-aged and senior adults with discretionary time and income, who enjoyed playing slot machines. These customers did not typically stay in a hotel, but visited a casino on the way home from work or on a weekend night out. These customers responded better to an offer of \$60 of casino chips than to a free room, two steak



meals, and \$30 worth of chips, because they enjoyed the anticipation and excitement of gambling itself (rather than seeing the trip as a vacation get-away).

This strategy offered a way to differentiate Harrah's brand. Understanding the lifetime value of the customers became critical to the company's marketing strategy. Instead of focusing on how much people spend in the casinos during a single visit, the company began to focus on their total spending over a long time. And, by gathering more and more specific information about customer preferences, running experiments and analyses on the newly collected data, and determining ways of appealing to players' interests, the company was able to increase the amount of money customers spent there by appealing to their individual preferences.

As in other casinos with loyalty programs, players are segregated into three tiers, and the biggest spenders get priorities in waiting lines and in awards. There is a visible differentiation in customer service based on the three-tier hierarchy, and every experience in Harrah's casinos was redesigned to drive customers to want to earn a higher-level card. Customers have responded by doing what they can to earn the higher-tiered cards.

However, Harrah's transactional database is doing much more than just calculating gambling spending. For example, the casino knows which specific customers were playing at particular slot machines and at what time. Using data mining techniques, Harrah's can discover what specific machines appealed to specific customers. This knowledge enabled Harrah's to configure the casino floor with a mix of slot machines that benefited both the customers and the company.

In addition, by measuring all employee performance on the matrices of speed and friendliness and analyzing these results with data mining, the company is able to provide its customers with better experiences as well as earn more money for the employees. Harrah's implemented a bonus plan to reward hourly workers with extra cash for achieving improved customer satisfaction scores. (Bonuses totaling \$43 million were paid over three years.) The bonus program worked because the reward depends on everyone's performance. The general manager of a lower-scoring property might visit a colleague at a higher-scoring casino to find out what he could do to improve his casino's scores.



THE RESULTS

Harrah's experience has shown that the better the experience a guest has and the more attentive you are to him or her, the more money will be made. For Harrah's, good customer service is not a matter of an isolated incident or two but of daily routine. So, while somewhere along the Las Vegas strip a "Vesuvian" volcano erupts loudly every 15 minutes, a fake British frigate battles a pirate ship at regular intervals, and sparkling fountains dance in a lake, Harrah's continues to enhance benefits to its Total Rewards program, improves customer loyalty through customer service supported by the data mining, and of course makes lots of money.

Sources: Compiled from Loveman (2003) and from Levinson (2001).



LESSONS LEARNED FROM THIS CASE

The opening case about Harrah's illustrates the importance of data to a large entertainment company. It shows that it is necessary to collect vast amount of data,



organize and store it properly in one place, and then analyze it and use the results for better marketing and other corporate decisions. The case shows us that new data go through a process and stages: Data are collected, processed, and stored in a data warehouse. Then, data are processed by analytical tools such as data mining and decision modeling. The findings of the data analysis direct promotional and other decisions. Finally, continuous collection and analysis of fresh data provide management with feedback regarding the success of management strategies.

In this chapter we explain how this process is executed with the help of IT. We will also deal with some additional topics that typically supplement the data management process.

11.1 DATA MANAGEMENT: A CRITICAL SUCCESS FACTOR

The Difficulties of Managing Data, and Some Potential Solutions

As illustrated throughout this textbook, IT applications cannot be done without using some kind of data. In other words, without data you cannot have most IT applications, nor can you make good decisions. Data, as we have seen in the opening case, are at the core of management and marketing operations. However, there are increasing difficulties in acquiring, keeping, and managing data.

Since data are processed in several stages and possibly places, they may be subject to some problems and difficulties.

DATA PROBLEMS AND DIFFICULTIES. Managing data in organizations is difficult for various reasons:

- The amount of data increases exponentially with time. Much past data must be kept for a long time, and new data are added rapidly. However, only small portions of an organization's data are relevant for any specific application, and that relevant data must be identified and found to be useful.
- Data are scattered throughout organizations and are collected by many individuals using several methods and devices. Data are frequently stored in several servers and locations, and in different computing systems, databases, formats, and human and computer languages.
- An ever-increasing amount of external data needs to be considered in making organizational decisions.
- Data security, quality, and integrity are critical, yet are easily jeopardized. In addition, legal requirements relating to data differ among countries and change frequently.
- Selecting data management tools can be a major problem because of the huge number of products available.

These difficulties, and the critical need for timely and accurate information, have prompted organizations to search for effective and efficient data management solutions.

SOLUTIONS TO MANAGING DATA. Historically, data management has been geared to supporting transaction processing by organizing the data in a *hierarchical format* in one location. This format supports secured and efficient high-volume

processing; however, it may be inefficient for queries and other ad-hoc applications. Therefore, *relational databases*, based on organization of data in rows and columns, were added to facilitate end-user computing and decision support.

With the introduction of client/server environments and Web technologies, databases became distributed throughout organizations, creating problems in finding data quickly and easily. This was the major reason that Harrah's sought the creation of a *data warehouse*. As we will see later, the intranet, extranets and Web technologies can also be used to improve data management.

It is now well recognized that data are an asset, although they can be a burden to maintain. Furthermore, the use of data, converted to information and knowledge, is power. The purpose of appropriate data management is to ease the burden of maintaining data and to enhance the power from their use. To see how this is done, let's begin by examining how data are processed during their life cycle.

Data Life Cycle Process

Businesses do not run on raw data. They run on data that have been processed to information and knowledge, which managers apply to businesses problems and opportunities. As seen at the Harrah's case, *knowledge* fuels solutions. Everything from innovative product designs to brilliant competitive moves relies on knowledge (see Markus et al., 2002). However, because of the difficulties of managing data, cited earlier, deriving knowledge from accumulated data may not be simple or easy.

Transformation of data into knowledge and solutions is accomplished in several ways. In general, it resembles the process shown in Figure 11.1. It starts with new data collection from various sources. These data are stored in a database(s). Then the data is preprocessed to fit the format of a data warehouse or data marts, where it is stored. Users then access the warehouse or data mart and take a copy of the needed data for analysis. The analysis is done with data analysis and mining tools (see Chopoorian et al., 2001) which look for patterns, and with intelligent systems, which support data interpretation.

Note that not all data processing follows this process. Small and medium companies do not need data warehouses, and even many large companies do not need them. (We will see later who needs them.) In such cases data go directly from data sources or databases to an analysis. An example of direct processing is an application that uses real-time data. These can be processed as they are collected and immediately analyzed. Many Web data are of this type. In such a case, as we will see later, we use Web mining instead of data mining.

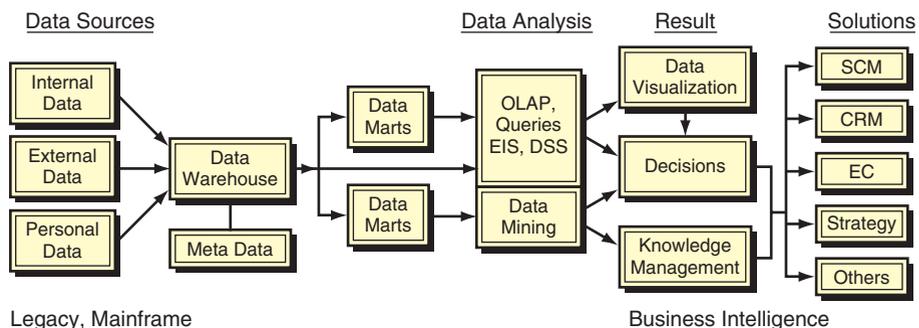


FIGURE 11.1 Data life cycle.



The result of all these activities is the generating of decision support and knowledge. Both the data (at various times during the process) and the knowledge (derived at the end of the process) may need to be presented to users. Such a presentation can be accomplished by using different visualization tools. The created knowledge may be stored in an organizational knowledge base (as shown in Chapter 10) and used, together with decision support tools, to provide solutions to organizational problems. The elements and the process shown in Figure 11.1 are discussed in the remaining sections of this chapter.

Data Sources The data life cycle begins with the acquisition of data from data sources. Data sources can be classified as internal, personal, and external.

INTERNAL DATA SOURCES. An organization's internal data are about people, products, services, and processes. Such data may be found in one or more places. For example, data about employees and their pay are usually stored in the corporate database. Data about equipment and machinery may be stored in the maintenance department database. Sales data can be stored in several places—aggregate sales data in the corporate database, and details at each regional database. Internal data are usually accessible via an organization's intranet.

PERSONAL DATA. IS users or other corporate employees may document their own expertise by creating personal data. These data are not necessarily just facts, but may include concepts, thoughts, and opinions. They include, for example, subjective estimates of sales, opinions about what competitors are likely to do, and certain rules and formulas developed by the users. These data can reside on the user's PC or be placed on departmental or business units' databases or on the corporate knowledge bases.

EXTERNAL DATA SOURCES. There are many sources for external data, ranging from commercial databases to sensors and satellites. Government reports constitute a major source for external data. Data are available on CD-ROMs and memory chips, on Internet servers, as films, and as sound or voices. Pictures, diagrams, atlases, and television are other sources of external data. Hundreds of thousands of organizations worldwide place publicly accessible data on their Web servers, flooding us with data. Most external data are irrelevant to any single application. Yet, much external data must be monitored and captured to ensure that important data are not overlooked. Large amounts of external data are available on the Internet.

THE INTERNET AND COMMERCIAL DATABASE SERVICES. Many thousands of databases all over the world are accessible through the Internet. Much of the database access is free. A user can access Web pages of vendors, clients, and competitors. He or she can view and download information while conducting research. Some external data flow to an organization on a regular basis through EDI or through other company-to-company channels. Much external data are free; other data are available from commercial database services.

A commercial *online database publisher* sells access to specialized databases, newspapers, magazines, bibliographies, and reports. Such a service can provide external data to users in a timely manner and at a reasonable cost. Many commercial database publishers will customize the data for each user. Several thousand services are currently available, most of which are accessible via the Internet. Many consulting companies sell reports online (e.g., *aberdeen.com*).



Methods for Collecting Raw Data

The diversity of data and the multiplicity of sources make the task of data collection fairly complex. Sometimes it is necessary to collect raw data in the field. In other cases it is necessary to elicit data from people.

Raw data can be collected manually or by instruments and sensors. Some examples of manual data collection methods are time studies, surveys, observations, and contributions from experts. Data can also be scanned or transferred electronically. Although a wide variety of hardware and software exists for data storage, communication, and presentation, much less effort has gone into developing software tools for data capture in environments where complex and unstable data exist. Insufficient methods for dealing with such situations may limit the effectiveness of IT development and use. One exception is the Web. **Clickstream data** are those that can be collected automatically, using special software, from a company's Web site or from what visitors are doing on the site (see Chapter 5, and Turban et al., 2004). In addition, the use of online polls and questionnaires is becoming very popular (see Baumer, 2003, and Ray and Tabor, 2003).

The collection of data from multiple external sources may be an even more complicated task. One way to improve it is to use a *data flow manager* (DFM), which takes information from external sources and puts it where it is needed, when it is needed, in a usable form (e.g., see *smartdraw.com*). A DFM consists of (1) a decision support system, (2) a central data request processor, (3) a data integrity component, (4) links to external data suppliers, and (5) the processes used by the external data suppliers.

The complexity of data collection can create data-quality problems. Therefore, regardless of how they are collected, data need to be validated. A classic expression that sums up the situation is "garbage in, garbage out" (GIGO). Safeguards for data quality are designed to prevent data problems.

Data Quality and Integrity

Data quality (DQ) is an extremely important issue since quality determines the data's usefulness as well as the quality of the decisions based on the data (Creese and Veysel, 2003). Data are frequently found to be inaccurate, incomplete, or ambiguous, particularly in large, centralized databases. The economical and social damage from poor-quality data has actually been calculated to have cost organizations billions of dollars (see Redman, 1998). According to Brauer (2001), data quality is the cornerstone of effective business intelligence.

Interest in data quality has been known for generations. For example, according to Hasan (2002), treatment of numerical data for quality can be traced to the year 1881. An example of typical data problems, their causes, and possible solutions is provided in Table 11.1. For a discussion of data auditing and controls, see Chapter 15.

Strong et al. (1997) conducted extensive research on data quality problems. Some of the problems are technical ones such as capacity, while others relate to potential computer crimes. The researchers divided these problems into the following four categories and dimensions.

- **Intrinsic DQ:** Accuracy, objectivity, believability, and reputation.
- **Accessibility DQ:** Accessibility and access security.
- **Contextual DQ:** Relevancy, value added, timeliness, completeness, amount of data.
- **Representation DQ:** Interpretability, ease of understanding, concise representation, consistent representation.

TABLE 11.1 Data Problems and Possible Solutions

Problem	Typical Cause	Possible Solutions (in Some Cases)
Data are not correct.	Raw data were entered inaccurately.	Develop a systematic way to ensure the accuracy of raw data. Automate (use scanners or sensors).
	Data derived by an individual were generated carelessly.	Carefully monitor both the data values and the manner in which the data have been generated. Check for compliance with collection rules.
Data are not timely.	The method for generating the data was not rapid enough to meet the need for the data.	Modify the system for generating the data. Move to a client/server system. Automate.
Data are not measured or indexed properly.	Raw data were gathered according to a logic or periodicity that was not consistent with the purposes of the analysis.	Develop a system for rescaling or recombining the improperly indexed data. Use intelligent search agents.
Needed data simply do not exist.	No one ever stored the data needed now.	Whether or not it is useful now, store data for future use. Use the Internet to search for similar data. Use experts.
	Required data never existed.	Make an effort to generate the data or to estimate them (use experts). Use neural computing for pattern recognition.

Source: Compiled and modified from Alter (1980).

Strong et al. (1997) have suggested that once the major variables and relationships in each category are identified, an attempt can be made to find out how to better manage the data.

Different categories of data quality are proposed by Brauer (2001). They are: *standardization* (for consistency), *matching* (of data if stored in different places), *verification* (against the source), and *enhancement* (adding of data to increase its usefulness).

An area of increasing importance is data quality that is done very fast in *real time*. Many decisions are being made today in such an environment. For how to handle data in such a case, see Creese and Veytsel (2003) and Bates (2003).

Another major data quality issue is **data integrity**. This concept means that data must be accurate, accessible, and up-to-date. Older filing systems may lack integrity. That is, a change made in the file in one place may not be made in a related file in another place. This results in *conflicting* data.

DATA QUALITY IN WEB-BASED SYSTEMS. Data are collected on a routine basis or for a special application on the Internet. In either case, it is necessary to organize and store the data before they can be used. This may be a difficult task especially when media-rich Web sites are involved. See *Online File W11.1* for an example of a multimedia Web-based system. For a comprehensive approach on how to ensure quality of Internet-generated data, see Creese and Veytsel (2003).



Document Management

There are several major problems with paper documents. For example, in maintaining paper documents, we can pose the following questions: (1) Does everyone



have the current version? (2) How often does it need to be updated? (3) How secure are the documents? and (4) How can the distribution of documents to the appropriate individuals be managed in a timely manner? The answers to these and similar questions may be difficult.

Electronic data processing overcome some of these problems. One of the earliest IT-enabled tools of data management is called *document management*. When documents are provided in electronic form from a single repository (typically a Web server), only the current version is provided. For example, many firms maintain their telephone directories in electronic form on an intranet to eliminate the need to copy and distribute hard copies of a directory that requires constant corrections. Also, with data stored in electronic form, access to various documents can be restricted as required (see Becker, 2003).

WHAT IS DOCUMENT MANAGEMENT? **Document management** is the automated control of electronic documents, page images, spreadsheets, word processing documents, and other complex documents through their entire life cycle within an organization, from initial creation to final archiving. Document management offers various benefits: It allows organizations to exert greater control over production, storage, and distribution of documents, yielding greater efficiency in the reuse of information, the control of a document through a workflow process, and the reduction of product cycle times.

Electronic delivery of documents has been around since 1999, with UPS and the U.S. Post Office playing a major role in such service. They deliver documents electronically over a secured system (e-mail is not secured), and they are able to deliver complex “documents” such as large files and multimedia videos (which can be difficult to send via e-mail). (See *exchange.ups.com*, and take the test drive there.) The need for greater efficiency in handling business documents to gain an edge on the competition has fueled the increased availability of document management systems, also known as electronic document management. Essentially, **document management systems (DMSs)** provide information in an electronic format to decision makers. The full range of functions that a document management system may perform includes document identification, storage, and retrieval; tracking; version control; workflow management; and presentation. The Thomas Cook Company, for example, uses a document management system to handle travel-refund applications. The system works on the PC desktop and has automated the workflow process, helping the firm double its volume of business while adding only about 33 percent more employees (see Cole, 1996). Another example is the Massachusetts Department of Revenue, which uses imaging systems to increase productivity of tax return processing by about 80 percent (see *civic.com/pubs*, 2001).

Document management deals with knowledge in addition to data and information. See Asprey and Middleton (2003) for an overview and for the relationship of document management with knowledge management.

The major tools of document management are workflow software, authoring tools, scanners, and databases (object-oriented mixed with relational, known as object-relational database management systems; see Technology Guide 3). Document management systems usually include computerized imaging systems that can result in substantial savings, as shown in *Online File W11.2*.

One of the major vendors of document management is Lotus Development Corporation. Its document databases and their replication property provide





A CLOSER LOOK

11.1 HOW COMPANIES USE DOCUMENT MANAGEMENT SYSTEMS

Here are some examples of how companies use document management systems to manage data and documents:

The Surgery Center of Baltimore stores all of its medical records electronically, providing instant patient information to doctors and nurses anywhere and any time. The system also routes charts to the billing department, whose employees can scan and e-mail any related information to insurance providers and patients. The DMS also helps maintain an audit trail, including providing records for legal purposes or action. Business processes have been expedited by more than 50 percent, the cost of such processes is significantly lower, and morale of office employees in the center is up (see laserfiche.com/newsroom/baltimore.html).

American Express is using a DMS to collect and process over one million customer satisfaction surveys each year. The data are collected in templates of over 600 different survey forms, in 12 languages, in 11 countries. The system (TELEform from Alchemy and Cardiff Software) is integrated with AMEX's legacy system and is capable of distributing processed results to many managers. Staff who process these forms has been reduced from 17 to 1, saving AMEX over \$500,000 each year (see imrgold.com/en/case-studies/fin_AMEX_Cardiff.asp).

LifeStar, an ambulance service in Tulare, California, is keeping all historical paper documents on optical disks. Hundreds of boxes with documents were digitized, and so are all new documents. Furthermore, all optical disks are backed up and are kept in different locations for security purposes (see laserfiche.com/newsroom/tulare.html).

Toronto, Canada, Works and Emergency Services Department uses a Web-based record document-retrieval solution. With it, employees have immediate access to drawings and the documents related to roads, buildings, utility lines, and more. Quick access to these documents

enables emergency crews to solve problems, and even save lives, much faster. Laptop computers are installed in each departmental vehicle, loaded with maps, drawings, and historical repair data. (see laserfiche.com/newsroom/torantoworks.html).

The University of Cincinnati, a state university in Ohio, is required to provide authorized access to the personnel files of 12,000 active employees and tens of thousand of retirees. There are over 75,000 queries about the personnel records every year, and answers need to be found among 2.5 million records. Using antiquated microfilm system to find answers tooks days. The solution was a DMS that digitized all paper and microfilm documents, making them available via the Internet and the intranet. An authorized employee can now use a browser and access a document in seconds (see imrgold.com/en/case-studies/edu_Univ_of_Cin.asp).

The European Court of Human Rights (44 countries in Europe) created a Web-based document and KM system which was originally stored on an intranet and now is stored in a separate organizational knowledge base. The DMS have had over 20 million hits in 2002 (Canada NewsWire, 2003). Millions of euros are saved each year just on printing and mailing documents.

McDonnell-Douglas (now part of the Boeing Company) distributed aircraft service bulletins to its customers around the world using the Internet. The company used to distribute a staggering volume of bulletins to over 200 airlines, using over 4 million pages of documentation every year. Now it is all on the Web, saving money and time both for the company and for its customers.

Motorola uses a DMS not only for document storage and retrieval, but also for small-group collaboration and companywide knowledge sharing. It develops virtual communities where people can discuss and publish information, all with the Web-enabled DMS.

many advantages for group work and information sharing (see lotus.com). For further discussion see imrgold.com and docuvantage.com.

WEB-BASED DMS. In many organizations, documents are now viewed as multimedia objects with hyperlinks. The Web provides easy access to pages of information. DMSs excel in this area. (see examples in *A Closer Look 11.1*). Web-enabled DMSs also make it easy to put information on intranets, since many of them provide instantaneous conversion of documents to HTML. BellSouth, for example,



saves an estimated \$17.5 million each year through its intranet-enabled forms-management system. For an example of Web-enabled document management systems see Delcambre et al. (2003). Other examples of how companies use document management systems, both on and off the Web, are shown in *A Closer Look 11.1*.

In all of the examples cited in the text and in *A Closer Look 11.1*, time and money are saved. Also, documents are not lost or mixed up. An issue related to document management systems is how to provide the privacy and security of personal data. We address that issue in Chapters 15 and 16.

11.2 DATA WAREHOUSING

Many large and even medium size companies are using data warehousing to make it easy and faster to process, analyze, and query data.

Transactional versus Analytical Processing

Data processing in organizations can be viewed either as *transactional* or *analytical*. The data in transactions processing systems (TPSs) are organized mainly in a *hierarchical structure* (Technology Guide 3) and are centrally processed. The databases and the processing systems involved are known as *operational systems*, and the results are mainly transaction reports. This is done primarily for fast and efficient processing of routine, repetitive data.

Today, however, the most successful companies are those that can respond quickly and flexibly to market changes and opportunities, and the key to this response is the effective and efficient use of data and information as shown in the Harrah's case. This is done not only via transaction processing, but also through a supplementary activity, called **analytical processing**, which involves analysis of accumulated data, frequently by end users. Analytical processing, also referred to as *business intelligence*, includes data mining, decision support systems (DSS), enterprise information systems (EIS), Web applications, querying, and other end-user activities. Placing strategic information in the hands of decision makers aids productivity and empowers users to make better decisions, leading to greater competitive advantage. A good data delivery system should be able to support easy data access by the end users themselves, quick, accurate, flexible and effective decision making.

There are basically two options for conducting analytical processing. One is to work directly with the operational systems (the "let's use what we have" approach), using software tools and components known as front-end tools, and *middleware* (see Technology Guide 3). The other is to use a data warehouse. The first option can be optimal for companies that do not have a large number of end users running queries and conducting analyses against the operating systems. It is also an option for departments that consist mainly of users who have the necessary technical skills for an extensive use of tools such as spreadsheets (see BIXL, 2002), and graphics. (See Technology Guide 2.) Although it is possible for those with fewer technical skills to use query and reporting tools, they may not be effective, flexible, or easy enough to use in many cases.

Since the mid-1990s, there has been a wave of *front-end tools* that allow end users to ease these problems by directly conducting queries and reporting on data stored in operational databases. The problem with this approach, however, is that the tools are only effective with end users who have a medium to high

degree of knowledge about databases. This situation improved drastically with the use of Web-based tools. Yet, when data are in several sources and in several formats, it is difficult to bring them together to conduct an analysis.

The second option, a data warehouse, overcomes these limitations and provides for improved analytical processing. It involves three concepts:

1. A business representation of data for end users
2. A Web-based environment that gives the users query and reporting capabilities
3. A server-based repository (the data warehouse) that allows centralized security and control over the data

The Data Warehouse

The Harrah’s case illustrates some major benefits of a **data warehouse**, which is a repository of subject-oriented historical data that is organized to be accessible in a form readily acceptable for analytical processing activities (such as data mining, decision support, querying, and other applications). The major benefits of a data warehouse are (1) the ability to reach data quickly, since they are located in one place, and (2) the ability to reach data easily and frequently by end users with Web browsers. To aid the accessibility of data, detail-level operational data must be transformed to a relational form, which makes them more amenable to analytical processing. Thus, data warehousing is not a concept by itself, but is interrelated with data access, retrieval, analysis, and visualization. (See Gray and Watson, 1998, and Inmon, 2002.)

The process of building and using a data warehouse is shown in Figure 11.2. The organization’s data are stored in operational systems (left side of the figure). Using special software called ETL (extraction, transformation, load), data

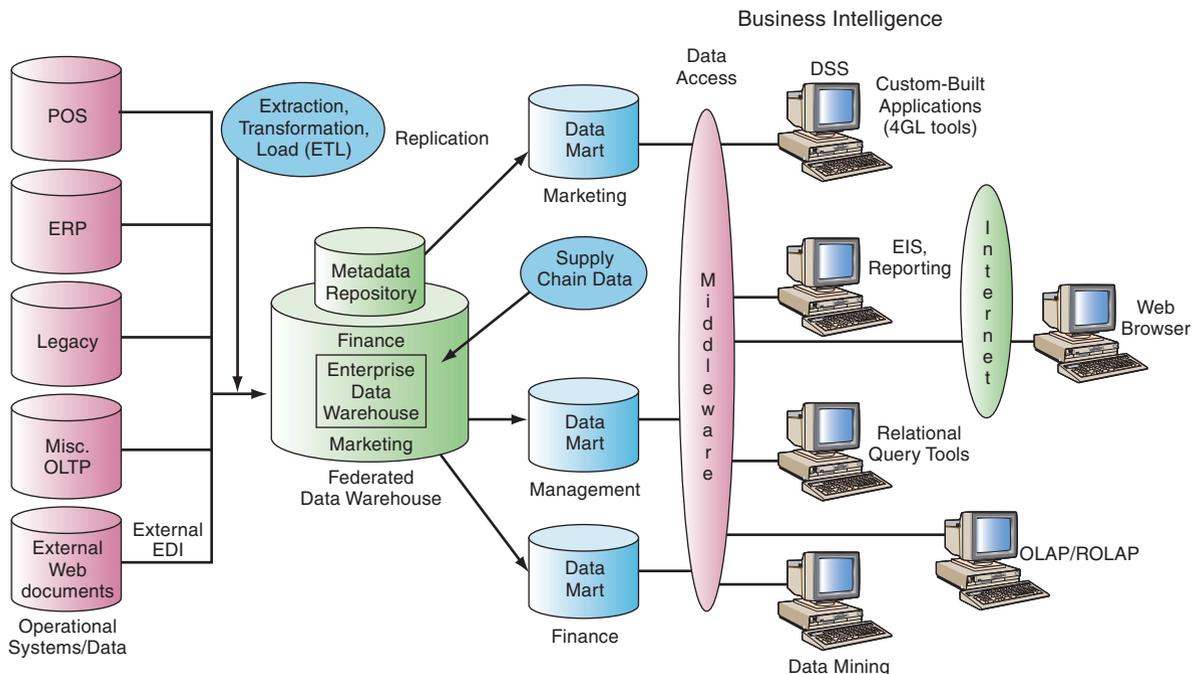


FIGURE 11.2 Data warehouse framework and views. (Source: Drawn by E. Turban.)



are processed and then stored in a data warehouse. Not all data are necessarily transferred to the data warehouse. Frequently only a summary of the data is transferred. The data that are transferred are organized within the warehouse in a form that is easy for end users to access. The data are also standardized. Then, the data are organized by subject, such as by functional area, vendor, or product. In contrast, operational data are organized according to a business process, such as shipping, purchasing, or inventory control and/or functional department. (Note that ERP data can be input to data warehouse as well as ERP and SCM decisions use the output from data warehouse. See Grant, 2003.)

Data warehouses provide for the storage of **metadata**, meaning data about data. Metadata include software programs about data, rules for organizing data, and data summaries that are easier to index and search, especially with Web tools. Finally, middleware tools enable access to the data warehouse (see Technology Guide 3, and Rundensteiner et al., 2000).

CHARACTERISTICS OF A DATA WAREHOUSE. The major characteristics of data warehousing are:

1. **Organization.** Data are organized by subject (e.g., by customer, vendor, product, price level, and region), and contain information relevant for decision support only.
2. **Consistency.** Data in different operational databases may be encoded differently. For example, gender data may be encoded 0 and 1 in one operational system and “m” and “f” in another. In the warehouse they will be coded in a consistent manner.
3. **Time variant.** The data are kept for many years so they can be used for trends, forecasting, and comparisons over time.
4. **Nonvolatile.** Once entered into the warehouse, data are not updated.
5. **Relational.** Typically the data warehouse uses a relational structure.
6. **Client/server.** The data warehouse uses the client/server architecture mainly to provide the end user an easy access to its data.
7. **Web-based.** Today’s data warehouses are designed to provide an efficient computing environment for Web-based applications (Rundensteiner et. al., 2000).

BENEFITS. Moving information off the mainframe presents a company with the unique opportunity to restructure its IT strategy. Companies can reinvent the way in which they shape and form their application data, empowering end users to conduct extensive analysis with these data in ways that may not have been possible before (e.g., see Minicase 1, about Sears). Another immediate benefit is providing a consolidated view of corporate data, which is better than providing many smaller (and differently formatted) views. For example, separate applications may track sales and coupon mailings. Combining data from these different applications may yield insights into the cost-efficiency of coupon sales promotions that would not be immediately evident from the output data of either applications alone. Integrated within a data warehouse, however, such information can be easily extracted and analyzed.

Another benefit is that data warehousing allows information processing to be offloaded from expensive operational systems onto low-cost servers. Once this is



done, the end-user tools can handle a significant number of end-user information requests. Furthermore, some operational system reporting requirements can be moved to decision support systems, thus freeing up production processing.

These benefits can improve business knowledge, provide competitive advantage (see Watson et. al., 2002), enhance customer service and satisfaction (see *Online File W11.3*), facilitate decision making, and help in streamlining business processes.

COST. The cost of a data warehouse can be very high, both to build and to maintain. Furthermore, it may difficult and expensive to incorporate data from obsolete legacy systems. Finally, there may be a lack of incentive to share data. Therefore, a careful feasibility study must be undertaken before a commitment is made to data warehousing.

ARCHITECTURE AND TOOLS. There are several basic architectures for data warehousing. Two common ones are two-tier and three-tier architectures. (See Gray and Watson, 1998.) In three-tier architecture, data from the warehouse are processed twice and deposited in an additional *multidimensional database*, organized for easy multidimensional analysis and presentation (see Section 11.3), or replicated in data marts. For a Web-based architecture see Rundensteiner et al., 2000. The architecture of the data warehouse determines the tools needed for its construction (see Kimball and Ross, 2002).

PUTTING THE WAREHOUSE ON THE INTRANET. Delivery of data warehouse content to decision makers throughout the enterprise can be done via an intranet. Users can view, query, and analyze the data and produce reports using Web browsers. This is an extremely economical and effective method of delivering data (see Kimball and Ross, 2002, and Inmon, 2002).

SUITABILITY. Data warehousing is most appropriate for organizations in which some of the following apply: large amounts of data need to be accessed by end users (see the Harrah's and Sears Cases); the operational data are stored in different systems; an information-based approach to management is in use; there is a large, diverse customer base (such as in a utility company or a bank); the same data are represented differently in different systems; data are stored in highly technical formats that are difficult to decipher; and extensive end-user computing is performed (many end users performing many activities; for example, Sears has 5,000 users).

Some of the successful applications are summarized in Table 11.2. Hundreds of other successful applications are reported (e.g., see client success stories and case studies at Web sites of vendors such as Brio Technology Inc., Business Objects, Cognos Corp., Information Builders, NCR Corp., Oracle, Platinum Technology, Software A&G, and Pilot Software). For further discussion see Gray and Watson (1998) and Inmon (2002). Also visit the Data Warehouse Institute (dw-institute.org).

Data Marts, Operational Data Stores, and Multidimensional Databases

Data warehouses are frequently supplemented with or substituted by the following: data marts, operational data stores, and multidimensional databases.

DATA MARTS. The high cost of data warehouses confines their use to large companies. An alternative used by many other firms is creation of a lower cost,

**TABLE 11.2** Summary of Strategic Uses of Data Warehousing

Industry	Functional Areas of Use	Strategic Use
Airline	Operations and Marketing	Crew assignment, aircraft deployment, mix of fares, analysis of route profitability, frequent flyer program promotions
Apparel	Distribution and Marketing	Merchandising, and inventory replenishment
Banking	Product Development, Operations, and Marketing	Customer service, trend analysis, product and service promotions. Reduction of IS expenses
Credit Card	Product Development and Marketing	Customer service, new information service for a fee, fraud detection
Health Care	Operations	Reduction of operational expenses
Investment and Insurance	Product Development, Operations, and Marketing	Risk management, market movements analysis, customer tendencies analysis, portfolio management
Personal Care Products	Distribution and Marketing	Distribution decision, product promotions, sales decision, pricing policy
Public Sector	Operations	Intelligence gathering
Retail Chain	Distribution and Marketing	Trend analysis, buying pattern analysis, pricing policy, inventory control, sales promotions, optimal distribution channel
Steel	Manufacturing	Pattern analysis (quality control)
Telecommunications	Product Development, Operations, and Marketing	New product and service promotions, reduction of IS budget, profitability analysis

Source: Park (1997), p. 19, Table 2.

scaled-down version of a data warehouse called a data mart. A **data mart** is a small warehouse designed for a strategic business unit (SBU) or a department.

The advantages of data marts include: low cost (prices under \$100,000 versus \$1 million or more for data warehouses); significantly shorter lead time for implementation, often less than 90 days; local rather than central control, conferring power on the using group. They also contain less information than the data warehouse. Hence, they have more rapid response and are more easily understood and navigated than an enterprisewide data warehouse. Finally, they allow a business unit to build its own decision support systems without relying on a centralized IS department.

There are two major types of data marts:

1. **Replicated (dependent) data marts.** Sometimes it is easier to work with a small subset of the data warehouse. In such cases one can replicate some subsets of the data warehouse in smaller datamarts, each of which is dedicated to a certain area, as was shown in Figure 11.2. In such a case the data mart is an *addition* to the data warehouse.
2. **Standalone data marts.** A company can have one or more independent data marts without having a data warehouse. Typical data marts are for marketing, finance, and engineering applications.

OPERATIONAL DATA STORES. An **operational data store** is a database for transaction processing systems that uses data warehouse concepts to provide

clean data. That is, it brings the concepts and benefits of the data warehouse to the operational portions of the business, at a lower cost. It is used for short-term decisions involving mission-critical applications rather than for the medium- and long-term decisions associated with the regular data warehouse. These decisions depend on much more current information. For example, a bank needs to know about all the accounts for a given customer who is calling on the phone. The operational data store can be viewed as situated between the operational data (in legacy systems) and the data warehouse. A comparison between the two is provided by Gray and Watson (1998).

MULTIDIMENSIONAL DATABASES. **Multidimensional databases** are specialized data stores that organize facts by dimensions, such as geographical region, product line, salesperson, or time. The data in multidimensional databases are usually preprocessed and stored in what is called a (multi-dimensional) *data cube*. Facts, such as quantities sold, are placed at the intersection of the dimensions. One such intersection might be the quantities of widgets sold by Ms. Smith in the Morristown, New Jersey, branch of XYZ Company in July 2003. Dimensions often have a hierarchy. Sales figures, for example, might be presented by day, by month, or by year. They might also roll up an organizational dimension from store to region to company. Multidimensional databases can be incorporated in a data warehouse, sometimes as its core, or they can be used as an additional layer. See *Online File W11.4* for details.



11.3 INFORMATION AND KNOWLEDGE DISCOVERY WITH BUSINESS INTELLIGENCE

Business Intelligence

Once the data are in the data warehouse and/or data marts they can be accessed by managers, and analysts, and other end users. Users can then conduct several activities. These activities are frequently referred to as analytical processing or more commonly as *business intelligence*. (Note: For a glossary of these and other terms, see *Dimensional Insight*, 2003.) **Business intelligence (BI)** is a broad category of applications and techniques for gathering, storing, analyzing and providing access to data to help enterprise users make better business and strategic decisions (see Oguz, 2003, and Moss and Atre, 2003). The process of BI usually, but not necessarily, involves the use of a data warehouse, as seen in Figure 11.3.

HOW BUSINESS INTELLIGENCE WORKS. Operational raw data are usually kept in corporate databases. For example, a national retail chain that sells everything from grills and patio furniture to plastic utensils, has data about inventory, customer information, data about past promotions, and sales numbers in various databases. Though all this information may be scattered across multiple systems—and may seem unrelated—a data warehouse building software can bring it together to the data warehouse. In the data warehouse (or mart) tables can be linked, and data cubes (another term for multidimensional databases) are formed. For instance, inventory information is linked to sales numbers and customer databases, allowing for extensive analysis of information. Some data warehouses have a dynamic link to the databases; others are static.

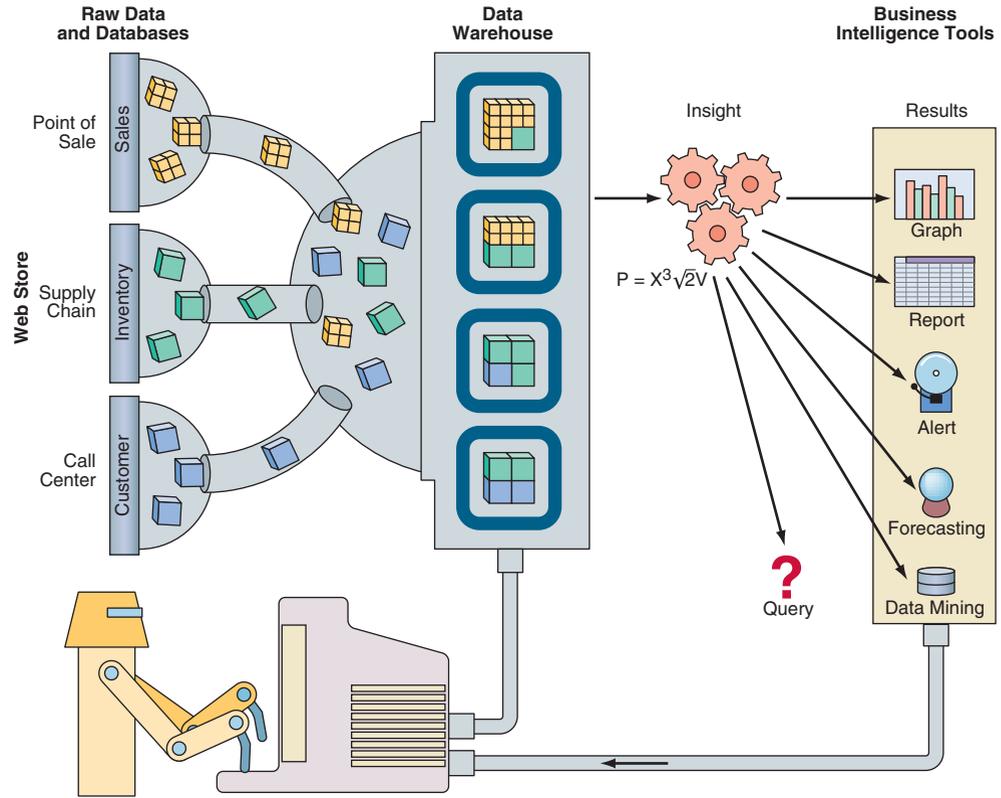


FIGURE 11.3 How business intelligence Works.

Using a business intelligence software the user can ask queries, request ad-hoc reports, or conduct any other analyses. For example, analysis can be carried out by performing multilayer queries. Because all the databases are linked, you can search for what products a store has too much of. You can then determine which of these products commonly sell with popular items, based on previous sales. After planning a promotion to move the excess stock along with the popular products (by bundling them together, for example), you can dig deeper to see where this promotion would be most popular (and most profitable). The results of your request can be reports, predictions, alerts, and/or graphical presentations. These can be disseminated to decision-making tasks.

More advanced applications of business intelligence include outputs such as financial modeling, budgeting, resource allocation, and competitive intelligence. Advanced business intelligence systems include components such as decision models, business performance analysis, metrics, data profiling and reengineering tools, and much more. (For details see dmreview.com)

THE TOOLS AND TECHNIQUES OF BUSINESS INTELLIGENCE. BI employs large number of tools and techniques. The major applications include the activities of query and reporting, online analytical processing (OLAP), DSS, data mining, forecasting and statistical analysis. A major BI vendor is SAS (sas.com). Other vendors include Microstrategy, Congos, SPSS, and Business Objects. We have divided the BI tools into two major categories: (1) *information and knowledge discovery* and (2) *decision support and intelligent analysis*. In each category there are

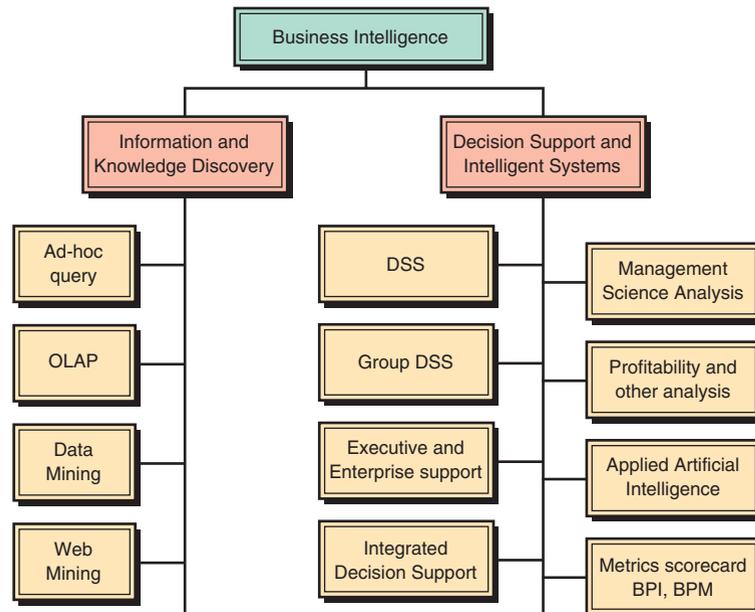


FIGURE 11.4 Categories of business intelligence.

several tools and techniques, as shown in Figure 11.4. In this chapter we will describe the information and knowledge discovery category, while Chapter 12 is dedicated to decision support and intelligent systems.

The Roles and Techniques of Information and Knowledge Discovery

Information and knowledge discovery differs from decision support in its main objective: Discovery. Once discovery is done the results can be used for decision support. Let's distinguish first between information and knowledge discovery.

THE EVOLUTION OF INFORMATION AND KNOWLEDGE DISCOVERY. *Information discovery* started in the late sixties and early seventies with data collection techniques. It was basically simple data collection and answered queries that involved one set of historical data. This analysis was extended to answer questions that involved several sets of data with tools such as SQL and relational database management systems (see Table 11.3 for the evolution). During the 1990s, a recognition for the need of better tools to deal with the ever increasing amount of data, was initiated. This resulted in the creation of the data warehouse and the appearance of OLAP and multidimensional databases and presentation. When the amount of data to be analyzed exploded in the mid 1990s *knowledge discovery* emerged as an important analytical tool.

The process of extracting useful knowledge from volumes of data is known as **knowledge discovery in databases (KDD)**, or just **knowledge discovery**, and it is the subject of extensive research (see Fayyad et al., 1996). KDD's major objective is to identify valid, novel, potentially useful, and ultimately understandable patterns in data. KDD is useful because it is supported by three technologies that are now sufficiently mature: massive data collection, powerful multiprocessor computers, and data mining and other algorithms. KDD processes have appeared under various names and have shown different characteristics. As time has passed, KDD has become able to answer more complex

TABLE 11.3 Stages in the Evolution of Knowledge Discovery

Evolutionary Stage	Business Question	Enabling Technologies	Characteristics
Data collection (1960s)	What was my total revenue in the last five years?	Computers, tapes, disks	Retrospective, static data delivery
Data access (1980s)	What were unit sales in New England last March?	Relational databases (RDBMS), structured query language (SQL)	Retrospective, dynamic data delivery at record level
Data warehousing and decision support (early 1990s)	What were the sales in region A, by product, by salesperson?	OLAP, multidimensional databases, data warehouses	Retrospective, dynamic data delivery at multiple levels
Intelligent data mining (late 1990s)	What's likely to happen to the Boston unit's sales next month? Why?	Advanced algorithms, multiprocessor computers, massive databases	Prospective, proactive information delivery
Advanced intellegent system	What is the best plan to follow?	Neural computing, advanced AI models, complex optimization, Web services	Proactive, integrative; multiple business partners
Complete integration (2000–2004)	How did we perform compared to metrics?		

Source: Based on material from accure.com (Accure Software).

business questions. In this section we will describe two tools of information discovery: Ad-hoc queries, and OLAP. Data mining as a KDD is described in Section 11.4. We discuss multidimensionality in Section 11.5. Web-based query tools are described in Section 11.7.

AD-HOC QUERIES AND REPORTING. Ad-hoc queries allow users to request, in real time, information from the computer that is not available in periodic reports. Such answers are needed to expedite decision making. The system must be intelligent enough to understand what the user wants. Simple ad-hoc query systems are often based on menus. More intelligent systems use structured query language (SQL) and query-by-example approaches, which are described in Technology Guide 3. The most intelligent systems are based on natural language understanding (Chapter 12) and some can communicate with users using voice recognition. Later on we will describe the use of Web tools to facilitate queries.

Querying systems are frequently combined with reporting systems that generate routine reports. For an example of such a combination in a radio rental store see Amato-McCoy, 2003. For Web-based information discovery tools see *Online File W11.5*.



ONLINE ANALYTICAL PROCESSING. The term **online analytical processing (OLAP)** was introduced in 1993 by E. F. Codd, to describe a set of tools that can analyze data to reflect actual business needs. These tools were based on a set of 12 rules: (1) multidimensional view, (2) transparency to the user, (3) easy accessibility, (4) consistent reporting, (5) client/server architecture, (6) generic dimensionality, (7) dynamic sparse matrix handling, (8) multiuser support, (9) cross-dimensional operations, (10) intuitive data manipulation, (11) flexible

reporting, and (12) unlimited levels of dimension and aggregation. For details see Codd et al., 1993. Let's see how these rules may work:

Assume that a business might organize its sales force by regions, say the Eastern and Western. These two regions might then be broken down into states. In an OLAP database, this organization would be used to structure the sales data so that the VP of sales could see the sales figures for each region. The VP might then want to see the Eastern region broken down by state so that the performance of individual state sales managers could be evaluated. Thus OLAP reflects the business in the data structure.

The power of OLAP is in its ability to create these business structures (sales regions, product categories, fiscal calendar, partner channels, etc.) and combine them in such a way as to allow users to quickly answer business questions. "How many blue sweaters were sold via mail-order in New York so far this year?" is the kind of question that OLAP is very good at answering. Users can interactively slice the data and drill down to the details they are interested in.

In terms of the technology, an OLAP database can be implemented on top of an existing relational database (this is called ROLAP, for Relational OLAP) or it can be implemented via a specialized multidimensional data store (this is called MOLAP, for Multidimensional OLAP). In ROLAP, the data request is translated into SQL and the relational database is queried for the answer. In MOLAP, the specialized data store is preloaded with the answers to (all) possible queries so that any request for data can be returned quickly. Obviously there are performance and storage tradeoffs between these two approaches. (Another technology called HOLAP attempts to combine these two approaches.)

Unlike online transaction processing (OLTP) applications, OLAP involves examining many data items (frequently many thousands or even millions) in complex relationships. In addition to answering users' queries, OLAP may analyze these relationships and look for patterns, trends, and exceptions.

A typical OLAP query might access a multigigabyte, multiyear sales database in order to find all product sales in each region for each product type. (See the Harrah's case.) After reviewing the results, an analyst might further refine the query to find sales volume for each sales channel within region or product classifications. As a last step, the analyst might want to perform year-to-year or quarter-to-quarter comparisons, for each sales channel. This whole process must be carried out *online* with rapid response time so that the analysis process is undisturbed.

The 12 original rules of Codd are reflected in today's software. For example, today's software permits access to very large amounts of data, such as several years of sales data, usually with a browser, and analysis of the relationships between many types of business elements, such as sales, products, regions, and channels. It enables users to process aggregated data, such as sales volumes, budgeted dollars, and dollars spent, to compare aggregated data over time, and to present data in different perspectives, such as sales by region versus sales by product or by product within each region. Today's software also enables complex calculations between data elements, such as expected profit as calculated as a function of sales revenue for each type of sales channel in a particular region; and responds quickly to user requests so that users can pursue an analytical thought process without being stymied by the system.

OLAP can be combined with data mining to conduct a very sophisticated multidimensional-based decision support as illustrated by Fong et al., 2002. By



attaching a rule-based component to the OLAP, one can make such integrated system an intelligent data mine system (see Lau et al., 2001). For more information, products and vendors visit *olapreport.com* and *olap.com*.

Although OLAP and ad-hoc queries are very useful in many cases, they are retrospective in nature and cannot provide the automated and prospective knowledge discovery that is done by advanced data mining techniques.

11.4 DATA MINING CONCEPTS AND APPLICATIONS

Data mining is becoming a major tool for analyzing large amount of data, usually in a data warehouse, (Nemati and Barko., 2002) as well for analyzing Web data. **Data mining** derives its name from the similarities between searching for valuable business information in a large database, and mining a mountain for a vein of valuable ore. Both processes require either sifting through an immense amount of material or intelligently probing it to find exactly where the value resides (see the Harrah's case at the start of the chapter). In some cases the data are consolidated in a data warehouse and data marts (e.g., see Chopoorian et al., 2001). In others they are kept on the Internet and intranet servers.

Capabilities of Data Mining

Given databases of sufficient size and quality, data mining technology can generate new business opportunities by providing these capabilities:

- **Automated prediction of trends and behaviors.** Data mining automates the process of finding predictive information in large databases. Questions that traditionally required extensive hands-on analysis can now be answered directly and quickly from the data. A typical example of a predictive problem is *targeted marketing*. Data mining can use data on past promotional mailings to identify the targets most likely to respond favorably to future mailings. Other predictive examples include forecasting bankruptcy and other forms of default, and identifying segments of a population likely to respond similarly to given events.
- **Automated discovery of previously unknown patterns.** Data mining tools identify previously hidden patterns in one step. An example of pattern discovery is the analysis of retail sales data to identify seemingly unrelated products that are often purchased together, such as baby diapers and beer. Other pattern discovery problems include detecting fraudulent credit card transactions and identifying invalid (anomalous) data that may represent data entry keying errors.

When data mining tools are implemented on high-performance parallel-processing systems, they can analyze massive databases in minutes. Often, these databases will contain data stored for several years. Faster processing means that users can experiment with more models to understand complex data. High speed makes it practical for users to analyze huge quantities of data. Larger databases, in turn, yield improved predictions (see Winter, 2001, and Hirji, 2001).

Data mining also can be conducted by nonprogrammers. The “miner” is often an end user, empowered by “data drills” and other power query tools to ask ad-hoc questions and get answers quickly, with little or no programming skill. Data mining tools can be combined with spreadsheets and other end-user software development tools, making it relatively easy to analyze and process the mined data. Data mining appears under different names, such as knowledge



A CLOSER LOOK

11.2 DATA MINING TECHNIQUES AND INFORMATION TYPES

The most commonly used techniques for data mining are the following.

- **Case-based reasoning.** The case-based reasoning approach uses historical cases to recognize patterns (see Chapter 12). For example, customers of Cognitive Systems, Inc., utilize such an approach for helpdesk applications. One company has a 50,000-query case library. New cases are matched quickly against the 50,000 samples in the library, providing more than 90 percent accurate and automatic answers to queries.
- **Neural computing.** Neural computing is a machine learning approach by which historical data can be examined for pattern recognition. These patterns can then be used for making predictions and for decision support (details are given in Chapter 12). Users equipped with neural computing tools can go through huge databases and, for example, identify potential customers of a new product or companies whose profiles suggest that they are heading for bankruptcy. Most practical applications are in financial services, in marketing, and in manufacturing.
- **Intelligent agents.** One of the most promising approaches to retrieving information from the Internet or from intranet-based databases is the use of intelligent agents. As vast amounts of information become available through the Internet, finding the right information is more difficult. This topic is further discussed in Chapters 5 and 12.
- **Association analysis.** Association analysis is a relatively new approach that uses a specialized set of

algorithms that sort through large data sets and express statistical rules among items. (See Moad, 1998, for details.)

- **Other tools.** Several other tools can be used. These include decision trees, genetic algorithms, nearest-neighbor method, and rule induction. For details, see Inmon, 2002.

The most common information types are:

- **Classification.** Implies the defining characteristics of a certain group (e.g., customers who have been lost to competitors).
- **Clustering.** Identifies groups of items that share a particular characteristic. Clustering differs from classification in that no predefining characteristic is given.
- **Association.** Identifies relationships between events that occur at one time (e.g., the contents of a shopping basket). For an application in law enforcement see Brown and Hagen, 2003.
- **Sequencing.** Similar to association, except that the relationship exists over a period of time (e.g., repeat visits to a supermarket or use of a financial planning product).
- **Forecasting.** Estimates future values based on patterns within large sets of data (e.g., demand forecasting).

There are a large number of commercial products available for conducting data mining (e.g., *dbminer.com*, *data-miner.com*, and *spss.com*). For a directory see *kdnuggets.com/software*.



The Tools of Data Mining

extraction, data dipping, data archeology, data exploration, data pattern processing, data dredging, and information harvesting. “Striking it rich” in data mining often involves finding unexpected, valuable results.

Data mining consists of two steps, building a *data cube* and using the cube to extract data for the mining functions that the mining tool supports. A data cube is multidimensional as shown in *Online File W11.6*. Data miners can use several tools and techniques; see a list and definitions in *A Closer Look 11.2*.

Data Mining Applications

Large number of applications exist in data mining both in business (see Apte et al., 2002) and other fields. According to a GartnerGroup report (*gartnergroup.com*), more than half of all the Fortune 1000 companies worldwide are using data mining technology.



A SAMPLER OF DATA MINING APPLICATIONS. Data mining is used extensively today for many business applications (see Apte et al., 2002), as illustrated by the 12 representative examples that follow. Note that the intent of most of these examples is to identify a business opportunity in order to create a sustainable competitive advantage.



1. **Retailing and sales.** Predicting sales; determining correct inventory levels and distribution schedules among outlets and loss prevention. For example, retailers such as AAFES (store in military bases) use data mining to combat fraud done by employees at their 1400 stores, using Fraud Watch solution from a Canadian Company, Triversity (see Amato-McCoy, 2003b). Eddie Bauer (see *Online File W11.7*) uses data mining for several applications.
2. **Banking.** Forecasting levels of bad loans and fraudulent credit card use, credit card spending by new customers, and which kinds of customers will best respond to (and qualify for) new loan offers.
3. **Manufacturing and production.** Predicting machinery failures; finding key factors that control optimization of manufacturing capacity.
4. **Brokerage and securities trading.** Predicting when bond prices will change; forecasting the range of stock fluctuations for particular issues and the overall market; determining when to buy or sell stocks.
5. **Insurance.** Forecasting claim amounts and medical coverage costs; classifying the most important elements that affect medical coverage; predicting which customers will buy new insurance policies.
6. **Computer hardware and software.** Predicting disk-drive failures; forecasting how long it will take to create new chips; predicting potential security violations.
7. **Policework.** Tracking crime patterns, locations, and criminal behavior; identifying attributes to assist in solving criminal cases.
8. **Government and defense.** Forecasting the cost of moving military equipment; testing strategies for potential military engagements; predicting resource consumption.
9. **Airlines.** Capturing data on where customers are flying and the ultimate destination of passengers who change carriers in hub cities; thus, airlines can identify popular locations that they do not service and check the feasibility of adding routes to capture lost business.
10. **Health care.** Correlating demographics of patients with critical illnesses; developing better insights on symptoms and their causes and how to provide proper treatments.
11. **Broadcasting.** Predicting what is best to air during prime time and how to maximize returns by interjecting advertisements.
12. **Marketing.** Classifying customer demographics that can be used to predict which customers will respond to a mailing or buy a particular product (as illustrated in Section 11.6).

Text Mining and Web Mining

TEXT MINING. **Text mining** is the application of data mining to nonstructured or less-structured text files (see Berry, 2002). Data mining takes advantage of the infrastructure of stored data to extract predictive information. For example, by mining a customer database, an analyst might discover that everyone who



buys product A also buys products B and C, but does so six months later. Text mining, however, operates with less structured information. Documents rarely have strong internal infrastructure, and when they do, it is frequently focused on document format rather than document content. Text mining helps organizations to do the following: (1) find the “hidden” content of documents, including additional useful relationship and (2) group documents by common themes (e.g., identify all the customers of an insurance firm who have similar complaints).

WEB MINING. **Web mining** is the application of data mining techniques to discover actionable and meaningful patterns, profiles, and trends from Web resources (see Linoff and Berry, 2002). The term Web mining is used to refer to both Web-content mining and Web-usage mining. *Web-content mining* is the process of information of analyzing Web access logs and other information connected to user browsing and access patterns on one or more Web localities.

Web mining is used in the following areas: information filtering (e-mails, magazines, and newspaper); surveillance (of competitors, patents, technological development); mining of Web-access logs for analyzing usage (clickstream analysis); assisted browsing, and services that fight crime on the Internet.

In e-commerce, Web content mining is especially critical, due to the large number of visitors to e-commerce sites, about 2.5 billion during the Christmas 2002 season (Weiss, 2003). For example, when you look for a certain book on Amazon.com, the site will also provide you with a lot of books purchased by the customers who have purchased the specific book you are looking for. By providing such mined information, the Amazon.com site minimizes the need for additional search by providing customers with valuable service.

According to Etzioni (1996), Web mining can perform the following functions:

- **Resource discovery:** locating unfamiliar documents and services on the Web.
- **Information extraction:** automatically extracting specific information form newly discovered Web resources.
- **Generalization:** uncovering general patterns at individual Web sites and across multiple sites. Miner3D (*miner3d.com*) is a suite of visual data analysis tools including a Web-mining tool that displays hundreds and even thousands of search hits on a single screen. The actual search for Web pages is performed through any major search engine, and this add on tool presents the resulting search in the form of a 3-D graphic instead of displaying links to the first few pages. For details on a number of Web-mining products see *Kdnuggets.com/software/web.html*. Also see *spss.com*, and *bayesia.com* (free downloads).

Failures of Data Warehouses and Data Mining

Since their early inceptions, data warehouses and mining have produced many success stories. However, there have also been many failures. Carbone (1999) defined levels of data warehouse failures as follows: (1) warehouse does not meet the expectations of those involved; (2) warehouse was completed, but went severely over budget in relation to time, money, or both; (3) warehouse failed one or more times but eventually was completed; and (4) warehouse failed with no effort to revive it.

Carbone provided examples and identified a number of reasons for failures (which are typical for many other large information systems): These are summarized in Table 11.4. Suggestions on how to avoid data warehouse failure are

TABLE 11.4 The Reasons Data Warehouses and Mining Fail

- | | |
|--|--|
| <ul style="list-style-type: none"> ● Unrealistic expectations—overly optimistic time schedule or underestimation of cost. ● Inappropriate architecture. ● Vendors overselling capabilities of products. ● Lack of training and support for users. ● Omitted information. ● Lack of coordination (or requires too much coordination). ● Cultural issues were ignored. ● Using the warehouse only for operational, not informational, purposes. ● Not enough summarization of data. ● Poor upkeep of technology. ● Improperly managing multiple users with various needs. ● Failure to align data marts and data warehouses. | <ul style="list-style-type: none"> ● Unclear business objectives; not knowing the information requirements. ● Lack of effective project sponsorship. ● Lack of data quality. ● Lack of user input. ● Using data marts instead of data warehouses (and vice versa). ● Inexperienced/untrained/inadequate number of personnel. ● Interfering corporate politics. ● Insecure access to data manipulation (users should not have the ability to change any data). ● Inappropriate format of information—not a single, standard format. ● Poor upkeep of information (e.g., failure to keep information current). |
|--|--|

Source: Compiled from Carbone (1999).

provided at *datawarehouse.com*, at *bitpipe.com*, and at *teradatauniversotynetwork.com*. Suggestions how to properly implement data mining are provided by Hirji (2001).

11.5 DATA VISUALIZATION TECHNOLOGIES

Once data have been processed, they can be presented to users as text, graphics, tables, and so on, via several data visualization technologies. A variety of methods and software packages are available to do visualization for supporting decision making (e.g., see *I/S Analyzer*, 2002 and Li, 2001).

Data Visualization

Visual technologies make pictures worth a thousand numbers and make IT applications more attractive and understandable to users. Data visualization refers to presentation of data by technologies such as digital images, geographical information systems, graphical user interfaces, multidimensional tables and graphs, virtual reality, three-dimensional presentations, vedios and animation. Visualization is becoming more and more popular on the Web not only for entertainment, but also for decision support (see *spss.com*, *microstrategy.com*). Visualization software packages offer users capabilities for self-guided exploration and visual analysis of large amounts of data. By using visual analysis technologies, people may spot problems that have existed for years, undetected by standard analysis methods. Data visualization can be supported in a dynamic way (e.g., by video clips). It can also be done in real time (e.g., Bates, 2003). Visualization technologies can also be integrated among themselves to create a variety of presentations, as demonstrated by the *IT At Work 11.1*.

Data visualization is easier to implement when the necessary data are in a data warehouse. Our discussion here will focused mainly on the data visualization techniques of multidimensionality, geographical information systems, visual interactive modeling, and virtual reality. Related topics, such as multimedia (see *informatica.com*) and hypermedia, are presented in Technology Guide 2.



IT At Work 11.1

DATA VISUALIZATION HELPS HAWORTH TO COMPETE



Manufacturing office furniture is an extremely competitive business. Haworth Corporation (*haworth.com*) operates in this environment and has been able to survive and even excel with the help of IT. To compete, Haworth allows its customers to customize what they want to buy (see demo at *haworth.com*). It may surprise you to learn that an office chair can be assembled in 200 different ways. The customization of all Haworth's products resulted in 21 million potential product combinations, confusing customers who were not able to visualize, until the item was delivered, how the customized furniture would look.

The solution was computer visualization software that allowed sales representatives with laptop computers to show customers exactly what they were ordering. Thus, the huge parts catalogs became more easily understood, and sales representatives were able to configure different options by entering the corporate database, showing what a product would look like, and computing its price. The customers can now make changes until the furniture design meets their needs. The salesperson can do all this from the customer's office by connecting to the corporate

intranet via the Internet and using Web tools to allow customers to make the desired changes. As of 2000 the company operates, on the Web, a design studio in which customers can interact with the designers.

These programs allow the company to reduce cycle time. After the last computer-assisted design (CAD) mockup of an order has been approved, the CAD software is used to create a bill of materials that goes to Haworth's factory for manufacturing. This reduces the time spent between sales reps and CAD operators, increasing the time available for sales reps to make more sales calls and increasing customer satisfaction with quicker delivery. By using this visualization computer program, Haworth has increased its competitive advantage.

Sources: Compiled from *Infoworld*, 1997, p. 92 and from *haworth.com* (2003).

For Further Exploration: How can the intranet be used to improve the process? How does this topic relate to car customization at *jaguar.com*? How can this case be related to wireless?

Multidimensionality Visualization

Modern data and information may have several dimensions. For example, management may be interested in examining sales figures in a certain city by product, by time period, by salesperson, and by store (i.e., in five dimensions). The common tool for such situations is OLAP, and it often includes a visual presentation. The more dimensions involved, the more difficult it is to present multidimensional information in one table or in one graph. Therefore, it is important to provide the user with a technology that allows him or her to add, replace, or change dimensions quickly and easily in a table and/or graphical presentation. Such changes are known as "slicing and dicing" of data. The technology of slicing, dicing, and similar manipulations is called *OLAP multidimensionality*, and it is available in most business intelligence packages (e.g., *brio.com*)

Figure 11.5 shows three views of the same data, organized in different ways, using multidimensional software, usually available with spreadsheets. Part a shows travel hours of a company's employees by means of transportation and by country. The "next year" column gives projections automatically generated by an embedded formula. In part b the data are reorganized, and in part c they are reorganized again and manipulated as well. All this is easily done by the end user with one or two clicks of the mouse.

The major advantage of multidimensionality is that data can be organized the way managers like to see them rather than the way that the system analysts do. Furthermore, different presentations of the same data can be arranged and rearranged easily and quickly.



	Travel Hours					
	Planes		Trains		Automobiles	
	This Year	Next Year	This Year	Next Year	This Year	Next Year
Canada	740	888	140	168	640	768
Japan	430	516	290	348	150	180
France	320	384	460	552	210	252
Germany	425	510	430	516	325	390
Country						

(a)

		Hours	
		This Year	Next Year
Planes	Canada	740	888
	Japan	430	516
	France	320	384
	Germany	425	510
Trains	Canada	140	168
	Japan	290	348
	France	460	552
	Germany	430	516
Automobiles	Canada	640	768
	Japan	150	180
	France	210	252
	Germany	325	390
Travel	Country		

(b)

Worksheet1-View1-TUTORIAL				Hours	
		This Year	Next Year		
Planes	Canada	740	888		
	Japan	430	516		
	France	320	384		
	Germany	425	510		
	Europe	Total	745	894	
Trains	Canada	140	168		
	Japan	290	348		
	France	460	552		
	Germany	430	516		
	Europe	Total	890	1068	
Automobiles	Canada	640	768		
	Japan	150	180		
	France	210	252		
	Germany	325	390		
	Europe	Total	535	642	
Travel	Country				

Next Year = (This Year)*1.2

- The software adds a *Total* Item
- The software adds formula 2 and calculates *Total*
- Auto-making shades the formulas using two shades of gray

Shows how formula 1 calculates cells (in this case, the cells *Total:Next Year*)

Shows that formula 2 calculates all Total cells.

(c)

FIGURE 11.5 Multidimensionality views.



Three factors are considered in multidimensionality: dimensions, measures, and time.

1. **Examples of dimensions:** products, salespeople, market segments, business units, geographical locations, distribution channels, countries, industries
2. **Examples of measures:** money, sales volume, head count, inventory profit, actual versus forecasted results
3. **Examples of time:** daily, weekly, monthly, quarterly, yearly

For example, a manager may want to know the sales of product M in a certain geographical area, by a specific salesperson, during a specified month, in terms of units. Although the answer can be provided regardless of the database structure, it can be provided much faster, and by the user himself or herself, if the data are organized in multidimensional databases (or data marts), or if the query tools are designed for multidimensionality (e.g., via OLAP). In either case, users can navigate through the many dimensions and levels of data via tables or graphs and then conduct a quick analysis to find significant deviations or important trends.

Multidimensionality is available with different degrees of sophistication and is especially popular in business intelligence software (e.g., see Campbell, 2001). There are several types of software from which multidimensional systems can be constructed, and they often work in conjunction with OLAP tools.

Geographical Information Systems

A **geographical information system (GIS)** is a computer-based system for capturing, storing, checking, integrating, manipulating, and displaying data using digitized maps. Its most distinguishing characteristic is that every record or digital object has an identified geographical location. By integrating maps with spatially oriented databases and other databases (called *geocoding*), users can generate information for planning, problem solving, and decision making, increasing their productivity and the quality of their decisions.

GIS SOFTWARE. GIS software varies in its capabilities, from simple computerized mapping systems to enterprisewide tools for decision support data analysis (see Minicase 2). As a high-quality graphics display and high computation and search speeds are necessary, most early GIS implementations were developed for mainframes. Initially, the high cost of GISs prevented their use outside experimental facilities and government agencies. Since the 1990s, however, the cost of GIS software and its required hardware has dropped dramatically. Now relatively inexpensive, fully functional PC-based packages are readily available. Representative GIS software vendors are ESRI, Intergraph, and Mapinfo.

GIS DATA. GIS data are available from a wide variety of sources. Government sources (via the Internet and CD-ROM) provide some data, while vendors provide diversified commercial data as well. Some are free (see CD-ROMs from MapInfo, and downloadable material from *esri.com* and *gisdatadepot.com*.)

The field of GIS can be divided into two major categories: *functions* and *applications*. There are four major functions: design and planning, decision modeling, database management, and spatial imaging. These functions support six areas of applications as shown in Figure 11.6. Note that the functions (shown as pillars) can support all the applications. The applications they support the most are shown closest to each pillar.

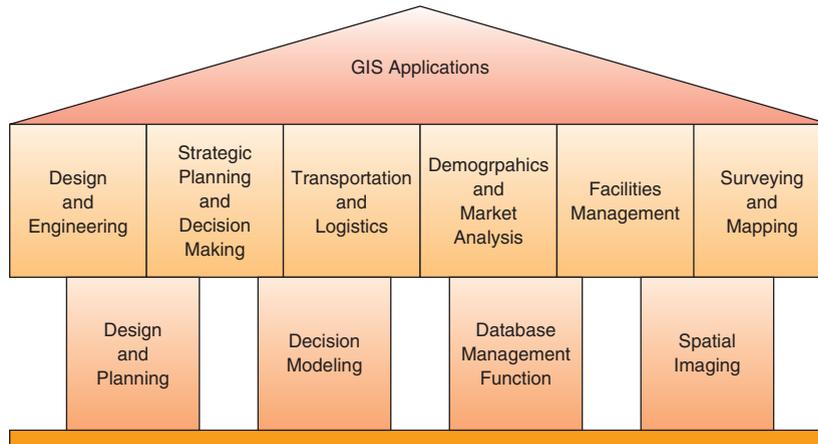


FIGURE 11.6 GIS functions and applications.

GIS AND DECISION MAKING. GISs provide a large amount of extremely useful information that can be analyzed and utilized in decision making. Its graphical format makes it easy for managers to visualize the data. For example, as Janet M. Hamilton, market research administrator for Dow Elanco, a \$2 billion maker of agricultural chemicals based in Indianapolis, Indiana, explains, “I can put 80-page spreadsheets with thousands of rows into a single map. It would take a couple of weeks to comprehend all of the information from the spreadsheet, but in a map, the story can be told in seconds” (Hamilton, 1996, p. 21).

There are countless applications of GISs to improve decision making in the public or private sector (see Nasirin and Birks, 2003). They include the dispatch of emergency vehicles, transit management (see Minicase 2), facility site selection, and wildlife management. GISs are extremely popular in local governments, where the tools are used not only for mapping but for many decision-making applications (see O’Looney, 2000). States, cities and counties are using a GIS application related to property assessment, mapping, and flood control. (e.g., Hardester, 2002). Banks have been using GIS for over a decade to support expansion and marketing decision making (See *Online File W11.8*).

For many companies, the intelligent organization of data within a GIS can provide a framework to support the process of decision making and of designing alternative strategies especially when location decisions are involved (Church, 2002). Some examples of successful GIS applications are provided by Korte (2000) and Hamilton (1996). Other examples of successful GIS applications are summarized in *A Closer Look 11.3*.

GIS AND THE INTERNET OR INTRANET. Most major GIS software vendors are providing Web access, such as embedded browsers, or a Web/Internet/intranet server that hooks directly into their software. Thus, users can access dynamic maps and data via the Internet or a corporate intranet.

A number of firms are deploying GISs on the Internet for internal use or for use by their customers. For example, Visa Plus, which operates a network of automated teller machines, has developed a GIS application that lets Internet users call up a locator map for any of the company’s 300,000 ATM machines worldwide. A common application on the Internet is a store locator. Not only do you get an address near you, but you also are told how to get there in the





A CLOSER LOOK

11.3 GIS SAMPLE APPLICATIONS

COMPANY

Pepsi Cola Inc., Super Value, Acordia Inc.

CIGNA (health insurance)

Western Auto (a subsidiary of Sears)

Sears, Roebuck & Co.

Health maintenance organizations

Wood Personnel Services (employment agencies)

Wilkening & Co. (consulting services)

CellularOne Corp.

Sun Microsystems

Consolidated Rail Corp.

Federal Emergency Management Agency

Toyota (other car manufacturers)

APPLICATION OF GIS FOR DECISION SUPPORT

Used in site selection for new Taco Bell and Pizza Hut restaurants; combining demographic data and traffic patterns used in deciding on new facilities and on marketing strategy decision

Uses GIS to answer such questions as "How many CIGNA-affiliated physicians are available within an 8-mile radius of a business?"

Integrates data with GIS to create a detailed demographic profile of a store's neighborhood to determine the best product mix to offer at the store. (Narisin and Birks, 2003)

Uses GIS to support planning of truck routes.

Using GIS to support drought risk management (Goddard et al., 2003)

Tracks cancer rate and other diseases to determine expansion strategy and allocation of expensive equipment in their facilities.

Maps neighborhoods where temporary workers live; for locating marketing and recruiting cities.

Map Real estate for tax assessments, property appraisals, flood control, land surveys and related applications (see Hardester, 2002)

Designs optimal sales territories and routes for their clients, reducing travel costs by 15 percent.

Maps its entire cellular network to identify clusters of call disconnects and to dispatch technicians accordingly.

Making decisions regarding location of facilities (Church, 2002)

Manages leased property in dozens of places worldwide. Monitors the condition of 20,000 miles of railroad track and thousands of parcels of adjoining land.

Assesses the damage of hurricanes, floods, and other natural disasters by relating videotapes of the damage to digitized maps of properties.

Combines GIS and GPS as a navigation tool. Drivers are directed to destinations in the best possible way.

shortest way (e.g., try *frys.com*). As GIS Web server software is deployed by vendors, more applications will be developed. Maps, GIS data, and information about GISs are available over the Web through a number of vendors and public agencies. (For design issues see Sikder and Gangopadhyay, 2002.)

EMERGING GIS APPLICATIONS. The integration of GISs and global positioning systems (GPSs) has the potential to help restructure and redesign the aviation,



transportation, and shipping industries. It enables vehicles or aircraft equipped with a GPS receiver to pinpoint their location as they move (Steede-Terry, 2000). Emerging applications of GPSs include personal automobile mapping systems, vehicle tracking (Terry and Kolb, 2003), and earth-moving equipment tracking. The price of these applications is dropping with improvements in hardware, increased demand, and the availability of more competing vendors. (A simple GPS cost less than \$50 in 2003.) GPSs have also become a major source of new GIS data (see Group Assignment 1). Some researchers have developed intelligent GISs that link a GIS to an expert system or to intelligent agents (Tang et al., 2001).

L-Commerce. In Chapter 6 we introduced the concept of location-based commerce (l-commerce), a major part of mobile-commerce (m-commerce). In l-commerce, advertising is targeted to an individual whose location is known (via a GPS and GIS combination). Similarly, emergency medical systems identify the location of a car accident in a second, and the attached GIS helps in directing ambulances to the scene. For other interesting applications, see Sadeh (2002).

CONCLUSIONS. Improvements in the GIS user interface have substantially altered the GIS “look” and “feel.” Advanced visualization (three-dimensional graphics) is increasingly integrated with GIS capabilities, especially in animated and interactive maps. GISs can provide information for virtual reality engines, and they can display complex information to decision makers. Multimedia and hypermedia play a growing role in GISs, especially in help and training systems. Object linking and embedding is allowing users to import maps into any document. More GISs will be deployed to provide data and access data over the Web and organizational intranets as “Web-ready” GIS software becomes more affordable. See Korte (2000) for an overview of GISs, their many capabilities, and potential advances.

Visual Interactive Models and Simulation

Visual interactive modeling (VIM) uses computer graphic displays to represent the impact of different management or operational decisions on goals such as profit or market share. VIM differs from regular simulation in that the user can intervene in the decision-making process and see the results of the intervention. A visual model is much more than a communication device, it is an integral part of decision making and problem solving.

A VIM can be used both for supporting decisions and for training. It can represent a static or a dynamic system. Static models display a visual image of the result of one decision alternative at a time. (With computer windows, several results can be compared on one screen.) Dynamic models use animation or video clips to show systems that evolve over time. These are also used in real-time simulations.

VIM has been used with DSSs in several operations management decision processes (see Beroggi, 2001). The method loads the current status of a plant (or a business process) into a virtual interactive model. The model is then run rapidly on a computer, allowing management to observe how a plant is likely to operate in the future.

One of the most developed areas in VIM is **visual interactive simulation (VIS)**, a method in which the end user watches the progress of the simulation



IT At Work 11.2

COMPUTER TRAINING IN COMPLEX LOGGING MACHINES AT PARTEK FOREST



The foresting industry is extremely competitive, and countries with high labor costs must automate tasks such as moving, cutting, delimiting, and piling logs. A new machine, called the “Harvester,” can replace 25 lumberjacks.

The Harvester is a highly complex machine that takes six months to learn how to operate. The trainee destroys a sizeable amount of forest in the process, and terrain suitable to practice on is decreasing. In unskilled hands, this expensive machine can also be damaged. Therefore, extensive and expensive training is needed. Sisu Logging of Finland (a subsidiary of Parter Forest) found a solution to the training problem by using a real-time simulation (*partekforest.com*).

In this simulation, the chassis, suspension, and wheels of the vehicles have to be modeled, together with the forces acting on them (inertia and friction), and the movement equations linked with them have to be solved in real time. This type of simulation is mathematically complex, and until recently it required equipment investment running into millions of dollars. However, with the help of a visual simulations program, simulation training can now be carried out for only 1 percent of the cost of the traditional method.

Inside the simulator are the Harvester’s actual controls, which are used to control a virtual model of a Harvester plowing its way through a virtual forest. The machine sways back and forth on uneven terrain, and the grapple of the Harvester grips the trunk of a tree, fells it, delimits it, and cuts it into pieces very realistically in real time.

The simulated picture is very sharp: even the structures of the bark and annual growth rings are clearly visible where the tree has been cut. In traditional simulators, the traveling path is quite limited beforehand, but in this Harvester simulator, you are free to move in a stretch of forest covering two hectares (25,000 square yards).

In addition, the system can be used to simulate different kinds of forest in different parts of the world, together with the different tree species and climatic conditions. An additional advantage of this simulator is that the operations can be videotaped so that training sessions can be studied afterward. Moreover, it is possible to practice certain dangerous situations that cannot be done using a real machine.

Source: Condensed from *Finnish Business Report*, April 1997

For Further Exploration: Why is the simulated training time shorter? Why is visualization beneficial?

model in an animated form using graphics terminals. The user may interact with the simulation and try different decision strategies. (See Pritsker and O’Reilly, 1999.) VIS is an approach that has, at its core, the ability to allow decision makers to learn about their own subjective values and about their mistakes. Therefore, VIS can be used for training as well as in games, as in the case of flight simulators, and as shown in *IT At Work 11.2*.

Animation systems that produce realistic graphics are available from many simulation software vendors (e.g., see SAS.com and vissim.com). The latest visual simulation technology is tied in with the concept of virtual reality, where an artificial world is created for a number of purposes—from training to entertainment to viewing data in an artificial landscape.

Virtual Reality

There is no standard definition of virtual reality. The most common definitions usually imply that **virtual reality (VR)** is interactive, computer-generated, three-dimensional graphics delivered to the user through a head-mounted display. Defined technically, virtual reality is an environment and/or technology that provides artificially generated sensory cues sufficient to engender in the user some willing suspension of disbelief. So in VR, a person “believes” that what he or she is doing is real even though it is artificially created.



More than one person and even a large group can share and interact in the same artificial environment. VR thus can be a powerful medium for communication, entertainment, and learning. Instead of looking at a flat computer screen, the VR user interacts with a three-dimensional computer-generated environment. To see and hear the environment, the user wears stereo goggles and a headset. To interact with the environment, control objects in it, or move around within it, the user wears a computerized display and hand position sensors (gloves). Virtual reality displays achieve the illusion of a surrounding medium by updating the display in real time. The user can grasp and move virtual objects.

VIRTUAL REALITY AND DECISION MAKING. Most VR applications to date have been used to support decision making indirectly. For example, Boeing has developed a virtual aircraft mockup to test designs. Several other VR applications for assisting in manufacturing and for converting military technology to civilian technology are being utilized at Boeing. At Volvo, VR is used to test virtual cars in virtual accidents; Volvo also uses VR in its new model-designing process. British Airways offers the pleasure of experiencing first-class flying to its Web site visitors. For a comprehensive discussion of virtual reality in manufacturing, see Banerjee and Zetu (2001).

Another VR application area is data visualization. VR helps financial decision makers make better sense of data by using visual, spatial, and aural immersion virtual systems. For example, some stock brokerages have a VR application in which users surf over a landscape of stock futures, with color, hue, and intensity indicating deviations from current share prices. Sound is used to convey other information, such as current trends or the debt/equity ratio. VR allows side-by-side comparisons with a large assortment of financial data. It is easier to make intuitive connections with three-dimensional support. Morgan Stanley & Co. uses VR to display the results of risk analyses.

VIRTUAL REALITY AND THE WEB. A platform-independent standard for VR called virtual reality markup language (VRML) (*vrmlsite.com*, and Kerlow, 2000) makes navigation through online supermarkets, museums, and stores as easy as interacting with textual information. VRML allows objects to be rendered as an Internet user “walks” through a virtual room. At the moment, users can utilize regular browsers, but VRML browsers will soon be in wide circulation.

Extensive use is expected in e-commerce marketing (see Dalglish, 2000). For example, Tower Records offers a virtual music store on the Internet where customers can “meet” each other in front of the store, go inside, and preview CDs and videos. They select and purchase their choices electronically and interactively from a sales associate. Applications of virtual reality in other areas are shown in Table 11.5.

Virtual supermarkets could spark greater interest in home grocery shopping. In the future, shoppers will enter a virtual supermarket, walk through the virtual aisles, select virtual products and put them in their virtual carts. This could help remove some of the resistance to virtual shopping. Virtual malls, which can be delivered even on a PC (*synthonics.com*), are designed to give the user a feeling of walking into a shopping mall.

Virtual reality is just beginning to move into many business applications. An interactive, three-dimensional world on the Internet should prove popular because it is a metaphor to which everyone can relate.

**TABLE 11.5** Examples of Virtual Reality Applications

Applications in Manufacturing	Applications in Business
Training Design testing and interpretation of results Safety analysis Virtual prototyping Engineering analysis Ergonomic analysis Virtual simulation of assembly, production, and maintenance	Real estate presentation and evaluation Advertising Presentation in e-commerce Presentation of financial data
Applications in Medicine	Applications in Research and Education
Training surgeons (with simulators) Interpretation of medical data Planning surgeries Physical therapy	Virtual physics lab Representation of complex mathematics Galaxy configurations
Amusement Applications	Applications in Architecture
Virtual museums Three-dimensional race car games (on PCs) Air combat simulation (on PCs) Virtual reality arcades and parks Ski simulator	Design of building and other structures

11.6 MARKETING DATABASES IN ACTION

Data warehouses and data marts serve end users in all functional areas. However, the most dramatic applications of data warehousing and mining are in marketing, as seen in the Harrah's case, in what is referred to as *marketing databases* (also referred to as *database marketing*).

In this section we examine how data warehouses, their extensions, and data mining are used, and what role they play in new marketing strategies, such as the use of Web-based marketing transaction databases in interactive marketing.

The Marketing Transaction Database

Most current databases are static: They simply gather and store information about customers. They appear in the following categories: operations databases, data warehouses, and marketing databases. Success in marketing today requires a new kind of database, oriented toward targeting the personalizing marketing messages in real time. Such a database provides the most effective means of capturing information on customer preferences and needs. In turn, enterprises can use this knowledge to create new and/or personalized products and services. Such a database is called a **marketing transaction database (MTD)**. The MTD combines many of the characteristics of the current databases and marketing data sources into a new database that allows marketers to engage in real-time personalization and target every interaction with customers.

MTD'S CAPABILITIES. The MTD provides dynamic, or interactive, functions not available with traditional types of marketing databases. In marketing terms, a transaction occurs with the exchange of information. With interactive media,



each exposure to the customer becomes an opportunity to conduct a marketing “transaction.” Exchanging information (whether gathered actively through registration or user requests, or passively by monitoring customer behavior) allows marketers to refine their understanding of each customer continuously and to use that information to target him or her specifically with personalized marketing messages. This is done most frequently on the Web.

Comparing various characteristics of MTDs with other marketing-related databases shows the advantages of MTDs. For example, marketing databases focus on understanding customers’ behavior, but do not target the individual customer nor personalize the marketing approach, as do MTDs. Additionally, data in MTDs can be updated in real time, as opposed to the periodic (weekly, monthly, or quarterly) updates that are characteristic of data warehouses and marketing databases. Also, the data quality in an MTD is focused, and is verified by the individual customers. It thus is of much higher quality than data in many operations databases, where legacy systems may offer only poor assurance of data quality. Further, MTDs can combine various types of data—behavioral, descriptive, and derivative; other types of marketing databases may offer only one or two of these types. Note that MTDs do not eliminate the need for traditional databases. They complement them by providing additional capabilities (see Online Minicase 1, Dell Computers).

THE ROLE OF THE INTERNET. Data mining, data warehousing, and MTDs are delivered on the Internet and intranets. The Internet does not simply represent another advertising venue or a different medium for catalog sales. Rather, it contains new attributes that smart marketers can exploit to their fullest degree. Indeed, the Internet promises to revolutionize sales and marketing. Dell Computer (see Online Minicase 1) offers an example of how marketing professionals can use the Internet’s electronic sales and marketing channels for market research, advertising, information dissemination, product management, and product delivery. For an overview of marketing databases and the Web, see Grossnickle and Raskin (2000).

Implementation Examples



Fewer and fewer companies can afford traditional marketing approaches, which include big-picture strategies and expensive marketing campaigns. Marketing departments are being scaled down, (and so is the traditional marketing approaches) and new approaches such as one-to-one marketing, speed marketing, interactive marketing, and relationship marketing are being employed (see Strauss et al., 2003). The following examples illustrate how companies use data mining and warehousing to support the new marketing approaches. For other examples, see *Online File W11.9*.

- Through its online registry for expectant parents, Burlington Coat Factory tracks families as they grow. The company then matches direct-mail material to the different stages of a family’s development over time. Burlington also identifies, on a daily basis, top-selling styles and brands. By digging into reams of demographic data, historical buying patterns, and sales trends in existing stores, Burlington determines where to open its next store and what to stock in each store.
- Au Bon Pain Company, Inc., a Boston-based chain of cafes, discovered that the company was not selling as much cream cheese as planned. When it analyzed point-of-sale data, the firm found that customers preferred small,



one-serving packaging (like butter). As soon as the package size of the cream cheese was changed, sales shot up.

- Bank of America gets more than 100,000 telephone calls from customers every day. Analyzing customers' banking activities, the bank determines what may be of interest to them. So when a customer calls to check on a balance, the bank tries to sell the customer something in which he or she might be interested.
- Supermarket chains regularly analyze reams of cash register data to discover what items customers are typically buying at the same time. These shopping patterns are used for issuing coupons, designing floor layouts and products' location, and creating shelf displays.
- In its data warehouse, the Chicago Tribune stores information about customer behavior as customers move through the various newspaper Web sites. Data mining helps to analyze volumes of data ranging from what browsers are used to what hyperlinks are clicked on most frequently.

The data warehouses in some companies include several terabytes or more of data (e.g., at Sears, see Minicase 1). They need to use supercomputing to sift quickly through the data. Wal-Mart, the world's largest discount retailer, has a gigantic database, as shown in *IT At Work 11.3*.



IT At Work 11.3

DATA MINING POWERS AT WAL-MART



With more than 50 terabytes of data (in 2003) on two NCR (National Cash Register) systems, Wal-Mart (walmart.com) manages one of the world's largest data warehouses. Besides the two NCR Teradata databases, which handle most decision-support applications, Wal-Mart has another 6 terabytes of transaction processing data on IBM and Hitachi mainframes.

Wal-Mart's formula for success—getting the right product on the appropriate shelf at the lowest price—owes much to the company's multimillion-dollar investment in data warehousing. "Wal-Mart can be more detailed than most of its competitors on what's going on by product, by store, by day—and act on it," says Richard Winter, a database consultant in Boston. "That's a tremendously powerful thing."

The systems house data on point of sale, inventory, products in transit, market statistics, customer demographics, finance, product returns, and supplier performance. The data are used for three broad areas of information discovery and decision support: analyzing trends, managing inventory, and understanding customers. What emerges are "personality traits" for each of Wal-Mart's 3,500 or so outlets, which Wal-Mart managers can use to determine product mix and inventory levels for each store.

Wal-Mart is using a data mining-based demand-forecasting application that employs neural networking software and runs on a 4,000-processor parallel computer. The application looks at individual items for individual stores to decide the seasonal sales profile of each item. The system keeps a year's worth of data on the sales of 100,000 products and predicts which items will be needed in each store and when.

Wal-Mart is expanding its use of market-basket analysis. Data are collected on items that comprise a shopper's total purchase so that the company can analyze relationships and patterns in customer purchases. The data warehouse is available over an extranet to store managers and suppliers. In 2003, 6,000 users made over 40,000 database queries each day.

"What Wal-Mart is doing is letting an army of people use the database to make tactical decisions," says consultant Winter. "The cumulative impact is immense."

Sources: This information is courtesy of NCR Corp. (2000) and walmart.com.

For Further Exploration: Since small retailers cannot afford data warehouses and data mining, will they be able to compete?

11.7 WEB-BASED DATA MANAGEMENT SYSTEMS

Data management and business intelligence activities—from data acquisition (e.g., Atzeni et al., 2002), through warehousing, to mining—are often performed with Web tools, or are interrelated with Web technologies and e-business (see Liautaud, 2001). Users with browsers can log onto a system, make inquiries, and get reports in a real-time setting. This is done through intranets, and for outsiders via extranets (see *remedy.com*).

E-commerce software vendors are providing Web tools that connect the data warehouse with EC ordering and cataloging systems. Hitachi's EC tool suite, Tradelink (at *hitachi.com*), combines EC activities such as catalog management, payment applications, mass customization, and order management with data warehouses and ERP systems. Oracle (see Winter, 2001) and SAP offer similar products.

Data warehousing and decision support vendors are connecting their products with Web technologies and EC. Examples include Brio's Brio One, Web Intelligence from Business Objects, and Cognos's DataMerchant. Hyperion's Appsource "wired for OLAP" product connects OLAP with Web tools. IBM's Decision Edge i makes OLAP capabilities available on the intranet from anywhere in the corporation using browsers, search engines, and other Web technologies. MicroStrategy offers DSS Agent and DSS Web for help in drilling down for detailed information, providing graphical views, and pushing information to users' desktops. Oracle's Financial Analyzer and Sales Analyzer, Hummingbird's Bi/Web and Bi/Broker, and several of the products cited above bring interactive querying, reporting, and other OLAP tasks to many users (both company employees and business partners) via the Web. Also, for a comprehensive discussion of business intelligence on the Web, see the white paper at *businessobjects.com*.

The systems described in the previous sections of this chapter can be integrated on by Web-based platforms, such as the one shown in Figure 11.7. The Web-based system is accessed via a portal, and it connects the following parts:

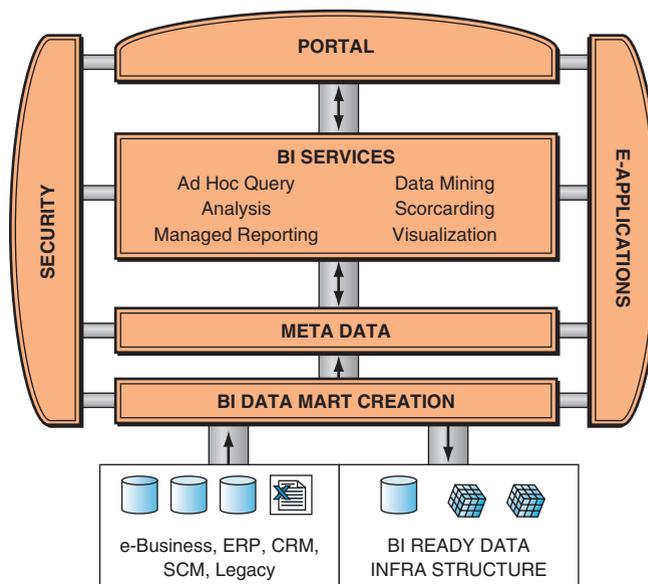


FIGURE 11.7 Web-based data management system. (Source: cognos.com. Platform for Enterprise Business Intelligence. © Cognos Inc. 2001.)

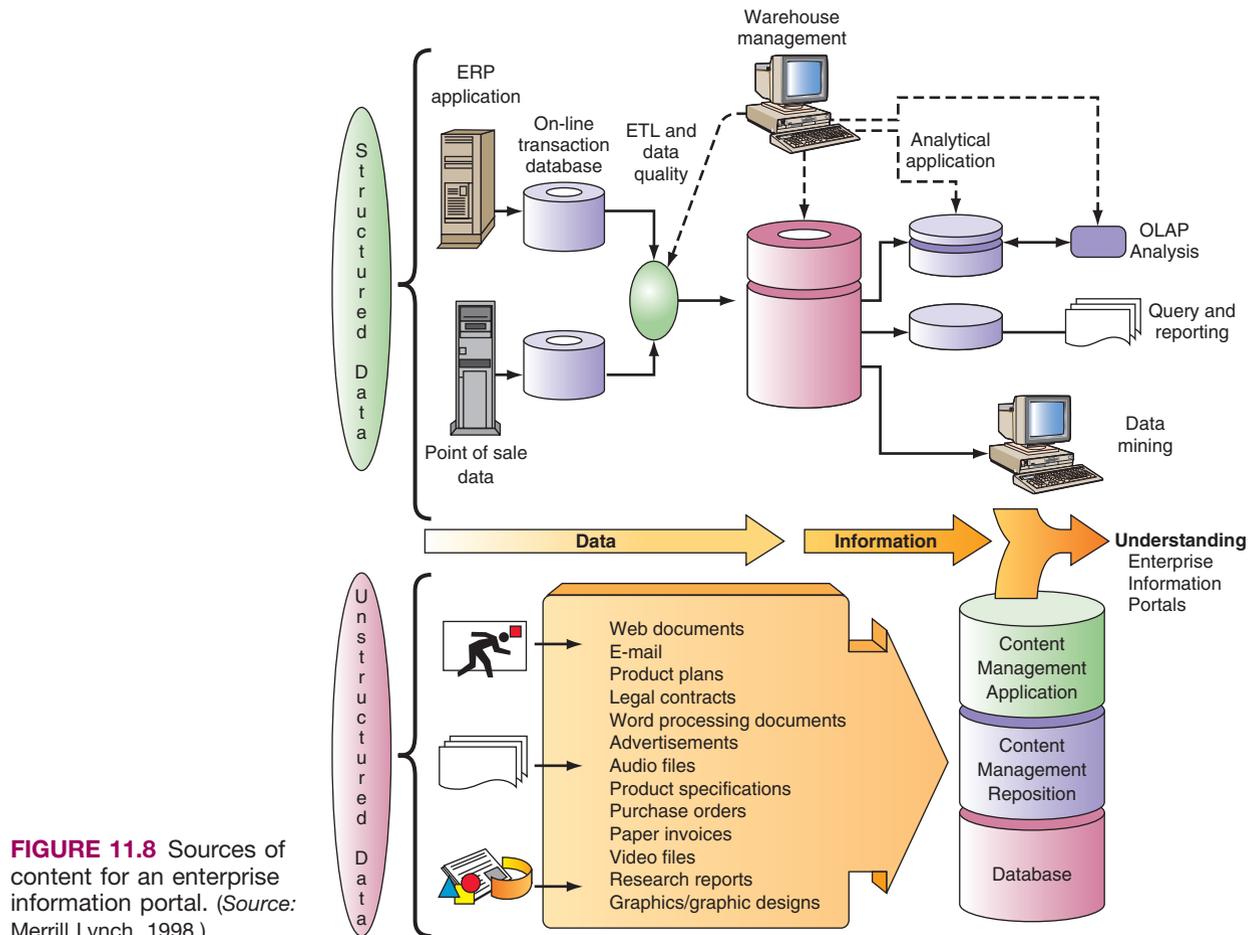


FIGURE 11.8 Sources of content for an enterprise information portal. (Source: Merrill Lynch, 1998.)

the business intelligence (BI) services, the data warehouse and marts, the corporate applications, and the data infrastructure. A security system protects the corporate proprietary data. Let's examine how all of these components work together via the corporate portal.

Enterprise BI suites and Corporate Portals

Enterprise BI suites (EBISs) integrate query, reporting, OLAP, and other tools. They are scalable, and offered by many vendors (e.g., IBM, Oracle, Microsoft, Hyperion Solution, Sagent Technology, AlphaBlox, MicroStrategy and Crystal Decisions). EBISs are offered usually via enterprise portals.

In Chapter 4 we introduced the concept of corporate portals as a Web-based gateway to data, information, and knowledge. As seen in Figure 11.8, the portal integrates data from many sources. It provides end users with a single Web-based point of personalized access to BI and other applications. Likewise, it provides IT with a single point of delivery and management of this content. Users are empowered to access, create, and share valuable information.

Intelligent Data Warehouse Web-based Systems

The amount of data in the data warehouse can be very large. While the organization of data is done in a way that permits easy search, it still may be useful to have a search engine for specific applications. Liu (1998) describes how



an intelligent agent can improve the operation of a data warehouse in the pulp and paper industry. This application supplements the monitoring and scanning of external strategic data. The intelligent agent application can serve both managers' ad-hoc query/reporting information needs and the external data needs of a strategic management support system for forest companies in Finland.

Clickstream Data Warehouse

Large and ever increasing amounts of B2C data about consumers, products, etc. can be collected. Such data come from several sources: internal data (e.g., sales data, payroll data etc.), external data (e.g., government and industry reports), and clickstream data. **Clickstream data** are those that occur inside the Web environment, when customers visit a Web site. They provide a trail of the users' activities in the Web site, including user behavior and browsing patterns. By looking at clickstream data, an e-tailer can find out such things as which promotions are effective and which population segments are interested in specific products.

According to Inmon (2001), clickstream data can reveal information to answer questions such as the following: What goods has the customer looked at or purchased? What items did the customer buy in conjunction with other items? What ads and promotion were effective? Which were ineffective? Are certain products too hard to find? Are certain products too expensive? Is there a substitute product that the customer find first?

The Web is an incredibly rich source of business intelligence, and many enterprises are scrambling to build data warehouses that capture the knowledge contained in the clickstream data from their Web sites. By analyzing the user behavior patterns contained in these clickstream data warehouses, savvy business can expand their markets, improve customer relationships, reduce costs, streamline operations, strengthen their Web sites, and hone their business strategies. One has two options: incorporate Web-based data into preexisting data warehouses, or to build new **clickstream data warehouses** that are capable of showing both e-business activities and the non-Web aspects of the business in an integrated fashion. (see Sweiger et al., 2002).

MANAGERIAL ISSUES

1. **Cost-benefit issues and justification.** Some of the data management solutions discussed in this chapter are very expensive and are justifiable only in large corporations. Smaller organizations can make the solutions cost effective if they leverage existing databases rather than create new ones. A careful cost-benefit analysis must be undertaken before any commitment to the new technologies is made.
2. **Where to store data physically.** Should data be distributed close to their users? This could potentially speed up data entry and updating, but adds replication and security risks. Or should data be centralized for easier control, security, and disaster recovery? This has communications and single point of failure risks.



3. **Legal issues.** Data mining may suggest that a company send catalogs or promotions to only one age group or one gender. A man sued Victoria's Secret Corp. because his female neighbor received a mail order catalog with deeply discounted items and he received only the regular catalog (the discount was actually given for volume purchasing). Settling discrimination charges can be very expensive.
4. **Internal or external?** Should a firm invest in internally collecting, storing, maintaining, and purging its own databases of information? Or should it subscribe to external databases, where providers are responsible for all data management and data access?
5. **Disaster recovery.** Can an organization's business processes, which have become dependent on databases, recover and sustain operations after a natural or other type of information system disaster? (See Chapter 15.) How can a data warehouse be protected? At what cost?
6. **Data security and ethics.** Are the company's competitive data safe from external snooping or sabotage? Are confidential data, such as personnel details, safe from improper or illegal access and alteration? A related question is, Who owns such personal data? (See Smith, 1997.)
7. **Ethics: Paying for use of data.** Compilers of public-domain information, such as Lexis-Nexis, face a problem of people lifting large sections of their work without first paying royalties. The Collection of Information Antipiracy Act (Bill HR 2652 in the U.S. Congress) will provide greater protection from on-line piracy. This, and other intellectual property issues, are being debated in Congress and adjudicated in the courts.
8. **Privacy.** Collecting data in a warehouse and conducting data mining may result in the invasion of individual privacy. What will companies do to protect individuals? What can individuals do to protect their privacy? (See Chapter 16.)
9. **The legacy data problem.** One very real issue, often known as the legacy data acquisition problem, is what to do with the mass of information already stored in a variety of systems and formats. Data in older, perhaps obsolete, databases still need to be available to newer database management systems. Many of the legacy application programs used to access the older data simply cannot be converted into new computing environments without considerable expense. Basically, there are three approaches to solving this problem. One is to create a database front end that can act as a translator from the old system to the new. The second is to cause applications to be integrated with the new system, so that data can be seamlessly accessed in the original format. The third is to cause the data to migrate into the new system by reformatting it. A new promising approach is the use of Web Services (see Chapter 14).
10. **Data delivery.** Moving data efficiently around an enterprise is often a major problem. The inability to communicate effectively and efficiently among different groups, in different geographical locations is a serious roadblock to implementing distributed applications properly, especially given the many remote sites and mobility of today's workers. Mobile and wireless computing (Chapter 6) are addressing some of these difficulties.





ON THE WEB SITE... Additional resources, including quizzes; online files of additional text, tables, figures, and cases; and frequently updated Web links to current articles and information can be found on the book's Web site. (wiley.com/college/turban).

KEY TERMS

Analytical processing •••	Geographical information system (GIS) •••	Object-oriented database •••
Business intelligence (BI) •••	Knowledge discovery •••	Online analytical processing (OLAP) •••
Clickstream data •••	Knowledge discovery in databases (KDD) •••	Operational data store •••
Data integrity •••	Marketing database •••	Text mining •••
Data mart •••	Marketing transaction database (MTD) •••	Virtual reality (VR) •••
Data mining •••	Metadata •••	Virtual reality markup language (VRML) •••
Data quality (DQ) •••	Multidimensional database •••	Visual interactive modeling (VIM) •••
Data visualization •••	Multidimensionality •••	Visual interactive simulation (VIS) •••
Data warehouse •••	Multimedia database •••	
Document management •••		
Document management system (DMS) •••		

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 Data are the foundation of any information system and need to be managed throughout their useful life cycle, which convert data to useful information, knowledge and a basis for decision support.
- 2 Data exist in internal and external sources. Personal data and knowledge are often stored in people's minds.
- 2 The Internet is a major source of data and knowledge. Other sources are databases, paper documents, videos, maps, pictures and more.
- 2 Many factors that impact the quality of data must be recognized and controlled.
- 3 Today data and documents are managed electronically. They are digitized, stored and used in electronic management systems.
- 3 Electronic document management, the automated control of documents, is a key to greater efficiency in handling documents in order to gain an edge on the competition.
- 3 Multidimensional presentation enables quick and easy multiple viewing of information in accordance with people's needs.
- 4 Data warehouses and data marts are necessary to support effective information discovery and decision making. Relevant data are indexed and organized for easy access by end users.
- 5 Online analytical processing is a data discovery method that uses analytical approaches.
- 5 Business intelligence is an umbrella name for large number of methods and tools used to conduct data analysis.
- 6 Data mining for knowledge discovery is an attempt to use intelligent systems to scan volumes of data to locate necessary information and knowledge.
- 7 Visualization is important for better understanding of data relationships and compression of information. Several computer-based methods exist.
- 7 A geographical information system captures, stores, manipulates, and displays data using digitized maps.
- 7 Virtual reality is 3-D, interactive, computer-generated graphics that provides users with a feeling that they are inside a certain environment.
- 8 Marketing databases provide the technological support for new marketing approaches such as interactive marketing.
- 8 Marketing transaction databases provide dynamic interactive functions that facilitate customized advertisement and services to customers.
- 9 Web-based systems are used extensively in supporting data access and data analysis. Also, Web-based systems are an important source of data. Finally, data visualization is frequently combined with Web systems.

QUESTIONS FOR REVIEW

1. List the major sources of data.
2. List some of the major data problems.
3. What is a terabyte? (Write the number.)
4. Review the steps of the data life cycle and explain them.
5. List some of the categories of data available on the Internet.
6. Define data quality.
7. Define document management.
8. Describe a data warehouse.
9. Describe a data mart.
10. Define business intelligence.
11. Define online analytical processing (OLAP).
12. Define data mining and describe its major characteristics.
13. Define data visualization.
14. Explain the properties of multidimensionality and its visualization.
15. Describe GIS and its major capabilities.
16. Define visual interactive modeling and simulation.
17. Define a marketing transaction database.
18. Define virtual reality.

QUESTIONS FOR DISCUSSION

1. Compare data quality to data integrity. How are they related?
2. Discuss the relationship between OLAP and multidimensionality.
3. Discuss business intelligence and distinguish between decision support and information and Knowledge discovery.
4. Discuss the factors that make document management so valuable. What capabilities are particularly valuable?
5. Relate document management to imaging systems.
6. Describe the process of information and knowledge discovery, and discuss the roles of the data warehouse, data mining, and OLAP in this process.
7. Discuss the major drivers and benefits of data warehousing to end users.
8. Discuss how a data warehouse can lessen the stovepipe problem. (See Chapter 9.)
9. A data mart can substitute for a data warehouse or supplement it. Compare and discuss these options.
10. Why is the combination of GIS and GPS becoming so popular? Examine some applications.
11. Discuss the advantages of terabyte marketing databases to a large corporation. Does a small company need a marketing database? Under what circumstances will it make sense to have one?
12. Discuss the benefits managers can derive from visual interactive simulation in a manufacturing company.
13. Why is the mass-marketing approach may not be effective? What is the logic of targeted marketing?
14. Distinguish between operational databases, data warehouses, and marketing data marts.
15. Relate the Sears minicase to the phases of the data life cycle.
16. Discuss the potential contribution of virtual reality to e-commerce.
17. Discuss the interaction between marketing and management theories and IT support at Harrah's case.

EXERCISES

1. Review the list of data management difficulties in Section 11.1. Explain how a combination of data warehousing and data mining can solve or reduce these difficulties. Be specific.
2. Interview a knowledge worker in a company you work for or to which you have access. Find the data problems they have encountered and the measures they have taken to solve them. Relate the problems to Strong's four categories.
3. Ocean Spray Cranberries is a large cooperative of fruit growers and processors. Ocean Spray needed data to determine the effectiveness of its promotions and its advertisements and to make itself able to respond strategically to its competitors' promotions. The company also wanted to identify trends in consumer preferences for new products and to pinpoint marketing factors that might be causing changes in the selling levels of certain brands and markets. Ocean Spray buys marketing data from InfoScan (*infores.com*), a company that collects data using bar code scanners in a sample of 2,500 stores nationwide and from A. C. Nielsen. The data for each product include sales volume, market share, distribution, price information, and information about promotions (sales, advertisements).

The amount of data provided to Ocean Spray on a daily basis is overwhelming (about 100 to 1,000 times more data items than Ocean Spray used to collect on its own). All the data are deposited in the corporate marketing data mart. To analyze this vast amount of data, the company developed a DSS. To give end users easy access to the data, the company uses an expert system-based data-mining process called CoverStory, which summarizes information in accordance with user preferences. CoverStory interprets data processed by the DSS, identifies trends, discovers cause and effect relationships, presents hundreds of displays, and provides any information required by the decision

makers. This system alerts managers to key problems and opportunities.

- a. Find information about Ocean Spray by entering Ocean Spray's Web site (oceanspray.com).
- b. Ocean Spray has said that it cannot run the business without the system. Why?
- c. What data from the data mart are used by the DSS?
- d. Enter infores.com or scanmar.nl and review the marketing decision support information. How is the company related to a data warehouse?
- e. How does Infoscan collect data? (Check the Data Wrench product.)

GROUP ASSIGNMENTS

1. Several applications now combine GIS and GPS.
 - a. Survey such applications by conducting literature and Internet searches and query GIS vendors.
 - b. Prepare a list of five applications, including at least two in e-commerce (see Chapter 6).
 - c. Describe the benefit of such integration.
2. Prepare a report on the topic of "data management and the intranet." Specifically, pay attention to the role of the data warehouse, the use of browsers for query, and data mining. Also explore the issue of GIS and the Internet. Finally, describe the role of extranets in support of business partner collaboration. Each student will visit one or two vendors' sites, read the white papers, and examine products (Oracle, Red Bricks, Brio, Siemens Mixdorf IS, NCR, SAS, and Information Advantage). Also, visit the Web site of the Data Warehouse Institute (dw-institute.org).
3. Companies invest billions of dollars to support database marketing. The information systems departments'

(ISD) activities that have supported accounting and finance in the past are shifting to marketing. According to Tucker (1997), some people think that the ISD should report to marketing. Do you agree or disagree? Debate this issue.

4. In 1996, Lexis-Nexis, the online information service, was accused of permitting access to sensitive information on individuals. Using data mining, it is possible not only to capture information that has been buried in distant courthouses, but also to manipulate and cross-index it. This can benefit law enforcement but invade privacy. The company argued that the firm was targeted unfairly, since it provided only basic residential data for lawyers and law enforcement personnel. Should Lexis-Nexis be prohibited from allowing access to such information or not? Debate the issue.

INTERNET EXERCISES



1. Conduct a survey on document management tools and applications by visiting dataware.com, documentum.com, and aiim.org/aim/publications.
2. Access the Web sites of one or two of the major data management vendors, such as Oracle, Informix, and Sybase, and trace the capabilities of their latest products, including Web connections.
3. Access the Web sites of one or two of the major data warehouse vendors, such as NCR or SAS; find how their products are related to the Web.
4. Access the Web site of the GartnerGroup (gartnergroup.com). Examine some of their research notes pertaining to marketing databases, data warehousing, and data management. Prepare a report regarding the state of the art.
5. Explore a Web site for multimedia database applications. Visit such sites as leisureplan.com, illustra.com, or adb.fr. Review some of the demonstrations, and prepare a concluding report.
6. Enter microsoft.com/solutions/BI/customer/biwithinreach_demo.asp and see how BI is supported by Microsoft's tools. Write a report.



7. Enter *teradatauniversitynetwork.com*. Prepare a summary on resources available there. Is it valuable to a student?
8. Enter *visualmining.com* and review the support they provide to business intelligence. Prepare a report.
9. Survey some GIS resources such as *geo.ed.ac.uk/home/hiswww.html* and *prenhall.com/stratgis/sites.html*. Identify GIS resources related to your industry, and prepare a report on some recent developments or applications. See http://nsdi.usgs.gov/nsdi/pages/what_is_gis.html.
10. Visit the sites of some GIS vendors (such as *mapinfo.com*, *esri.com*, *autodesk.com* or *bentley.com*). Join a newsgroup and discuss new applications in marketing, banking, and transportation. Download a demo. What are some of the most important capabilities and new applications?
11. Enter *websurvey.com*, *clearlearning.com*, and *tucows.com/webforms*, and prepare a report about data collection via the Web.
12. Enter *infoscan.com*. Find all the services related to dynamic warehouse and explain what it does.
13. Enter *ibm.com/software* and find their data mining products, such as DB2 Intelligent Miner. Prepare a list of products and their capabilities.
14. Enter *megapuker.com*. Read "Data Mining 101," "Text Analyst," and "WebAnalyst." Compare the two products. (Look at case studies.)



Minicase 1

Precision Buying, Merchandising, and Marketing at Sears

The Problem. Sears, Roebuck and Company, the largest department store chain and the third-largest retailer in the United States, was caught by surprise in the 1980s as shoppers defected to specialty stores and discount mass merchandisers, causing the firm to lose market share rapidly. In an attempt to change the situation, Sears used several response strategies, ranging from introducing its own specialty stores (such as Sears Hardware) to restructure its mall-based stores. Recently, Sears has moved to selling on the Web. It discontinued its paper catalog. Accomplishing the transformation and restructuring, required the retooling of its information systems.

Sears had 18 data centers, one in each of 10 geographical regions as well as one each for marketing, finance, and other departments. The first problem was created when the reorganization effort produced only seven geographical regions. Frequent mismatches between accounting and sales figures and information scattered among numerous databases forced users to query multiple systems, even when they needed an answer to a simple query. Furthermore, users found that data that were already summarized made it difficult to conduct analysis at the desired level of detail. Finally, errors were virtually inevitable when calculations were based on data from several sources.

The Solution. To solve these problems Sears constructed a single sales information data warehouse. This replaced the 18 old databases which were packed with

redundant, conflicting, and sometimes obsolete data. The new data warehouse is a simple repository of relevant decision-making data such as authoritative data for key performance indicators, sales inventories, and profit margins. Sears, known for embracing IT on a dramatic scale, completed the data warehouse and its IT reengineering efforts in under one year—a perfect IT turnaround story.

Using an NCR enterprise server, the initial 1.7 terabyte (1.7 trillion bytes) data warehouse is part of a project dubbed the Strategic Performance Reporting System (SPRS). By 2003, the data warehouse had grown to over 70 terabytes. SPRS includes comprehensive sales data; information on inventory in stores, in transit, and at distribution centers; and cost per item. This has enabled Sears to track sales by individual items (skus) in each of its 1,950 stores (including 810 mall-based stores) in the United States and 1,600 international stores and catalog outlets. Thus, daily margin by item per store can be easily computed, for example. Furthermore, Sears now fine tunes its buying, merchandising, and marketing strategies with previously unattainable precision.

SPRS is open to all authorized employees, who now can view each day's sales from a multidimensional perspective (by region, district, store, product line, and individual item). Users can specify any starting and ending dates for special sales reports, and all data can be accessed via a highly user-friendly graphical interface. Sears managers

can now monitor the precise impact of advertising, weather, and other factors on sales of specific items. This means that buyers and other specialists can examine and adjust if needed, inventory quantities, merchandising, and order placement, along with myriad other variables, almost immediately, so they can respond quickly to environmental changes. SPRS users can also group together widely divergent kinds of products, for example, tracking sales of items marked as “gifts under \$25.” Advertising staffers can follow so-called “great items,” drawn from vastly different departments, that are splashed on the covers of promotional circulars. SPRS enables extensive data mining, but only on sku and location related analysis.

In 1998 Sears created a large customer database, dubbed LCI (Leveraging Customer Information) which contained customer-related sale information (which was not available on SPRS). The LCI enable hourly records of transactions, for example, guiding hourly promotion (such as 15% discounts for early birds).

In the holiday season of 2001 Sears decided to replace its regular 10% discount promotion by offering deep discount during early shopping hours. This new promotion, which was based on SPRS failed, and only when LCI was used the problem was corrected. This motivated Sears to combine LCI and SPRS in a single platform, which enables sophisticated analysis (in 2002).

By 2001 Sears also had the following Web initiatives: e-commerce home improvement center, a B2B supply exchange for the retail industry, a toy catalog (wishbook.com), an e-procurement system, and much more. All of these Web-marketing initiatives feed data into the data

warehouse, and their planning and control are based on accessing the data in the data warehouse.

The Results. The ability to monitor sales by item per store enables Sears to create a sharp local market focus. For example, Sears keeps different shades of paint colors in different cities to meet local demands. Therefore, sales and market share have improved. Also, Web-based data monitoring of sales at LCI helps Sears to plan marketing and Web advertising.

At its inception, the data warehouse had been used daily by over 3,000 buyers, replenishers, marketers, strategic planners, logistics and finance analysts, and store managers. By 2003, there were over 5000 users, since users found the system very beneficial. Response time to queries has dropped from days to minutes for typical requests. Overall, the strategic impact of the SPRS-LC data warehouse is that it offers Sears employees a tool for making better decisions, and Sears retailing profits have climbed more than 20 percent annually since SPRS was implemented.

Sources: Compiled from Amato-McCoy (2002), Beitler and Leary (1997); and press releases of Sears (2001–2003).

Questions for Minicase 1

1. What were the drivers of SPRS?
 2. How did the data warehouse solve Sears' problems?
 3. Why was it beneficial to integrate the customers' database with SPRS?
-



Minicase 2

GIS at Dallas Area Rapid Transit

Public transportation in Dallas and its neighboring communities is provided by Dallas Area Rapid Transit (DART), which operates buses, vans, and a train system. The service area has grown very fast. By the mid-1980s, the agency was no longer able to respond properly to customer requests, make rapid changes in scheduling, plan properly, or manage security.

The solution to these problems was discovered using GISs. A GIS digitizes maps and maplike information, integrates it with other database information, and uses the combined information for planning, problem solving, and decision making. DART (*dart.org*) maintains a centralized graphical database of every object for which it is responsible.

The GIS presentation makes it possible for DART's managers, consultants, and customers to view and analyze data on digitized maps. Previously, DART created service maps on paper showing bus routes and schedules. The maps were updated and redistributed several times a year, at a high cost. Working with paper maps made it difficult to respond quickly and accurately to the nearly 6,000 customer inquiries each day. For example, to answer a question concerning one of the more than 200 bus routes or a specific schedule, it was often necessary to look at several maps and routes. Planning a change was also a time-consuming task. Analysis of the viability of bus route alternatives made it necessary to photocopy maps from map books, overlay tape to show proposed routes, and spend considerable time gathering information on the demographics of the corridors surrounding the proposed routes.

The GIS includes attractive and accurate maps that interface with a database containing information about bus schedules, routes, bus stops (in excess of 15,000), traffic surveys, demographics, and addresses on each street in the database. The system allows DART employees to:

- Respond rapidly to customer inquiries (reducing response time by at least 33 percent).
- Perform the environmental impact studies required by the city.
- Track where the buses are at any time using a global positioning system.
- Improve security on buses.
- Monitor subcontractors quickly and accurately.
- Analyze the productivity and use of existing routes.

For instance, a customer wants to know the closest bus stop and the schedule of a certain bus to take her to a certain destination. The GIS automatically generates the answer when the caller says where she is by giving an address, a name of an intersection, or a landmark. The computer can calculate the travel time to the desired destination as well.

Analyses that previously took days to complete are now executed in less than an hour. Special maps, which previously took up to a week to produce at a cost of \$13,000 to \$15,000 each, are produced in 5 minutes at the cost of 3 feet of plotter paper.

In the late 1990s, the GIS was combined with a GPS. The GPS tracks the location of the buses and computes the expected arrival time at each bus stop. Many maps are on display at the Web site, including transportation lines and stops superimposed on maps.

Sources: Condensed from GIS World, July 1993; updated with information compiled from *dart.org* (2003).

Questions for Minicase 2

1. Describe the role of data in the DART system.
2. What are the advantages of computerized maps?
3. Comment on the following statement: "Using GIS, users can improve not only the inputting of data but also their use."
4. Speculate on the type of information provided by the GPS.



Virtual Company Assignment

Data Management

You were intrigued by the opening story of Harrah's use of CRM data to improve the customer experience, and it seems to you that there are many parallels between satisfying Harrah's customers and The Wireless Café's customers (aside from the slot machines, of course). You have noticed that Jeremy likes to review The Wireless Café's financial and customer data using Excel charts and graphs, so you think he might be interested in discussing ways to exploit existing The Wireless Café data for improving the customer experience in the diner.

1. As you've grown quite fond of Marie-Christine's cooking, you would like to help her develop even more popular menu hits. The idea of using business intelligence and data mining to better predict customer ordering trends and behaviors strikes you as something that would help. For example, do customers buy more desserts on Friday and Saturday than during the week? Do some research on business intelligence software and

prepare a brief report for Jeremy and Marie-Christine to describe the kinds of business intelligence that could be used to prepare smash-hit menus.

2. The Wireless Café does not have a significant marketing budget; however, some inexpensive Web-based marketing strategies can be effective. Earlier, Barbara expressed interest in creating a CRM system to better know and serve The Wireless Café's customers. Describe a strategy whereby you could combine CRM data and Web-based marketing to increase the business at The Wireless Café.
3. Business intelligence, data warehousing, data mining, and visualization are activities that could benefit The Wireless Café's bottom line. Many CIOs these days expect an IT project to pay for itself within 12 months or less. How would you measure the benefits of introducing new data management software to determine which competing projects to implement and whether you could expect a 12-month payback on the software?

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PART IV
**Managerial and Decision
Support Systems**



- 10. Knowledge Management
- 11. Data Management: Warehousing, Analyzing, Mining, and Visualization
- ▶ 12. Management Decision Support and Intelligent Systems

CHAPTER
12

Management Decision Support and Intelligent Systems

Singapore and Malaysia Airlines	
12.1	
Managers and Decision Making	
12.2	
Decision Support Systems	
12.3	
Group Decision Support Systems	
12.4	
Enterprise and Executive Decision Support Systems	
12.5	
Intelligent Support Systems: The Basics	
12.6	
Expert Systems	
12.7	
Other Intelligent Systems	
12.8	
Web-Based Decision Support	
12.9	
Advanced and Special Decision Support Topics	
Minicases: (1) Nederlandse Spoorweges / (2) O'Hare Airport	
Online Appendix W12.1 Intelligent Software Agents	

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Describe the concepts of managerial, decision making, and computerized support for decision making.
- 2 Justify the role of modeling and models in decision making.
- 3 Describe decision support systems (DSSs) and their benefits, and describe the DSS structure.
- 4 Describe the support to group (including virtual) decision making.
- 5 Describe organizational DSS and executive support systems, and analyze their role in management support.
- 6 Describe artificial intelligence (AI) and list its benefits and characteristics.
- 7 List the major commercial AI technologies.
- 8 Define an expert system and its components and describe its benefits and limitations.
- 9 Describe natural language processing and compare it to speech understanding.
- 10 Describe Artificial Neural Networks (ANNs), their characteristics and major applications. Compare it to fuzzy logic and describe its role in hybrid intelligent systems.
- 11 Describe the relationships between the Web, DSS, and intelligent system.
- 12 Describe special decision support applications including the support of frontline employees.



SINGAPORE AND MALAYSIA AIRLINES EXPERT SYSTEMS

➡ THE PROBLEM

Airlines fly around the globe, mostly with their native crew. Singapore Airlines and Malaysia Airlines are relatively small airlines, but they serve dozens of different countries. If a crewmember is ill on route, there is a problem of finding, quickly, a replacement. This is just one example why crew scheduling may be complex, especially when it is subject to regulatory constraints, contract agreements and crew preferences. Disturbance such as weather conditions, maintenance problems etc. also make crew management difficult.

➡ THE SOLUTION

Singapore airlines, uses Web-based intelligent systems such as expert systems and neural computing to manage the company's flight crew scheduling and handle disruptions to the crew rosters. The Integrated Crew Management System (ICMS) project, implemented in Singapore 1997, consists of three modules: one roster assignment module for cockpit crew, one for the cabin crew, and a crew tracking module. The first two modules automate the tracking and scheduling of the flight crew's timetable. The second module tracks the positions of the crew and includes an *intelligent system* that handles crew pattern disruptions.

For example, crews are rearranged if one member falls ill while in a foreign port, the system will find a backup in order to prevent understaffing on the scheduled flight. The intelligent system then determines the best way to reschedule the different crew members' rosters to accommodate the sick person. When a potentially disruptive situation occurs, the intelligent system automatically draws upon the knowledge stored in the database and advises the best course of action. This might mean repositioning the crew or calling in backup staff. The crew tracking system includes a crew disruption handling module which provides decision-support capabilities in real time.

A similar Web-based system is used by Malaysia Airlines, as of summer 2003, to optimize manpower utilization. Also called ICMS, it leverages optimization software from *ilog.com*. Its Crew Pairing Optimization (CPO) module utilizes Ilog Cplex and Ilog Solver optimization components to ensure compliance with airline regulations, trade union agreements and company policies, minimize the costs associated with crew accommodations and transportation and efficiently plan and optimize manpower utilization and activities associated with long-term planning and daily operations. The Crew Duty Assignment (CDA) module provides automatic assignment of duties to all flight crews. The system considers work rules, regulatory requirements as well as crew requests to produce an optimal monthly crew roster.

➡ THE RESULTS

Despite the difficult economic times both airlines are competing successfully in the region and their balanced sheets are better than most other airlines.

Sources: Compiled from news item at *Computerworld Singapore* (April 10, 2003), and from *ilog.com* (accessed June 9, 2003).

 **LESSONS LEARNED FROM THIS CASE**

The opening case illustrates that a solution to complex scheduling and other problems can be enhanced with the use of an intelligent decision support system (DSS). As a matter of fact, the DSS software supported several important decisions. We also learned that decisions are supported both in operational and HRM areas. Furthermore, much of the case illustrates the concepts of optimization and quantitative analysis. Finally, the Web is playing an increasing role in facilitating the use of such systems.

This chapter is dedicated to describing computer and Web support to *managerial decision makers*. We begin by reviewing the manager's job and the nature of today's decisions, which help explain why computerized support is needed. Then we present the concepts and methodology of the computerized decision support system for supporting individuals, groups, and whole organizations. Next, we introduced several types of intelligent systems and their role in decision support. Finally, the topic of decision support in the Web environment is described. A discussion of intelligent agents and their role in decision support appears in an online appendix to the chapter.

12.1 MANAGERS AND DECISION MAKING

Decisions are being made by all of us, every day. However, most major organizational decisions are made by managers. We begin with a brief description of the manager's job, of which making decisions is a major activity.

The Manager's Job

Management is a process by which organizational goals are achieved through the use of resources (people, money, energy, materials, space, time). These resources are considered to be *inputs*, and the attainment of the goals is viewed as the *output* of the process. Managers oversee this process in an attempt to optimize it.

To understand how computers support managers, it is necessary first to describe what managers do. They do many things, depending on their position in the organization, the type and size of the organization, organizational policies and culture, and the personalities of the managers themselves. Mintzberg (1973) divided the manager's roles into three categories: *interpersonal* (figurehead, leader, liaison), *informational* (monitor, disseminator, spokesperson), and *decisional roles* (entrepreneur, problem solver, resource allocator, and negotiator). Mintzberg and Westley, 2001 also analyzed the role of decision makers in the information age.

Early information systems mainly supported informational roles. In recent years, however, information systems have grown to support all three roles. In this chapter, we are mainly interested in the support that IT can provide to *decisional* roles. We divide the manager's work, as it relates to decisional roles, into two phases. Phase I is the identification of problems and/or opportunities. Phase II is the decision of what to do about them. *Online File W12.1* provides a flowchart of this process and the flow of information in it.



DECISION MAKING AND PROBLEM SOLVING. A *decision* refers to a choice made between two or more alternatives. Decisions are of diverse nature and are made continuously by both individuals and groups. The purposes of making decision in organizations can be classified into two broad categories: *problem solving* and *opportunity exploiting*. In either case managers must make decisions.



The ability to make crisp decisions was rated first in importance in a study conducted by the Harbridge House in Boston, Massachusetts. About 6,500 managers in more than 100 companies, including many large, blue-chip corporations, were asked how important it was that managers employ certain management practices. They also were asked how well, in their estimation, managers performed these practices. From a statistical distillation of these answers, Harbridge ranked “making clear-cut decisions when needed” as the *most important* of ten management practices. Ranked second in importance was “getting to the heart of the problems rather than dealing with less important issues.” Most of the remaining eight management practices were related directly or indirectly to decision making. The researchers also found that only 10 percent of the managers thought management performed “very well” on any given practice, mainly due to the difficult decision-making environment. It seems that the trial-and-error method, which might have been a practical approach to decision making in the past, is too expensive or ineffective today in many instances.

Therefore, managers must learn how to use the new tools and techniques that can help them make better decisions. Many of such techniques use a quantitative analysis (see the opening case) approach, and they are supported by computers. Several of the computerized decision aids are described in this chapter.

Computerized Decision Aids



The discussion on computerized decision aids here deals with four basic questions: (1) Why do managers need the support of information technology in making decisions? (2) Can the manager’s job be fully automated? (3) What IT aids are available to support managers? And (4): How the information needs of managers is determined (see *Online File W12.2*).

WHY MANAGERS NEED THE SUPPORT OF INFORMATION TECHNOLOGY. It is very difficult to make good decisions without valid and relevant information. Information is needed for each phase and activity in the decision-making process.

Making decisions while processing information manually is growing increasingly difficult due to the following trends:

- The *number of alternatives* to be considered is ever *increasing*, due to innovations in technology, improved communication, the development of global markets, and the use of the Internet and e-Business. A key to good decision making is to explore and compare many relevant alternatives. The more alternatives exist, the more computer-assisted search and comparisons are needed.
- Many decisions must be made *under time pressure*. Frequently, it is not possible to manually process the needed information fast enough to be effective.
- Due to increased fluctuations and uncertainty in the decision environment, it is frequently necessary to *conduct a sophisticated analysis* to make a good decision. Such analysis usually requires the use of mathematical modeling. Processing models manually can take a very long time.
- It is often necessary to rapidly access remote information, consult with experts, or have a group decision-making session, all without large expenses. Decision makers can be in different locations and so is the information. Bringing them all together quickly and inexpensively may be a difficult task.

These trends cause difficulties in making decisions, but a computerized analysis can be of enormous help. For example, a DSS can examine numerous alternatives very quickly, provide a systematic risk analysis, can be integrated with



communication systems and databases, and can be used to support group work. And, all this can be done with relatively low cost. *How* all this is accomplished will be shown later. According to Bonabeau (2003), intuition plays an important role in decision making, but it can be dangerously unreliable. Therefore one should use analytical tools such as those presented in this chapter and in Chapter 11.

Complexity of Decisions. Decisions range from simple to very complex. Complex decisions are composed of a sequence of interrelated sub-decisions. As an example, see decision process pursued by a pharmaceutical company, Bayer Corp., regarding developing a new drug, as shown in *Online File W12.3*.

CAN THE MANAGER'S JOB BE FULLY AUTOMATED? The generic decision-making process involves specific tasks (such as forecasting consequences and evaluating alternatives). This process can be fairly lengthy, which is bothersome for a busy manager. Automation of certain tasks can save time, increase consistency, and enable better decisions to be made. Thus, the more tasks we can automate in the process, the better. A logical question that follows is this: Is it possible to completely automate the manager's job?

In general, it has been found that the job of middle managers is the most likely job to be automated. Mid-level managers make fairly routine decisions, and these can be fully automated. Managers at lower levels do not spend much time on decision making. Instead, they supervise, train, and motivate non-managers. Some of their routine decisions, such as scheduling, can be automated; other decisions that involve behavioral aspects cannot. But, even if we completely automate their decisional role, we cannot automate their jobs. Note: the Web also provides an opportunity to automate certain tasks done by *front-line* employees. (This topic is discussed in Section 12.9.) The job of top managers is the least routine and therefore the most difficult to automate. The job of top managers is the least routine and therefore the most difficult to automate.

WHAT INFORMATION TECHNOLOGIES ARE AVAILABLE TO SUPPORT MANAGERS?

In addition to discovery, communication and collaboration tools (Chapters 4 and 11) that provide indirect support to decision making, several other information technologies have been successfully used to support managers. The Web can facilitate them all. Collectively, they are referred to as **management support systems (MSSs)** (see Aronson et al., 2004). The first of these technologies are *decision support systems*, which have been in use since the mid-1970s. They provide support primarily to analytical, quantitative types of decisions. Second, *executive (enterprise) support systems* represent a technology developed initially in the mid-1980s, mainly to support the informational roles of executives. A third technology, *group decision support systems*, supports managers and staff working in groups. A fourth technology is *intelligent systems*. These four technologies and their variants can be used independently, or they can be combined, each providing a different capability. They are frequently related to data warehousing. A simplified presentation of such support is shown in Figure 12.1.

As Figure 12.1 shows, managers need to find, filter, and interpret information to determine potential problems or opportunities and then decide what to do about them. The figure shows the support of the various MSS tools (circled) as well as the role of a data warehouse, which was described in Chapter 11.

Several other technologies, either by themselves or when integrated with other management support technologies, can be used to support managers. One

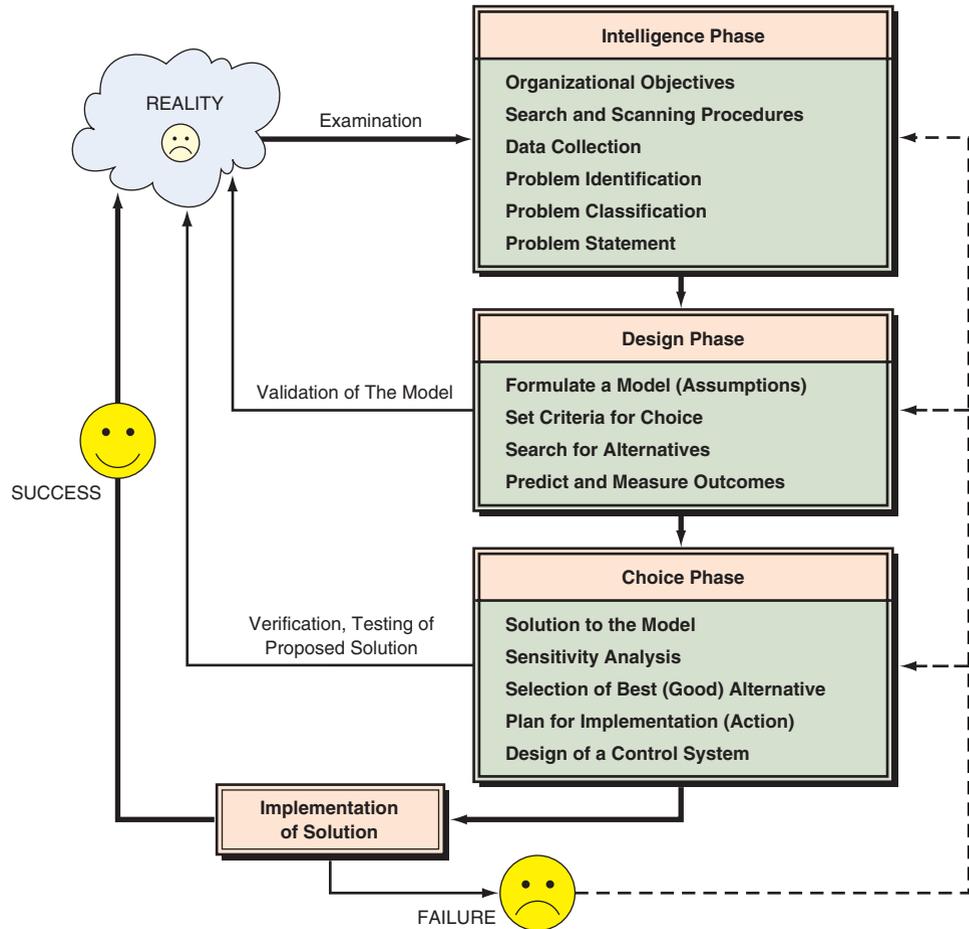


FIGURE 12.1 The process and phases in decision making/modeling.

example is the **personal information manager (PIM)**. A set of tools labelled PIM is intended to help managers be more organized. A PIM can play an extremely important role in supporting several managerial tasks. Lately, the use of mobile PDA tools, such as personal Palm computers, is greatly facilitating the work of managers. Several other analytical tools are being used. For example, McGuire (2001) describes the use of such tools in the retail industry and Bonabeau (2003) describes them in complex decision situations.

The Process of Making Computer-Based Decision Making

When making a decision, either organizational or personal, the decision maker goes through a fairly systematic process. Simon (1977) described the process as composed of three major phases: *intelligence*, *design*, and *choice*. A fourth phase, *implementation*, was added later. Simon claimed that the process is general enough so that it can be supported by *decision aids* and modeling. A conceptual presentation of the four-stage modeling process is shown in Figure 12.2, which illustrates what tasks are included in each phase. Note that there is a continuous flow of information from intelligence to design to choice (bold lines), but at any phase there may be a return to a previous phase (broken lines). For details see Stonebraker, 2002.

The decision-making process starts with the *intelligence phase*, in which managers examine a situation and identify and define the problem. In the *design*

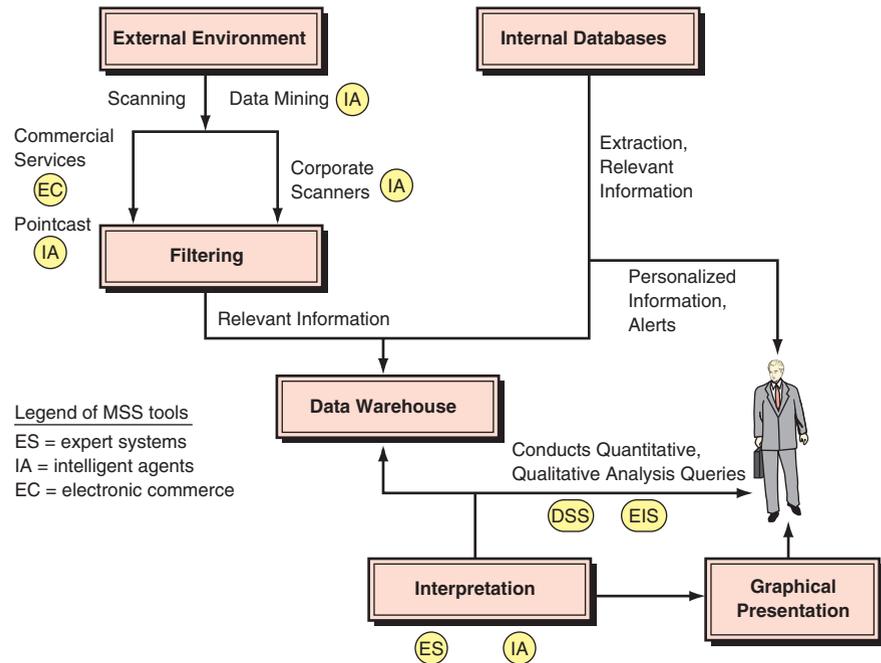


FIGURE 12.2
 Computerized support for
 decision making.

phase, decision makers construct a model that simplifies the problem. This is done by making assumptions that simplify reality and by expressing the relationships among all variables. The model is then validated, and decision makers set criteria for the evaluation of alternative potential solutions that are identified. The process is repeated for each sub decision in complex situations. The output of each sub decision is an input for the sub decision. The *choice phase* involves selecting a solution, which is tested “on paper.” Once this proposed solution seems to be feasible, we are ready for the last phase—*implementation*. Successful implementation results in resolving the original problem or opportunity. Failure leads to a return to the previous phases. A computer-based decision support attempts to automate several tasks in this process, in which *modeling* is the core.

MODELING AND MODELS. A **model** (in decision making) is a *simplified representation*, or abstraction of reality. It is usually simplified because reality is too complex to copy exactly, and because much of its complexity is actually irrelevant to a specific problem. With modeling, one can perform virtual experiments and an analysis on a model of reality, rather than on reality itself. The benefits of modeling in decision making are:

1. The cost of virtual experimentation is much lower than the cost of experimentation conducted with a real system.
2. Models allow for the simulated compression of time. Years of operation can be simulated in seconds of computer time.
3. Manipulating the model (by changing variables) is much easier than manipulating the real system. Experimentation is therefore easier to conduct, and it does not interfere with the daily operation of the organization.
4. The cost of making mistakes during a real trial-and-error experiment is much lower than when models are used in virtual experimentation.



5. Today's environment holds considerable uncertainty. Modeling allows a manager to better deal with the uncertainty by introducing many "what-ifs" and calculating the risks involved in specific actions.
6. Mathematical models allow the analysis and comparison of a very large, sometimes near-infinite number of possible alternative solutions. With today's advanced technology and communications, managers frequently have a large number of alternatives from which to choose.
7. Models enhance and reinforce learning and support training.

Representation by models can be done at various degrees of abstraction. Models are thus classified into four groups according to their degree of abstraction: iconic, analog, mathematical, and mental. Brief descriptions follow.

ICONIC (SCALE) MODELS. An *iconic model*-the least abstract model-is a physical replica of a system, usually based on a *smaller scale* from the original. Iconic models may appear to scale in three dimensions, such as models of an airplane, car, bridge, or production line. Photographs are another type of iconic model, but in only two dimensions.

ANALOG MODELS. An *analog model*, in contrast to an iconic model, does not look like the real system but behaves like it. An analog model could be a physical model, but the *shape* of the model differs from that of the actual system. Some examples include organizational charts that depict structure, authority, and responsibility relationships; maps where different colors represent water or mountains; stock charts; blueprints of a machine or a house; and a thermometer.

MATHEMATICAL (QUANTITATIVE) MODELS. The complexity of relationships in many systems cannot conveniently be represented iconically or analogically, or such representations and the required experimentations may be cumbersome. A more abstract model is possible with the aid of mathematics. Most DSS analysis is executed numerically using mathematical or other quantitative models.

Mathematical models are composed of three types of variables (decision, uncontrollable, and result) and the relationships among them. These are shown in *Online File W12.4*. With recent advances in computer graphics, there is an increased tendency to use iconic and analog models to complement mathematical modeling in decision support systems.



MENTAL MODELS. In addition to the three explicit models described above, people frequently use a behavioural mental model. A *mental model* provides a subjective description of how a person thinks about a situation. The model includes beliefs, assumptions, relationships, and flows of work as perceived by an individual. For example, a manager's mental model might say that it is better to promote older workers than younger ones and that such a policy would be preferred by most employees. Mental models are extremely useful in situations where it is necessary to determine which information is important.

Developing a mental model is usually the first step in modeling. Once people perceive a situation, they may then model it more precisely using another type of model. Mental models may frequently change, so it is difficult to document them. They are important not only for decision making, but also for human-computer interaction (see Saxby et al., 2000).

A Framework for Computerized Decisions Analysis

Gorry and Scott-Morton (1971) proposed a framework for decision support, based on the combined work of Simon (1977) and Anthony (1965). The first half of the framework is based on Simon's idea that decision-making processes fall along a continuum that ranges from highly structured (sometimes referred to as *programmed*) to highly unstructured (*nonprogrammed*) decisions. *Structured* processes refer to routine and repetitive problems for which standard solutions exist. *Unstructured* processes are "fuzzy," complex problems for which there are no cut-and-dried solutions.

In a *structured problem*, the intelligence, design, and choice are all structured, and the procedures for obtaining the best solution are known. Whether the solution means finding an appropriate inventory level or deciding on an optimal investment strategy, the solution's criteria are clearly defined. They are frequently cost minimization or profit maximization.

In an *unstructured problem*, none of the three phases is structured, and human intuition is frequently the basis for decision making. Typical unstructured problems include planning new services to be offered, hiring an executive, or choosing a set of research and development projects for next year.

Semistructured problems, in which only some of the phases are structured, require a combination of standard solution procedures and individual judgment. Examples of semistructured problems include trading bonds, setting marketing budgets for consumer products, and performing capital acquisition analysis. Here, a DSS is most suitable. It can improve the quality of the information on which the decision is based (and consequently the quality of the decision) by providing not only a single solution but also a range of what-if scenarios.

The second half of the decision support framework is based upon Anthony's taxonomy (1965). It defines three broad categories that encompass managerial activities: (1) *strategic planning*—the long-range goals and policies for resource allocation; (2) *management control*—the acquisition and efficient utilization of resources in the accomplishment of organizational goals; and (3) *operational control*—the efficient and effective execution of specific tasks. Anthony's and Simon's taxonomies can be combined in a nine-cell decision support framework (see *Online File W12.5*).



COMPUTER SUPPORT FOR STRUCTURED DECISIONS. Structured and some semistructured decisions, especially of the operational and managerial control type, have been supported by computers since the 1950s. Decisions of this type are made in all functional areas, especially in finance and operations management.

Problems that are encountered fairly often have a high level of structure. It is therefore possible to abstract, analyze, and classify them into standard classes. For example, a "make-or-buy" decision belongs to this category. Other examples are capital budgeting (e.g., replacement of equipment), allocation of resources, distribution of merchandise, and some inventory control decisions. For each standard class, a prescribed solution was developed through the use of mathematical formulas. This approach is called *management science* or *operations research* and is also executed with the aid of computers.

Management Science. The *management science* approach takes the view that managers can follow a fairly systematic process for solving problems. Therefore, it is possible to use a scientific approach to managerial decision making. This approach, which also centers on modeling, is presented in *Online File W12.6*. For a list of management science problems and tools see *Online File W12.7*. Management science frequently attempts to find the best possible solution, an approach known as **optimization**.



12.2 DECISION SUPPORT SYSTEMS

DSS Concepts Broadly defined, a **decision support system (DSS)** is a computer-based information system that combines models and data in an attempt to solve semi-structured and some unstructured problems with extensive user involvement. But the term decision support system (DSS), like the terms MIS and MSS, means different things to different people. DSSs can be viewed as an *approach* or a *philosophy* rather than a precise methodology. However, a DSS does have certain recognized characteristics, which we will present later. First, let us look at a classical case of a successfully implemented DSS, which occurred long ago, yet the scenario is typical, as shown in *IT At Work 12.1*.

The case demonstrates some of the major characteristics of a DSS. The risk analysis performed first was based on the decision maker's initial definition of the situation, using a management science approach. Then, the executive vice president, using his experience, judgment, and intuition, felt that the model should be modified. The initial model, although mathematically correct, was incomplete. With a regular simulation system, a modification of the computer program would have taken a long time, but the DSS provided a very quick analysis. Furthermore, the DSS was flexible and responsive enough to allow managerial intuition and judgment to be incorporated into the analysis.

Many companies are turning to DSSs to improve decision making. Reasons cited by managers for the increasing use of DSSs include the following: New and accurate information was needed; information was needed fast; and tracking the company's numerous business operations was increasingly difficult. Or, the company was operating in an unstable economy; it faced increasing foreign and domestic competition; or the company's existing computer system did not properly support the objectives of increasing efficiency, profitability, and entry



IT At Work 12.1 **USING A DSS TO DETERMINE RISK**



An oil and minerals corporation in Houston, Texas was evaluating in a proposed joint venture with a petrochemicals company to develop a chemical plant. Houston's executive vice president responsible for the decision wanted analysis of the risks involved in areas of supplies, demands, and prices. Bob Sampson, manager of planning and administration, at that time and his staff built a DSS in a few days by means of a specialized planning language. The results strongly suggested that the project should be accepted.

Then came the real test. Although the executive vice president accepted the validity and value of the results, he was worried about the potential downside risk of the project, the chance of a catastrophic outcome. Sampson explains that the executive vice president said something like this: "I realize the amount of work you have already done,

and I am 99 percent confident of it. But I would like to see this in a different light. I know we are short of time and we have to get back to our partners with our yes or no decision."

Sampson replied that the executive could have the risk analysis he needed in less than one hour. As Sampson explained, "Within 20 minutes, there in the executive boardroom, we were reviewing the results of his what-if questions. Those results led to the eventual dismissal of the project, which we otherwise would probably have accepted."

Source: Information provided to author by Comshare Corporation (now Geac Computer Corp.).

For Further Exploration: What were the benefits of the DSS? Why might it have reversed the initial decision?

into profitable markets. Other reasons include: the IS department was unable to address the diversity of the company's needs or management's ad-hoc inquiries, and business analysis functions were not inherent within the existing systems. For a brief history of DSS see Power (2002).

In many organizations that have adopted a DSS, the conventional information systems, which were built for the purpose of supporting transaction processing, were *not sufficient* to support several of the company's critical response activities, described in Chapter 1, especially those that require fast and/or complex decision making. A DSS, on the other hand, can do just that. (See Carlsson and Turban, 2002.)

Another reason for the development of DSS is the *end-user computing movement*. With the exception of large-scale DSSs, end users can build systems themselves, using DSS development tools such as Excel.

Characteristics and Capabilities of DSSs

Because there is no consensus on exactly what constitutes a DSS, there obviously is no agreement on the characteristics and capabilities of DSSs. However, most DSSs at least have some of the attributes shown in Table 12.1. DSSs also employ mathematical model and have a related, special capability, known as sensitivity analysis.

SENSITIVITY ANALYSIS: "WHAT-IF" AND GOAL SEEKING. **Sensitivity analysis** is the study of the impact that changes in one (or more) parts of a model have on other parts. Usually, we check the impact that changes in input variables have on result variables.

Sensitivity analysis is extremely valuable in DSSs because it makes the system flexible and adaptable to changing conditions and to the varying requirements of different decision-making situations. It allows users to enter their own data, including the most pessimistic data, worst scenario and to view how systems will behave under varying circumstances. It provides a better understanding of the model and the problem it purports to describe. It may increase the users' confidence in the model, especially when the model is not so sensitive to changes. A *sensitive model* means that small changes in conditions dictate a

TABLE 12.1 The Capabilities of a DSS

<p>A DSS provides support for decision makers at all management levels, whether individuals or groups, mainly in semistructured and unstructured situations, by bringing together human judgment and objective information.</p> <p>A DSS supports several interdependent and/or sequential decisions.</p> <p>A DSS supports all phases of the decision-making process—intelligence, design, choice, and implementation—as well as a variety of decision-making processes and styles.</p> <p>A DSS is adaptable by the user over time to deal with changing conditions.</p> <p>A DSS is easy to construct and use in many cases.</p> <p>A DSS promotes learning, which leads to new demands and refinement of the current application, which leads to additional learning, and so forth.</p> <p>A DSS usually utilizes quantitative models (standard and/or custom made).</p> <p>Advanced DSSs are equipped with a knowledge management component that allows the efficient and effective solution of very complex problems.</p> <p>A DSS can be disseminated for use via the Web.</p> <p>A DSS allows the easy execution of <i>sensitivity analyses</i>.</p>
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Structure and Components of DSS

different solution. In a *nonsensitive model*, changes in conditions do not significantly change the recommended solution. This means that the chances for a solution to succeed are very high. Two popular types of sensitivity analyses are *what-if* and *goal seeking* (see *Online File W12.8*).

Every DSS consists of at least data management, user interface, and model management components, and end users. A few advanced DSSs also contain a knowledge management component. What does each component (subsystem) consist of?

DATA MANAGEMENT SUBSYSTEM. A DSS data management subsystem is similar to any other data management system. It contains all the data that flow from several sources, and usually are *extracted* prior to their entry into a DSS database or a data warehouse. In some DSSs, there is no separate database, and data are entered into the DSS model as needed; i.e., as soon as they are collected by sensors, as in the ChevronTexaco case in Chapter 7.

MODEL MANAGEMENT SUBSYSTEM. A model management subsystem contains completed models, and the building blocks necessary to develop DSSs applications. This includes standard software with financial, statistical, management science, or other quantitative models. An example is Excel, with its many mathematical and statistical functions. A model management subsystem also contains all the custom models written for the specific DSS. These models provide the system's analytical capabilities. Also included is a **model-based management system (MBMS)** whose role is analogous to that of a DBMS. (See Technology Guide 3.) The major functions (capabilities) of an MBMS are shown in *Online File W12.9*.

The model base may contain standard models (such as financial or management science) and/or customized models as illustrated in *IT At Work 12.2*.

THE USER INTERFACE. The term *user interface* covers all aspects of the communications between a user and the DSS. Some DSS experts feel that user interface is the most important DSS component because much of the power, flexibility, and ease of use of the DSS are derived from this component. For example, the ease of use of the interface in the Guinness DSS enables, and encourages, managers and salespeople to use the system. Most interfaces today are Web-based and some are supplemented by voice.

The user interface subsystem may be managed by software called *user interface management system (UIMS)*, which is functionally analogous to the DBMS.

THE USERS. The person faced with the problem or decision that the DSS is designed to support is referred to as the *user*, the *manager*, or the *decision maker*.

The user is considered to be a part of the system. Researchers assert that some of the unique contributions of DSSs are derived from the extensive interaction between the computer and the decision maker. A DSS has two broad classes of users: managers, and staff specialists (such as financial analysts, production planners, and market researchers).

DSS Intermediaries. When managers utilize a DSS, they may use it via an intermediary person who performs the analysis and reports the results. However, with Web-based systems, the use of DSSs becomes easier. Managers can use the Web-based system by themselves, especially when supported by an intelligent knowledge component.





IT At Work 12.2

WEB-BASED DECISION SUPPORT SYSTEM HELPS A BREWERY TO COMPETE



Guinness Import Co., a U.S. subsidiary of U.K.'s Guinness Ltd. (*guinness.com*), needed a decision support system for (1) executives, (2) salespeople, and (3) analysts. The company did not want three separate systems. Using InfoAdvisor (from Platinum Technology Inc., now part of Computer Associates, *cai.com*), a client/server DSS was constructed. In the past, if manager Diane Goldman wanted to look at sales trends, it was necessary to ask an analyst to download data from the mainframe and then use a spreadsheet to compute the trend. This took up to a day and was error-prone. Now, when Diane Goldman needs such information she queries the DSS herself and gets an answer in a few minutes. Furthermore, she can quickly analyze the data in different ways. Over 100 salespeople keep track of sales and can do similar analyses, from anywhere, using a remote Internet access.

To expedite the implementation of the system, highly skilled users in each department taught others how to use the DSS. The DSS helped to increase productivity of the employees. This improved productivity enables the company to compete against large companies such as Anheuser-Busch, as well as against microbrewers. The system reduced the salespeople's paperwork load by about one day each month. For 100 salespeople, this means 1,200 extra days a year to sell. Corporate financial and marketing analysts are also using the system to make better decisions. As a result, sales increased by 20 percent every year since the system was installed.

Sources: Compiled from *Computerworld*, July 7, 1997; *platinum.com* (2000); and *dmreview.com* (2001).

For Further Exploration: What can a DSS do that other computer programs cannot do for this company?

KNOWLEDGE-BASED SUBSYSTEMS. Many unstructured and semistructured problems are so complex that they require expertise for their solutions. Such expertise can be provided by a knowledge-based system, such as an expert system. Therefore, the more advanced DSSs are equipped with a component called a *knowledge-based* (or *an intelligent*) *subsystem*. Such a component can provide the required expertise for solving some aspects of the problem, or provide knowledge that can enhance the operation of the other DSS components.

The knowledge component consists of one or more expert (or other intelligent) systems, or it draws expertise from the *organizational knowledge base* (see Chapter 10).

A DSS that includes such a component is referred to as an *intelligent DSS*, a *DSS/ES*, or a *knowledge-based DSS (KBDSS)*. An example of a KBDSS is in the area of estimation and pricing in construction. It is a complex process that requires the use of models as well as judgmental factors. The KBDSS includes a knowledge management subsystem with 200 rules incorporated with the computational models. (For details, see Kingsman and deSouza, 1997.)

HOW DSS WORKS. The DSS components (see Figure 12.3) are all software. They are housed in a computer and can be facilitated by additional software (such as multimedia). Tools like Excel include some of the components and therefore can be used for DSS construction by end users.

The figure also illustrates how the DSS works. As you recall from Chapter 11, the DSS users get their data from the data warehouse, databases, and other data sources. When user has a problem, it is evaluated by the processes described in Figures 12.1 and 12.2. A DSS system is then constructed. Data are entered from sources on the left side, and models on the right side, as shown in Figure 12.3. Knowledge can be also tapped from the corporate knowledge base. As more

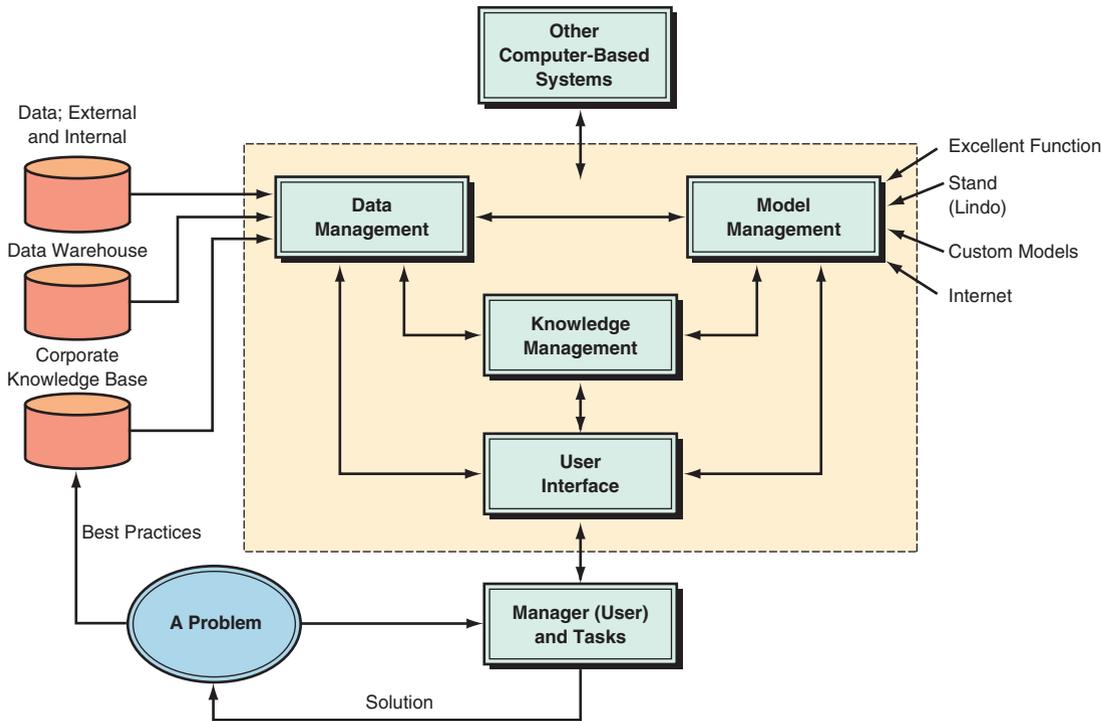


FIGURE 12.3 The DSS and Its Computing Environment. Conceptual model of a DSS shows four main software components and their relationships with other systems.



problems are solved, more knowledge is accumulated in the organizational knowledge base. For an application of DSS see Online Minicase W12.1.

The DSS methodology just described was designed initially to support individual decision makers. However, most organizational decisions are made by groups, such as an executive committee. Next we see how IT can support such situations.

12.3 GROUP DECISION SUPPORT SYSTEMS

Decision making is frequently a shared process. For example, Meetings among groups of managers from different areas are an essential element for reaching consensus. The group may be involved in making a decision or in a decision-related task, like creating a short list of acceptable alternatives, or deciding on criteria for accepting an alternative. When a decision-making group is supported electronically, the support is referred to as a *group decision support system (GDSS)*. Two types of groups are considered: a one-room group whose members are in one place (e.g., a meeting room); and a **virtual group**, whose members are in different locations).

A **group decision support system (GDSS)** is an interactive computer-based system that facilitates the solution of semistructured and unstructured problems when made by a group of decision makers. The objective of a GDSS is to support the *process* of arriving at a decision. Important characteristics of a GDSS, according to DeSanctis and Gallupe (1987), are shown in *Online File W12.10*. These characteristics can negate some of the dysfunctions of group processes described in Chapter 4, Table 4.2.





IT At Work 12.3

VIRTUAL MEETINGS AT THE WORLD ECONOMIC FORUM



The World Economic Forum (WEF, at weforum.org) is a consortium of top business, government, academic, and media leaders from virtually every country in the world. WEF's mission is to foster international understanding. Until 1998, the members conferred privately or debated global issues only at the forum's annual meeting in Davos, Switzerland, and at regional summits. Follow-up was difficult because of the members' geographic dispersion and conflicting schedules.

A WEF online strategy and operations task force developed a collaborative computing system to allow secure communication among members, making the non-profit group more effective in its mission. Now WEF is making faster progress toward solutions for the global problems it studies. Called the World Electronic Community (WELCOM), the GDSS and its complementary videoconferencing system, give members a secure channel through which to send e-mail, read reports available in a WEF library, and communicate in point-to-point or multipoint videoconferences. Forum members now hold real-time discussions and briefings on pressing issues and milestones, such as, for example, when the 2003 Iraqi War ended.

The WELCOM system was designed with a graphical user interface (GUI) to make it easily accessible to inexpe-

rienced computer users, because many WEF members might not be computer-literate or proficient typists. The forum also set up "concierge services," based in Boston, Singapore, and Geneva, for technical support and to arrange videoconferences and virtual meetings. To handle any time/any place meetings, members can access recorded forum events and discussions that they may have missed, as well as an extensive library, which is one of the most heavily used features of the system. The site also operates a knowledge base ("knowledge navigator") and media center.

As of 2001 the system has been completely on the Web. With *Webcasting*, all sessions of the annual meetings can be viewed in real time. The virtual meetings are done in a secured environment, and private chat rooms are also available.

Sources: Compiled from weforum.org (accessed June 29, 2003) and *PC Week*, August 17, 1998.

For Further Exploration: Check the Netmeeting and Netshow products of Microsoft, and see how their capabilities facilitate the WEF virtual meetings. How does an environment such as *eroom* at documentum.com support the process of group decision making, if at all?



Some Applications of GDSSs

The first generation of GDSSs was designed to support face-to-face meetings in what is called a **decision room**. Such a GDSS is described in *Online File W12.11*).

An increasing number of companies are using GDSSs especially when virtual groups are involved. One example is the Internal Revenue Service, which used a one-room GDSS to implement its quality-improvement programs based on the participation of a number of its quality teams. The GDSS was helpful in identifying problems, generating and evaluating ideas, and developing and implementing solutions. Another example is the European automobile industry, which used one-room GDSS to examine the competitive automotive business environment and make ten-year forecasts, needed for strategic planning. Atkins et al., (2003) report on successful application at the U.S. Air Force. A virtual GDSS application is described in *IT At Work 12.3*.

12.4 ENTERPRISE AND EXECUTIVE DECISION SUPPORT SYSTEMS

Two types of enterprise decision support system are described here: systems that support whole organizational tasks and systems that support decisions made by top-level managers and executives.



Organizational Decision Support System

The term **organizational decision support system (ODSS)** was first defined by Hackathorn and Keen (1981), who discussed three levels of decision support: individual, group, and organization. They maintained that computer-based systems can be developed to provide decision support for *each* of these levels. They defined an ODSS as one that focuses on an organizational task or activity involving a *sequence* of operations and decision makers, such as developing a divisional marketing plan or doing capital budgeting. Each individual's activities must mesh closely with other people's work. The computer support was primarily seen as a vehicle for improving communication and coordination, in addition to problem solving.



Some decision support systems provide support throughout large and complex organizations (see Carter et al., 1992). A major benefit of such systems is that many DSS users become familiar with computers, analytical techniques, and decision supports, as illustrated in *Online File W12.12*.

The major characteristics of an ODSS are: (1) it affects several organizational units or corporate problems, (2) it cuts across organizational functions or hierarchical layers, and (3) it involves computer-based technologies and usually involve communication technologies. Also, an ODSS often interacts or integrates with enterprise-wide information systems such as executive support systems.

For further information on a very-large-scale ODSS, see El Sharif and El Sawy (1988) and Carter et al. (1992).

Executive Information (Support) Systems

The majority of personal DSSs support the work of professionals and middle-level managers. Organizational DSSs provide support primarily to planners, analysts, researchers, or to some managers. For a DSS to be used by top managers it must meet the executives' needs. An executive information system (EIS), also known as an executive support system (ESS), is a technology designed in response to the specific needs of executives, as shown in the *IT At Work 12.4*.

The terms *executive information system* and *executive support system* mean different things to different people, though they are sometimes used interchangeably. The following definitions, based on Rockart and DeLong (1988), distinguish between EIS and ESS:

- **Executive information system (EIS).** An EIS is a computer-based system that serves the information needs of top executives. It provides rapid access to timely information and direct access to management reports. An EIS is very user friendly, is supported by graphics, and provides the capabilities of *exception reporting* (reporting of only the results that deviate from a set standard) and *drill down* (investigating information in increasing detail). It is also easily connected with online information services and electronic mail.
- **Executive support system (ESS).** An ESS is a comprehensive support system that goes beyond EIS to include analyse support, communications, office automation, and intelligence support.



Capabilities and Characteristics of ESSs

Executive support systems vary in their capabilities and benefits. (e.g., see Singh et al., 2002) Capabilities common to many ESSs are summarized in Table 12.2. One of these capabilities, the CSF, is measured by key performance indicators (KPI) as shown in *Online File W12.14*.



IT At Work 12.4

AN EXECUTIVE SUPPORT SYSTEM AT HERTZ CORPORATION



Hertz (*hertz.com*), the world's largest car rental company (a subsidiary of Ford Motor Company), competes against dozens of companies in hundreds of locations worldwide. Several marketing decisions must be made almost instantaneously (such as whether to follow a competitor's price discount). Marketing decisions are decentralized and are based on information about cities, climates, holidays, business cycles, tourist activities, past promotions, competitors' actions, and customer behavior. The amount of such information is huge, and the only way to process in timely manner it is to use a computer. The problem faced by Hertz was how to provide accessibility by its employees, at each branch, to such information and use it properly.

To address its decision-making needs, Hertz developed a mainframe DSS to allow fast routine analysis by executives and branch managers. But if a manager had a question, or a non-routine analysis was needed, he (she) had to go through a staff assistant, to get an answer, which made the process lengthy and cumbersome. The need for a better system was obvious.

Therefore, the following year Hertz decided to add an ESS, a PC-based system used as a companion to the DSS. The combined system gave executives the tools to analyze the mountains of stored information and make real-time decisions without the help of assistants. The system is

extremely user-friendly and is maintained by the marketing staff. Since its assimilation into the corporate culture conformed to the manner in which Hertz executives were used to working, implementation was easy.

With the ESS, executives can manipulate and refine data to be more meaningful and strategically significant to them. The ESS allows executives to draw information from the mainframe, store the needed data on their own PCs, and perform a DSS-type analysis without tying up valuable mainframe time. Hertz managers feel that the ESS creates synergy in decision making. It triggers questions, a greater influx of creative ideas, and more cost-effective marketing decisions.

In the late 1990s, the system was integrated with a data warehouse and connected to the corporate intranets and the Internet. Today local managers use the Web to find competitors' prices, in real time, and by using supply-demand model, they can assess the impact of price changes on the demand for cars. This model is similar to the price setting model described in *A Closer Look 2.2*. (Chapter 2).

Sources: Compiled from O'Leary, (1990) and from *hertz.com* (1998).

For Further Exploration: Why was the DSS insufficient by itself, and how did the addition of the ESS make it effective?

TABLE 12.2 The Capabilities of an ESS

Capability	Description
Drill down	Ability to go to details, at several levels, can be done by a series of menus or by direct queries (using intelligent agents and natural language processing).
Critical success factors (CSF)	The factors most critical for the success of business. These can be organizational, industry, departmental, etc.
Key performance indicators (KPI)	The specific measures of CSFs. Examples are provided in <i>Online File W12.10</i> .
Status access	The latest data available on KPI or some other metric, ideally in real time.
Trend analysis	Short-, medium-, and long term trend of KPIs or metrics are projected using forecasting methods.
Ad-hoc analysis	Make analysis any time, and with any desired factors and relationships.
Exception reporting	Based on the concept of management by exception, reports highlight deviations larger than certain thresholds. Reports may include only deviations.



ESS TYPES. ESS can be enhanced with multidimensional analysis and presentation (Chapter 11), friendly data access, user-friendly graphical interface, imaging capabilities, intranet access, e-mail, Internet access, and modeling. These can be helpful to many executives. We can distinguish between two types of ESSs: (1) those designed especially to support top executives and (2) those intended to serve a wider community of users. The latter type of ESS applications embrace a range of products targeted to support professional decision makers throughout the enterprise. For this reason, some people define the acronym ESS to mean *enterprise support systems*, or *everybody's support systems*. Most Web-based system and enterprise portals are of this nature. Only few companies have a top executive-only ESS. However, in the enterprise system, some data can be accessed by executives only.

Some of the capabilities discussed in this section are now part of a business intelligence product, as shown in Figure 12.4.

INTELLIGENT ESS. In order to save the executive's time in conducting a drill down, finding exceptions, or identifying trends, an *intelligent ESS* has been

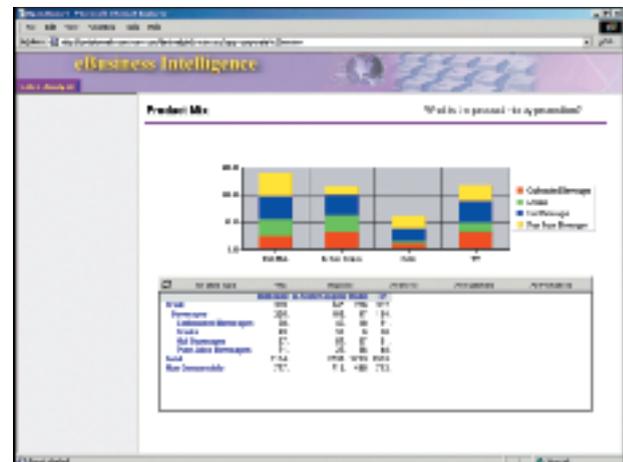
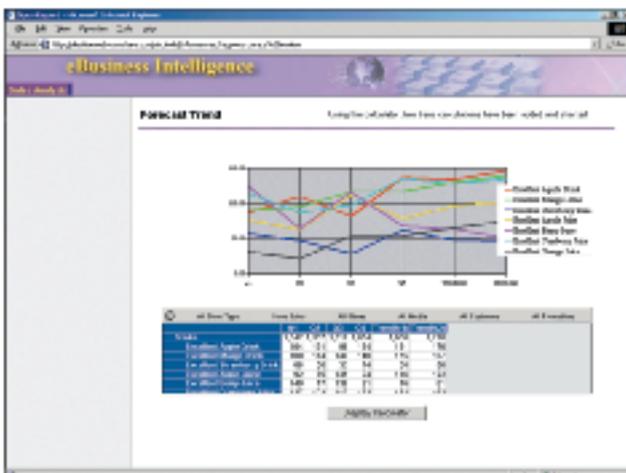
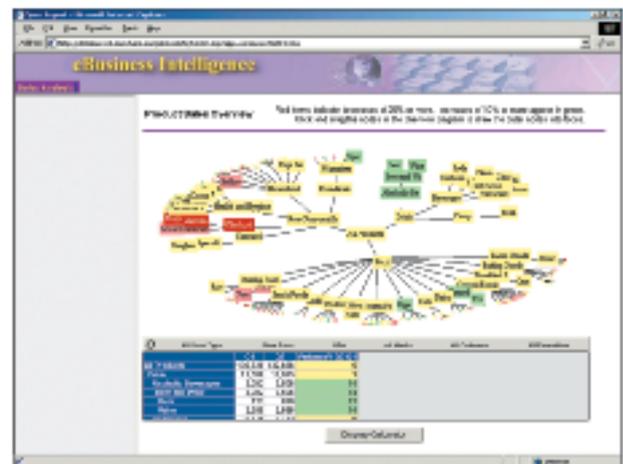
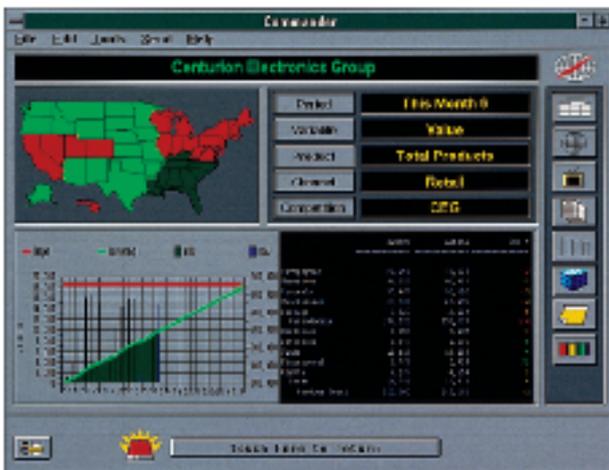


FIGURE 12.4 Sample screens from Comshare Decision—a modular system for generating a business intelligence report.



developed. Automating these activities not only saves time but also ensures that the executive will not miss any important indication in a large amount of data. Intelligent ESSs may include an intelligent agent for alerting management to exceptions. For further details, see King and O'Leary (1996) and Liu et al. (2000).

INTEGRATION WITH DSS. Executive support systems are especially useful in identifying problems and opportunities. Such identification can be facilitated by an intelligent component. In addition, it is necessary to do something if a problem or an opportunity is discovered. Therefore, many software vendors provide ESS/DSS integrated tools that are sold as part of business intelligence suite.

Enterprise Decision Simulator

An interesting example of enterprise decision support is the corporate war room. This concept has been used by the military for a long time, and it has now been transformed by SAP for use in industry, as described in *A Closer Look* 12.1.

DSS Failures

Over the years there have been many cases of failures of all types of decision support systems. There are multiple reasons for such failures, ranging from human factors to software glitches. Here are two examples:

1. The ill-fated Challenger Shuttle mission was partially attributed to a flawed GDSS (see http://frontpage/hypermall.com/jforrest/challenger/challenger_sts.htm). NASA used a mismanaged GDSS session in which anonymity was not allowed and other procedures were violated.
2. In an international congress on airports, failures in Denver, Hong Kong, and Malaysia airports were analyzed (onera.fr/congress/jso2000airport). Several DSS applications did not work as intended for reasons such as poor planning and inappropriate models.

Brezillon and Pomerol (1997) describe some failures of intelligent DSSs. Also, Briggs and Arnoff (2002) conducted a comprehensive evaluation of a DSS failure and identified areas that could create system failures. Most DSS failures can be eliminated by using appropriate planning, collaboration, and management procedures. Also, attaching an intelligent system makes them more useful and less likely to fail.

12.5 INTELLIGENT SUPPORT SYSTEMS: THE BASICS

Intelligent systems is a term that describes the various commercial applications of artificial intelligence (AI).

Artificial Intelligence and Intelligent Behavior

Most experts (see Cawsey, 1998, and Russell and Norvig, 2002) agree that **artificial intelligence (AI)** is concerned with two basic ideas. First, it involves studying the thought processes of humans; second, it deals with representing those processes via machines (computers, robots, and so on). Following 9/11, AI has been getting lots of attention, due to its capability to assist in fighting terrorism (Kahn, 2002). Another development that helps AI to get attention is the large number of intelligent devices (Rivlin, 2002) in the marketplace.

One well-publicized definition of AI is "behavior by a machine that, if performed by a human being, would be considered *intelligent*." Let us explore the



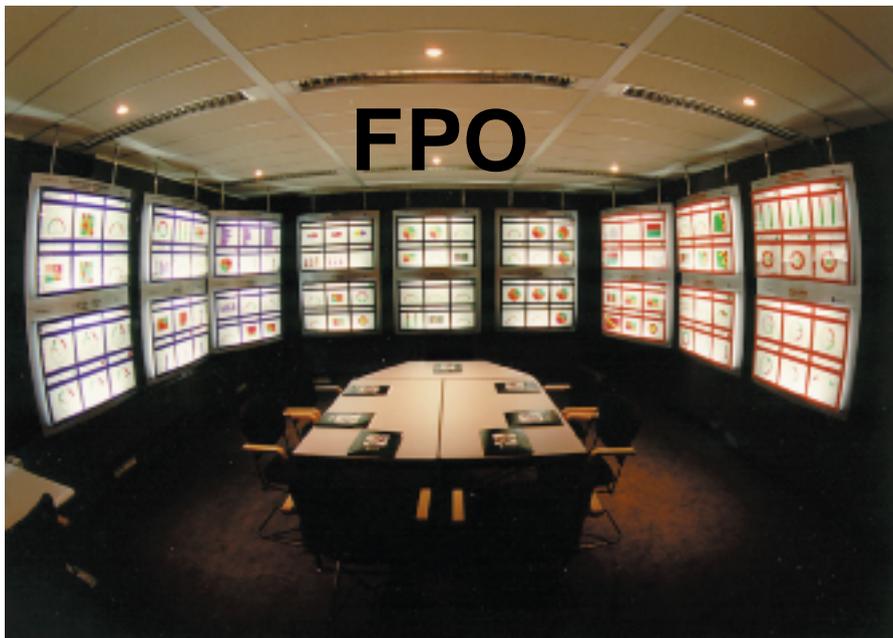
A CLOSER LOOK

12.1 THE MANAGEMENT COCKPIT

The Management Cockpit (*management-cockpit.com*) is a strategic management room that enables managers to pilot their businesses better. The aim is to create an environment that encourages more efficient management meetings and boosts team performance via effective communication. To help achieve this, key performance indicators and information relating to critical success factors are displayed graphically on the walls of a meeting room (see photo). The Management Cockpit supports top-level decision-makers by letting them concentrate on the essentials and conduct “what-if” scenarios. The cockpit-like arrangement of instrument panels and displays enables top

performance; the Blue Wall, the performance of internal processes and employees; and the White Wall, the status of strategic projects. The Flight Deck, a six-screen high-end PC, enables executives to drill down to detailed information.

Board members and other executives can hold meetings in this room. Typically, managers will also meet there with their comptrollers to discuss current business issues. For this purpose, the Management Cockpit can implement various scenarios. A major advantage of the Management Cockpit is that it provides a common basis for information and communication. At the same time, it supports efforts



managers to recognize whether corporate structures need changing and to grasp how all the different factors interrelate.

Executives can call up this information on their laptops, of course, but a key element of the concept is the Management Cockpit Room. There, on the four walls—Black, Red, Blue, and White—ergonomically-designed graphics depict performance as reflected in mission-critical factors. The Black Wall shows the principal success factors and financial indicators; the Red Wall, market

to translate a corporate strategy into concrete activities by identifying performance indicators, in addition to permitting appropriate monitoring.

The Cockpit environment is integrated with SAP's ERP products and reporting systems. External information can be easily imported to the room to allow competitive analysis.

Sources: Compiled from *management-cockpit.com*, *sap.com*, and from *origin-it.com*.



meaning of the term *intelligent behavior*. The following capabilities are considered to be signs of intelligence: learning or understanding from experience, making sense of ambiguous or contradictory messages, and responding quickly and successfully to a new situation. Using reasoning to solve problems and direct actions effectively is another indicator of intelligence. Some other indicators include dealing with complex situations, understanding and inferring in ordinary, rational ways. Applying knowledge to manipulate the environment and recognizing the relative importance of different elements in a situation complete our list.

AI's ultimate goal is to build machines that will mimic human intelligence. So far, current intelligent systems, exemplified in commercial AI products, are far from exhibiting any significant intelligence. Nevertheless, they are getting better with the passage of time, and are currently useful in making many cumbersome tasks that require some human intelligence faster, more efficient, and cheaper.

An interesting test to determine whether a computer exhibits intelligent behavior was designed by Alan Turing, a British AI pioneer. According to the **Turing test**, a computer could be considered "smart" only when a human interviewer, conversing with both an unseen human being and an unseen computer, cannot determine which is which.

So far we have concentrated on the concept of *intelligence*. According to another definition, artificial intelligence is the branch of computer science that deals with ways of representing *knowledge*. It uses symbols rather than numbers, and *heuristics*, or rules of thumb, rather than algorithms for processing information. Some of these properties are described next.

KNOWLEDGE AND AI. Although a computer cannot have experiences or study and learn as a human can, it can use knowledge given to it by human experts. Such knowledge consists of facts, concepts, theories, heuristic methods, procedures, and relationships. Knowledge is also information organized and analyzed to make it *understandable* and *applicable* to problem solving or decision making. The collection of knowledge related to a specific problem (or an opportunity) to be used in an intelligent system is organized and stored in a **knowledge base**. The collection of knowledge related to the operation of an organization is called an **organizational knowledge base** (see Chapter 10).

Comparing Artificial and Natural Intelligence

The potential value of AI can be better understood by contrasting it with natural (human) intelligence. AI has several important commercial advantages over natural intelligence, but also some limitations, as shown in Table 12.3.

Benefits of AI

Despite their limitations, AI applications can be extremely valuable. They can make computers easier to use and can make knowledge more widely available. One major potential benefit of AI is that it significantly increases the speed and consistency of some problem-solving procedures, including those problems that are difficult to solve by conventional computing and those that have incomplete or unclear data. Another benefit of AI is that it significantly increases the productivity of performing many tasks; it helps in handling information overload by summarizing or interpreting information and by assisting in searching through large amounts of data.

**TABLE 12.3** Comparison of the Capabilities of Natural vs. Artificial Intelligence

Capabilities	Natural Intelligence	AI
Preservation of knowledge	Perishable from an organizational point of view	Permanent.
Duplication and dissemination of knowledge	Difficult, expensive, takes time.	Easy, fast, and inexpensive once knowledge is in a computer
Total cost of knowledge	Can be erratic and inconsistent. Incomplete at times	Consistent and thorough
Documentability of process and knowledge	Difficult, expensive	Fairly easy, inexpensive
Creativity	Can be very high.	Low; uninspired
Use of sensory experiences	Direct and rich in possibilities	Must be interpreted first; limited.
Recognizing patterns and relationships	Fast, easy to explain	Machine learning still not as good as people in most cases, but in some cases can do better than people.
Reasoning	Making use of wide context of experiences	Good only in narrow, focused, and stable domains

Conventional versus AI Computing

Conventional computer programs are based on algorithms. An *algorithm* is a mathematical formula or sequential procedure that leads to a solution. It is converted into a computer program that tells the computer exactly what operations to carry out. The algorithm then uses data such as numbers, letters, or words to solve problems. AI software is using knowledge and heuristics instead of or with algorithms.

In addition, AI software is based on **symbolic processing** of knowledge. In AI, a symbol is a letter, word, or number that represents objects, processes, and their relationships. Objects can be people, things, ideas, concepts, events, or statements of fact. Using symbols, it is possible to create a knowledge base that contains facts, concepts, and the relationships that exist among them. Then various processes can be used to manipulate the symbols in order to generate advice or a recommendation for solving problems.

The major differences between AI computing and conventional computing are shown in *Online File W12.14*.



DOES A COMPUTER REALLY THINK? Knowledge bases and search techniques certainly make computers more useful, but can they really make computers more intelligent? The fact that most AI programs are implemented by search and pattern-matching techniques leads to the conclusion that *computers are not really intelligent*. You give the computer a lot of information and some guidelines about how to use this information, and the computer can then come up with a solution. But all it does is test the various alternatives and attempt to find some combination that meets the designated criteria. The computer appears to be “thinking” and often gives a satisfactory solution. But Dreyfus and Dreyfus (1988) feel that the public is being misled about AI, whose usefulness is overblown and whose goals are unrealistic. They claim, and we agree, that the human mind is just too complex to duplicate. *Computers certainly cannot think*, but they can be very useful for increasing our productivity. This is done by several commercial AI technologies.

TABLE 12.4 The Commercial AI Techniques

Name	Short Description
Expert system (ES)	Computerized advisory systems usually based on rules (See Section 12.6.)
Natural language processing (NLP)	Enables computers to recognize and even understand human languages. (See Section 12.7.)
Speech understanding	Enables computers to recognize words and understand short voice sentences. (See Section 12.7.)
Robotic and sensory systems	Programmable combination of mechanical and computer program. Recognize their environments via sensors.
Computer vision and scene recognition	Enable computers to interpret the content of pictures captured by cameras.
Machine learning	Enables computers to interpret the content of pictures captured by cameras.
Handwriting recognition	Enables computers to recognize characters (letters, digits), written by hand.
Neural computing (networks)	Using massive parallel processing, able to recognize patterns in large amount of data. (See Section 12.7.)
Fuzzy logic	Enables computers to reason with partial information. (See Section 12.7.)
Intelligent agents	Software programs that perform tasks for a human or machine master. (See Online Appendix W12.1.)
Semantic Web	An intelligent software program that “understands” content of Web pages. (See Section 12.7.)

The Commercial AI Technologies



The development of machines that exhibit intelligent characteristics draws upon several sciences and technologies, ranging from linguistics to mathematics see the roots of the tree in *Online File W12.15*. Artificial intelligence itself is not a commercial field; it is a collection of concepts and ideas that are appropriate for research but cannot be marketed. However, AI provides the scientific foundation for several commercial technologies.

The major intelligent systems are: expert systems, natural language processing, speech understanding, robotics and sensory systems, fuzzy logic, neural computing, computer vision and scene recognition, and intelligent computer-aided instruction. In addition, a combination of two or more of the above is considered a *hybrid* intelligent system. The major intelligent systems are listed in Table 12.4 and are discussed further in *Online File W12.16*

SOFTWARE AND INTELLIGENT AGENTS. As described in Chapters 4 and 5, software and intelligent agents play a major role in supporting work on computers (such as search, alerts, monitor Web activities, suggestions to users) and work in general (e.g., configure complex product, diagnose malfunctions in networks). A coverage of the topic is provided in Online Appendix W12.1.

12.6 EXPERT SYSTEMS

When an organization has a complex decision to make or a problem to solve, it often turns to experts for advice. These experts have specific knowledge and experience in the problem area. They are aware of alternative solutions, chances of success, and costs that the organization may incur if the problem is not solved. Companies engage experts for advice on such matters as equipment



purchase, mergers and acquisitions, and advertising strategy. The more unstructured the situation, the more specialized and expensive is the advice. **Expert systems (ESs)** are an attempt to mimic human experts. Expert systems can either *support* decision makers or completely *replace* them (see Edwards et al., 2000). Expert systems are the most widely applied and commercially successful AI technology.

Typically, an ES is decision-making software that can reach a level of performance comparable to a human expert in some specialized and usually narrow problem area. The basic idea behind an ES is simple: *Expertise* is transferred from an expert (or other source of expertise) to the computer. This knowledge is then stored in the computer. Users can call on the computer for specific advice as needed. The computer can make inferences and arrive at a conclusion. Then, like a human expert, it advises the nonexperts and explains, if necessary, the logic behind the advice. ESs can sometimes perform better than any single expert can.

Expertise and Knowledge

Expertise is the extensive, task-specific knowledge acquired from training, reading, and experience. It enables experts to make better and faster decisions than nonexperts in solving complex problems. Expertise takes a long time (possibly years) to acquire, and it is distributed in organizations in an uneven manner. A senior expert possesses about 30 times more expertise than a junior (novice) staff member.

The transfer of expertise from an expert to a computer and then to the user involves four activities: *knowledge acquisition* (from experts or other sources), *knowledge representation* (in the computer), *knowledge inferencing*, and *knowledge transfer* to the user.

Knowledge is acquired from experts or from documented sources. Through the activity of knowledge representation, acquired knowledge is organized as rules or frames (object-oriented) and stored electronically in a knowledge base. Given the necessary expertise stored in the knowledge base, the computer is programmed so that it can make inferences. The inferencing is performed in a component called the **inference engine** the “brain” of the ES and results in a recommendation for novices. Thus, the expert’s knowledge has been *transferred* to users.

A unique feature of an ES is its ability to explain its recommendations. The explanation and justification is done in a subsystem called the *justifier* or the *explanation subsystem* (e.g., presents the sequence of rules used by the inference engine to generate a recommendation).

The Benefits and Limitations of Expert Systems



THE BENEFITS OF EXPERT SYSTEMS. Expert systems have considerable benefits, but their use is constrained. During the past few years, the technology of expert systems has been successfully applied in thousands of organizations worldwide to problems ranging from AIDS research to the analysis of dust in mines. Why have ESs become so popular? It is because of the large number of capabilities and benefits they provide. The major ones are listed in Table 12.5. For examples of ES applications, see *Online File W12.17*.

THE LIMITATIONS OF EXPERT SYSTEMS. Despite their many benefits, available ES methodologies are not always straightforward and effective. Some factors that have slowed the commercial spread of ES are provided in *Online File W12.18*.

In addition, expert systems may not be able to arrive at any conclusions. For example, even some fully developed complex expert systems are unable to

**TABLE 12.5** Benefits of Expert Systems

Benefit	Description/Example
Increased output and productivity	At Digital Equipment Corp. (now part of Hewlett-Packard), an ES plans configuration of components for each custom order, increasing preparation production fourfold.
Increased quality	ESs can provide consistent advice and reduce error rates.
Capture and dissemination of scarce expertise	Physicians in Egypt and Algeria use an eye-care ESs developed at Rutgers University to diagnose and to recommend treatment.
Operation in hazardous environments	ESs that interpret information collected by sensors enable human workers to avoid hot, humid, or toxic environments.
Accessibility to knowledge and help desks	ESs can increase the productivity of help-desk employees (there are over 30 million in the U.S. alone), or even automate this function.
Reliability	ESs do not become tired or bored, call in sick, or go on strike. They consistently pay attention to details and do not overlook relevant information.
Increased capabilities of other systems	Integration of an ES with other systems makes the other systems more effective.
Ability to work with incomplete or uncertain information	Even with an answer of "don't know" or "not sure," an ES can still produce an answer, though it may not be a certain one.
Provision of training	Novices who work with an ES become more experienced thanks to the explanation facility which serves as a teaching device and knowledge base.
Enhancement of decision-making and problem-solving capabilities	ESs allow the integration of expert judgment into analysis. Successful applications are diagnosis of machine malfunction and even medical diagnosis.
Decreased decision-making time	ESs usually can make faster decisions than humans working alone. American Express authorizers can make charge authorization decisions in 3 minutes without an ES and in 30 seconds with one.
Reduced downtime	ESs can quickly diagnose machine malfunctions and prescribe repairs. An ES called Drilling Advisor detects malfunctions in oil rigs, saving the cost of downtime (as much as \$250,000/day).

fulfill about 2 percent of the orders presented to it. Finally, expert systems, like human experts, sometimes produce incorrect recommendations.

Failing expert systems. Various organizational, personal, and economic factors can slow the spread of expert systems, or even cause them to fail, as shown in *IT At Work 12.5*.

The Components of Expert Systems

The following components exist in an expert system: knowledge base, inference engine, blackboard (workplace), user interface, and explanation subsystem (justifier). In the future, systems will include a knowledge-refining component. The relationships among components are shown in Figure 12.5.

DESCRIPTION OF THE COMPONENTS. The major components of expert systems are described below.

The *knowledge base* contains knowledge necessary for understanding, formulating, and solving problems. It includes two basic elements: (1) *facts*, such as the problem situation and theory of the problem area, and (2) *rules* that direct the use of knowledge to solve specific problems in a particular domain.



IT At Work 12.5

EVEN AN INTELLIGENT SYSTEM CAN FAIL



Mary Kay (*marykay.com*), the multinational cosmetics company, uses teams of managers and analysts to plan its products. This process attempted to iron out potential weaknesses before production. However, the company still faced costly errors resulting from such problems as product-container incompatibility, interaction of chemical compositions, and marketing requirements with regard to packaging and distribution.

An eclectic group of Mary Kay managers, representing various functional areas, used to meet every six weeks to make product decisions. The group's decision-making process was loosely structured: The marketing team would give its requirements to the product formulator and the package engineer at the same time. Marketing's design requests often proved to be beyond the allocated budget or technical possibilities, and other problems arose as a result of not knowing the ultimate product formulation. The result was more meetings and redesign.

Mary Kay decided to implement an expert system to help. In an effort to keep costs to a minimum, it engaged the services of a research university that developed a system that consisted of a DSS computational tool plus two ES components. The decision support tool was able to select compatible packages for a given cosmetic product and to test product and package suitability. The ES component used this information to guide users through design and to determine associated production costs.

At first the system was a tremendous success. There was a clear match between the abilities of the system technology and the nature of the problem. The director of package design enthusiastically embraced the system solution. The entire decision process could have been accomplished in two weeks with no inherent redesign. By formulating what previously was largely intuitive, the ES improved understanding of the decision process itself, increasing the team's confidence. By reducing the time required for new product development, executives were freed for other tasks, and the team met only rarely to ratify the recommendations of the ES.

However, without support staff to *maintain* the ES, no one knew how to add or modify decision rules. Even the firm's IT unit was unable to help, and so the system fell into disuse. More importantly, when the director of package design left the firm, so did the enthusiasm for the ES. No one else was willing to make the effort necessary to maintain the system or sustain the project. Without managerial direction about the importance of the system to the firm's success, the whole project floundered.

Source: Condensed from Vedder et al. (1999).

For Further Exploration: What can a company do to prevent such failures? Can you speculate on why this was not done at Mary Kay?

The "brain" of the ES is the **inference engine**. This component is essentially a computer program that provides a methodology for reasoning and formulating conclusions.

The *user interface* in ESs allows for user-computer dialogue, which can be best carried out in a natural language, usually presented in a questions-and-answers format and sometimes supplemented by graphics. The dialogue triggers the inference engine to match the problem symptoms with the knowledge in the knowledge base and then generate advice.

The *blackboard* is an area of working memory set aside for the description of a current problem, as specified by the input data; it is also used for recording intermediate results. It is a kind of database.

The *explanation subsystem* can trace responsibility for arriving of conclusion and explain the ES's behavior by interactively answering questions such as the following: *Why* was a certain question asked by the expert system? *How* was a certain conclusion reached? *What* is the plan to reach the solution? (See the discussion by Gregor and Benbasat, 1999.)

Human experts have a *knowledge-refining* system; that is, they can analyze their own performance, learn from it, and improve it for future consultations.

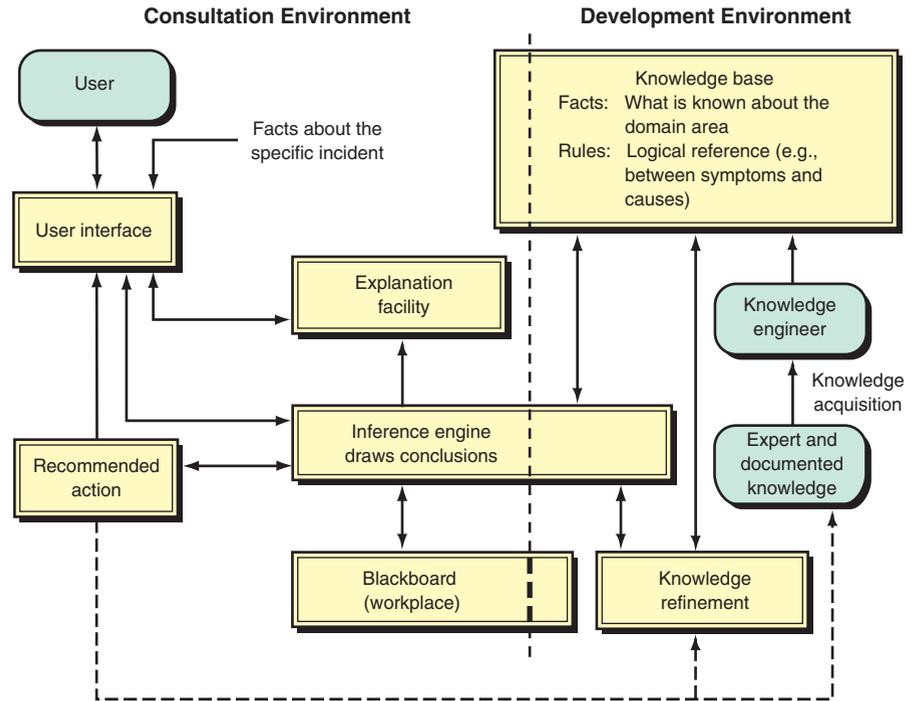


FIGURE 12.5 Structure and process of an expert system.



Applications of Expert Systems

Similarly, such evaluation is necessary in computerized learning so that the program will be able to improve by analyzing the reasons for its success or failure. Such a component is not available in commercial expert systems at the moment, but it is being developed in experimental.

The process of building and using expert systems is described in *Online File W12.19*, which includes an example of how an ES consultation is done.

Expert systems are in use today in all types of organizations. For many examples, by industry, see *exsys.com* (in the case studies) and Jackson (1999). Expert systems are especially useful in ten generic categories, displayed in Table 12.6. For other examples see Jareb and Rajkovic (2001) and Pontz and Power (2003).

TABLE 12.6 Generic Categories of Expert Systems

Category	Problem Addressed
1. Interpretation	Inferring situation descriptions from observations.
2. Prediction	Inferring likely consequences of given situations.
3. Diagnosis	Inferring system malfunctions from observations.
4. Design	Configuring objects under constraints.
5. Planning	Developing plans to achieve goal(s).
6. Monitoring	Comparing observations to plans, flagging exceptions.
7. Debugging	Prescribing remedies for malfunctions.
8. Repair	Executing a plan to administer a prescribed remedy.
9. Instruction	Diagnosing, debugging, and correcting student performance.
10. Control	Interpreting, predicting, repairing, and monitoring systems behavior.



EMBEDDED EXPERT SYSTEMS. One of the most useful applications of expert systems is as an embedded component in other systems, including robots. The ES components are so integrated that they have turned into transparent parts of processes or systems. Actually, many software and hardware products include embedded ESs or other intelligent systems, which the users may not be aware of. IT systems are sold based on their functionalities, not on whether they include an intelligent component.

12.7 OTHER INTELLIGENT SYSTEMS

An expert system's major objective is to provide expert advice. Other intelligent systems can be used to solve problems or provide capabilities in areas in which they excel. Several such technologies are described next.

Natural Language Processing and Voice Technologies

Today, when you tell a computer what to do, you type commands in the keyboard. In responding to a user, the computer outputs message symbols or other short, cryptic notes of information. Many problems could be minimized or even eliminated if we could communicate with the computer in our own language. We would simply type in directions, instructions, or information. Better yet, we would converse with the computer using voice. The computer would be smart enough to interpret the input, regardless of its format. **Natural language processing (NLP)** refers to such communicating with a computer in English or whatever language you may speak.

To understand a natural language inquiry, a computer must have the knowledge to analyze and then interpret the input. This may include linguistic knowledge about words, domain knowledge, common-sense knowledge, and even knowledge about the users and their goals. Once the computer understands the input, it can take the desired action. For details see Reiter and Dale (2000).

In this section we briefly discuss two types of NLP:

1. Natural language *understanding*, which investigates methods of allowing a computer to comprehend instructions given in ordinary English, via the keyboard or by voice, speech understanding so that computers are able to understand people.
2. Natural language *generation*, which strives to allow computers to produce ordinary English language, on the screen or by voice (known as voice synthesis), so people can understand computers more easily.

APPLICATIONS OF NATURAL LANGUAGE PROCESSING. Natural language processing programs have been applied in several areas. The most important are human-to-computer interfaces, which include abstracting and summarizing text, analyzing grammar, understanding speech, and even composing letters by machines. These programs translate one natural language to another, or one computer language to another, and they even translate Web pages (see Chapter 4).

By far the most dominant use of NLP is "front-ends" for other software packages, especially databases that allow the user to operate the applications programs with everyday language.

SPEECH (VOICE) RECOGNITION AND UNDERSTANDING. Speech recognition is a process that allows us to communicate with a computer by speaking to it. The term **speech recognition** is sometimes applied only to the first part of the communication process, in which the computer recognizes words that have been spoken without necessarily interpreting their meanings. The other part of the process, wherein the meaning of speech is ascertained, is called **speech understanding**. It may be possible to understand the meaning of a spoken sentence without actually recognizing every word, and vice versa. When a speech recognition system is combined with a natural language processing system, the result is an overall system that not only recognizes voice input but also understands it. For multiple applications in stores and warehouses see Amato-McCoy (2003). Speech recognition is deployed today in wireless PDAs as well (see Kumagai 2002 and Alesso and Smith, 2002).

Advantages of Speech Recognition and Understanding. The ultimate goal of speech recognition is to allow a computer to understand the natural speech of any human speaker at least as well as a human listener could understand it. Speech recognition offers several other advantages:

- **Ease of access.** Many more people can speak than can type. As long as communication with a computer depends on typing skills, many people may not be able to use computers effectively.
- **Speed.** Even the most competent typists can speak more quickly than they can type. It is estimated that the average person can speak twice as quickly as a proficient typist can type.
- **Manual freedom.** Obviously, communicating with a computer through typing occupies your hands. There are many situations in which computers might be useful to people whose hands are otherwise engaged, such as product assemblers, pilots of aircraft, and busy executives. Speech recognition also enables people with hand-related physical disabilities to use computers (see Chapter 16).
- **Remote access.** Many computers can be accessed remotely by telephones. If a remote database includes speech recognition capabilities, you could retrieve information by issuing oral commands into a telephone.
- **Accuracy.** People tend to make mistakes when typing, especially in spelling. These could be reduced with voice input.

American Express Travel Related Services (AETRS) is using interactive voice recognition (IVR) (Chapter 6) that allows its customers to check and book domestic flights by talking to a computer over the phone. The system asks customers questions such as: Where do you want to travel? When do you want to go?. The system can handle 400 city and airport names, and lets callers use more than 10,000 different ways to identify a location. The reservation transaction costs were reduced about 50 percent compared to operator handled costs. The average transaction time was reduced from 7 to 2 minutes. AETRS offers a similar service on the Web.

Limitations of Speech Recognition and Understanding. The major limitation of speech understanding is its inability to recognize long sentences, or the long time needed to accomplish it. The better the system is at speech recognition, the higher is its cost. Also, in voice recognition systems, you cannot manipulate icons and windows, so speech may need to be combined with a keyboard entry, which slows communication.

VOICE SYNTHESIS. The technology by which computers speak is known as **voice synthesis**. The synthesis of voice by computer differs from the simple playback of a prerecorded voice by either analog or digital means. As the term *synthesis* implies, sounds that make up words and phrases are electronically constructed from basic sound components and can be made to form any desired voice pattern.

The current quality of synthesized voice is very good, but the technology remains somewhat expensive. Anticipated lower cost and improved performance of synthetic voice should encourage more widespread commercial IVR applications, especially those in the Web. Opportunities for its use will encompass almost all applications that can provide an automated response to a user, such as inquiries by employees pertaining to payroll and benefits. A number of banks already offer a voice service to their customers, informing them about their balance, which checks were cashed, and so on. Many credit card companies provide similar services, telling customers about current account balances, recent charges, and payments received. For a list of other voice synthesis and voice recognition applications, see Table 12.7.

TABLE 12.7 Examples of Voice Technology Applications

Company	Applications
Scandinavian Airlines, other airlines	Answering inquiries about reservations, schedules, lost baggage, etc. ^a
Citibank, many other banks	Informing credit card holders about balances and credits, providing bank account balances and other information to customers ^a
Delta Dental Plan (CA)	Verifying coverage information ^a
Federal Express	Requesting pickups ^b
Illinois Bell, other telephone companies	Giving information about services, ^a receiving orders ^b
Domino's Pizza	Enabling stores to order supplies, providing price information ^{a,b}
General Electric, Rockwell International, Austin Rover, Westpoint Pepperell, Eastman Kodak	Allowing inspectors to report results of quality assurance tests ^b
Cara Donna Provisions	Allowing receivers of shipments to report weights and inventory levels of various meats and cheeses ^b
Weidner Insurance, AT&T	Conducting market research and telemarketing ^b
U.S. Department of Energy, Idaho National Engineering Laboratory, Honeywell	Notifying people of emergencies detected by sensors ^a
New Jersey Department of Education	Notifying parents when students are absent and about cancellation of classes ^a
Kaiser-Permanente Health Foundation (HMO)	Calling patients to remind them of appointments, summarizing and reporting results ^a
Car manufacturers	Activating radios, heaters, and so on, by voice ^b
Taxoma Medical Center	Logging in and out by voice to payroll department ^b
St. Elizabeth's Hospital	Prompting doctors in the emergency room to conduct all necessary tests, reporting of results by doctors ^{a,b}
Hospital Corporation of America	Sending and receiving patient data by voice, searching for doctors, preparing schedules and medical records ^{a,b}

^aOutput device.
^bInput device.

Artificial Neural Networks

Artificial neural networks (ANNs) are biologically inspired. Specifically, they borrow ideas from the manner in which the human brain works. The human brain is composed of special cells called *neurons*. Estimates of the number of neurons in a human brain cover a wide range (up to 150 billion), and there are more than a hundred different kinds of neurons, separated into groups called *networks*. Each network contains several thousand neurons that are highly interconnected. Thus, the brain can be viewed as a collection of neural networks.

Today's ANNs, whose application is referred to as **neural computing**, uses a very limited set of concepts from biological neural systems. The goal is to simulate massive parallel processes that involve processing elements interconnected in a network architecture. The artificial neuron receives inputs analogous to the electrochemical impulses biological neurons receive from other neurons. The output of the artificial neuron corresponds to signals sent out from a biological neuron. These artificial signals can be changed, like the signals from the human brain. Neurons in an ANN receive information from other neurons or from external sources, transform or process the information, and pass it on to other neurons or as external outputs.

The manner in which an ANN processes information depends on its structure and on the algorithm used to process the information as explained in *Online File W12.20*.



BENEFITS AND APPLICATIONS OF NEURAL NETWORKS. The value of neural network technology includes its usefulness for pattern recognition, learning, and the interpretation of incomplete and “noisy” inputs.

Neural networks have the potential to provide some of the human characteristics of problem solving that are difficult to simulate using the logical, analytical techniques of DSS or even expert systems. One of these characteristics is **pattern recognition**. Neural networks can analyze large quantities of data to establish patterns and characteristics in situations where the logic or rules are not known. An example would be loan applications. By reviewing many historical cases of applicants' questionnaires and the “yes or no” decisions made, the ANN can create “patterns” or “profiles” of applications that should be approved or denied. A new application can then be matched by the computer against the pattern. If it comes close enough, the computer classifies it as a “yes” or “no”; otherwise it goes to a human for a decision. Neural networks are especially useful for financial applications such as determining when to buy or sell stock (see Shadbolt, 2002, for examples), predicting bankruptcy (Gentry et al., 2002), and prediction exchange rates (Davis et al., 2001).

Neural networks have several other benefits, which are illustrated in *Online File W12.21*, together with typical applications. For a comprehensive coverage see Smith and Gupta (2002).

Beyond its role as an alternative computing mechanism, and in data mining, neural computing can be combined with other computer-based information systems to produce powerful hybrid systems, as illustrated in *IT At Work 12.6*.

Neural computing is emerging as an effective technology in pattern recognition. This capability is being translated to many applications (e.g., see Haykin





IT At Work 12.6

BANKS ARE CRACKING DOWN ON CREDIT CARD FRAUD



Only 0.2 percent of Visa International's turnover in 1995 was lost to fraud, but at \$655 million it is a loss well worth addressing. Visa (*visa.com*) is now concentrating its efforts on reversing the number of fraudulent transactions by using neural network technology.

Most people stick to a well-established pattern of credit card use and only rarely splurge on expensive nonessentials. Neural networks are designed to notice when a card that is usually used to buy gasoline once a week is suddenly used to buy a number of tickets to the latest theater premiere on Broadway.

Visa's participating banks believe the neural network technology has been successful in combating fraud. Bank of America uses a cardholder risk identification system (CRIS) and has cut fraudulent card use by up to two-thirds. Toronto Dominion Bank found that losses were reduced, and overall customer service improved, with the introduction of neural computing. Another bank recorded savings of \$5.5 million in six months. In its first year of use, Visa member banks lost 16% to counterfeiters; considering such numbers, the \$2 million Visa spent to implement CRIS certainly seems worth the investment. In fact, Visa says, CRIS had paid for itself in one year.

In 1995, CRIS conducted over 16 billion transactions. By 2003, VisaNet (Visa's data warehouse and e-mail operations)

and CRIS were handling more than 8,000 transactions per second or about 320 billions a year. By fall 2003, CRIS was able to notify banks of fraud within a few seconds of a transaction. The only downside to CRIS is that occasionally the system prompts a call to a cardholder's spouse when an out-of-the-ordinary item is charged, such as a surprise vacation trip or a diamond ring. After all, no one wants to spoil surprises for loved ones.

Sumitomo Credit Service Co., a credit card issuer in Japan, is using Falcon, a neural network-based system from HNC Corp (*hnc.com*). The product works well reading Japanese characters, protecting 18 million cardholders in Japan. The system is used by many other banks worldwide.

Sources: Condensed from "Visa Stamps Out Fraud" (1995), p. viii; "Visa Cracks Down on Fraud" (1996); customer success stories at *hnc.com* (July 6, 2003) and *visa.com* (press releases, accessed June 19, 2003).

For Further Exploration: What is the advantage of CRIS over an automatic check against the balance in the account? What is the advantage of CRIS against a set of rules such as "Call a human authorizer when the purchase price is more than 200 percent of the average previous bill"?

1998, Chen 1996, and Giesen 2002) and is sometimes integrated with fuzzy logic.

Fuzzy Logic

Fuzzy logic deals with uncertainties by simulating the process of human reasoning, allowing the computer to behave less precisely and logically than conventional computers do. Fuzzy logic is a technique developed by Zadeh (1994), and its use is gaining momentum (Nguyen and Walker, 1999). The rationale behind this approach is that decision making is not always a matter of black and white, true or false. It often involves gray areas where the term *maybe* is more appropriate. In fact, creative decision-making processes are often unstructured, playful, contentious, and rambling.

According to experts, productivity of decision makers can improve many times using fuzzy logic (see Nguyen and Walker, 1999). At the present time, there are only a few examples of pure fuzzy logic applications in business, mainly in prediction-system behavior (see Peray, 1999, for investment, and Flanagan, 2000, for project evaluation). An interesting application is available at *yatra.net/solutions*, where fuzzy logic is used to support services for corporate travelers (see *Information Week*, May 15, 2000). More often, fuzzy logic is used together with other intelligent systems.



Semantic Web

One of the major problems of the Web is the information overload, which is growing rapidly with time. Software and search agents are helpful, but they cannot understand today words that have multiple meanings. Meaning depends on content, context, graphics and even positioning on a Web page. The proposed solution is known as the **semantic Web**. It is an extension of the current Web, in which information is given a well-defined meaning, better enabling computers and people to work in cooperation. The technology behind the semantic Web is based in part on NLP, on XML presentation, and new technologies such as resource description framework (RDF).

The semantic Web is expected to facilitate search, interoperability, and the composition of complex applications. It is an attempt to make the Web more homogenous, more data-like, and more amenable to computer understanding. If Web pages contained their own semantics, then software agents could conduct smarter searches. The semantic Web will enable software agents understanding Web forms and databases.



According to Cherry (2002), the semantic Web, if become successful, could provide “personal assistants” to people in term of software agents that will be able to conduct many useful tasks such as completely book your business trip. For an example, see *Online File W12.22*.

Hybrid Intelligent Systems

Intelligent systems are frequently integrated with other intelligent systems or with conventional systems, such as DSSs. The following examples illustrate such *hybrid* systems.

DEVELOPING MARKETING STRATEGY. Developing marketing strategy is a complex process performed by several people working as a team. The process involves many tasks that must be performed sequentially, with contributions from corporate experts. Numerous marketing strategy models were developed over the years to support the process. Unfortunately, most of the models support only one IT goal (e.g., to perform forecasting). A proposal to integrate expert systems, fuzzy logic, and ANN was made by Li (2000). The process of developing marketing strategy and the support of the three technologies in that process is shown in Figure 12.6. This hybrid system is powerful enough to incorporate strategic models, such as Porter’s five forces, and the directional policy matrices model. The integrated technologies and their roles are:

- **Neural networks.** These are used to predict future market share and growth.
- **Expert systems.** These provide intelligent advice on developing market strategy to individuals and to the planning team.
- **Fuzzy logic.** This helps managers to handle uncertainties and fuzziness of data and information.

The integration of the technologies helps in sharing information, coordination, and evaluation. The system is designed to support both individuals and groups. It allows for inclusion of users’ judgment in implementing the model.

OPTIMIZING THE DESIGN PROCESS. Lam et al. (2000) applied an integrated fuzzy logic, ANN, and algorithmic optimization to the design of a complex design process for ceramic casting manufacturing. The ANN estimates the inputs

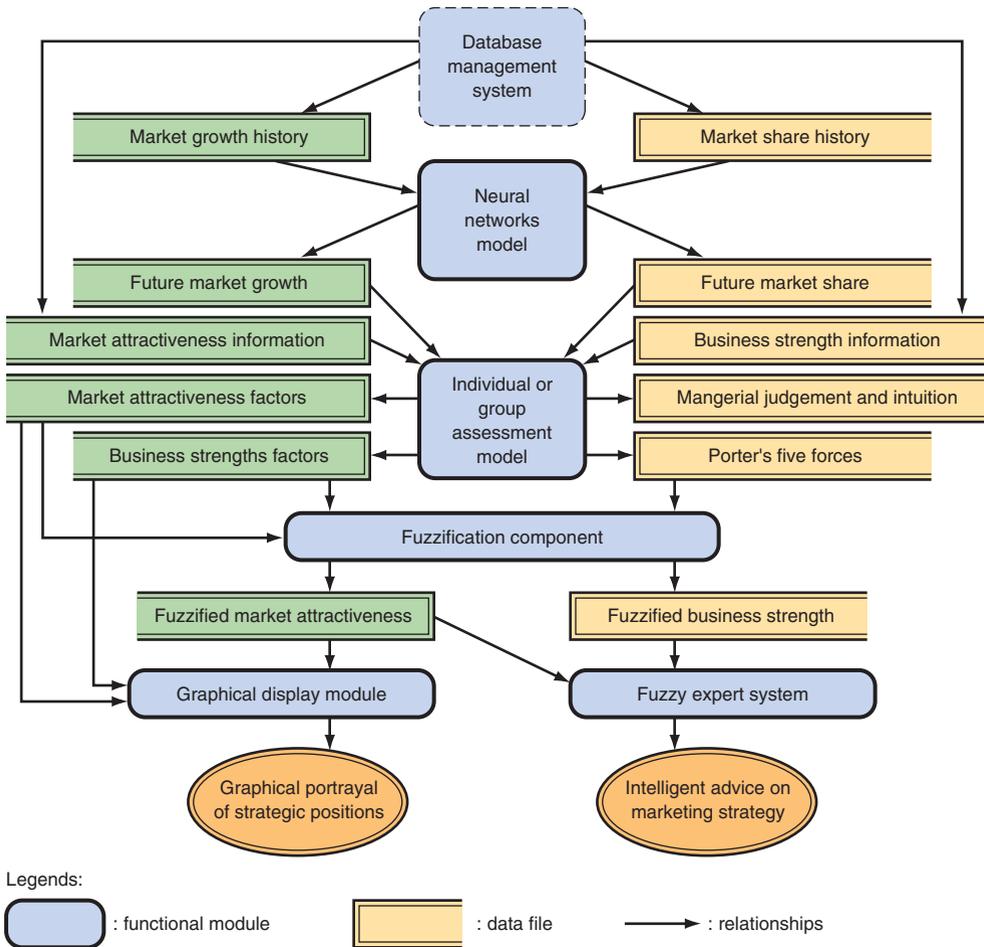


FIGURE 12.6 The architecture of a hybrid intelligent system. (Source: Reprinted from *Decision Support Systems*, January 2000, Fig. 1, p. 399. Reprinted from *Decision Support Systems*, January 2000, S. Li, "The Development of a Hybrid Intelligent System for Developing Market Strategy," p. 399. © 2000, with permission from Elsevier Science.)

needed by the fuzzy-rule base and also provides evaluation of the objective function of the optimization model. The system was successfully used, enabling fast and consistent production decision making.

12.8 WEB-BASED MANAGEMENT SUPPORT SYSTEMS



The Web is a perfect medium for deploying decision support capabilities on a global basis (see Power and Kaparathi, 2002 and Simic and Devedzic, 2003). Let's look at **Web-based management support systems (MSSs)** that can benefit both users and developers. These systems include decision support systems of all types, including intelligent and hybrid ones. Web-based MSSs are especially suitable for enterprise systems. An example is provided in *IT At Work 12.7*. For more, see *Online File W12.23*.

The major beneficial features of Web-based MSSs are provided in Table 12.8. For examples of applications see Cohen et al. (2001).



IT At Work 12.7

WEB-BASED MSS AT A LUXEMBOURG BANK



SEB Private Bank is the Luxembourg subsidiary of Swedish Bank SEB, an elite international bank that is quickly moving to take advantage of big growth opportunities in Europe with Internet banking. SEB is finding that customers on the Internet conduct more transactions than others, a trend that could deliver high profitability. The bank sees its greatest and most attractive opportunity in Europe, where SEB participates in a growing investment market and distinguishes itself with high-performance financial tools that empower managers to offer superior customer service. The bank has set an ambitious goal of having 5 million Internet customers by the end of 2004 with the help of a pan-European Internet partner.

To move into real-time 24/7 operations, SEB Private Bank decided to investigate a MSS software called Web-FOCUS (from Information Builders.) The software allows users to quickly build self-service production reporting and business analysis systems. Everything from standard to customized reports can be developed quickly and delivered immediately, internally or externally, by intranets, extranets, and over the Internet. As a result, the entire *decision-making process* is shifted onto a real-time transaction platform. The bank developed over 600 reports, of which more than 150 are used by the bank's managers on a day-to-day basis.

Two core elements of SEB Private Bank's information system are the IBM AS/400 hardware platform and

Olympic, a Swiss-developed financial application. The combination of WebFOCUS and Information Builders' EDA (integration middleware that offers access to virtually any database) has improved information access for account managers.

Olympic software generates messages to leading stock exchanges, which in turn deliver a return message to the application, giving current financial updates. This streamlines the bank's reaction times with the outside world, giving up-to-the-minute information.

But having this intelligent information source is one thing; making full use of it is another. SEB Private Bank sees the increasing use of its intranet, with its Web-based, thin-client architecture, as a move toward fewer paper reports. For example: Through this system, the bank's managers can easily check the inventory value of a client's assets; when the DSS is asked to evaluate a dossier, it can quickly produce a result.

With reliable security and high value-added services, SEB Private Bank feels well positioned to expand its markets with new expatriate investor business.

Source: Compiled from informationbuilders.com/applications/seb.html (2001).

For Further Exploration: What other applications can be developed with such a MSS?

TABLE 12.8 The Benefits of Web-Based MSSs

Benefit	Description
Reach rich data sources	The Web can have many resources with multimedia presentation, all accessible with a browser.
Easy data retrieval	Data can be accessed any time, from anywhere. Salespeople for example, can run proposals, using DSS models at a client's place of business.
Ease of use and learning	Use of browser, search engine, hypertext, etc., makes DSSs easy to learn and use. Even top executives are using them directly.
Reduce paperwork and processing efforts for raw data	All data are visible on the Web. If a data warehouse exists, data are organized for view.
Better decisions	With accessibility to more and current information, as well as to DSS models and technology, users of DSSs can make better decisions.
Expanding the use of ready-made DSSs	ASPs are using the Internet to lease DSS models as needed. Soon utility computing will make such distribution a common scenario. Also, more and cheaper applications are available.
Reduced development cost	Building one's own DSS can be cheaper when one uses components (Chapter 14) available on the Web. Also customizing vendor's products is faster and cheaper when done in the Internet environment.

12.9 ADVANCED AND SPECIAL DECISION SUPPORT TOPICS

Several topics are involved in implementing DSS. The major ones are presented in this section. (For others and more details, see Aronson et al., 2004.)

Simulation for Decision Making

Simulation has many meanings. In general, to *simulate* means to assume the appearance of characteristics of reality. In DSS, **simulation** generally refers to a technique for conducting experiments (such as “what-if”) with a computer on a model of a management system.

Because a DSS deals with semistructured or unstructured situations, it involves complex reality, which may not be easily represented by optimization or other standard models but can often be handled by simulation. Therefore, simulation is one of the most frequently used tools of DSSs. (See Law and Kelton, 1999.)

MAJOR CHARACTERISTICS. To begin, simulation is not a regular type of model. Models in general *represent* reality, whereas simulation usually *imitates* it closely. In practical terms, this means that there are fewer simplifications of reality in simulation models than in other models.

Second, simulation is a technique for *conducting experiments* especially “What if” ones. As such it can describe or predict the characteristics of a given system under different circumstances. Once the characteristics’ values are computed, the best among several alternatives can be selected. The simulation process often consists of the repetition of an experiment many, many times to obtain an estimate of the overall effect of certain actions. It can be executed manually in some cases, but a computer is usually needed. Simulation can be used for complex decision making is illustrated in an application of an automated underground freight transport system (Heijden 2002) and in *Online File W12.24*.



Advantages of Simulation. Simulation is used for decision support because it:

- **Allows for inclusion of the real-life complexities of problems.** Only a few simplifications are necessary. For example, simulation may utilize the real-life probability distributions rather than approximate theoretical distributions.
- **Is descriptive.** This allows the manager to ask what-if type questions. Thus, managers who employ a trial-and-error approach to problem solving can do it faster and cheaper, with less risk, using a simulated problem instead of a real one.
- **Can handle an extremely wide variation in problem types,** such as inventory and staffing, *as well as higher managerial-level tasks* like long-range planning. Further, the manager can experiment with different variables to determine which are important, and with different alternatives to determine which is best.
- **Can show the effect of compressing time,** giving the manager in a matter of minutes some feel as to the long-term effects of various policies.
- **Can be conducted from anywhere** using Web tools on the corporate portal or extranet.

Of the various types of simulation, the most comprehensive is *visual interactive simulation* (see Chapter 11).



Specialized Ready-Made Decisions Support



Initially, DSSs were custom-built. This resulted in two categories of DSS: The first type was small, end-user DSSs which were built by inexpensive tools such as Excel. The second type was large scale, expensive DSSs built by IT staff and/or vendors with special tools. For most applications, however, building a custom system was not justified. As a result, vendors started to offer DSSs in specialized areas such as financial services, banking, hospitals, or profitability measurements (or combinations of these areas). The popularity of these DSSs has increased since 1999 when vendors started to offer them online as ASP services. Examples of ready-made DSS applications are provided on *Online File W12.25*.

These tools and many more can be customized, at additional cost. However, even when customized, the total cost to users can be usually much lower than that of developing DSSs from scratch.

Decision support in ready-made expert systems is also provided on the Web. For examples see *Online File W12.26*.

Frontline Decision Support Systems

Decisions at all levels in the organization contribute to the success of a business. But decisions that maximize a sales opportunity or minimize the cost of customer service requests are made on the front lines by those closest to situations that arise during the course of daily business. Whether it is an order exception, an upselling opportunity resolving customer complaint, or a contract that hangs on a decision, the decision maker on the front line must be able to make effective decisions rapidly sometimes in seconds based on context and according to strategies and guidelines set forth by senior management.

FRONTLINE SYSTEMS. **Frontline decision making** is the process by which companies automate decision processes and push them down into the organization and sometimes out to partners. It includes *empowering employees* by letting them devise strategies, evaluate metrics, analyze impacts, and make operational changes.

Frontline decision making automates simple decisions-like freezing the account of a customer who has failed to make payments-by predefining business rules and events that trigger them. At more complex decision points, such as inventory allocation, frontline decision making gives managers the necessary context-available alternatives, business impacts, and success measurements-to make the right decision.

Frontline decision making serves business users such as line managers, sales representatives, and call-center staff by incorporating decision making into their daily work. These workers need applications to help them make good operational decisions that meet overall corporate objectives. Frontline decision making provides users with the right questions to ask, the location of needed data, and metrics that translate data into corporate objectives and suggest actions that can improve performance. Analytical application products are now emerging to support these actions.

Frontline software that started to appear on the market in late 1999 can solve standard problems (such as what to do if a specific bank customer withdraws 100 percent more than the average withdrawal) by packaging in a single browser a self-service solution that requires some business logic (including rules, algorithms, intelligent systems, and so on). Also provided are metrics such as life-cycle expectancy, decision workflow, and so on. Finally, to be successful, such systems must work hand in hand with transactional systems.



According to Forrester Research Inc., such systems are essential for the survival of many companies, but it is expected to take five years for the technology to mature. The major current vendors are Hyperion Solutions Corporation, NCR Corporation, SAS Institute Inc., and i2 Technology. However, almost all the SCM, ERP, and business intelligence vendors mentioned in this and the previous chapter may be involved in such systems. For further details see McCullough (1999) and Sheth and Sisodia (1999).

Real-Time Decision Support

Business decisions today must be made at the right time, and frequently under time pressure. To do so, managers need to know what is going on in the business at any moment and be able to quickly select the best decision alternatives. In recent years, special decision support software has been developed for this purpose. These tools appear under different names such as *business activity monitoring* (BAM) and *extreme analytic frameworks* (EAF). For details and examples see Bates (2003). A variant of these methods is the *business performance intelligence* (BPI) (Sorensen, 2003) and *business performance management* (BPM) (Choy, 2003). Also related are business performance measurement (BPM) programs such as benchmarking and balanced scorecard (Chapter 9).

Creativity in Decision Support

In order to solve problems or assess opportunities it is often necessary to generate alternative solutions and/or ideas. Creativity is an extremely important topic in decision support but it is outside the scope of this IT book. However, there is one topic that clearly belongs to IT and this is the use of computers to support the process of idea generation (some of which we discussed in Section 12.3) as well as the use of computers to generate ideas and solutions by themselves. Actually expert systems can be considered contributors to creativity since they can generate proposed solutions that will help people generate new ideas (e.g., via association, a kind of a “brainstorming”). Interested readers are referred to Yiman-Seid and Kobsa (2003) and *Online File W12.27*.



➔ MANAGERIAL ISSUES

1. **Cost justification; intangible benefits.** While some of the benefits of management support systems are tangible, it is difficult to put a dollar value on the intangible benefits of many such systems. While the cost of small systems is fairly low and justification is not a critical issue, the cost of a medium-to-large systems can be very high, and the benefits they provide must be economically justified.
2. **Documenting personal DSS.** Many employees develop their own DSSs to increase their productivity and the quality of their work. It is advisable to have an inventory of these DSSs and make certain that appropriate documentation and security measures exist, so that if the employee leaves the organization, the productivity tool remains.
3. **Security.** Decision support systems may contain extremely important information for the livelihood of organizations. Taking appropriate security measures, especially in Web-based distributed applications, is a must. End users who build a DSS are not professional systems builders. For this reason, there could be problems with data integrity and the security of the systems developed.



4. **Ready-made commercial DSSs.** With the increased use of Web-based systems and ASPs, it is possible to find more DSS applications sold off the shelf, frequently online. The benefits of a purchased or leased DSS application sometimes make it advisable to change business processes to fit a commercially available DSS. Some vendors are willing to modify their standard software to fit the customer's needs. Commercial DSSs are available both for certain industries (hospitals, banking) and for specific tasks (profitability analysis).
5. **Intelligent DSS.** Introducing intelligent agents into a DSS application can greatly increase its functionality. The intelligent component of a system can be less than 3 percent of the entire system (the rest is models, a database, and telecommunications), yet the contribution of the intelligent component can be incredible.
6. **Organizational culture.** The more people recognize the benefits of a DSS and the more support is given to it by top management; the more the DSS will be used. If the organization's culture is supportive, dozens of applications can be developed.
7. **Embedded technologies.** Intelligent systems are expected to be embedded in at least 20 percent of all IT applications in about 10 years. It is critical for any prudent management to closely examine the technologies and their business applicability.
8. **Ethical issues.** Corporations with management support systems may need to address some serious ethical issues such as privacy and accountability. For example, a company developed a DSS to help people compute the financial implications of early retirement. However, the DSS developer did not include the tax implications, which resulted in incorrect retirement decisions.



Another important ethical issue is human judgment, which is frequently used in DSSs. Human judgment is subjective, and therefore, it may lead to unethical decision making. Companies should provide an ethical code for DSS builders. Also, the possibility of automating managers' jobs may lead to massive layoffs.

There can be ethical issues related to the implementation of expert systems and other intelligent systems. The actions performed by an expert system can be unethical, or even illegal. For example, the expert system may advise you to do something that will hurt someone or will invade the privacy of certain individuals.

An example is the behavior of robots, and the possibility that the robots will not behave the way that they were programmed to. There have been many industrial accidents, caused by robots, that resulted in injuries and even deaths. The issue is, Should an organization employ productivity-saving devices that are not 100 percent safe?

Another ethical issue is the use of knowledge extracted from people. The issue here is, Should a company compensate an employee when knowledge that he or she contributed is used by others? This issue is related to the motivation issue. It is also related to privacy. Should people be informed as to who contributed certain knowledge?

A final ethical issue that needs to be addressed is that of dehumanization and the feeling that a machine can be "smarter" than some people (see Chapter 16). People may have different attitudes toward smart machines, which may be reflected in the manner in which they will work together.



ON THE WEB SITE... Additional resources, including quizzes; online files of additional text, tables, figures, and cases; and frequently updated Web links to current articles and information can be found on the book's Web site (wiley.com/college/turban).

KEY TERMS

Ad-hoc analysis •••	Intelligent agent (IA) •••	Pattern recognition •••
Artificial intelligence (AI) •••	Knowledge base •••	Personal information manager (PIM) •••
Artificial neural network (ANN) •••	Machine learning •••	Robot •••
Decision room •••	Management support system (MSS) •••	Semantic Web •••
Decision support system (DSS) •••	Model (in decision making) •••	Sensitivity analysis •••
Executive information system (EIS) •••	Model-based management system (MBMS) •••	Simulation •••
Executive support system (ESS) •••	Natural language processing (NLP) •••	Speech recognition •••
Expert system (ES) •••	Neural computing •••	Speech understanding •••
Frontline decision making •••	Optimization •••	Symbolic processing •••
Fuzzy logic •••	Organizational decision support system (ODSS) •••	Turing test •••
Goal Seek feature •••	Organizational knowledge base •••	Virtual groups •••
Goal-seeking analysis •••	Parallel processing •••	Voice synthesis •••
Group decision support system (GDSS) •••		Web-based MSS •••
Inference engine •••		What-if analysis •••

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 Managerial decision making is synonymous with management.
- 1 In today's business environment it is difficult or impossible to conduct analysis of complex problems without computerized support.
- 1 Decision making is becoming more and more difficult due to the trends discussed in Chapter 1. Information technology enables managers to make better and faster decisions.
- 1 Decision making involves four major phases: intelligence, design, choice, and implementation, they can be modeled as such.
- 2 Models allow fast and inexpensive virtual experiments with systems. Models can be iconic, analog, or mathematical.
- 3 A DSS is an approach can improve the effectiveness of decision making, decrease the need for training, improve management control, facilitate communication, reduce costs, and allow for more objective decision making. DSSs deal mostly with unstructured problems
- 3 The major components of a DSS are a database and its management, the model base and its management, and the friendly user interface. An intelligent (knowledge) component can be added.
- 4 Computer support to groups is designed to improve the process of making decisions in groups, which can meet face-to-face, or online. The support increases the effectiveness of decisions and reduces the wasted time and other negative effects of face-to-face meetings.
- 5 Organizational DSSs are systems with many users, throughout the enterprise. This is in contrast with systems that support one person or one functional area.
- 5 Executive support systems are intended to support top executives. Initially these were standalone systems, but today they are part of enterprise systems delivered on intranets.
- 6 The primary objective of AI is to build computers that will perform tasks that can be characterized as intelligent.

- 6 The major characteristics of AI are symbolic processing, use of heuristics instead of algorithms, and application of inference techniques.
- 6 AI has several major advantages: It is permanent; it can be easily duplicated and disseminated; it can be less expensive than human intelligence; it is consistent and thorough; and it can be documented.
- 7 The major application areas of AI are expert systems, natural language processing, speech understanding, intelligent robotics, computer vision, neural networks, fuzzy logic, and intelligent computer-aided instruction.
- 8 Expert system technology attempts to transfer knowledge from experts and documented sources to the computer, in order to make that knowledge available to nonexperts for the purpose of solving difficult problems.
- 8 The major components of an ES are a knowledge base, inference engine, user interface, blackboard, and explanation subsystem.
- 8 Expert systems can provide many benefits. The most important are improvement in productivity and/or quality, preservation of scarce expertise, enhancing other systems, coping with incomplete information, and providing training.
- 9 Natural language processing (NLP) provides an opportunity for a user to communicate with a computer in day-to-day spoken language.
- 9 Speech understanding enables people to communicate with computers by voice. There are many benefits to

this emerging technology, such as speed of data entry and having free hands.

- 10 Neural systems are composed of processing elements called artificial neurons. They are interconnected, and they receive, process, and deliver information. A group of connected neurons forms an artificial neural network (ANN). ANNs are used to discover patterns of relationships among data, to make difficult forecasts, and to fight fraud. It can process incomplete input information.
- 10 Fuzzy logic is a technology that helps analyze situations under uncertainty. The technology can also be combined with an ES and ANN to conduct complex predictions and interpretations. ANNs, fuzzy logic and ES complement each other.
- 11 The Web can facilitate decision making by giving managers easy access to information and to modeling tools to process this information. Furthermore, Web tools such as browsers and search engines increase the speed of gathering and interpreting data. Finally, the Web facilitates collaboration and group decision making.
- 11 The Web helps in building decision support and intelligent systems, providing easy access to them from anywhere reducing their per item cost, as well as in information discovery and customer service.
- 12 Special applications of decision support include complex simulations, ready-made systems and empowerment of frontline employees.

QUESTIONS FOR REVIEW

-
- 1. Describe the manager's major roles.
 - 2. Define models and list the major types used in DSSs.
 - 3. Explain the phases of intelligence, design, and choice.
 - 4. What are structured (programmed) and unstructured problems? Give one example of each in the following three areas: finance, marketing, and personnel administration.
 - 5. Give two definitions of DSSs. Compare DSS to management science.
 - 6. Explain sensitivity analysis.
 - 7. List and briefly describe the major components of a DSS.
 - 8. What is the major purpose of the model base component in a DSS?
 - 9. Define GDSS. Explain how it supports the group decision-making process.
 - 10. What is an organizational DSS?
 - 11. What is the difference between an EIS and an ESS?
 - 12. What are the major benefits of an ESS?
 - 13. What is an enterprise decision simulator?
 - 14. What causes different decision support systems to fail?
 - 15. Define artificial intelligence and list its major characteristics.
 - 16. What is the Turing test?
 - 17. List the major advantages and disadvantages of artificial intelligence as compared with natural intelligence.
 - 18. List the commercial AI technology.
 - 19. List three major capabilities and benefits of an ES.
 - 20. Define the major components of an ES.
 - 21. Which component of ES is mostly responsible for the reasoning capability?
 - 22. List the ten generic categories of ES.
 - 23. Describe some of the limitations of ES.
 - 24. Describe a natural language and natural language processing; list their characteristics.



25. List the major advantages of voice recognition, and voice understanding.
26. What is an artificial neural network?
27. What are the major benefits and limitations of neural computing?
28. Define fuzzy logic, and describe its major features and benefits.
29. Describe simulation as a decision support tool.
30. Define software and intelligent agents and describe their capabilities.
31. How can frontline employees be supported for decision making?

QUESTIONS FOR DISCUSSION

1. What could be the biggest advantages of a mathematical model that supports a major investment decision?
2. Your company is considering opening a branch in China. List several typical activities in each phase of the decision (intelligence, design, choice, and implementation).
2. How is the term *model* used in this chapter? What are the strengths and weaknesses of modeling?
4. American Can Company announced that it was interested in acquiring a company in the health maintenance organization (HMO) field. Two decisions were involved in this act: (1) the decision to acquire an HMO, and (2) the decision of which one to acquire. How can a DSS, ES or ESS be used in such situation?
5. Relate the concept of knowledge subsystem to frontline decision support. What is the role of Web tools in such support?
6. Discuss how GDSSs can negate the dysfunctions of face-to-face meetings (Chapter 4).
7. Discuss the advantages of Internet-based DSSs.
8. A major difference between a conventional decision support system and an ES is that the former can explain a “how” question whereas the latter can also explain a “why” question. Discuss.
9. What is the difference between voice recognition and voice understanding?
10. Compare and contrast neural computing and conventional computing.
11. Fuzzy logic is frequently combined with expert systems and/or neural computing. Explain the logic of such integration.
12. Explain why even an intelligent system can fail.

EXERCISES

1. Sofmic (fictitious name) is a large software vendor. About twice a year, Sofmic acquires a small specialized software company. Recently, a decision was made to look for a software company in the area of data mining. Currently, there are about 15 companies that would gladly cooperate as candidates for such acquisitions.

Bill Gomez, the corporate CEO, asked that a recommendation for a candidate for acquisition be submitted to him within one week. “Make sure to use some computerized support for justification, preferably from the area of AI,” he said. As a manager responsible for submitting the recommendation to Gomez, you need to select a computerized tool for conducting the analysis. Respond to the following points:

 - a. Prepare a list of all the tools that you would consider.
 - b. Prepare a list of the major advantages and disadvantages of each tool, as it relates to this specific case.
 - c. Select a computerized tool.
 - d. Mr. Gomez does not assign grades to your work. You make a poor recommendation and you are out. Therefore, carefully justify your recommendation.
2. Table 12.6 provides a list of ten categories of ES. Compile a list of ten examples from the various functional areas in an organization (accounting, finance, production, marketing, human resources, and so on) that will show functional applications as they are related to the 10 categories.
3. Review the opening case and answer these questions:
 - a. Why do airlines need optimization systems for crew scheduling?
 - b. What role can experts’ knowledge play in this case?
 - c. What are the similarities between the systems in Singapore and Malaysia?
4. *Debate*: Prepare a table showing all the arguments you can think of that justify the position that computers cannot think. Then, prepare arguments that show the opposite.



GROUP ASSIGNMENTS

1. Development of an organizational DSS is proposed for your university. As a group, identify the management structure of the university and the major existing information systems. Then, identify and interview several potential users of the system. In the interview, you should check the need for such a system and convince the potential users of the benefits of the system.
2. Prepare a report regarding DSSs and the Web. As a start go to *dssresources.com*. (Take the DSS tour.) Each group represents one vendor such as *microstrategy.com*, *sas.com*, and *cai.com*. Each group should prepare a report that aims to convince a company why its DSS Web tools are the best.
3. Find recent application(s) of intelligent systems in an organization. Assign each group member to a major functional area. Then, using a literature search, material from vendors, or industry contacts, each member should find two or three recent applications (within the last six months) of intelligent systems in this area. (*Primenet.pcai.com* is a good place to search. Also try the journals *Expert Systems* and *IEEE Intelligent Systems*.)
 - a. The group will make a presentation in which it will try to convince the class via examples that intelligent systems are most useful in its assigned functional area.
 - b. The entire class will conduct an analysis of the similarities and differences among the applications across the functional areas.
 - c. The class will vote on which functional area is benefiting the most from intelligent systems.
4. Each group member composes a list of mundane tasks he or she would like an intelligent software agent to prepare. The group will then meet and compare and draw some conclusions.
5. Investigate the use of NLP and voice recognition techniques that enable consumers to get information from the Web, conduct transactions, and interact with others, all by voice, through regular and cell telephones. Investigate articles and vendors of voice portals and find the state of the art. Write a report.

INTERNET EXERCISES



1. Enter the site of *microstrategy.com* and identify its major DSS products. Find success stories of customers using these products.
2. Find DSS-related newsgroups. Post a message regarding a DSS issue that is of concern to you. Gather several replies and prepare a report.
3. Several DSS vendors provide free demos on the Internet. Identify a demo, view it, and report on its major capabilities. (Try *microstrategy.com*, *sas.com*, *brio.com*, and *crystaldecision.com*. You may need to register at some sites.)
4. Search the Internet for the major DSSs and business intelligence vendors. How many of them market a Web-based system? (Try *businessobjects.com*, *brio.com*, *cognos.com*)
5. Enter *asymetrix.com*. Learn about their decision support and performance management tool suite (Toolbook Assistant). Explain how the software can increase competitive advantage.
6. Find ten case studies about DSSs. (Try *microstrategy.com*, *sas.com*, and *findarticles.com*) Analyze for DSS characteristics.
7. Enter *solver.com*, *ncr.com*, *hyperion.com*, and *ptc.com*. Identify their frontline system initiatives.
8. Prepare a report on the use of ES in help desks. Collect information from *ginesys.com*, *exsys.com*, *ilog.com*, and *pcai.com/pcai*.
9. Enter the Web site of Carnegie Mellon University (*cs.cmu.edu*) and identify current activities on the Land Vehicle. Send an e-mail to ascertain when the vehicle will be on the market.
10. At MIT (*media.mit.edu*) there is a considerable amount of interest in intelligent agents. Find the latest activities regarding IA. (Look at research and projects.)
11. Visit *sas.com/pub/neural/FAZ.html*. Identify links to real-world applications of neural computing in finance, manufacturing, health care, and transportation. Then visit *hnc.com*. Prepare a report on current applications.
12. Visit *spss.com* and *accure.com* and identify their Internet analytic solutions. Compare and comment. Relate your findings to business performance measurement.
13. Enter *del.gov/eLaws/* and *exsps.com* and identify public systems oriented advisory systems. Summarize in a report.



Minicase 1

A DSS Reshapes the Railway in the Netherlands

More than 5,000 trains pass through 2,800 railway kilometers and 400 stations each day in the Netherlands. As of the mid-1990s, the railway infrastructure was hardly sufficient to handle the passenger flow. The problem worsened during rush hours, and trains are delayed. Passengers complained and tended to use cars, whose variable cost is lower than that of using the train. This increased the congestion on the roads, adding pollution and traffic accidents. Several other problems plagued the system. The largest railway company, Nederlandse Spoorweges (NS), was losing money in rural areas and agreed to continue services there only if the government would integrate the railways with bus and taxi systems, so that commuters would have more incentives to use the trains. Government help was needed.

Rail 21 is the name of the government's attempt to bring the system into the twenty-first century. It is a complex, multibillion-dollar project. The government wanted to reduce road traffic among the large cities, stimulate regional economies by providing a better public transportation system, stimulate rail cargo, and reduce the number of short-distance passenger flights in Europe. NS wanted to improve service and profitability. A company called Railned is managing the project, which is scheduled for completion in 2010.

Railned developed several alternative infrastructures (called "cocktails"), and put them to analysis. The analysis involved four steps: (1) use experts to list possible alternative projects, (2) estimate passenger flows in each, using an econometric model, (3) determine optimization of rail lines, and (4) test feasibility. The last two steps were complex enough that following computerized DSSs were developed for their execution:

- **PROLOP:** This DSS was designed to do the lines optimization. It involves a database and three quantitative models. It supports several decisions regarding rails, and it can be used to simulate the scenarios of the "cocktails." It incorporates a management science model, called integer linear programming. PROLOP also compares line systems based on different criteria. Once the appropriate line system is completed, an analysis of the required infrastructure is done, using the second DSS, called DONS.
- **DONS:** This system contains a DSS database, graphical user interface, and two algorithmic modules. The first algorithm computes the arrival and departure times for each train at each station where it stops, based on "hard" constraints (must be met), and "soft" constraints (can be delayed). It represents both safety and

customer-service requirements. The objective is to create a feasible timetable for the trains. If a feasible solution is not possible, planners relax some of the "soft" constraints. If this does not help, modifications in the lines system are explored.

- **STATIONS:** Routing the trains through the railway stations is an extremely difficult problem that cannot be solved simultaneously with the timetable. Thus, STATIONS, another DSS, is used. Again, feasible optimal solutions are searched for. If these do not exist, system modifications are made.

This DSS solution is fairly complex due to conflicting objectives of the government and the railway company (NS), so negotiations on the final choices are needed. To do so, Railned developed a special DSS model for conducting cost-benefit evaluations. It is based on a multiple-criteria approach with conflicting objectives. This tool can rank alternative cocktails based on certain requirements and assumptions. For example, one set of assumptions emphasizes NS long-term profitability, while the other one tries to meet the government requirements.

The DSSs were found to be extremely useful. They reduced the planning time and the cost of the analysis and increased the quality of the decisions. An example was an overpass that required an investment of \$15 million. DONS came up with a timetable that required an investment of only \$7.5 million by using an alternative safety arrangement. The DSS solution is used during the operation of the system as well for monitoring and making adjustments and improvements in the system.

Source: Compiled from Hooghiemstra et al. (1999).

Questions for Minicase 1

1. Why were management science optimizations by themselves not sufficient in this case?
2. What kinds of DSSs were used?
3. Enter *NS.nl* and find information about NS's business partners and the system. (English information is available on some pages.)
4. Given the environment described in the case, which of the DSS generic characteristics described in this chapter are likely to be useful, and how?
5. In what steps of the process can simulation be used, and for what?
6. Identify sensitivity analysis in this case.



Minicase 2

Gate Assignment Display Systems

Gate assignment, the responsibility of gate controllers and their assistants, is a complex and demanding task at any airport. At O'Hare Airport in Chicago, for example, two gate controllers typically plan berthing for about 500 flights a day at about 50 gates. Flights arrive in clusters for the convenience of customers who must transfer to connecting flights, and so controllers must sometimes accommodate a cluster of 30 or 40 planes in 20 to 30 minutes. To complicate the matter, each flight is scheduled to remain at its gate a different length of time, depending on the schedules of connecting flights and the amount of servicing needed. Mix these problems with the need to juggle gates constantly because of flight delays caused by weather and other factors, and you get some idea of the challenges. The problem is even more complex because of its interrelationship with remote parking and constraints related to ground equipment availability and customer requirements.

To solve these problems, many airports are introducing expert systems. The pioneering work was done at Chicago O'Hare in 1987 and 1988. The Korean Air system at Kimpo Airport, Korea, won the 1999 innovative application award from the American Association of Artificial Intelligence (aaai.org). The two systems have several common features and similar architectures.

An intelligent gate assignment system can be set up and quickly rescheduled and contains far more information than a manual system. Its superb graphical display shows times and gate numbers. The aircraft are represented as colored bars; each bar's position indicates the gate assigned, and its length indicates the length of time the plane is expected to occupy the gate. Bars with pointed ends identify arrival-departure flights; square ends are used for originator-terminator flights. The system also shows, in words and numbers near each bar, the flight number, arrival and departure times, plane number, present fuel load, flight status, ground status, and more.

Each arriving aircraft carries a small radio transmitter that automatically reports to the mainframe system when

the nose wheel touches down. The system immediately changes that plane's bar from "off," meaning off the field, to "on," meaning on the field. When the plane is parked at its gate, the code changes to "in." So gate controllers have access to an up-to-the-second ground status for every flight in their display.

The system also has a number of built-in reminders. For instance, it won't permit an aircraft to be assigned to the wrong kind of gate and explains why it can't. The controller can manually override such a decision to meet an unusual situation. The system also keeps its eye on the clock—when an incoming plane is on the field and its gate hasn't been assigned yet, flashing red lines bracket the time to alert the controller.

Three major benefits of the system have been identified. First, the assistant gate controller can start scheduling the next day's operations 4 or 5 hours earlier than was possible before. The Korean system, for example, produces a schedule in 20 seconds instead of in 5 manually worked hours. Second, the ES is also used by zone controllers and other ground operations (towing, cleaning, resupply). At O'Hare, for example, each of the ten zone controllers is responsible for all activities at a number of gates (baggage handling, catering service, crew assignment, and the rest). Third, superreliability is built into these systems.

Sources: Compiled from press releases from the American Association of Artificial Intelligence (1999) and Texas Instruments Data System Group (1988).

Questions for Minicase 2

1. Why is the gate assignment task so complex?
2. Why is the system considered a real-time ES?
3. What are the major benefits of the ES compared to the manual system? (Prepare a detailed list.)
4. Can a system be replicated for similar use in a non-airport environment? Give an example and discuss.



Virtual Company Assignment

Management Decision Support and Intelligent Systems

Everyday, you see Jeremy and Barbara make dozens of decisions, from deciding how much lettuce to buy, to accommodating a schedule request from an employee, to creating a bid on a large dinner party. Given the timing, information, and complexity of these decisions, their responses impress you, but still you wonder if they could make even better decisions if they had the right automated tools.

1. Describe the interpersonal, informational, and decisional roles of the three shift managers at The Wireless Café (Jeremy, Larry, and Arun). How can decision support systems help them in each of these roles?
2. Since the employees of The Wireless Café are quite mobile within the diner, without desks or workstations,

they need to have mobile (and possibly wireless) PDA's. What would you recommend Jeremy and Barbara buy for their managers to help them in their on-the-job decision making?

3. DSS implementation failures can be costly, both in terms of money invested and bad implementations that lead to bad decisions. What are some critical success factors for successful implementation of decision support systems for small as well as large organizations? In your recommendation, consider the kinds of users and the types of interfaces and information.

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PART V
Implementing and Managing



- ▶ 13. Information Technology Economics
- 14. Building Information Systems
- 15. Managing Information Resources and Security
- 16. Impacts of IT on Organizations, Individuals, and Society (online)

CHAPTER

13

Information Technology Economics

State of Iowa

13.1

Economic and Financial Trends

13.2

Evaluating IT Investment: Benefits, Costs, and Issues

13.3

Evaluating IT: Perspectives on Intangible Benefits

13.4

IT Strategies: Chargeback and Outsourcing

13.5

Economics of Web-based Systems and e-commerce

13.6

Other Economic Aspects of Information Technology

Minicases: (1) Intranets / (2) Kone Inc.

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Identify the major aspects of the economics of information technology.
- 2 Explain and evaluate the productivity paradox.
- 3 Describe approaches for evaluating IT investment and explain why it is difficult to do it.
- 4 Explain the nature of intangible benefits and the approaches to deal with it.
- 5 List and briefly describe the traditional and modern methods of justifying IT investment.
- 6 Identify the advantages and disadvantages of approaches to charging end users for IT services (chargeback).
- 7 Identify the advantages and disadvantages of outsourcing.
- 8 Describe the economic impact of EC.
- 9 Describe economic issues related to Web-based technologies including e-commerce.
- 10 Describe causes of systems development failures, the theory of increasing returns, and market transformation through new technologies.



JUSTIFYING IT INVESTMENT IN THE STATE OF IOWA

➡ THE PROBLEM

For years there was little planning or justification for IT projects developed by agencies of the state of Iowa. State agencies requested many projects, knowing that they would get only a few. Bargaining, political favors, and pressures brought to bear by individuals, groups, citizens, and state employees determined who would get what. As a result some important projects were not funded, some unimportant ones were funded, and there was very little incentive to save money.

This situation existed in Iowa until 1999, and it exists even today in most other states, countries, cities, and other public institutions. Any agency that needed money in Iowa for an IT project slipped it into its budget request. A good sales pitch would have resulted in approval. But, this situation, which cost taxpayers lots of money, changed in 1999 when a request for \$22.5 million to fix the Y2K problem was made. This request triggered work that led Iowans to realize that the state government needed a better approach to planning and justifying IT investment.

➡ THE SOLUTION

The solution that Iowa chose is an *IT value model*. The basic idea was to promote *performance-based government*, an approach that measures the results of government programs. Using the principles deployed to justify the investment in the Y2K, a methodology was developed to measure the value an IT project would create. The system is based on the return on investment (ROI) financial model, and is known as R.O. Iowa (a play on words). Its principles are described below.

First, new IT investments are paid for primarily from a pot of money called the Pooled Technology Account, which is appropriated by the legislature and is controlled by the state's IT department. Pooling the funds makes budget oversight easier and help avoid duplication of systems. Second, the IT department reimburses agencies for expenses from this fund only after verifying that they are necessary. If an agency's expenditures are not in line with the project schedule, it's a red flag for auditors that the project could be in trouble.

To support spending decisions, agency managers have to document the expected costs and benefits according to a standard set of factors. The score for each factor ranges from 5 to 15 points, for a maximum total score of 100 points. In addition they must specify metrics related to those factors to justify requests and later to determine the project's success. The scores are based on ten criteria that are used to determine values. Besides asking for standard financial data, the ROI program also requires agencies to detail their technology requirements and functional needs. This level of detail enforces standards, but it also helps officials identify duplicative expenditures. For example, in 2001 several agencies were proposing to build pieces of an ERP system, such as electronic procurement and human resources management. The IS department suggested that, for less money, the state could deploy a single ERP system that agencies could share. The project, which had an estimated cost of \$9.6 million, could easily have cost many times that amount, if agencies were allowed to go it alone.



As noted earlier, once a project is funded, the state scrutinizes agencies' expenses. Agencies have to submit their purchase orders and invoices to the Enterprise Quality Assurance Office for approval before they can be reimbursed.

THE RESULTS

The R.O. Iowa system became, by 2002, a national model for documenting value and prioritizing IT investments in the U.S. public sector. In 2002 the program was named the "Best State IT Management Initiative" by the National Association of State CIOs. It saved Iowa taxpayers more than \$5 million in less than 4 years (about 16 percent of the spending on new IT projects).

The process has changed users' behavior as well. For example, during the fiscal-year 2003 budget approval process, agencies asked for 17 IT projects, and were granted only six. For the year 2004 they asked for only four projects, all of which were granted. Also, there is considerable collaboration among agencies and use of cross-functional teams to write applications, so the need to "play games" to get project funding is largely gone. Another improvement is elimination of duplicated systems. Finally, the methodology minimizes politics and political pressures.

The success of R.O. Iowa led to the Iowa Accounting Government Act, which requires establishing similar methodology in all state investments, not just IT projects.

Source: Compiled from Varon (2003).

LESSONS LEARNED FROM THIS CASE

Justifying the cost of IT is a major financial decision that organizations must make today. The unique aspects of IT make its justification and economics different in many respects from the economics of other aspects of business. This chapter explores the issues related to IT economics.

In order to understand the factors that determine the IT investment justification, we need to understand the technological trends of increasing investment in technology and the changes that IT makes to productivity. These are the first topics we address in the chapter.

A major problem in making IT-related economic decisions is the measurement and comparison of performance under alternative methods. This is done with approaches such as scoring (used in R.O. Iowa), benchmarking, and metrics. Other important issues are assessing intangible variables and dealing with costs, including chargeback and outsourcing which are viable strategies that are explored in this chapter. We also deal with e-commerce, whose economic foundations are also explained here. Finally, we discuss some failure issues which, as pointed out throughout the book, are common in IT and can cost dearly.

13.1 FINANCIAL AND ECONOMIC TRENDS

Technological and Financial Trends

Information technology capabilities are advancing at a rapid rate, and this trend is likely to continue for the foreseeable future. Expanding power and declining costs enable new and more extensive applications of information technology,

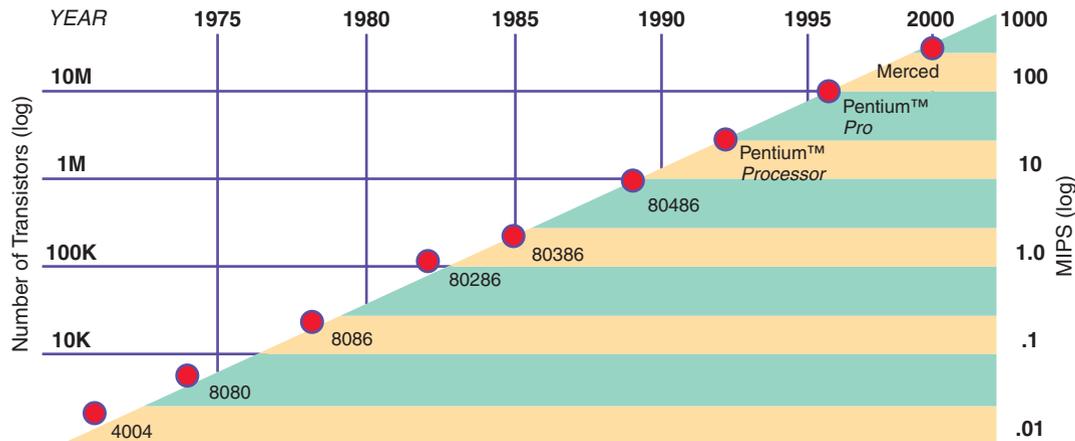


FIGURE 13.1 Moore's law as it relates to Intel microprocessors. (Source: Intel Corporation, intel.com.research/silicon/mooreslaw.htm. Reprinted by permission of Intel Corporation, ©Intel Corporation.)

which makes it possible for organizations to improve their efficiency and effectiveness.

On the hardware side, capabilities are growing at an exponential rate. As discussed in Chapter 1, **Moore's law**, named for one of the founders of Intel Corp., posited that the number of transistors, and thus the power, of an integrated circuit (now, computer chip) would double every year, while the cost remained the same. Moore later revised this estimate to a slightly less rapid pace: doubling every 18 months. Figure 13.1 illustrates Moore's law as it relates to the power of Intel microprocessors, measured in MIPS, or millions of (computer) instructions per second. Moore has also applied the law to the Web, electronic commerce, and supply chain management (see Moore, 1997). Others applied it with slight modifications, to storage capability.

Assuming the current rate of growth in computing power, organizations will have the opportunity to buy, for the same price, twice the processing power in 1½ years, four times the power in 3 years, eight times the power in 4½ years, and so forth. Another way of saying this is that the **price-to-performance ratio** will continue to decline exponentially. Limitations associated with current technologies could end this trend for silicon-based chips in 10 or 20 years (or possibly earlier; see Pountain, 1998), but new technologies will probably allow this phenomenal growth to continue. Advances in network technology, as compared to those in chip technology, are even more profound, as shown in Chapter 1.

What does this growth in computing power mean in economic terms? First, most organizations will perform existing functions at decreasing costs over time and thus become more efficient. Second, creative organizations will find new uses for information technology—based on the improving price-to-performance ratio—and thus become more effective. They will also apply technology to activities that are technically feasible at current power levels but will not be economically feasible until costs are reduced. Information technology will become an even more significant factor in the production and distribution of almost every product and service.



These new and enhanced products and services will provide competitive advantage to organizations that have the creativity to exploit the increasing power of information technology. They will also provide major benefits to consumers, who will benefit from the greater functionality and lower costs.

The remainder of this chapter focuses on evaluating the costs, benefits, and other economic aspects of information technology. Productivity is a major focus of economists, and those who studied the payoff from massive IT investments in the 1970s and 1980s observed what has been called the *productivity paradox*. It is that topic we address next.

What Is the Productivity Paradox?

Over the last 50 years, organizations have invested trillions of dollars in information technology. By the start of the twenty-first century, total worldwide *annual* spending on IT had surpassed two trillion dollars (ITAA, 2000). As this textbook has demonstrated, these expenditures have unquestionably transformed organizations: The technologies have become an integral aspect of almost every business process. The business and technology presses publish many “success stories” about major benefits from information technology projects at individual organizations. It seems self-evident that these investments must have increased productivity, not just in individual organizations, but throughout the economy.

On the other hand, it is very hard to demonstrate, at the level of a national economy, that the IT investments really have increased outputs or wages. Most of the investment went into the service sector of the economy which, during the 1970s and 1980s, was showing much lower productivity gains than manufacturing. Fisher (2001) reports on a study that showed that only 8 percent of total IT spending actually delivers value. Nobel prize winner in economics Robert Solow quipped, “We see computers everywhere except in the productivity statistics.” The discrepancy between measures of investment in information technology and measures of output at the national level has been called the **productivity paradox**.

To understand this paradox, we first need to understand the concept of productivity. Economists define *productivity* as outputs divided by inputs. Outputs are calculated by multiplying units produced (for example, number of automobiles) by their average value. The resulting figure needs to be adjusted for price inflation and also for any changes in quality (such as increased safety or better gas mileage). If inputs are measured simply as hours of work, the resulting ratio of outputs to inputs is *labor productivity*. If other inputs—investments and materials—are included, the ratio is known as *multifactor productivity*. *A Closer Look 13.1* shows an example of a productivity calculation.

Explaining the Productivity Paradox

Economists have studied the productivity issue extensively in recent years and have developed a variety of possible explanations of the apparent paradox (e.g., see Olazabal, 2002). These explanations can be grouped into several categories: (1) problems with data or analyses hide productivity gains from IT, (2) gains from IT are offset by losses in other areas, and (3) IT productivity gains are offset by IT costs or losses. We discuss these explanations in more detail next.

DATA AND ANALYSIS PROBLEMS HIDE PRODUCTIVITY GAINS. Productivity numbers are only as good as the data used in their calculations. Therefore, one possible explanation for the productivity paradox is that the data or the analysis of the data is actually hiding productivity gains.



A CLOSER LOOK

13.1 CALCULATING LABOR PRODUCTIVITY AT THE DRISCOLL COMPANY

Assume that The Driscoll Company uses 10 employees who manually process 1,000 customer service inquiries per day. Unit sales are increasing at 5 percent per year, and the number of customer inquiries is increasing at about the same rate. Turnover among customer service representatives is 20 percent: On the average, two of these employees leave the company every year.

The company purchased an automated call-answering and customer-service system, which should make it possible to increase output per employee by 50 percent. That increase will make it possible to answer the calls using fewer customer-service reps. However, rather than having a layoff to achieve the 50 percent productivity gain right away, the company will wait until there is a need to hire new employees to replace those who leave. The following calculations compare productivity with the previous system and new systems.

PRODUCTIVITY WITH THE MANUAL SYSTEM:

$$1,000 \text{ inquiries}/10 \text{ employees} = 100 \text{ inquiries handled per employee per day}$$

PRODUCTIVITY WITH THE AUTOMATED SYSTEM (ONE YEAR LATER):

$$1,050 \text{ inquiries}/8 \text{ employees} = 131 \text{ inquiries handled per employee per day}$$

The productivity increase is 31 percent ($131 - 100 = 31 \div 100 \text{ calls} = 31\%$). Productivity will increase further as additional employees leave up, to the 50 percent increase determined by the technology.

For manufacturing, it is fairly easy to measure outputs and inputs. General Motors, Ford, and DaimlerChrysler, for example, produce motor vehicles, relatively well-defined products whose quality changes gradually over time. It is not difficult to identify, with reasonable accuracy, the inputs used to produce these vehicles. However, the trend in the United States and other developed countries is away from manufacturing and toward services.

In service industries, such as finance or health care delivery, it is more difficult to define what the products are, how they change in quality, and how to allocate to them the corresponding costs. For example, banks now use IT to handle a large proportion of deposit and withdrawal transactions through automated teller machines (ATMs). The ability to withdraw cash from ATMs 24 hours per day, 7 days per week is a substantial quality increase in comparison to the traditional 9 A.M. to 4 P.M. hours for live tellers. But what is the value of this quality increase in comparison with the associated costs? If the incremental value exceeds the incremental costs, then it represents a productivity gain; otherwise the productivity impact is negative.

Similarly, the productivity gains may not be apparent in all processes supported by information systems. Mukhopadhyay et al. (1997), in an assessment of productivity impacts of IT on a toll-collection system, found that IT had a significant impact on the processing of complex transactions, but not on simple transactions. Based on an investigation of IT performance in 60 construction-industry firms in Hong Kong, Li et al. (2000) found productivity improvements in architecture and quantity surveying firms (which perform a wide range of functions involved in the estimation and control of construction project costs) and no evidence of productivity improvement in engineering firms.



Another important consideration is the amount of time it takes to achieve the full benefits of new technologies. Economists point out that it took many decades to start achieving the full productivity impacts of the Industrial Revolution. Productivity actually may decrease during the initial learning period of new software and then increase over a period of a year or longer.

Hitt and Brynjolfsson (1996) point out that answers to questions about the value of IT investments depend on how the issue is defined. They emphasize that productivity is not the same thing as profitability. Their research indicates that IT increases productivity and value to consumers but does not increase organizational profitability. Brynjolfsson and Hitt (1998) suggest using alternate measures, other than traditional productivity measures, to measure productivity.

IT PRODUCTIVITY GAINS ARE OFFSET BY LOSSES IN OTHER AREAS. Another possible explanation of the productivity paradox is that IT produces gains in certain areas of the economy, but that these gains are offset by losses in other areas. One company's IT usage could increase its share of market at the expense of the market share of other companies. Total output in the industry, and thus productivity, remains constant even though the competitive situation may change.

Offsetting losses can also occur within organizations. Consider the situation where an organization installs a new computer system that makes it possible to increase output per employee. If the organization reduces its production staff but increases employment in unproductive overhead functions, the productivity gains from information technology will be dispersed.

IT PRODUCTIVITY GAINS ARE OFFSET BY IT COSTS OR LOSSES. The third possibility is that IT in itself really does not increase productivity. This idea seems contrary to common sense: Why would organizations invest tremendous amounts of money in something that really does not improve performance? On the other hand, there are considerations that support this possibility. Strassmann (1997) compared relative IT spending at a sample of corporations and found little or no relationship between IT spending and corporate profitability. (See *Online File W13.1*.)



To determine whether IT increases productivity, it is not enough simply to measure changes in outputs for a new system. If outputs increase 40 percent but inputs increase 50 percent, the result is a decline in productivity rather than a gain. Or consider a situation where a new system is developed and implemented but then, because of some major problems, is replaced by another system. Even though the second system has acceptable performance, an analysis that includes the costs of the unsuccessful system could indicate that IT did not increase productivity, at least in the short run.

Therefore, productivity evaluations must include changes in inputs, especially labor, over the total life cycle, including projects that are not implemented. These inputs need to include not just the direct labor required to develop and operate the systems, but also indirect labor and other costs required to maintain the system. Examples of factors that, under this broader perspective, reduce productivity include:

- **Support costs.** The GartnerGroup estimates the total cost of a networked PC can be as high as \$13,000 per year (Munk, 1996). Technical support accounts

FIGURE 13.2 Dilbert analyzes the productivity paradox. (Source: Dilbert; reprinted by permission of United Feature Syndicate, Inc.)



for 27 percent of this cost, and administration for another 9 percent. The additional employees required for these support activities could offset a significant portion of the productivity benefits from the hardware and software.

- **Wasted time.** Personal computers make it possible to work more productively on some tasks but also result in nonproductive activities. A survey of 6,000 workers indicated the average PC user loses 5 hours per week waiting—for programs to run, reports to print, tech support to answer the phone, and so on—or “futzing” with the hardware or software (Munk, 1996). The GartnerGroup estimates that businesses lose 26 million hours of employee time per year to these nonproductive activities, and that these activities account for 43 percent of the total cost of a personal computer on a network. The cartoon in Figure 13.2 highlights the issue of wasted time. Employees also use the Internet and e-mail for private purpose, wasting even more time.
 - **Software development problems.** Some information systems projects fail and are not completed. Others are abandoned—completed but never used. Others are **runaway projects**, systems that are eventually completed but require much more time and money than originally planned. Software development problems are not uncommon: One survey (King, 1997) found that 73 percent of software projects at 360 U.S. corporations were canceled, over budget, or were late. Labor hours associated with these projects can offset productivity gains from more successful projects.
 - **Software maintenance.** The expense of software maintenance, which includes fixing bugs and modifying or enhancing system functionality, now accounts for up to 80 percent of IS budgets (see Murphy, 2003). Many of the modifications—for example, updates to payroll systems to reflect tax law changes—do not increase outputs. They are necessary just to keep the system at the same level of performance, so productivity declines because labor increases while output volumes do not. The “Year 2K Problem” is a notable example of software maintenance that did not add to productivity. (For more on this aspect of the Y2K problem, see *Online File W13.2*.)
- Most global organizations are also required to incur additional costs for acquiring and maintaining domain name registrations. GartnerGroup (2000) estimated that the average global organization has to register a total of at least 300 name variants, which may amount to \$75,000. Many additional names are required because companies want to avoid cyberbashing.
- **Incompatible systems and workarounds.** Although individual systems produce productivity gains, the increased labor required to get them to work together (or at all) could offset these benefits.





Conclusion: Does the Productivity Paradox Matter?

Other possible explanations of the productivity paradox have been noted. A number of researchers have pointed out, for example, that time lags may throw off the productivity measurements (Reichheld and Scheffer, 2000; Qing and Plant, 2001). Many IT investments, especially those in CRM, for example, take 5 or 6 years to show results, but many studies do not wait that long to measure productivity changes. For a list of other explanations of the paradox proposed by Devaraj and Kohli (2002), see *Online File W13.3*.

The productivity-offsetting factors described earlier largely reflect problems with the administration of IT, rather than with the technologies themselves. In many cases these problems in administration are controllable through better planning or more effective management techniques. For organizations, the critical issue is not whether and how IT increases productivity *in the economy as a whole*, but how it improves their own productivity. Lin and Shao (2000) find a robust and consistent relationship between IT investment and efficiency, and they support evaluating IT investments in terms of organizational efficiency rather than productivity. For the results of a comprehensive study on the economic value of IT in Europe see Legrenzi (2003).

Some of the difficulties in finding the relationship between IT investment and organizational performance can be seen in Figure 13.3. The relationships are basically indirect, via IT assets and IT impacts. The figure shows that the relationship between IT investment and performance are not direct; other factors exist in between. This is exactly why the productivity paradox exists, since these intermediary factors (in the middle of the figure) can moderate and influence the relationship.

The inconclusiveness of studies about the value of IT investment and inaccuracies in measurements have prompted many companies to skip formal evaluations (see Seddon et al., 2002, and Sawhney, 2002). However, as became apparent during the dot-coms bubble, when many dot-coms were started and almost as many quickly failed, this can be a very risky approach. Therefore, before deciding to skip evaluation, an organization should examine some of the new methods which may result in more accurate evaluation (see Section 13.3).

Many believe that the productivity paradox as it relates to IT is no longer valid, since we are able to explain what caused it. Others believe that the issue is still very relevant, especially on the level of the economy as a whole. They claim that the paradox still matters because IT has failed to lift productivity growth throughout the economy, although it may have improved productivity

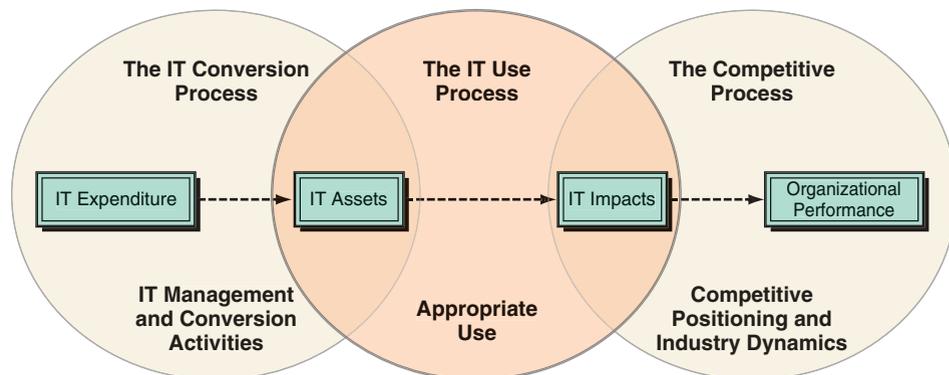


FIGURE 13.3 Process approach to IT organizational investment and impact. (Source: Soh and Markus, 1995.)



at the level of firms or of industries. We may not at this point be able to provide a final answer to the question about whether the paradox still matters. The important conclusion that we can draw is that we need to be careful in measuring the economic contributions of information technology on all three levels—firms, industries, and economies. Because almost 50 percent of all capital investment in the United States is in IT and it is growing with time, it is even more important to properly assess its benefits and costs, and that is what this chapter is attempting to do.

The next three sections cover ways organizations can evaluate IT benefits and costs and target their IT development and acquisition toward systems that will best contribute to the achievement of organizational goals.

13.2 EVALUATING IT INVESTMENT: BENEFITS, COSTS, AND ISSUES

Evaluating IT investment covers many topics. Let's begin by categorizing types of IT investment.

IT Investment Categories

One basic way to segregate IT investment is to distinguish between investment in infrastructure and investment in specific applications.

IT infrastructure, as defined in Chapter 2, provides the foundations for IT applications in the enterprise. Examples are a data center, networks, data warehouse, and knowledge base. Infrastructure investments are made for a long time, and the infrastructure is shared by many applications throughout the enterprise. For the nature and types of IT infrastructure, see Broadbent and Weill (1997). *IT applications*, as defined in Chapter 2, are specific systems and programs for achieving certain objective—for example, providing a payroll or taking a customer order. The number of IT applications is large. Applications can be in one functional department, as shown in Chapter 7, or they can be shared by several departments, which makes evaluation of their costs and benefits more complex.

Another way to look at IT investment categories is proposed by Ross and Beath (2002). As shown in Table 13.1, their categories are based on the purpose of the investment (called drivers in the table). They also suggest a cost justification (funding approach) as well as the probable owner. Still other investment categories are offered by Devaraj and Kohli (2002), who divide IT investments into operational, managerial, and strategic types, and by Lucas (1999), whose types of investment are shown in *Online File W13.4*. The variety of IT investment categories demonstrates the complex nature of IT investment.



The Value of Information in Decision Making

People in organizations use information to help them make decisions that are better than they would have been if they did not have the information. Senior executives make decisions that influence the profitability of an organization for years to come; operational employees make decisions that affect production on a day-to-day basis. In either case, the value of information is the difference between the *net benefits* (benefits adjusted for costs) of decisions made using information and the net benefits of decisions made without information. The value of the net benefits with information obviously needs to reflect the additional costs of obtaining the information. The value of information can be expressed as follows:

$$\begin{aligned} \text{Value of information} &= \text{Net benefits with information} \\ &\quad - \text{Net benefits without information} \end{aligned}$$

**TABLE 13.1** Categories of IT Investments

Investment Type	Drivers	Funding Approach	Probable Owner	Sample Initiative
Transformation	A core infrastructure that is inadequate for desired business model	Executive-level allocation	Entire company or all affected business units	ERP implementations Transforming network to TCP/IP Standardizing desktop technologies Building data warehouses Implementing middleware layer to manage Web environment
Renewal	Opportunity to reduce cost or raise quality of IT services A vendor's decision to stop supporting existing technology	Business case Annual allocation under CIO	Technology owner or service provider (usually IT for shared components)	Purchasing additional capacity Enabling purchase discounts Facilitating access to existing data Upgrading technology standards Retiring outdated systems and technologies
Process improvement	Opportunity to improve operational performance	Business case	Strategic business unit (SBU), process owner or functional area that will realize the benefits	Shifting customer services to lower-cost channel Allowing employees to self-serve for benefits, HR services Shifting data capture to customers Eliminating costs of printing and mailing paper reports of bills Streamlining cycle times for processes Capturing new data automatically
Experiments	New technologies, new ideas for products or processes, new business models	Business or executive-level allocation	IT unit, SBU or functional area needing to learn	Testing demand for new products Testing cannibalization of channels Learning if customers can self-serve Testing new pricing strategy Assessing customer interest in new channels, new technologies Assessing costs of new channels

Source: Ross and Beath (2000), p. 54.

It is generally assumed that systems that provide relevant information to support decision making will result in better decisions, and therefore they will contribute toward the return on investment. But, this is not always the case. For example, Dekker and de Hoog (2000) found that the return on most knowledge assets created for loan evaluation decisions in a large bank was negative. However, as technology gets cheaper and applications get more sophisticated, this situation is changing, making it more attractive to use technology not only to improve service but also to increase profit. Careful evaluation of investment in information systems is needed.

A popular alternative is to have the decision maker subjectively estimate the value of the information. This person is most familiar with the problem and has the most to lose from a bad decision. However, to make sure the estimates are not inflated in order to get an approval, the organization needs to hold the decision maker accountable for the cost of the information. Before we deal with



such accountability we will examine the methodologies of evaluating automation of business processes with IT.

Evaluating IT Investment by Traditional Cost-Benefit Analysis

Automation of business processes is an area where it is necessary to define and measure IT benefits and costs. For example, automation was implemented in the organization's business offices when word processing replaced typing and spreadsheet programs replaced column-ruled accounting pads and 10-key calculators. In the factory, robots weld and paint automobiles on assembly lines. In the warehouse, incoming items are recorded by bar-code scanners. The decision of whether to automate is an example of a *capital investment* decision. Another example is replacement of an old system by a new or improved one. Traditional tools used to evaluate capital investment decisions are net present value and return on investment.

USING NPV IN COST-BENEFIT ANALYSIS. Capital investment decisions can be analyzed by **cost-benefit analyses**, which compare the total value of the benefits with the associated costs. Organizations often use *net present value (NPV)* calculations for cost-benefit analyses. In an NPV analysis, analysts convert future values of benefits to their present-value equivalent by discounting them at the organization's cost of funds. They then can compare the present value of the future benefits to the cost required to achieve those benefits, in order to determine whether the benefits exceed the costs. (For more specific guidelines and decision criteria on how NPV analysis work, consult financial management textbooks.)

The NPV analysis works well in situations where the costs and benefits are well defined or "tangible," so that it is not difficult to convert them into monetary values. For example, if human welders are replaced by robots that produce work of comparable quality, the benefits are the labor cost savings over the usable life of the robots. Costs include the capital investment to purchase and install the robots, plus the operating and maintenance costs.

RETURN ON INVESTMENT. Another traditional tool for evaluating capital investments is *return on investment (ROI)*, which measures the effectiveness of management in generating profits with its available assets. The ROI measure is a percentage, and the higher this percentage return, the better. It is calculated essentially by dividing net income attributable to a project by the average assets invested in the project. An example of a detailed studies of the ROI of a portal, commissioned by Plumtree Software and executed by META group can be found at plumtree.com (also white papers at metagroup.com). Davamanirajan et al. (2002) found an average 10 percent rate of return on investment in IT projects in the financial services sector. For a comprehensive study see Kudyba and Vitaliano (2003).

Costing IT Investment

Placing a dollar value on the cost of IT investments may not be as simple as it may sound. One of the major issues is to allocate fixed costs among different IT projects. *Fixed costs* are those costs that remain the same in total regardless of change in the activity level. For IT, fixed costs include infrastructure cost, cost of IT services (Gerlach et al., 2002), and IT management cost. For example, the salary of the IT director is fixed, and adding one more application will not change it.



Another area of concern is the fact that the cost of a system does not end when the system is installed. Costs for keeping it running, dealing with bugs, and for improving and changing the system may continue for some time. Such costs can accumulate over many years, and sometimes they are not even anticipated when the investment is made. An example is the cost of the year Y2K reprogramming projects that cost billions of dollars to organizations worldwide. (For a discussion see Read et al., 2001.)

The fact that organizations use IT for different purposes further complicates the costing process (see DiNunno, 2002, for discussion). There are multiple kinds of values (e.g., improved efficiency, improved customer or partner relations); the return of a capital investment measured in numeric (e.g., dollar or percentage) terms is only one of these values. In addition, the probability of obtaining a return from an IT investment also depends on probability of implementation success. These probabilities reflect the fact that many systems are not implemented on time, within budget, and/or with all the features originally envisioned for them. Finally, the expected value of the return on IT investment in most cases will be less than that originally anticipated. For this reason, Gray and Watson (1998) pointed out that managers often make substantial investments in projects like data warehousing by relying on intuition when evaluating investment proposals rather than on concrete evaluation.

After the dot-com problems of 2000–2002 it became almost mandatory to justify IT projects with a solid business case, including ROI. However, according to Sawhney 2002, and others this may have little value due to the difficulties in dealing with intangible benefits. These are real and important, but it is not easy to accurately estimate their value. (For further guidelines on cost-benefit analysis, see Clermont, 2002.)

The Problem of Intangible Benefits

As indicated above, in many cases IT projects generate **intangible benefits** such as increased quality, faster product development, greater design flexibility, better customer service, or improved working conditions for employees. These are very desirable benefits, but it is difficult to place an accurate monetary value on them. For example, many people would agree that e-mail improves communications, but it is not at all clear how to measure the value of this improvement. Managers are very conscious of the bottom line, but no manager can prove that e-mail is responsible for so many cents per share of the organization's total profits.

Intangible benefits can be very complex and substantial. For example, according to Arno Penzias, a Nobel Laureate in physics, the New York Metropolitan Transit Authority (MTA) had not found the need to open another airport for almost two decades, even when traffic had tripled. This, according to his study was due to productivity gains derived from improved IT systems (quoted by Devaraj and Kohli, 2002). IT systems added by the MTA played critical roles in ticket reservations, passenger and luggage check-in, crew assignment and scheduling, runway maintenance and management, and gate assignments. These improvements enabled MTA to cope with increased traffic without adding new facilities, saving hundreds of millions of dollars. Many similar examples of increased capacity exist.

An analyst could ignore such intangible benefits, but doing so implies that their value is zero and may lead the organization to reject IT investments that could substantially increase revenues and profitability. Therefore, financial



analyses need to consider not just tangible benefits but also intangible benefits in such a way that the decision reflects their potential impact. The question is how to do it.

HANDLING INTANGIBLE BENEFITS. The most straightforward solution to the problem of evaluating intangible benefits in cost-benefit analysis is to make *rough estimates* of monetary values for all intangible benefits, and then conduct a NVP or similar financial analysis. The simplicity of this approach is attractive, but in many cases the assumptions used in these estimates are debatable. If the technology is acquired because decision makers assigned too high a value to intangible benefits, the organization could find that it has wasted some valuable resources. On the other hand, if the valuation of intangible benefits is too low, the organization might reject the investment and then find that it is losing market share to competitors who did implement the technology. (See Plumtree Corp., 2001, for a study on translating intangible benefits to dollar amounts.)

There are many approaches to handling intangibles (e.g., see Read et al., 2001). Sawhney (2002) suggests the following solutions:

- **Think broadly and softly.** Supplement hard financial metrics with soft ones that may be more strategic in nature and may be important leading indicators of financial outcomes. Measures such as customer and partner satisfaction, customer loyalty, response time to competitive actions, and improved responsiveness are examples of soft measures. Subjective measures can be objective if used consistently over time. For instance, customer satisfaction measured consistently on a five-point scale can be an objective basis for measuring the performance of customer-facing initiatives.
- **Pay your freight first.** Think carefully about short-term benefits that you can “pay the freight” for the initial investment in the project. For example, a telecom company found that it could justify its investment in data warehousing based on the cost savings from data mart consolidation, even though the real payoffs from the project would come later from increased cross-selling opportunities.
- **Follow the unanticipated.** Keep an open mind about where the payoff from IT and e-business projects may come from, and follow opportunities that present themselves. Eli Lilly & Co. created a Web site called InnoCentive (innocentive.com) to attract scientists to solve problems in return for financial rewards (“bounties”). In the process, Lilly established contact with 8,000 exceptional scientists, and the Lilly’s HR department has used this list of contacts for recruiting.

The Business Case Approach

One method used to justify investments in projects, or even in entire new companies, is referred to as the *business case approach*. The concept of a business case received lots of attention in the mid 1990s when it was used to justify funding for investment in dot-coms. In 2002–2003, it has become clear that one of the reasons for the collapse of the dot-com bubble was improper business cases submitted to investors. Nevertheless, if done correctly, business cases can be a useful tool.

A **business case** is a written document that is used by managers to garner funding for one or more specific applications or projects. Its major emphasis is the justification for a specific required investment, but it also provides the bridge between the initial plan and its execution. Its purpose is not only to get approval

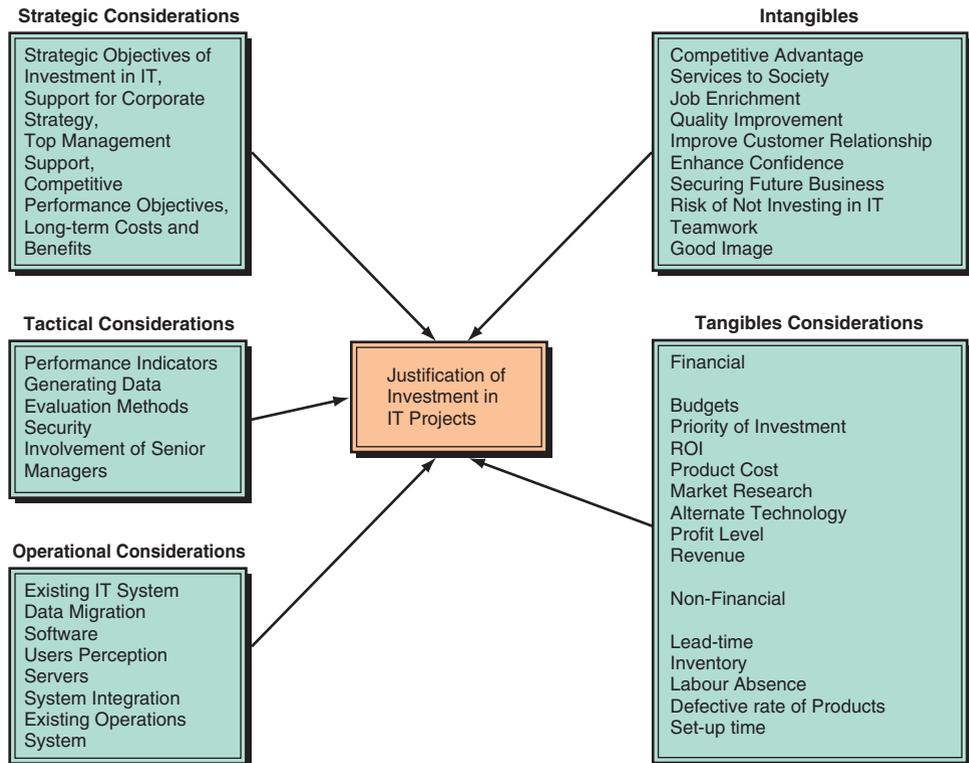


FIGURE 13.4 A model for investment justification in IT projects. (Source: Gunagekaran et. Al., 2001, p. 354.)

and funding, but also to provide the foundation for tactical decision making and technology risk management. A business case is usually conducted in existing organizations that want to embark on new IT projects (for example, an e-procurement project). The business case helps to clarify how the organization will use its resources in the best way to accomplish the IT strategy. It helps the organization concentrate on justifying the investment, on risk management, and on fit of an IT project with the organization's mission. Software for preparing a business case for IT (and for EC in particular) is commercially available (e.g., from *paloalto.com* and from *bplans.com*).

A business case for IT investment can be very complex. Gunasekaran et al. (2001) divided such justification to five parts as shown in Figure 13.4.

Sometimes an IT project is necessary in order for the organization to stay in business, and in those instances, the business case is very simple: "We must do it, we have no choice." For example, the U.S. Internal Revenue Service is requiring businesses to switch to electronic systems for filing their tax returns. Similarly, sometimes an organization must invest because its competitors have done so and if it does not follow, it will lose customers. Examples are e-banking and some CRM services. These types of investments do not require firms to do a lot of analysis.

For a description of business cases in e-commerce, see Turban et al. (2004). For a tool for building a business case, see *sap.com/solutions/case builder*. For a discussion of how to conduct a business case for global expansion see DePalma (2001). An example of a business case for wireless networks, prepared by Intel Corp. (2002), is presented in *Online File W13.5*.



**TABLE 13.2** Traditional Methods of Evaluating Investments

Method	Advantages	Disadvantages
Internal rate of return (IRR)	Brings all projects to common footing. Conceptually familiar.	Assumes reinvestment at same rate. Can have multiple roots. No assumed discount rate.
Net present value or net worth (NPV or NW)	Very common. Maximizes value for unconstrained project selection.	Difficult to compare projects of unequal lives or sizes.
Equivalent annuity (EA)	Brings all project NPVs to common footing. Convenient annual figure.	Assumes projects repeat to least common multiple of lives, or imputes salvage value.
Payback period	May be discounted or nondiscounted. Measure of exposure.	Ignores flows after payback is reached. Assumes standard project cash flow profile.
Benefit-to-cost ratio	Conceptually familiar. Brings all projects to common footing.	May be difficult to classify outlays between expense and investment.

Source: Compiled from *Capital Budgeting and Long-Term Financing Decisions*, 2nd ed., by N. E. Seitz © 1995. Reprinted with permission of South-Western College Publishing, a division of Thomson Learning.

Evaluating IT Investment: Conclusions

This section has showed that several traditional methods can be used to assess the value of IT information and IT investment. Table 13.2 lists some of the traditional financial evaluation methods with their advantages and disadvantages. Different organizations use different methods, which often are chosen by management and may change over time as an organization's finance personnel come and go. For example, many companies have automated programs that use company-specific inputs and hurdles for making ROI calculations.

However, traditional methods may not be useful in some of the newest technologies (e.g., see Violino, 1997). (An example of one such case—acquiring expert systems—is shown in *Online File W13.6*). Because traditional methods may not be useful for evaluating new technologies, there are special methodologies (some of them incorporated in computerized models) for dealing with investment in IT. We will address some of these methods in the next section.

13.3 METHODS FOR EVALUATING AND JUSTIFYING IT INVESTMENT

As indicated earlier, evaluating and justifying IT investment can pose different problems from traditional capital investment decisions such as whether to buy a new delivery truck. However, even though the relationship between intangible IT benefits and performance is not clear, some investments should be better than others. How can organizations increase the probability that their IT investments will improve their performance?

A comprehensive list of over 60 different appraisal methods for IT investments can be found in Renkema (2000). The appraisal methods are categorized into the following four types.

- **Financial approach.** These appraisal methods consider only impacts that can be monetary-valued. They focus on incoming and outgoing cash flows as a



result of the investment made. Net present value and return on investment are examples of financial-approach methods.

- **Multicriteria approach.** These appraisal methods consider both financial impacts and nonfinancial impacts that cannot be (or cannot easily be) expressed in monetary terms. These methods employ quantitative and qualitative decision-making techniques. Information economics and value analysis are examples.
- **Ratio approach.** These methods use several ratios (e.g., IT expenditures vs. total turnover) to assist in IT investment evaluation.
- **Portfolio approach.** These methods apply portfolios (or grids) to plot several investment proposals against decision-making criteria. The portfolio methods are more informative compared to multicriteria methods and generally use fewer evaluation criteria.

The following specific evaluation methods that are particularly useful in evaluating IT investment are discussed in this section: total cost of ownership, value analysis, information economics, use of benchmarks, management by maxim, and real-option valuation. Other methods are cited briefly at the end of the section.

Total Cost of Ownership

As mentioned earlier, the costs of an IT system can sometimes accumulate over many years. An interesting approach for IT cost evaluation is the **total cost of ownership (TCO)**. TCO is a formula for calculating the cost of owning, operating, and controlling an IT system, even one as simple as a PC. The cost includes *acquisition cost* (hardware and software), *operations cost* (maintenance, training, operations, evaluation, technical support, installation, downtime, auditing, viruses damage, and power consumption), and *control cost* (standardization, security, central services). The TCO can be a hundred percent higher than just the cost of the hardware, especially for PCs (David et al., 2002). By identifying these various costs, organizations can make more accurate cost-benefit analyses. A methodology for calculating TCO is offered by David et al. (2002). They also provide a detailed example of the items to be included in the TCO calculations (see *Online File W13.7*) For further discussion, see Vijayan (2001) and Blum (2001), and for a comprehensive study, see Ferrin and Plank (2002).



A similar concept to TCO is **total benefits of ownership (TBO)**. These benefits cover both tangible and the intangible benefits. By calculating and comparing both TCO and TBO, one can compute the payoff of an IT investment [$\text{Payoff} = \text{TBO} - \text{TCO}$]. For details on the calculations, see Devaraj and Kohli (2002) and also *Online File W13.7*.

Value Analysis

The **value analysis** method evaluates intangible benefits on a low-cost, trial basis before deciding whether to commit to a larger investment in a complete system. Keen (1981) developed the value analysis method to assist organizations considering investments in decision support systems (DSSs). The major problem with justifying a DSS is that most of the benefits are intangible and not readily convertible into monetary values. Some—such as better decisions, better understanding of business situations, and improved communication—are difficult to measure even in nonmonetary terms. These problems in evaluating DSS are similar to the problems in evaluating intangible benefits for other types of systems. Therefore, value analysis could be applicable to other types of IT

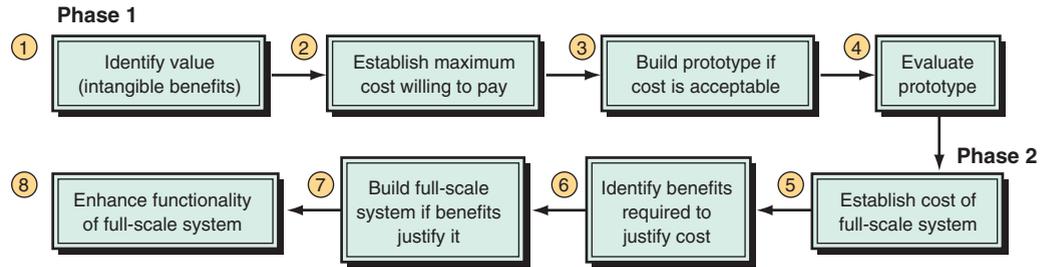


FIGURE 13.5 Steps in the Value Analysis Approach.

investments in which a large proportion of the added value derives from intangible benefits.

The value analysis approach includes eight steps, grouped into two phases. As illustrated in Figure 13.5, the first phase (first four steps) works with a low-cost prototype. Depending on the initial results, this prototype is followed by a full-scale system in the second phase.

In the first phase the decision maker identifies the desired capabilities and the (generally intangible) potential benefits. The developers estimate the cost of providing the capabilities; if the decision maker feels the benefits are worth this cost, a small-scale prototype of the DSS is constructed. The prototype then is evaluated.

The results of the first phase provide information that helps with the decision about the second phase. After using the prototype, the user has a better understanding of the value of the benefits, and of the additional features the full-scale system needs to include. In addition, the developers can make a better estimate of the cost of the final product. The question at this point is: What benefits are necessary to justify this cost? If the decision maker feels that the system can provide these benefits, development proceeds on the full-scale system.

Though it was designed for DSSs, the value analysis approach is applicable to any information technology that can be tested on a low-cost basis before deciding whether to make a full investment. The current trend of buying rather than developing software, along with the increasingly common practice of offering software on a free-trial basis for 30 to 90 days, provide ample opportunities for the use of this approach. Organizations may also have opportunities to pilot the use of new systems in specific operating units, and then to implement them on a full-scale basis if the initial results are favorable. For further discussion see Fine et al. (2002).

Information Economics

The **information economics** approach is similar to the concept of critical success factors in that it focuses on key organizational objectives, including intangible benefits. Information economics incorporates the familiar technique of *scoring* methodologies, which are used in many evaluation situations.

A **scoring methodology** evaluates alternatives by assigning weights and scores to various aspects and then calculating the weighted totals. The analyst first identifies all the key performance issues and assigns a weight to each one. Each alternative in the evaluation receives a score on each factor, usually between zero and 100 points, or between zero and 10. These scores are multiplied by the weighting factors and then totaled. The alternative with the highest score is judged the best (or projects can be ranked, as in the R.O.Iowa case at the beginning of the chapter). *A Closer Look 13.2* shows an example of using a scoring methodology to evaluate two different alternatives.



A CLOSER LOOK

13.2 SCORING WORKSHEET FOR EVALUATION OF ALTERNATIVES A VERSUS B

Decision Participant Most Interested in Criteria

Criteria	Weight	Alternative A Grade	Alternative A Score	Alternative B Grade	Alternative B Score
<i>Intangibles (Benefits and Risks)</i>					
CEO	4	2	8	2	8
CEO	4	3	12	5	20
CFO	4	4	16	2	8
CFO	4	3	12	3	12
VP, Human Resources (HR)	2	2	4	1	2
CIO	2	-1	-2	-3	?6
CIO	2	-1	-2	-2	?4
Total Senior Management	22		48		40
CFO	2	2	4	2	4
CFO	2	2	4	3	6
Dir. Acctg.	2	3	6	2	4
Director, Fincl. Reporting	2	3	6	3	6
Total Finance	8		20		20
VP-HR	2	3	6	3	6
VP-HR	2	3	6	2	4
Dir. Employee Relations (ER)	2	3	6	2	4
VP-HR	2	3	6	2	4
Dir.-ER	2	-2	-4	-3	-6
Total Human Resources	10		20		12
CIO	2	4	8	2	4
Director, Systems	2	4	8	3	6
Dir.-Sys	2	4	8	3	6
Dir.-Sys	2	4	8	4	8
CIO	2	2	4	4	8
Total Information Systems	10		36		32
Total Intangibles	50		124		104
<i>Tangible Benefits</i>					
CEO	20	3	60	3	60
CEO	20	3	60	2	40
Total Tangibles	40		120		100
The results favor option A (Total of 244 vs. 204)					
Grand Total	90		244		204

Source: Compiled from "Peoplesoft Strategic Investment Model," Peoplesoft.com (accessed August 1997).



The information economics approach uses *organizational objectives* to determine which factors to include, and what weights to assign, in the scoring methodology. The approach is flexible enough to include factors in the analysis such as impacts on customers and suppliers (the value chain). Executives in an organization determine the relevant objectives and weights at a given point in time, subject to revision if there are changes in the environment. These factors and weights are then used to evaluate IT alternatives; the highest scores go to the items that have the greatest potential to improve organizational performance.

Note that this approach can incorporate both tangible and intangible benefits. If there is a strong connection between a benefit of IT investment (such as quicker decision making) and an organizational objective (such as faster product development), the benefit will influence the final score even if it does not have a monetary value. Thus the information economics model helps solve the problem of assessing intangible benefits by linking the evaluation of these benefits to the factors that are most important to organizational performance.

Approaches like this are very flexible. The analyst can vary the weights over time; for example, tangible benefits might receive heavier weights at times when earnings are weak. The approach can also take risk into account, by using negative weights for factors that reduce the probability of obtaining the benefits. Information economic studies appear in various shapes depending on the circumstances. An example in banking is provided by Peffers and Sarrinan (2002). Note that in this study, as in many others, special attention is paid to the issue of *risk assessment*. (See also Gaulke, 2002.) *Online File W13.8* shows an analysis of a decision of whether to develop a system in-house or buy it. Information economics can be implemented by software packages such as Expert Choice (expertchoice.com).



Assessing Investments in IT Infrastructure

Information systems projects are usually not stand-alone applications. In most cases they depend for support on enabling infrastructures already installed in the organization. These infrastructure technologies include mainframe computers, operating systems, networks, database management systems, utility programs, development tools, and more. Since many of the infrastructure benefits are intangible and are spread over many different present and future applications, it is hard to estimate their value, or evaluate the desirability of enhancements or upgrades. In other words, it is much more difficult to evaluate infrastructure investment decisions than investments in specific information systems application projects. Two methods are recommended: use of benchmarks, and management by maxim.

USING BENCHMARKS TO ASSESS INFRASTRUCTURE INVESTMENTS. One approach to evaluating infrastructure is to focus on *objective* measures of performance known as *benchmarks*. These measures are often available from trade associations within an industry or from consulting firms. A comparison of measures of performance or a comparison of an organization's expenditures with averages for the industry or with values for the more efficient performers in the industry indicates how well the organization is using its infrastructure. If performance is below standard, corrective action is indicated. The benchmark approach implicitly assumes that IT infrastructure investments are justified if they are managed efficiently.



Benchmarks come in two very different forms: *Metrics* and *best-practice benchmarks*. **Metric benchmarks** provide numeric measures of performance, for example: (1) IT expenses as percent of total revenues, (2) percent of downtime (time when the computer is unavailable), (3) central processing unit (CPU) usage as a percentage of total capacity, and (4) percentage of IS projects completed on time and within budget. These types of measures are very useful to managers, even though sometimes they lead to the wrong conclusions. For example, a ratio of IT expenses to revenues that is lower than the industry average might indicate that a firm is operating more efficiently than its competitors. Or it might indicate that the company is investing less in IT than it should and will become less competitive as a result. An illustration of typical support expected from benchmarking tools in complex IT environments is described in *Online File W13.9*.



Metric benchmarks can help diagnose problems, but they do not necessarily show how to solve them. Therefore, many organizations also use **best-practice benchmarks**. Here the emphasis is on how information system activities are actually performed rather than on numeric measures of performance. For example, an organization might feel that its IT infrastructure management is very important to its performance. It then could obtain information about best practices about how to operate and manage IT infrastructure. These best practices might be from other organizations in the same industry, from a more efficient division of its own organization, or from another industry entirely. The organization would then implement these best practices for all of its own IT infrastructure, to bring performance up to the level of the leaders.

MANAGEMENT BY MAXIM FOR IT INFRASTRUCTURE. Organizations that are composed of multiple business units, including large, multidivisional ones, frequently need to make decisions about the appropriate level and types of infrastructure that will support and be shared among their individual operating units. These decisions are important because infrastructure can amount to over 50 percent of the total IT budget, and because it can increase effectiveness through synergies across the organization. However, because of substantial differences among organizations in their culture, structure, and environment, what is appropriate for one will not necessarily be suitable for others. The fact that many of the benefits of infrastructure are intangible further complicates this issue.

Broadbent and Weill (1997) suggest a method called **management by maxim** to deal with this problem. This method brings together corporate executives, business-unit managers, and IT executives in planning sessions to determine appropriate infrastructure investments through five steps which are diagrammed in Figure 13.6. In the process, managers articulate *business maxims*—short well-defined statements of organizational strategies or goals—and develop corresponding *IT maxims* that explain how IT could be used to support the business maxims. The five steps are further discussed in *Online File W13.10*.



Notice that Figure 13.6 also shows a line at the bottom flowing through an item labeled “Deals.” This represents a theoretical alternative approach in the absence of appropriate maxims, where the IT manager negotiates with individual business units to obtain adequate funding for *shared infrastructure*. This approach can work where there is no shared infrastructure, or where the infrastructure category is a utility. However, Broadbent and Weill have not found any cases of firms that developed an enabling infrastructure via deals.

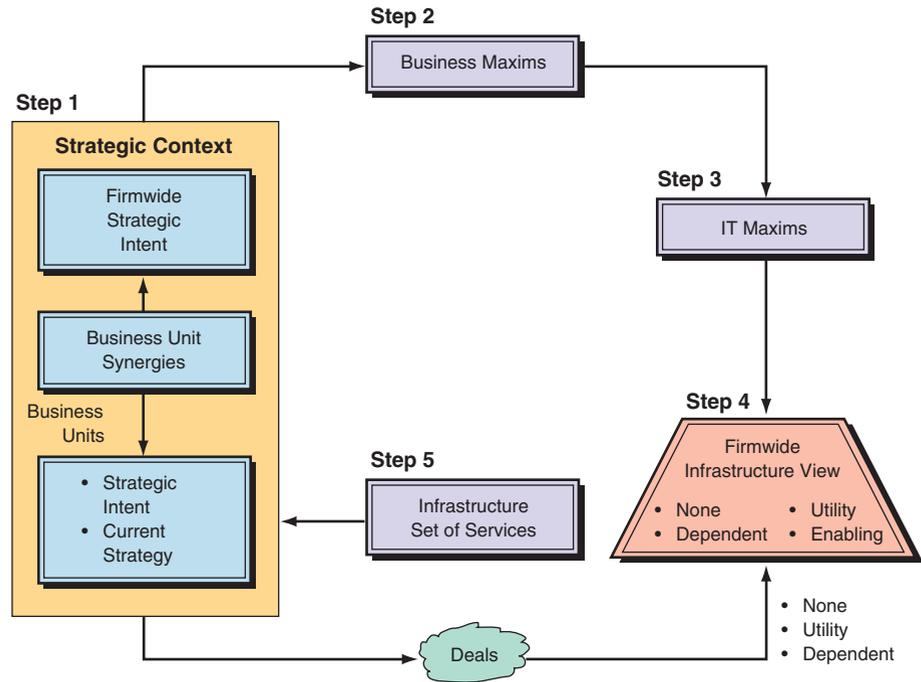


FIGURE 13.6 Management by maxim: linking strategy and infrastructure. (Source: M. Broadbent and P. Weill, “Management by Maxim,” *Sloan Management Review*, Spring 1997, p. 79, by permission of publisher. ©2001 by Massachusetts Institute of Technology. All rights reserved.)

Real-Option Valuation of IT Investment

A promising new approach for evaluating IT investments is to recognize that they can increase an organization’s performance in the future. The concept of real options comes from the field of finance, where financial managers have in recent years developed a strategic approach to capital budgeting decisions. Instead of using only traditional measures like NPV to make capital decisions, financial managers are looking for opportunities that may be embedded in capital projects. These opportunities, if taken, will enable the organization to alter future cash flows in a way that will increase profitability. These opportunities are called **real options** (to distinguish them from *financial options* that give investors the right to buy or sell a financial asset at a stated price on or before a set date). Common types of real options include the option to expand a project (so as to capture additional cash flows from such growth), the option to terminate a project that is doing poorly (in order to minimize loss on the project), and the option to accelerate or delay a project. Current IT investments, especially for infrastructure, can be viewed as another type of real option. Such capital budgeting investments make it possible to respond quickly to unexpected and unforeseeable challenges and opportunities in later years. If the organization waits in its investment decisions until the benefits have been established, it may be very difficult to catch up with competitors that have already invested in the infrastructure and have become familiar with the technology.

Applying just the NPV concept (or other purely financial) measure to an investment in IT infrastructure, an organization may decide that the costs of a proposed investment exceed the tangible benefits. However, if the project creates opportunities for additional projects in the future (that is, creates opportunities for real options), the investment also has an options value that should be added to its other benefits (see Benaroch, 2002 and Devaraj and Kohli, 2002).



The mathematics of real-option valuation are well established but unfortunately are too complex for many managers. (See Dixit and Pindyck, 1995, for details.) For a discussion on using real-option pricing analysis to evaluate a real-world IT project investment in four different settings, see Benaroch and Kauffman (1999). Li and Johnson (2002) use a similar approach. For an example of DSS evaluation using real-option theory, see Kumar (1999). Rayport and Jaworski (2001) applied the method for evaluating EC initiatives (see *Online File W13.11*).

Other Methods and Tools

Several other methods exist for evaluating IT investment. For example, most large vendors provide proprietary calculators for ROI. However, according to King (2002), those may be biased (and may lead to a sometimes-unjustified decision to adopt a project). To make the decision less biased, some companies use a third-party evaluator, such as IDC (*idc.com*) or META Group (*metagroup.com*) to conduct ROI studies. An example of such a calculator is SAP Business Case Builder. (For details see *sap.com/solutions/casebuilder*.) Several independent vendors offer ROI calculators (e.g., CIO View Corporation).

In addition, there are other popular methods (e.g., see Irani and Love, 2000–2001), a few of which we describe briefly before ending this section.

THE BALANCED SCORECARD METHOD. The **balanced scorecard method** evaluates the overall health of organizations and projects. Initiated by Kaplan and Norton (1996), the method advocates that managers focus not only on short-term financial results, but also on four other areas for which metrics are available. These areas are: (1) finance, including both short- and long-term measures; (2) customers (how customers view the organization); (3) internal business processes (finding areas in which to excel); and (4) learning and growth (the ability to change and expand). The key idea is that an organization should consider all four strategic areas when considering IT investments.

Swamy (2002) attempted to use the balanced scorecard to measure the performance of EC systems, including intangible benefits. He examined the EC systems from two perspectives: that of the e-business and that of the user. Rayport and Jaworski (2001) developed a variant of the balanced scorecard called *performance dashboard*, which they advocate for evaluation of EC strategy. Several other attempts to fit the balanced scorecard approach to IT project assessment have been made. (e.g., see *balancedscorecard.org*). The methodology actually is embedded in several vendors' products (e.g., *sas.com/solutions/bscl*). For demos see *corvu.com*.

THE EXPLORATION, INVOLVEMENT, ANALYSIS, AND COMMUNICATIONS (EIAC) MODEL. Devaraj and Kohli (2002) proposed a methodology for implementing IT payoff initiatives. The method is composed of 9 phases, divided into four categories: exploration (E), involvement (I), analysis (A), and communication (C). These are shown in *Online File W13.12* at the book's Web site. For details see Devaraj and Kohli, 2002.



ACTIVITY-BASED COSTING. A more recent approach for assessing IT investment is proposed by Gerlach et al. (2002), who suggest use of the *activity-based costing* (ABC) approach to assist in IT investment analysis. (For details on how ABC works, see a management or managerial accounting textbook.) Using a case study, Gerlach et al. showed that the company that utilized ABC derived



significant benefits from a better understanding of IT delivery costs and a rationale for explaining IT costs to department managers. Mutual understanding of IT costs is a necessary condition for shared responsibility of IT, which in turn leads to effective economic decision making that optimizes resource utilization and the alignment of IT with business strategy. In addition, the use of the ABC helps in reducing operational costs.

EXPECTED VALUE ANALYSIS. It is relatively easy to estimate **expected value (EV)** of possible future benefits by multiplying the size of the benefit by the probability of its occurrence. For example, an organization might consider investing in a corporate portal only if there is a 50 percent probability that this would result in new business worth \$10 million in additional profits and the cost will be less than \$5 million. The value of this specific benefit would be 50 percent times \$10 million, or \$5 million. This method is simple but like any EV approach, it can be used only for repetitive investments.

Unfortunately, none of the above methods is perfect, and it is not simple for organizations to decide which method to use in which case.

13.4 IT ECONOMIC STRATEGIES: CHARGEBACK AND OUTSOURCING

In addition to identifying and evaluating the benefits of IT, organizations also need to account for its costs. Ideally, the organization's accounting systems will effectively deal with two issues: First, they should provide an accurate measure of total IT costs for management control purposes. Second, they should charge users for shared (usually infrastructure) IT investments and services in a manner that contributes to the achievement of organization goals. These are two very challenging goals for any accounting system, and the complexities and rapid pace of change make them even more difficult to achieve in the context of IT.

In the early days of computing it was much easier to identify costs than it is today. Computers and other hardware were very expensive and were managed by centralized organizational units with their own personnel. Most application software was developed internally rather than purchased. IT was used only for a few well-defined applications, such as payroll, inventory management, and accounts payable/receivable. In contrast, nowadays computers are cheap, and software is increasingly purchased or leased. The overwhelming majority of the total processing power is located on the collective desktops of the organization rather than in centralized computer centers, and it is managed by individual organizational units rather than a centralized IS department. A large proportion of the costs are in "hidden," indirect costs that are often overlooked (e.g., See Barthelmy, 2001.)

These trends make it very difficult just to identify, let alone effectively control, the total costs of IT. As a practical matter, many organizations track costs associated with centralized IS and leave management accounting for desktop IT to the user organizations. However, the trend toward attaching personal computers to networks, and the availability of network management software, make it easier to track and manage costs related to desktop IT. Some organizations indicate "six-digits" savings by using network management software to identify which computers use what software, and then reducing the site licenses to correspond to the actual usage (see Coopee, 2000, for details).



In this section we look at two strategies for costing of IT services: chargeback and outsourcing.

Chargeback

Although it is hard to accurately measure total IT costs, organizations can nevertheless use accounting systems to influence organizational IT usage in desirable directions. Large organizations typically require individual operating and support units to develop annual budgets and to justify variances. Services from the central IS department represent a significant budget item for most of these units, so the way users are charged for these services will influence how much they use them.

In some organizations, the ISD functions as an unallocated cost center: All expenses go into an overhead account. The problem with this approach is that IT is then a “free good” that has no explicit cost, so there are no incentives to control usage or avoid waste.

A second alternative is called **chargeback** (also known as chargeout or cost recovery). In this approach, all costs of IT are allocated to users as accurately as possible, based on actual costs and usage levels. Accurate allocation sounds desirable in principle, but it can create problems in practice. The most accurate measures of use may reflect technological factors that are totally incomprehensible to the user. If fixed costs are allocated on the basis of total usage throughout the organization, which varies from month to month, charges will fluctuate for an individual unit even though its own usage does not change. These considerations can reduce the credibility of the chargeback system.

BEHAVIOR-ORIENTED CHARGEBACK. A third approach is to employ a **behavior-oriented chargeback** system. Such a system sets IT service costs in a way that meets organizational objectives, even though the charges may not correspond to actual costs. The primary objective of this type of system is influencing users’ behavior. For example, it is possible to encourage (or discourage) usage of certain IT resources by assigning lower (or higher) costs. For example, the organization may wish to encourage use in off-peak hours and so might decide to charge business units less for processing from 1 to 4 A.M. than from 9 A.M. to noon. Or, the organization may encourage use of wireless over wired technologies, or encourage the use of a central printer rather than a departmental one.

Although more difficult to develop, a behavior-oriented chargeback system recognizes the importance of IT—and its effective management—to the success of the organization. It not only avoids the unallocated-cost-center’s problem of overuse of “free” resources; it can also reduce the use of scarce resources where demand exceeds supply, even with fully allocated costs. For more on behavior-oriented chargeback see *Online File W13.13*.

There are other methods of chargeback in addition to the regular and behavior-oriented methods. The reason for the variety of methods is that it is very difficult to approximate costs, especially in companies where multiple independent operating units are sharing a centralized system. Therefore, organizations have developed chargeback methods that make sense to their managers and their particular needs. For a review of methods, see McAdam (1996).

The difficulties in applying chargeback systems may be one of the drivers of IT outsourcing.



Outsourcing as an Economic Strategy

Information technology is now a vital part of almost every organization and plays an important supporting role in most functions. However, IT is not the



primary business of many organizations. Their core competencies—the things they do best and that represent their competitive strengths—are in manufacturing, or retailing, or services, or some other function. IT is an enabler only, and it is complex, expensive, and constantly changing. IT is difficult to manage, even for organizations with above-average management skills. For such organizations, the most effective strategy for obtaining the economic benefits of IT and controlling its costs may be **outsourcing**, which is obtaining IT services from outside vendors rather than from internal IS units within the organization. According to a survey reported by Corbett (2001), the major reasons cited by large U.S. companies for use of outsourcing are: focus on core competency (36%), cost reduction (36%), improved quality (13%), increased speed to market (10%), and faster innovation (4%).

Companies typically outsource many of their activities, from contract manufacturing to physical security. But most of all they outsource IT activities (see Minicases 1 and 2 at the end of the chapter, and Online Minicase 13.1). Outsourcing is more than just purchasing hardware and software. It is a long-term result-oriented relationship for whole business activities, over which the provider has a large amount of control and managerial direction. For an overview of the past, present, and future of outsourcing, see Lee et al., 2003.

Outsourcing IT functions, such as payroll services, has been around since the early days of data processing. Contract programmers and computer time-sharing services are longstanding examples. What is new is that, since the late 1980s, many organizations are outsourcing the majority of their IT functions rather than just incidental parts. The trend became very visible in 1989 when Eastman Kodak announced it was transferring its data centers to IBM under a 10-year, \$500 million contract. This example, at a prominent multibillion-dollar company, gave a clear signal that outsourcing was a legitimate approach to managing IT. Since then, many mega outsourcing deals were announced, some for several billion dollars. (For a list of some recent outsourcing deals and the story of a 10-year, \$3 billion contract between Procter & Gamble and Hewlett-Packard, see Cushing, 2003. For the case of outsourcing at Pilkington, see *Online File W13.14*.)



In a typical situation, the outsourcing firm hires the IS employees of the customer and buys the computer hardware. The cash from this sale is an important incentive for outsourcing by firms with financial problems. The outsourcer provides IT services under a five- to ten-year contract that specifies a baseline level of services, with additional charges for higher volumes or services not identified in the baseline. Many smaller firms provide limited-scale outsourcing of individual services, but only the largest outsourcing firms can take over large proportions of the IT functions of major organizations. In the mid-1990s, IBM, EDS, and Computer Sciences Corp. were winning approximately two-thirds of the largest outsourcing contracts. Today other vendors (e.g., HP and Oracle) also provide such services.

Offshore outsourcing of software development has become a common practice in recent years. About one-third of Fortune 500 companies have started to outsource software development to software companies in India (Carmel and Agarwal, 2002). This trend of offshore outsourcing is largely due to the emphasis of Indian companies on process quality by adhering to models such as Software Engineering Institute's Software Capability Maturity Model (SW-CMM) and through ISO 9001 certification. India has fifteen of the twenty-three



organizations worldwide that have achieved Level 5, the highest in SW-CMM ratings. For further details on offshore outsourcing, see Cusumano (2000), Gillin (2003), and Carmel and Agarwal (2002).

In addition to the traditionally outsourced services, Brown and Young (2000) identify two more scenarios for future outsourcing: creation of shared environments (e.g., exchanges, portals, e-commerce backbones), and providing access to shared environments (e.g., applications service providers, Internet data centers). For example, Flooz.com, an online gift-currency store, outsourced its storage requirements to StorageNetworks, a storage service provider (Wilkinson, 2000). See *outsourcing-center.com* for details on practices in outsourcing of various types of services.

Finally, a relatively new approach is *strategic outsourcing* (Garner, 1998), where you can generate new business, retain skilled employees, and effectively manage emerging technologies. Strategic outsourcing facilitates the leveraging of knowledge capabilities and investments of others by exploiting intellectual outsourcing in addition to outsourcing of traditional functions and services (Quinn, 1999).

ASPs AND UTILITY COMPUTING. The concept behind an **application service provider (ASP)** is simple: From a central, off-site data center, a vendor manages and distributes software-based services and solutions, via the Internet. Your data seems to be run locally, whereas it is actually coming from the off-site data center. The user company pays subscription and/or usage fees, getting IT services on demand (utility computing). In other words, ASPs are a form of outsourcing.

ASP services are becoming very popular, but they do have potential pitfalls. A comprehensive comparison of the advantages and pitfalls of ASPs is provided by Segev and Gebauer (2001). According to Lee et al. (2003), the ASP approach is the future of outsourcing. The authors provide a list of ASPs in different areas and suggest a collaborative strategy with the users. For further discussion see Chapter 14 and Trudy (2002).

MANAGEMENT SERVICE PROVIDERS. A **management service provider (MSP)** is a vendor that remotely manages and monitors enterprise applications—ERP, CRM, firewalls, proprietary e-business applications, network infrastructure, etc. Like ASPs, MSPs charge subscription fees. But they claim to be an improvement over the ASP model because they permit companies to outsource the *maintenance* of their applications. MSPs make sure that applications are up and running, thus providing a relatively cheap, easy, and unobtrusive way for an organization to prevent outages and malfunctions. Meanwhile, because MSPs provide 24/7 monitoring, companies do not have to worry about staffing up to handle that nonrevenue-producing task. And if the MSP suddenly shuts its doors, as has happened all too often in the ASP world (and recently in the MSP world too), the organization can continue with minimal disruption because it still has its applications.

OUTSOURCING AND E-COMMERCE. Consider the following story, described by Palvia (2002): In the spring of 1996 the competitors of Canadian Imperial Bank of Commerce (CIBC) were ahead in implementing Internet banking, and CIBC was starting to lose market share. The bank needed to move quickly to implement its own Internet capabilities. But, being a bank and not an IT expert, this



was a challenge. So the bank decided to outsource the job to IBM's Global Services. Together, CIBC and IBM were able to implement home banking in six months. By 1998 the bank regained market share, having 200,000 online clients.

CIBC's dilemma is becoming a familiar story in just about every industry. Time constraints brought on by competitive challenges, security issues, and a shortage of skilled system developers in the Internet/intranet field contribute to a boom in the outsourcing business. Some organizations may decide to outsource because they need to sell off IT assets to generate funds. In addition, implementing EC applications forces companies to outsource mission-critical applications on a scale never before seen. According to the GartnerGroup, this need for EC applications will result in the tripling of IT outsourcing in three years. Forrester Research found that 90 percent of the companies they polled use or plan to use Internet-related outsourcing (Palvia, 2002).

A special EC outsourcing consideration is the implementation of extranets. Implementing an extranet is very difficult due to security issues and the need to have the system be rapidly expandable. (Some companies report 1,000 percent growth for EC activities in a year; e.g., see *hotmail.com*.) General Electric Information Services (*geis.com*), an extranet outsourcer, charges between \$100,000 and \$150,000 to set up an extranet, plus a \$5,000/month service fee. However, users of these services admit an ROI of 100 to 1,000 percent. For details see Duvall (1998).

OUTSOURCING ADVANTAGES AND DISADVANTAGES. The use of IT outsourcing is still very controversial (e.g., see Hirschheim and Lacity, 2000). Outsourcing advocates describe IT as a commodity, a generic item like electricity or janitorial services. They note the potential benefits of outsourcing, in general, as listed in Table 13.3.

In contrast, others see many limitations of outsourcing (e.g., see Cramm, 2001). One reason for the contradicting opinions is that many of the benefits of outsourcing are intangible or have long-term payoffs. Clemons (2000) identifies the following risks associated with outsourcing:

- *Shirking* occurs when a vendor deliberately underperforms while claiming full payment (e.g., billing for more hours than were worked, providing excellent staff at first and later replacing them with less qualified ones).
- *Poaching* occurs when a vendor develops a strategic application for a client and then uses it for other clients (e.g., vendor redevelops similar systems for other clients at much lower cost, or vendor enters into client's business, competing against him).
- *Opportunistic repricing* ("holdup") occurs when a client enters into a long-term contract with a vendor and the vendor changes financial terms at some point or overcharges for unanticipated enhancements and contract extensions.

Another possible risk of outsourcing is failure to consider all the costs. Some costs are hidden. Barthelmy (2001) discusses the following hidden costs: (1) vendor search and contracting, (2) transitioning from in-house IT to a vendor, (3) cost of managing the effort, and (4) transition back to in-house IT after outsourcing. These cost can be controlled to some extent, however.

Despite the risks and limitations, the extent of IT outsourcing is increasing rapidly together with the use of ASPs. We will return to these topics in Chapter 14.

**TABLE 13.3 Potential Outsourcing Benefits****FINANCIAL**

- Avoidance of heavy capital investment, thereby releasing funds for other uses.
- Improved cash flow and cost accountability.
- Cost benefits from economies of scale and from sharing computer housing, hardware, software, and personnel.
- Less need for expensive office space.

TECHNICAL

- Greater freedom to choose software due to a wider range of hardware.
- Ability to achieve technological improvements more easily.
- Greater access to technical skills.

MANAGEMENT

- Concentration on developing and running core business activity.
- Delegation of IT development (design, production, and acquisition) and operational responsibility to supplier.
- Elimination of need to recruit and retain competent IT staff.

HUMAN RESOURCES

- Opportunity to draw on specialist skills, available from a pool of expertise, when needed.
- Enriched career development and opportunities for staff.

QUALITY

- Clearly defined service levels.
- Improved performance accountability.
- Quality accreditation.

FLEXIBILITY

- Quick response to business demands.
- Ability to handle IT peaks and valleys more effectively.

STRATEGIES FOR OUTSOURCING. Organizations should consider the following strategies in managing the risks associated with outsourcing contracts.

1. **Understand the project.** Clients must have a high degree of understanding of the project, including its requirements, the method of its implementation, and the source of expected economic benefits. A common characteristic of successful outsourcing contracts is that the client was generally capable of developing the application but chose to outsource simply because of constraints on time or staff availability (Clemons, 2000).
2. **Divide and conquer.** Dividing a large project into smaller and more manageable pieces will greatly reduce programmatic risk and provides clients with an exit strategy if any part of the project fails (Clemons, 2000).
3. **Align incentives.** Designing contractual incentives based on activities that can be measured accurately can result in achieving desired performance (Clemons, 2000).
4. **Write short-period contracts.** Outsourcing contracts are often written for five- to ten-year terms. Because IT and the competitive environment change so rapidly, it is very possible that some of the terms will not be in the customer's best interests after five years. If a long-term contract is used, it needs to include adequate mechanisms for negotiating revisions where necessary (Marcolin and McLellan, 1998).

5. **Control subcontracting.** Vendors may subcontract some of the services to other vendors. The contract should give the customer some control over the circumstances, including choice of vendors, and any subcontract arrangements (Marcolin and McLellan, 1998).
6. **Do selective outsourcing.** This is a strategy used by many corporations who prefer not to outsource the majority of their IT, but rather to outsource certain areas (such as system integration or network security) (Marcolin and McLellan, 1998). Cramm (2001) suggests that an organization *insource* important work, such as strategic applications, investments, and HRM.

At this point of time, the phenomenon of large-scale IT outsourcing is approximately 20 years old. The number of organizations that have used it for at least several years is growing. Business and IT-oriented periodicals have published numerous stories about their experiences. Outsourcing is also popular on a global basis, as is demonstrated in Minicase 2 and as described by Zviran et al. (2001). The general consensus of the various sources of anecdotal information is that the cost savings of outsourcing are not large (perhaps around 10 percent) and that not all organizations experience savings. This still leaves the question of whether outsourcing IT can improve organizational performance by making it possible to focus more intensely on core competencies. Further research is necessary to answer this question.

13.5 ECONOMICS OF WEB-BASED SYSTEMS AND E-COMMERCE

As indicated throughout this text, Web-based systems can considerably increase productivity and profitability. In order to understand the economic logic of this, let us first examine the cost curves of digital products versus nondigital products, as shown in Figure 13.7. As the figure shows, for regular physical products the average cost declines up to a certain quantity, but then, due to increased production (e.g., adding a manager) and marketing costs, the cost will start to increase. For digital products the cost will continue to decline with increased quantity. The variable cost in the case of digital products is very little, so increases in quantity produce little or no change in average cost.

However, even for nondigital products, e-commerce can shift economic curves, as shown in Figure 13.8. The production function will decline (from L1 to L2) since you can get the same quantity with less labor and IT cost. The *transaction cost* for the same quantity (size) will be lower due to computerization. And finally, the administrative cost for the same quantity will be lower.

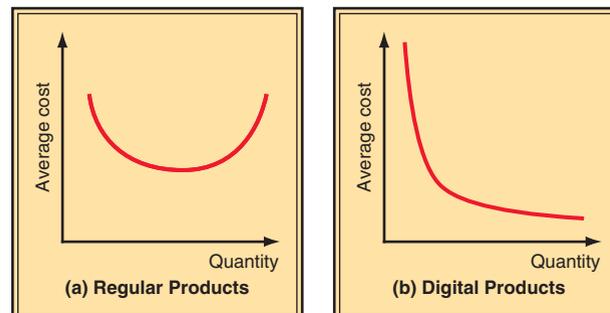


FIGURE 13.7 Cost curves of regular and digital products.

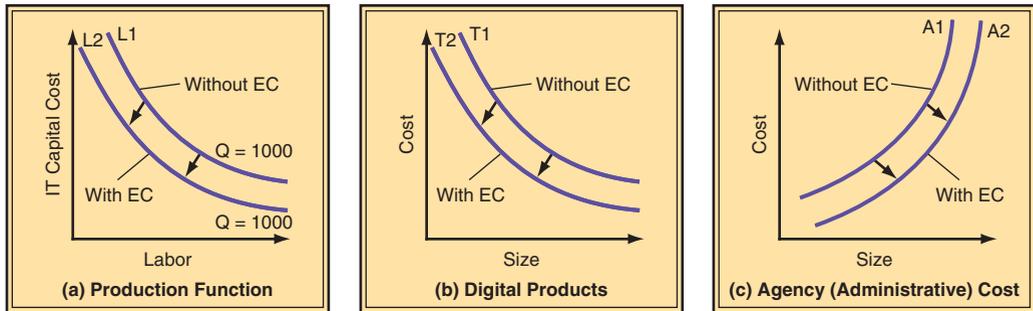


FIGURE 13.8
Economic Effects
of E-commerce.

The justification of EC applications can be difficult. Usually one needs to prepare a business case, as described earlier in the chapter. A proper business case develops the baseline of desired results, against which actual performance can and should be measured. The business case should cover both the financial and nonfinancial performance metrics against which to measure the e-business implementation. For further details on use of metrics to justify e-commerce, see Straub et al. (2000a and 2000b), Sterne (2002), Tjan (2001 and in Chapter 9 of this book), and Chapter 16 in Turban et al. (2004).

The benefits and costs of EC depend on its definitions. The complexity of the EC payoff can be seen in *Online File W13.15*. (For a discussion see Devaraj and Kohli, 2002). But even when the applications are well defined, we still have measurement complexities. It is difficult even to conduct risk analysis, not to mention cost-benefit analysis. (See insights from Thomas Mesenbourg, of the Economic Programs of the U.S. Bureau of the Census, at census.gov/epdc/www/ebusins.htm).

Web-based systems are being implemented by many organizations. However, hardly any efforts are being made to perform cost-benefit analysis or measure return on investment (ROI) on Web-based systems. Instead, most decisions to invest in Web-based systems are based on the assumption that the investments are needed for strategic reasons and that the expected returns cannot be measured in monetary values. Raskin (1999) advocates determining a return on investment (ROI) for extranet projects, though it is a difficult task, and suggests strategies for calculating ROI. *Online File W13.16* illustrates that some organizations calculate ROIs for their intranets and extranets and others do not.

As indicated earlier, many vendors provide ROI examples, proprietary methodologies, and calculators for IT projects including EC, such as for portals (e.g., *plumtree.com*). Although use of third-party evaluators, such as IDC, is common, the reported high ROIs should be considered with care. As noted earlier, bias is possible.

13.6 OTHER ECONOMIC ASPECTS OF INFORMATION TECHNOLOGY

In this final section of the chapter, we look at some associated other economic aspects of information technology. The first of these is IT failures and runaway projects, many of which occur for economic reasons.



IT Failures and “Runaway” Projects



Information technology is difficult to manage and can be costly when things do not go as planned. Indeed, a high proportion of IS development projects either fail completely or fail to meet some of the original targets for features, development time, or cost. Many of these are related to economic issues, such as an incorrect cost-benefit analysis.

Many failures occur in smaller systems that handle internal processes within an organization, and they usually remain corporate secrets. The total investment is not large, the failure does not have a major economic impact, and the effects are generally not visible to outsiders so we do not know about them. On the other hand, some IS failures result in losses in excess of ten million dollars and may severely damage the organization, as well as generate a lot of negative publicity, as in the Nike case in Chapter 1 or the ERP cases cited in Chapter 8. Failures in large public organizations such as the IRS and Social Security Administration have also been well advertised. Another large-scale, very public failure is described in *IT At Work 13.1*.

Because of the complexity and associated risks of developing computer systems, some IT managers refuse to develop systems in house beyond a certain size. The “one, one, ten rule” says not to develop a system if it will take longer than one year, has a budget over one million dollars, and will require more than ten people. Following this strategy, an organization will need to buy rather than develop large systems, or do without them.

The economics of software production suggest that, for relatively standardized systems, purchasing or leasing can result in both cost savings and increased functionality. Purchasing or leasing can also be the safest strategy for very large and complex systems, especially those that involve multiple units within an



IT At Work 13.1 **A LARGE-SCALE FAILURE AT DENVER INTERNATIONAL AIRPORT**



The Denver International Airport (DIA), at 53 square miles, was designed to be the largest U.S. airport. By 1992, it was recognized that baggage handling would be critically important and that this issue could not be off-loaded to the airlines that would be operating out of DIA. Consequently, an airportwide, IT-based baggage handling system was planned to dramatically improve the efficiency of airport luggage delivery. BAE Automated Systems, Inc., a world leader in the design and implementation of material handling systems, was commissioned by the City of Denver to develop the system. The system was composed of 55 networked computers, 5,000 electric sensors, 400 radio frequency receivers, and 56 bar code scanners. It was to orchestrate the safe and timely arrival of every suitcase and ski bag at DIA.

Problems with the baggage system, however, kept the new airport from opening as originally scheduled in

October 1993. Soon the national and international media began to pick up the story, and the DIA came under investigation by various federal agencies. By the time the airport opened in late February 1995, it was 16 months behind schedule and close to \$2 billion over budget. DIA eventually opened with two concourses served by a manual baggage system and one concourse served by a scaled-down semi-automated system. It took more than 2 additional years to put all the information systems into place. Major reasons were inappropriate ROI analysis, underestimation of costs, and lack of a contingency plan for unforeseen delays.

Source: Compiled from Monealegre and Keil (2000).

For Further Exploration: Why do organizations keep investing money in large IT-enabled projects in spite of clear evidence that they are failing? What are the issues in a decision to terminate a failing project?



organization. For example, the SAP AG software firm offers a family of integrated, enterprise-level, large-scale information systems (see Chapter 8). These systems are available in versions tailored for specific industries, including aerospace, banking, utilities, retail, and so forth as well as to SMEs. Many organizations feel that buying from a good vendor reduces their risk of failure, even if they have to change their business processes to be compatible with the new system.

The Economics of the Web

In the preceding sections, our focus has been on the economics of *the use of IT* in organizations as an enabler. In this section, we turn to the economics of *IT as a product in itself*, rather than in a supporting role.

In 1916, David Sarnoff attempted to persuade his manager that the American Marconi Company should produce inexpensive radio receivers to sell to the consumer market. Others in the company (which subsequently became RCA) opposed the idea because it depended on the development of a radio broadcasting industry. They did not expect such an industry to develop because they could not see how broadcasters could generate revenues by providing a service without any charges to the listeners. The subsequent commercial development of radio, and the even greater success of television, proved that Sarnoff was right. If it is possible to provide a popular service to a large audience at a low cost per person, there will be ways of generating revenues. The only question is, How?

The World Wide Web on the Internet resembles commercial broadcasting in its early days. Fixed costs—initial investments and production costs—can be high in themselves, but they are low in terms of average cost per potential customer. The incremental or variable costs of delivering content to individual customers or of processing transactions are very low (see Choi and Whinston, 2000).

The market for the Web is large. About 60 percent of the U.S. population, plus foreign markets, now have access to the Internet. Many people who do not have computers at home can access the Internet through computers at work, schools, libraries, or via mobile devices. The arrival in 1995 of Web TV adapters for TV sets made it possible for homes without computers to get on the Internet for as little as \$400. By 2003, the cost of the Simputer and other thin computers has come down to about \$200. These trends could lead to a situation of “universal connectivity,” in which almost every citizen in the industrialized countries has access to the Net. Using wireless, nearly universal connectivity can be achieved in developing countries as well.

The Web is different from broadcasting in ways that increase its economic potential. For example, Chapter 5 provides detailed information on specific applications of e-commerce. These applications demonstrate how favorable economic factors are leading to a wide variety of approaches to generating income using the Web or other aspects of the Internet. In 1996–2001, in the rush to introduce Web systems in general, and e-commerce in particular, basic economic principles often were neglected, resulting in failures of many projects as well as entire companies. For further discussion see Kohli et al. (2003) and Choi and Whinston (2000).

Increasing Returns

Stanford University economist Brian Arthur (1996) is the leading proponent of the economic theory of *increasing returns*, which applies to the Web and to other forms of information technology. He starts with the familiar concept that the

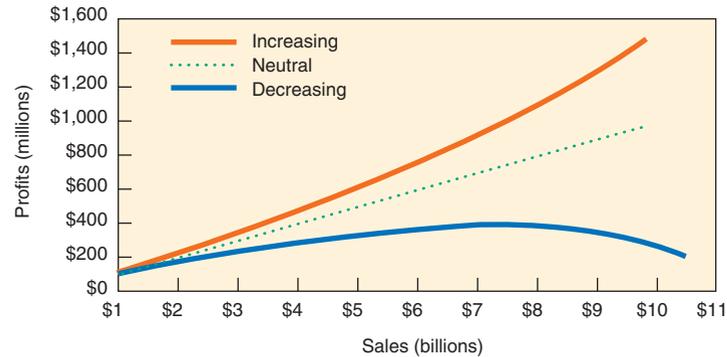


FIGURE 13.9 Increasing versus decreasing returns.

economy is divided into different sectors, one that produces physical products and another that focuses on information. Producers of physical products (e.g., foodstuffs, petroleum, automobiles) are subject to what are called diminishing returns: Although they may have initial increasing economies of scale, they eventually reach a point where costs go up and additional production becomes less profitable.

Arthur notes that in the information economy the situation is very different. For example, initial costs to develop new software are very high, but the cost of producing additional copies is very low. The result is **increasing returns**, where profitability rises more rapidly than production increases. A firm with a high market share can use these higher profits to improve the product or to enhance the marketing in order to strengthen its leading position. Figure 13.9 illustrates the difference between increasing and decreasing returns.

In addition to higher profitability, two other factors favor firms with higher market share. The first is **network effects**. The leading products in an industry attract a base of users, and this base leads to development of complementary products, further strengthening the position of the dominant product. For example, the open architecture of the IBM PC made it possible to develop add-on hardware and to create clones that run the same software. The market for PCs became much larger than the market for Apple computers, which have a closed architecture. Software companies shifted production to PC versions of their products, which further enhanced the dominance of the PC. All this happened in spite of a substantial amount of evidence that Apple's computers really were better products.

The second factor is the **lock-in effect**. Most new software is hard to learn, so users typically will not switch to a different product unless it is much more powerful or they are forced into making the change. The end result of these factors is that when a firm establishes a clear lead over its competitors, it tends to become stronger and stronger in its market.

The potential for increasing returns requires management strategies that are very different from those in other industries. Arthur (1996) suggests strategies for producing increasing returns which are shown in *Online File W13.17*.



Market Transformation through New Technologies

In some cases, IT has the potential to completely transform the economics of an industry. For example, until recently the encyclopedia business consisted of low-volume sales, primarily to schools and libraries. The physically very bulky product resulted in relatively high manufacturing and shipping costs, which



made the price even higher. The high price, and the space required to store the books, reduced potential sales to the home market.

Two things happened to change this situation. First, CD-ROM technology was adapted from storing music to storing other digital data, including text and images. Second, since the mid-1990s use of CD-ROMs has been a standard component of a majority of computers sold for the home market. Encyclopedia producers began selling their products on CD-ROMs, in some cases at reduced prices that reflected the lower production costs. These CD-ROM versions include new features made possible by the technology, most notably sound and hyper-link cross-references to related material in other sections. Lower prices and additional features have the potential to substantially increase the size of the total market. The hypothetical example in *A Closer Look 13.3* shows how the economics of this business could change.



A CLOSER LOOK

13.3 THE ENCYCLOPEDIA ATLANTICA

The attached table shows a financial analysis for an aggressive scenario in which the (hypothetical) Encyclopedia Atlantica immediately shifts all its production from the traditional hardbound book format to a CD-ROM version. Note that manufacturing and shipping costs drop from \$150 to \$10 per unit. The cost of the contents increases by \$2 million, reflecting the addition of sound, greater use of graphics, and the effort required to set up hyperlinks between different sections. The price per unit is reduced by 50 percent, from \$700 to \$350, while unit sales more than double and marketing expenses increase in proportion to unit sales. Despite the lower price and higher costs for content and marketing, the profit margin on the CD-ROM version is projected at 19.6 percent versus 16.7 percent on the hardbound version.

	Hardbound	CD-ROM
Unit sales	30,000	70,000
Price per unit	\$700	\$350
Gross revenue	\$21,000,000	\$24,500,000
– Cost of content	–10,000,000	–12,000,000
– Manufacturing & shipping costs	–4,500,000	–700,000
– Marketing costs	–3,000,000	–7,000,000
= Profit before taxes	\$3,500,000	\$4,800,000
Profit margin	16.7%	19.6%

In practice, some customers in Atlantica's traditional markets (e.g., libraries and schools) will continue buying the hardbound version for many years to come. Additional scenarios are necessary to show a more gradual transition to a market dominated by CD-ROM versions.

The scenarios also need to include additional revenues from customers after the initial sale. Customers can receive annual updates for \$25 per year, as well as the opportunity to buy new editions at a 50 percent discount every five years.

Some interesting questions may be raised regarding this situation:

- Should Atlantica cut the price of the CD-ROM version to reflect economies of production and shipping, and to dramatically increase the size of the total market? Or should it set the price at the same level as the hardbound version, and try to market the CD-ROM version as a low-volume, high-margin, premium product?
- What will happen if Atlantica starts to publish on the Web? Should it do so?

To answer these questions you may want to see what happened to Encyclopedia Britannica (britannica.com).



➔ **MANAGERIAL ISSUES**

Information technology has certain characteristics that differentiate it, and its economics, from other aspects of the organizational world. Therefore IT requires management practices that are more effective than, and in some cases different from, those that are adequate for non-IT activities. For example, organizational resistance on many fronts can turn the most promising system into a failure (Watson and Haley, 1998). Managers need to be aware of and responsive to the following issues.

1. **Constant growth and change.** The power of the microprocessor chip doubles every two years, while the cost remains constant. This ever-increasing power creates both major opportunities and large threats as its impacts ripple across almost every aspect of the organization and its environment. Managers need to continuously monitor developments in this area to identify new technologies relevant to their organizations, and to keep themselves up-to-date on their potential impacts.
2. **Shift from tangible to intangible benefits.** Few opportunities remain for automation projects that simply replace manual labor with IT on a one-for-one basis. The economic justification of IT applications will increasingly depend on intangible benefits, such as increased quality or better customer service. In contrast to calculating cost savings, it is much more difficult to accurately estimate the value of intangible benefits prior to the actual implementation. Managers need to understand and use tools that bring intangible benefits into the decision-making processes for IT investments.
3. **Not a sure thing.** Although IT offers opportunities for significant improvements in organizational performance, these benefits are not automatic. Managers need to very actively plan and control implementations to increase the return on their IT investments.
4. **Chargeback.** Users have little incentive to control IT costs if they do not have to pay for them at all. On the other hand, an accounting system may allocate costs fairly accurately to users but discourage exploration of promising new technologies. The solution is to have a chargeback system that has the primary objective of encouraging user behaviors that correspond to organizational objectives.
5. **Risk.** Investments in IT are inherently more risky than investments in other areas. Managers need to evaluate the level of risk before committing to IT projects. The general level of management involvement as well as specific management techniques and tools need to be appropriate for the risk of individual projects.
6. **Outsourcing.** The complexities of managing IT, and the inherent risks, may require more management skills than some organizations possess. If this is the case, the organization may want to outsource some or all of its IT functions. However, if it does outsource, the organization needs to make sure that the terms of the outsourcing contract are in its best interests both immediately and throughout the duration of the agreement.
7. **Increasing returns.** Industries whose primary focus is IT, or that include large amounts of IT in their products, often operate under a paradigm of increasing returns. In contrast, industries that primarily produce physical outputs



are subject to diminishing returns. Managers need to understand which paradigm applies to the products for which they are responsible and apply management strategies that are most appropriate.



ON THE WEB SITE... Additional resources, including quizzes; online files of additional text, tables, figures, and cases; and frequently updated Web links to current articles and information can be found on the book's Web site (wiley.com/college/turban).

KEY TERMS

Application service provider (ASP) •••	Intangible benefits •••	Price-to-performance ratio •••
Balanced-scorecard method •••	Lock-in effect •••	Productivity paradox •••
Behavior-oriented chargeback •••	Management by maxim •••	Real-option valuation •••
Best-practice benchmarks •••	Management service provider (MSP) •••	Runaway project •••
Business case •••	Metric benchmarks •••	Scoring methodology •••
Chargeback •••	Moore's law •••	Total benefits of ownership (TBO) •••
Cost-benefit analysis •••	Net present value (NPV) •••	Total cost of ownership (TCO) •••
Expected value (EV) •••	Network effects •••	Value analysis •••
Increasing returns •••	Offshore outsourcing •••	
Information economics •••	Outsourcing •••	

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 The power of computer hardware should continue increasing at an exponential rate for at least 10 years, doubling every 18 months, while costs remain at the same levels as before. Also the performance/cost ratio of storage and networks behaves in a similar way.
- 2 Although organizations have spent tremendous amounts of money on IT, it is difficult to prove that this spending has increased national or industry productivity. The discrepancy between measures of IT investment and measures of output is described as the productivity paradox.
- 3 Evaluating IT investment requires finding the total costs of ownership and the total benefits of ownership and subtracting the costs from the benefits. The value of information to an organization should be part of that calculation.
- 3 The major difficulty in evaluating IT investment is assessing the intangible benefits. Also, some costs are difficult relate to specific projects.
- 3 Traditional financial approaches can be used to evaluate IT investment, but in many cases method such as value analysis, benchmarking, or real option analysis fit better, especially for investment in infrastructures.
- 4 Intangible benefits cover many areas ranging from customer satisfaction to deferring IT investments. To include intangible benefits in IT justification, one may attempt to quantify them, to list them as arguments for justification, or to ignore them. Specific methodologies may be useful.
- 5 The NPV and ROI work well with tangible benefits. When intangible benefits are involved one may try one of the following: value analysis, information economics, benchmarks, management by maxim, real option valuation, balanced scorecard, and activity-based costing.
- 6 Behavior-oriented chargeback systems, if properly designed, encourage efficient and effective usage of IT resources.



- 7 Outsourcing may reduce IT costs and can make it possible for organizations to concentrate their management efforts on issues related to their core competencies. However, outsourcing may reduce the company's flexibility to find the best IT fit for the business, and it may also pose a security risk.
- 8 EC enables electronic delivery of digital products at very low cost. Also, many nondigital products can be produced and delivered with lower overhead and with less administrative cost.
- 9 Web-based technologies may be approached differently for conducting cost-benefit analysis due to their different economic curves, lack of baseline data, frequent changes, etc. Modifying existing concepts, such as is done in portfolio selection, is advisable.
- 10 Several topics are related to the economics of IT. IT failures are frequently the result of poor cost-benefit analysis, and IT projects sometimes linger because of poor planning of economic resources.

QUESTIONS FOR REVIEW

1. Describe Moore's Law.
2. Define productivity.
3. Define the productivity paradox. Why is it important?
4. List three major explanations of the productivity paradox.
5. Define information infrastructure and list some of its costs.
6. Define cost-benefit analysis.
7. What is TCO? What is TBO?
8. List some tangible and intangible benefits of IT.
9. Describe the value analysis method.
10. Define information economics.
11. Define IT benchmarks.
12. Describe best practice benchmarks.
13. What is management by maxim?
14. What is real option valuation in IT?
15. Describe IT chargeback.
16. Define behavior-oriented chargeback.
17. Define IT outsourcing.
18. List five benefits of outsourcing.
19. List five drawbacks or limitation of outsourcing.
20. Describe increasing returns in IT.

QUESTIONS FOR DISCUSSION

1. What are the general implications for managers, organizations, and consumers of constantly increasing computer capabilities and declining costs?
2. What are the impacts of exponentially increasing computer hardware power and declining price-to-performance ratios on business production activities and new product development?
3. Discuss what is necessary to achieve productivity gains from IT investments.
4. Why is it more difficult to measure productivity in service industries?
5. Compare and contrast metrics and best practices. Give an example of each in an IT in a university.
6. Discuss what may happen when an organization does not charge users for IT services.
7. Identify circumstances that could lead a firm to outsource its IT functions rather than continue with an internal IS unit.
8. Identify arguments for including estimated values for intangible benefits in net present value (NPV) analyses of IT investments, and contrast them with the arguments for excluding such estimates.
9. What is IT infrastructure, and why is it difficult to justify its cost?
10. Discuss the economic advantages of digital products compared to nondigital ones.
11. Explain how a behavior-oriented chargeback system can be superior to an accounting system that charges users fairly accurate estimates of the costs of services they use.
12. Discuss the pros and cons of outsourcing IT, including alternatives to outsourcing.
13. Discuss how giving products away can be a profitable strategy in industries with increasing returns.



EXERCISES

1. Conduct research on how long exponential growth in computer hardware capabilities (Moore's Law) will continue.
2. Create a scoring methodology that reflects your personal requirements, and use it to evaluate two competing software products in the same category (for example, two Web browsers or two corporate portal development environments).
3. If you have access to a large organization, conduct research on the methods it uses to charge users for IT services and how the users feel about these charges.
4. Enter *ibm.com* and find information about how IBM measures the ROI on WebSphere. Then examine ROI from CIOView Corporation (*CIOview.com*). Identify the variables included in the analysis (at both *ibm.com* and *CIOview.com*). Prepare a report about the fairness of such a tool.
5. A small business invests \$50,000 in robotic equipment. This amount is shown as a negative value in Year 0. Projected cash flows of \$20,000 per year in Year 1 through Year 5 result from labor savings, reduced material costs, and tax benefits. The business plans to replace the robots with more modern ones after 5 years and does not expect them to have any scrap value. The equipment generates a total of \$100,000 in savings over 5 years, or \$50,000 more than the original investment. However, a dollar saved in the future is worth less than a dollar invested in the present. If the business estimates its return on investment as 15 percent, then \$1.00 should be worth \$1.15 in one year, \$1.32 after 2 years with compound interest, and so on. Cash flows are divided by these "discount factors" to estimate what they are worth at present. Calculate the total cash flow after this discounting, and discuss whether the investment can be justified.

GROUP ASSIGNMENTS

1. Considerable discussions and disagreements exist among IS professionals regarding outsourcing. Divide the group into two parts: One will defend the strategy of large-scale outsourcing. One will oppose it. Start by collecting recent material at *google.com* and *cio.com*.
2. Each group is assigned to an ROI calculator (e.g., from peopleSoft, Oracle, IBM, etc.) Each group should prepare a list of the functionalities included and the variables. Make a report that shows the features and limitations of each tool.

INTERNET EXERCISES



1. Enter *google.com* and search for material on the used of the balanced scorecard method for evaluating IT investments. Prepare a report on your findings.
2. Read the *Information Week* article at *techweb.com/se/directlink.cgi?IWK19970630S0038*. Compare and contrast the approaches to evaluating intangible benefits in the article to those suggested in this textbook.
3. Enter the Web sites of the GartnerGroup (*gartnergroup.com*), The Yankee Group (*yankeegroup.com*), and CIO (*cio.com*). Search for recent material about outsourcing, and prepare a report on your findings.
4. Enter the Web site of IDC (*idc.com*) and find how they evaluate ROI on intranets, supply chain, and other IT projects.
5. Visit the Web site of Resource Management Systems (*rms.net*) and take the IT investment Management Approach Assessment Self-Test (*rms.net/self_test.htm*) to compare your organization's IT decision-making process with those of best-practices organizations.
6. Enter *compaq.com/tco* and *cosn.org/tco*. Find information about the total cost of ownership model. Write a report on the state of the art.
7. Enter *plumtree.com* and see how they conduct ROI on portals. List major elements of the analysis. Is it biased?
8. Enter *sap.com* and use the casebuilder calculator for a hypothetical (or real) IT project. Write a report on your experience.



Minicase 1

Intranets: Invest First, Analyze Later?

The traditional approach to information systems projects is to analyze potential costs and benefits before deciding whether to develop the system. However, for moderate investments in promising new technologies that could offer major benefits, organizations may decide to do the financial analyses after the project is over. A number of companies took this latter approach in regard to intranet projects initiated prior to 1997.

Judd's

Located in Strasburg, Virginia, Judd's is a conservative, family-owned printing company that prints *Time* magazine, among other publications. Richard Warren, VP for IS, pointed out that Judd's "usually waits for technology to prove itself . . . but with the Internet the benefits seemed so great that our decision proved to be a no-brainer." Judd's first implemented Internet technology for communications to meet needs expressed by customers. After this it started building intranet applications to facilitate internal business activities. One indication of the significance of these applications to the company is the bandwidth that supports them. Judd's increased the bandwidth by a magnitude of about 900 percent in the 1990s without formal cost-benefit analysis.

Eli Lilly & Company

A very large pharmaceutical company with headquarters in Indianapolis, Eli Lilly has a proactive attitude toward new technologies. It began exploring the potential of the Internet in 1993. Managers soon realized that, by using intranets, they could reduce many of the problems associated with developing applications on a wide variety of hardware platforms and network configurations. Because the benefits were so obvious, the regular financial justification process was waived for intranet application development projects. The IS group that helps user departments develop and maintain intranet applications increased its staff from three to ten employees in 15 months.

Needham Interactive

Needham, a Dallas advertising agency, has offices in various parts of the country. Needham discovered that, in developing presentations for bids on new accounts, employees found it helpful to use materials from other employees' presentations on similar projects. Unfortunately, it was very difficult to locate and then transfer relevant material in different locations and different formats. After doing research on alternatives, the company identified intranet technology as the best potential solution.

Needham hired EDS to help develop the system. It started with one office in 1996 as a pilot site. Now part of

DDB Needham, the company has a sophisticated corporate-wide intranet and extranet in place. Although the investment is "substantial," Needham did not do a detailed financial analysis before starting the project. David King, a managing partner explained, "The system will start paying for itself the first time an employee wins a new account because he had easy access to a co-worker's information."

Cadence Design Systems

Cadence is a consulting firm located in San Jose, California. It wanted to increase the productivity of its sales personnel by improving internal communications and sales training. It considered Lotus Notes but decided against it because of the costs. With the help of a consultant, it developed an intranet system. Because the company reengineered its sales training process to work with the new system, the project took somewhat longer than usual.

International Data Corp., an IT research firm, helped Cadence do an after-the-fact financial analysis. Initially the analysis calculated benefits based on employees meeting their full sales quotas. However, IDC later found that a more appropriate indicator was having new sales representatives meet half their quota. Startup costs were \$280,000, average annual expenses were estimated at less than \$400,000, and annual savings were projected at over \$2.5 million. Barry Demak, director of sales, remarked, "We knew the economic justification . . . would be strong, but we were surprised the actual numbers were as high as they were."

Sources: Compiled from Korzenioski (1997) and the companies' Web sites.

Questions for Minicase 1

1. Where and under what circumstances is the "invest first, analyze later" approach appropriate? Where and when is it inappropriate? Give specific examples of technologies and other circumstances.
2. How long do you think the "invest first, analyze later" approach will be appropriate for intranet projects? When (and why) will the emphasis shift to traditional project justification approaches? (Or has the shift already occurred?)
3. What are the risks of going into projects that have not received a thorough financial analysis? How can organizations reduce these risks?
4. Based on the numbers provided for Cadence Design System's intranet project, use a spreadsheet to calculate the net present value of the project. Assume a 5-year life for the system.



5. Do you see any relationship between the “invest first, analyze later” approach to financial analysis and the use of behavior-oriented chargeback systems?
6. Relate the Needham case to the concept of a repository knowledge base.



Minicase 2

Outsourcing Its IT, Kone Is Focusing on Its Core Competencies

The Problem

Kone Inc. is a multinational corporation, based in Finland. Kone makes over 20,000 new escalators and elevators each year, installing and servicing them in more than 40 countries, with about 30 percent of Kone’s business in the United States. The company embarked on a globalization strategy several years ago, and soon discovered that the internal IT processes were insufficient to support the expansion. The same was true with the IT for the company’s value-added private communication networks. IT costs were growing rapidly, yet their contribution to reducing the administrative cost of global sales was minimal. Kone was managing different IT platforms around the world with a variety of home-grown and nonstandard applications. None of the regional IT infrastructures was integrated, nor were they connected or compatible. Kone’s global strategy was in danger.

The Solution

Kone Inc. realized that it must implement and manage a global-standard IT environment. But the company also realized that its business is about escalators and elevators, not IT, so it decided to pursue IT outsourcing. Kone had had an experience with IT outsourcing before, when it outsourced its mainframe operations to Computer Science Corp. But this time the scope of outsourcing was much larger, so the company solicited proposals and finally decided to partner with two global IT providers, SAP AG from Germany and Hewlett-Packard (HP) from the United States.

As described in Chapter 8, SAP is the world’s largest ERP provider, and almost all the 72 modules of SAP R/3 software (including a data warehouse) were deployed at Kone. The SAP environment is deployed in 16 countries, where 4,300 users, in all functional areas, work in this highly integrated product.

HP was hired to provide and manage the hardware on which SAP is run. The decision to use two vendors was not easy. IBM and Oracle each could have provided both the

software and hardware, but using two separate vendors promised the best-of-breed approach.

HP manages 20 Kone Unix Servers in three data centers (one in Atlanta for North America, one in Singapore for Asia, and one in Brussels for Europe). HP uses its latest technology. HP’s OpenView network, and system management and security software is also deployed with the system to ensure high availability environment. The system is linked with EMC storage and back up. The annual cost of this global outsourcing is \$5 million.

The entire global IT infrastructure is connected and integrated, and it supports identical business processes and practices in all countries. The system provides management with real-time data on product sales, profitability, and backlogs—on a country, regional, or global basis.

Kone maintains some IT competencies to allow it to actively manage its outsourcing partners. The internal team meets online regularly, and SAP and HP collaborate and work closely together.

The Results

The outsourcing arrangement allows Kone to concentrate on its core competencies. The cost is only 0.02 percent of sales. Large fixed costs in infrastructure and people have been eliminated. The company has better cost control, as well as flexible opportunity for business processes redesign, thus speeding up restructuring. The outsourcing vendors guarantee to have the system available 99.5 percent of the time. Actual uptime has been very close to 100 percent.

Sources: Compiled from “The Elevation of IT Outsourcing Partnership” (2002), and *rsleads.com/208cn-254* (accessed February 13, 2003).

Questions for Minicase 2

1. What were the major drivers of the outsourcing at Kone?
2. Why did Kone elect to work with several vendors?
3. What are some of the risks of this outsourcing?
4. How can Kone control its vendors?



Virtual Company Assignment

Information Technology Economics

This chapter has brought you back to reality. Over the course of your internship, you've recommended many useful and innovative technologies that would help make everybody's job at The Wireless Café more productive and interesting, including CRM, SCM, DSS, and wireless networks and applications, to name a few. However, The Wireless Café's budget definitely won't support all of your recommendations in one year. Barbara is concerned that Jeremy may overextend The Wireless Café's finances, because he sees benefits in all of the technologies, so she has asked you to help with a more reasoned analysis of the IT economics for The Wireless Café.

1. What is the *business case* for implementing the following systems at The Wireless Café?
 - a. CRM

b. SCM

c. Wireless networks and applications

2. Consider the costs of acquiring and implementing the Wireless Waitress software package. What are the components of TCO and TBO that should be analyzed in an acquisition decision?
3. This chapter presents a number of ways to evaluate the economic viability of a technology investment. Which method would you choose for a small business such as The Wireless Café and why?

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PART V
Implementing and Managing



- ▶ 13. Information Technology Economics
- ▶ 14. Building Information Systems
- ▶ 15. Managing Information Resources and IT Security
- ▶ 16. Impacts of IT on Organizations, Individuals, and Society (online)

CHAPTER

14

Building Information Systems

Utility Computing

14.1

The Concept of a Systems Development Life Cycle

14.2

Methods for Complex or Quickly Needed Systems

14.3

Component-based Development and Web Services

14.4

Systems Developed Outside the IS Department

14.5

Building E-Commerce Applications, ASPs, and Outsourcing

14.6

Some Important Systems Development Issues

Minicases: (1) "Do or Die" / (2) University of Nebraska

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Explain the concept of a systems development life cycle (SDLC).
- 2 Compare and contrast prototyping, rapid application development (RAD), joint application design (JAD), object-oriented (OO) development, extreme programming (XP), and traditional SDLC approaches to systems development.
- 3 Describe the contributions of component-based development and Web services to building information systems.
- 4 Evaluate alternatives (including the adoption of utility computing) to in-house systems development.
- 5 Discuss the major strategies, methods, and tools for building e-commerce applications.
- 6 Identify advantages and disadvantages of CASE tools. Describe alternative approaches to software process quality improvement.



UTILITY COMPUTING: “THE NEXT BIG THING”

➔ THE PROBLEM

Imagine this scene. It’s noon on Friday and you just found out that your relatives are coming to spend the weekend. It’s time to contact the electric company to let them know that you will need extra electricity for the weekend. You’re told you have to fill out a purchase order and it will be five to seven days before you can get extra electricity. Of course, life is not like this, because basic utilities have extra capacity built into their delivery systems. But this would be a likely scenario if you were to find out at noon on Friday that you were expecting a major spike in usage on your servers. You’d have to call your provider, do a bunch of paperwork, and maybe in a few days you could get the extra capacity you need. That’s the kind of problem that utility computing aims to solve.

➔ THE SOLUTION

Utility computing vendors are looking toward a future in which computing capacity is as easy to acquire as electricity. Rather than having a fixed amount of computing resources, you would have access to computing resources on an as-needed basis—just like with electricity. Many IT market leaders are now starting to catch on to the concept of utility computing as a bullet-proof utility service that we can virtually take for granted. IBM announced it is spending \$10 billion on its on-demand computing initiatives. HP also announced its Utility Data Center architecture, and Sun has its own N1 data virtualization center plans. Sun, HP, and IBM are duking it out over how best to meet utility computing requirements and command a leadership position.

➔ THE RESULTS

Already present in a variety of capacity-based pricing models, utility computing is poised to expand throughout the enterprise as various key technologies—such as Web services, grid computing, and provisioning—intersect. Growth of utility computing in the enterprise will deliver to the industry not only equal access to supercomputing resources, but also new revenue streams for commercial data centers, new application pricing models based on metered use, and an open computing infrastructure for companies with little or no standing IT maintenance budget. Utility computing is on track to be the “next big thing” for IT vendors and services companies that sell to large enterprises.

Sources: Compiled from Zimmerman (2003) and from Neel (2002).

➔ LESSONS LEARNED FROM THIS CASE

Utility computing (also called “on-demand computing”) has become one of the hot topics in the IT analyst community and, increasingly, in larger enterprises that are looking for ways to reduce the fixed costs and complexity of IT. Utility computing tools provide total flexibility in information systems development, from in-house and self-managed to fully outsourced, with everything in between—including a hybrid deployment model in which in-house capacity can be supplemented by third-party resources to handle peak needs.



In this chapter we will look at the topic of building information systems. Since organizational environments and general technologies change over time, organizations need new systems, or major revisions to existing systems, to continue to meet their objectives. Therefore, systems development is an ongoing process in all organizations that use IT.

In this chapter we discuss various approaches to development that can increase the probability of favorable outcomes. We initially present the concept of a systems development life cycle. We then discuss various system development alternatives (prototyping, rapid application development, joint application design, object-oriented development and extreme programming). Then we provide a comprehensive discussion of the contributions of component-based development and Web services to building information system. The subsequent section covers end-user development, acquiring systems from outside sources, utility computing and deciding between development approaches. Next is a section on the approaches, methods, and techniques used in developing Web-based information systems. The final section looks at the use of CASE tools, discusses quality improvement, and presents project-planning techniques used to improve outcomes of the development process.

14.1 THE CONCEPT OF A SYSTEMS DEVELOPMENT LIFE CYCLE

In the early years of data processing, many software developers did not use any kind of formal approach. They would simply ask users a few questions about what the system was supposed to do and then start programming. Sometimes this approach resulted in desirable outcomes, but often it failed. The failures were frequent enough to indicate that a more formal approach was necessary. **Systems development** refers to the set of activities that create systems for the effective and efficient processing of information. One approach to systems development is the **systems development life cycle (SDLC)**. It provides a comprehensive framework for formal design and development activities.

To understand the idea of a systems development life cycle, consider this analogy. A business firm moves from one city to another. The moving project requires a very detailed plan. Someone has to acquire property in the new city. Someone has to arrange for telephone and utility services at the new location. People need to pack, ship, unpack, and install furniture and equipment at the new location. The list goes on and on. The plan should identify every significant task and assign it to an individual or groups within or outside the organization. Every task needs a start date and a completion date, and some tasks cannot start until after the completion of others. Also, the plan needs to coordinate the start and completion dates of the individual tasks within the limitation of the target completion date for the whole project.

Looking at the plans for several such moving projects, we could find many similar tasks. With a little more effort, we could group the tasks into logically related categories and then arrange the categories in a sequence corresponding to the different phases of a moving project over time. These general categories would apply to most moving projects, even though the individual tasks could vary from project to project.

Substitute the words “information systems development” for the word “moving” in the above paragraphs and you get an idea of what a systems development life cycle is like. An SDLC shows the major steps, over time, of an

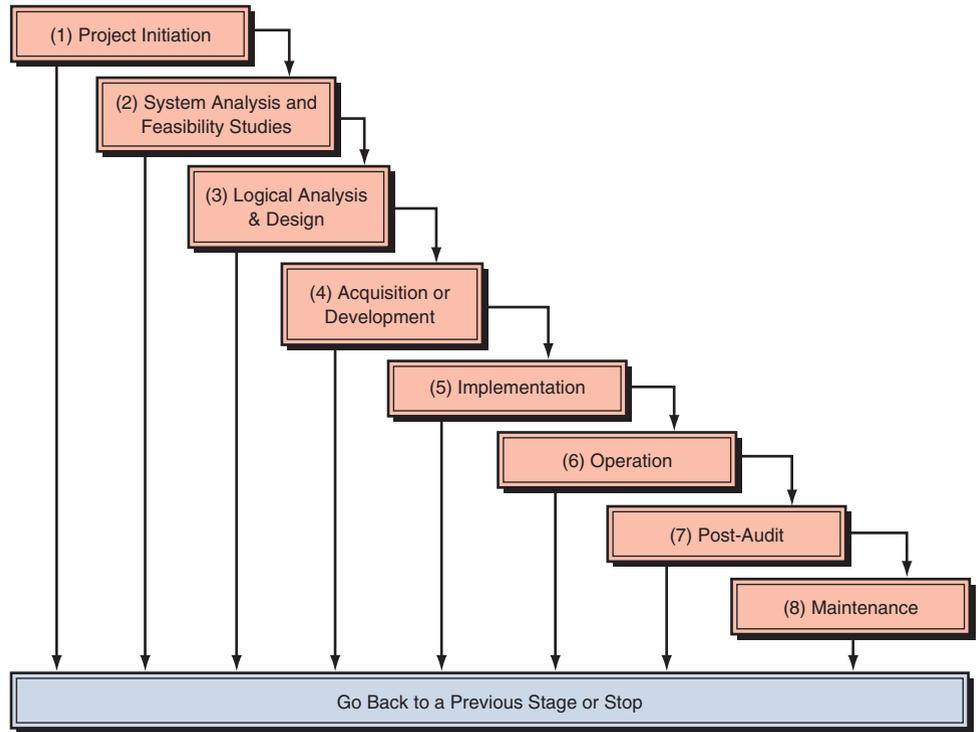


FIGURE 14.1 An eight-stage SDLC.

information systems development project. Within these general categories are individual tasks. Some of these tasks are present in most projects, while others would apply only to certain types of projects. For example, smaller projects may not require as many tasks as larger ones.

Note that there is no universal, standardized version of the SDLC. Consulting firms, as well as IS groups within organizations, develop individualized versions appropriate to their own operations. They give their versions unique names. For example, Accenture calls its version Method/1. The Microsoft certification programs include training in its Solution Development Discipline (SDD) methodology. This chapter's version of an SDLC is relevant to most other SDLCs.

An Eight-Stage SDLC

Figure 14.1 provides a graphic model of an SDLC that has eight stages, or groups of major tasks. Note also that the stages overlap: One stage may start before the previous stage ends. This is in contrast to the traditional **waterfall method**, in which the work flows through all the tasks in one stage before going on to the next stage. Also note that this process can go backward more than one stage, if necessary. These overlapping stages provide flexibility for adapting quickly to the volatile demands of the current business environment. The method also allows for the implementation of ideas or correction of defects that are discovered in later stages. The following discussion outlines the individual stages and their major tasks.

STAGE 1: PROJECT INITIATION. Projects often start when a manager has a problem or sees an opportunity related to the area where he or she works. The manager calls IS and requests that a formal planning process be initiated to



discover ways that can help the organization meet its objectives. Sometimes the IS group initiates projects that will improve its own operations or deal with common problems among the user areas.

STAGE 2: SYSTEMS ANALYSIS AND FEASIBILITY STUDIES. Stage 2 consists of two phases of analysis: systems analysis and feasibility studies.

Systems Analysis. After a project is initiated, the systems analysis phase begins. **Systems analysis** is the phase that develops a thorough understanding of the existing organization, its operation, and the situation that is causing a problem. Systems analysis methods include observation, review of documents, interviews, and performance measurement. Several methods exist for the execution of systems analysis, and some of them are supported by software. Systems analysis also examines the proposed system and its anticipated contribution to the solution of the problem.

Feasibility Studies. **Feasibility studies** calculate the probability of success of the proposed solution; they may be run several times throughout the systems development life cycle. They determine whether the solution is achievable, given the organization's resources and constraints. The feasibility study often includes an impact analysis that examines the effect of the system on other processes and its impact on the surrounding environment. The major areas of study are:

- **Technology.** Are the performance requirements achievable utilizing current information technologies?
- **Economics.** Are the expected benefits greater than the costs?
- **Organizational factors.** Are the skill levels needed to use the new system consistent with the employees who will operate it?
- **Legal, ethical, and other constraints.** Does the system meet all regulatory requirements?

If the proposed project is feasible (and the sponsors are still interested), planning can go on to the next stage.

STAGE 3: LOGICAL ANALYSIS AND DESIGN. The emphasis at the third stage is on **logical design**, the design of system from the (business) user's point of view. The analyst identifies *information requirements* and specifies processes and generic IS functions such as input, output, and storage, rather than writing programs or identifying hardware. The analysts often use modeling tools such as *data flow diagrams* (DFDs, see Figure 14.2) and *entity-relationship diagrams* (ERDs, see Figure 14.3) to represent logical processes and data relationships.

Logical design is followed by a *physical design*, which translates the abstract logical model into the specific technical design (the "blueprints") for the new system.

The trend toward purchasing software, instead of developing it, is changing both the general emphasis and the specific tasks in the logical analysis and design phase. Analysts still need to identify user requirements. However, they now spend more time *comparing* requirements to features of available software, and less time on *designing* systems. They need to prepare detailed specifications only when the functionality that users need is not available in software in the marketplace. They also have to identify configuration requirements for commercial

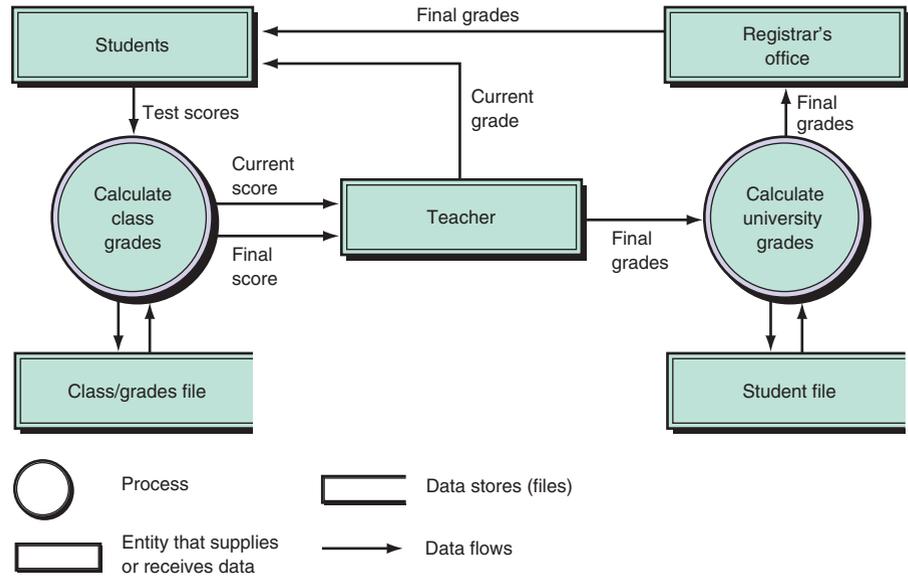


FIGURE 14.2 Data flow diagram for student grades example.

packages that offer a wide range of customization options. *IT At Work 14.1* shows how an information system fails due to poor choice of software.

STAGE 4: DEVELOPMENT OR ACTUAL ACQUISITION. The logical design of the new system guides the actual development or acquisition, just as blueprints guide the construction of a new building. IS personnel use the specifications to purchase the hardware and software required for the system and then to configure it as needed. Programmers write code for parts of the system when commercial sources are not available or appropriate. Technical writers develop documentation and training materials. IS personnel test the system, and users do some testing prior to the actual implementation. The testing identifies bugs and also compares system performance to the specifications in the design.

STAGE 5: IMPLEMENTATION. Implementation is obviously an important stage; the system can fail here even if it has all the specified functionality. The project team should plan the implementation very carefully, to avoid problems that could lead to failure or user resistance. The users need training in the mechanics of the system to reduce frustration and to minimize productivity losses in the transition period. In addition to developing technical skills, the training should also attempt to motivate users, for example, by stressing the benefits the system brings to the organization.

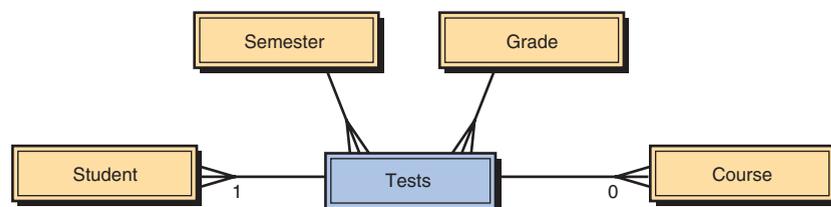


FIGURE 14.3 Entity-relationship diagram of students, courses, and grades.



IT At Work 14.1

HOW DO TECHNOLOGY INITIATIVES FAIL?



Mail Boxes Etc. (MBE) spent \$25 million to position itself as the real-world shipping partner to the virtual e-tail space. It was indisputably a great idea. Only one problem: the technology doesn't appear to work. Many franchisees revolted against the system, calling it "a pipe dream." Headquarters insists everything is just fine. But key customers are disenchanted. What follows is a cautionary saga of frustration, stubbornness, poor communication, arrogance, raw power and wasted opportunity.

The iShip system is part of a massive technology overhaul MBE embarked on two years ago. The brainchild of MBE President and CEO Jim H. Amos Jr., the project was meant to position San Diego-based MBE as the premier shipping partner for e-tailers. "Because of our bricks-and-mortar on the ground, I thought we might have an opportunity that no one else had," said Amos.

By building a satellite network to connect the 3,500 domestic franchises with corporate systems, an Internet-enabled point-of-sale (POS) system and the iShip manifest system, shipping at MBE would become enticingly simple. The idea was that a returning customer would need to give only his phone number to the MBE clerk for service. Up would pop his entire order history and recipient address information. Customers would no longer need to carry their address books into the store. They would feel instantly at home, as if they were part of a special group. At least, that was the plan.

"It's a great idea, all right. It just doesn't work," said Sousa. Besides using the DOS manifest as the default shipping system, Sousa ditched the satellite network in favor of a local digital subscriber line (DSL) provider for Internet service. He relies on paper forms in duplicate to do the bulk of his business. To Sousa, the new systems have been a big disappointment. "None of it connects. This is all a pipe dream."

Although MBE executives insist that the technology works fine, an internal MBE memo obtained by *Darwin Magazine* seems to suggest that the company is indeed rethinking its technology strategy, which would mean "deep-sixing" (discarding) a lot of time and money. All told, MBE spent in the neighborhood of \$25 million on its technology program, including equity investments in a host of dotcoms such as iShip, in which MBE invested \$4 million. That's a significant chunk of change for a company with only \$81 million in revenues (sales for the global MBE network were approximately \$1.4 billion in fiscal 2000). The system is only part of the problem with Amos' e-business strategy. Its high-profile agreement to be the exclusive shipper for online auction giant eBay has stalled, and iShip is faltering financially. As *Darwin* went to press in May 2001, MBE announced that it had been acquired by shipping giant United Parcel Service of America (UPS).

The MBE story is shaping up as one giant case study for how not to do a strategic technology initiative. While the UPS deal will likely add an infusion of capital to help mend MBE's technology woes, it's still worth asking why such a well-intentioned idea failed so signally. After all, the plan to connect the franchises and Internet-enable their operations was not fundamentally flawed. The answer seems to lie in a tangle of poor technology decisions, bad market timing, and a disconnect between the services MBE offers and what many of the e-tailers want.

Sources: Condensed from Paul (2001) and from *mbe.com* (2003).

For Further Exploration: What are the problems with MBE's "jump into new technology"? Discuss the possible impacts of poor technology decision on MBE.

In most cases, implementing a new system requires a *conversion* from a previous system. Approaches to conversion include:

- **Parallel conversion:** The old and new systems operate concurrently for a test period, and then the old system is discontinued.
- **Direct cutover:** The old system is turned off, and the new system is turned on.
- **Pilot conversion:** The new system is implemented in a subset of locations (for example, some of the branches in a large banking chain) and is extended to remaining locations over time.



- **Phased conversion:** Large systems often are built from distinct modules. If the modules were originally designed to be relatively independent, it may be possible to replace the modules one at a time.

STAGE 6: OPERATION. After a successful conversion, the system will operate for an indefinite period of time, until the system is no longer adequate or necessary, or cost effective.

STAGE 7: POST-AUDIT EVALUATION. An organization should perform a **post-audit** to evaluate all its larger systems projects after their completion. Post-audits introduce an additional element of discipline into the development process. If the implementation was successful, an audit should occur after the system's operations have stabilized. If the project failed, the audit should be done as soon as possible after the failure.

STAGE 8: MAINTENANCE. Every system needs two regular kinds of maintenance: fixing of bugs and regular system updating. Maintenance is expensive, accounting for up to 80 percent of organizational IS budgets. Therefore it is important that the design and development stages produce systems that are easy to maintain and are flexible enough to handle future expansion, upgrading and capacity increases.

Traditional versus Modern SDLCs

There are two major problems with systems development life cycle methodologies. First, many systems projects fail, even though the project management incorporates a formal SDLC approach. Second, the environment is very different from what it was 30 years ago. Information technology is much more powerful and includes features such as graphical user interfaces and client/server architectures that are very different from earlier forms of programming.

Do these problems mean that project managers should abandon the SDLC concept? Not really. All the stages in Figure 14.1 are still either absolutely necessary or highly desirable for larger projects. The benefits described above are still important. The increasing complexity of systems development means that some form of structure is even more necessary now than 30 years ago. However, the general organization of the SDLC needs to adjust to the realities of the current environment. IS groups considering the implementation of a formal SDLC methodology and associated tools for managing projects should look for the characteristics listed at *Online File W14.1* at the book's Web site. Yourdon (1989, 2002) proposes a modern structured project life cycle.



A Light SDLC Methodology for Web-based System Development

The SDLC (both traditional and modern) is a formal and disciplined approach to systems development. The time pressures for e-business development projects in the twenty-first century have tempted many project teams to simply abandon whatever degree of disciplined and formal process methodology they may have used in the 1980s and 1990s and simply proceed with an anarchical approach.

That "winging it" may have succeeded in first-generation e-business projects, but the risk of building a mission-critical system that's unstable, buggy, non-scalable, and vulnerable to hacker attacks is forcing more and more companies to look for a methodology that strikes a balance between rigor and speed (Yourdon,



2000, 2002). Such a so-called **light methodology** imposes discipline upon the most critical project activities, without wasting precious time on bureaucratic processes associated with old mainframe-era projects. It is less structured than the traditional SDLC and serves more as a framework or reference guide for skilled people than as a foolproof recipe for success.

14.2 METHODS FOR COMPLEX OR QUICKLY NEEDED SYSTEMS

The traditional systems development life cycle approach works best on projects in which users have a clear idea about what they want. The typical automation project is a good example because, in this type of project, computer systems replace manual labor with only minimal changes in processes. Unfortunately, simple automation projects are becoming less common. Nowadays projects tend to require major changes in existing processes, through reengineering or through development of processes that are new to the organization. Furthermore, the need to build inter-organizational and international systems using Web technologies such as extranets, and the need to build or modify systems quickly (see Minicases 1 and 2), created a major shift in the nature of information systems.

This shift in emphasis, along with the high failure rate in traditional systems development, indicates a need for alternatives to conventional SDLC methodologies. Prototyping, rapid application development, joint application design, object-oriented development, and component-based development are five possible alternatives.

Prototyping The **prototyping** approach to systems development is, in many ways, the very opposite of an old-style SDLC. Instead of spending a lot of time producing very detailed specifications, the developers find out only generally what the users want. The developers do not develop the complete system all at once. Instead they *quickly* create a prototype, which either contains portions of the system of most interest to the users, or is a small-scale working model of the entire system. After reviewing the prototype with the users, the developers refine and extend it. This process continues through several iterations until either the users approve the design or it becomes apparent that the proposed system cannot meet their needs. If the system is viable, the developers create a full-scale version that includes additional features.

In this approach, which is also known as *evolutionary development*, the emphasis is on producing something quickly for the users to review. To speed up the process, programmers may use a fourth-generation language (4GL) and other tools such as screen generators or spreadsheet software for parts of the prototype. Figure 14.4 shows a flowchart of the prototyping process, using a relational database for the initial versions of the system.

Prototyping is particularly useful for situations in which user interaction is especially important. Examples of such situations would be decision support (DSS), e-commerce “sell-sides,” or executive information systems. Prototyping is also good for IS projects that substantially change business processes. For users of these types of systems, prototyping allows opportunities to work with the model, and to identify necessary changes and enhancements, before making a

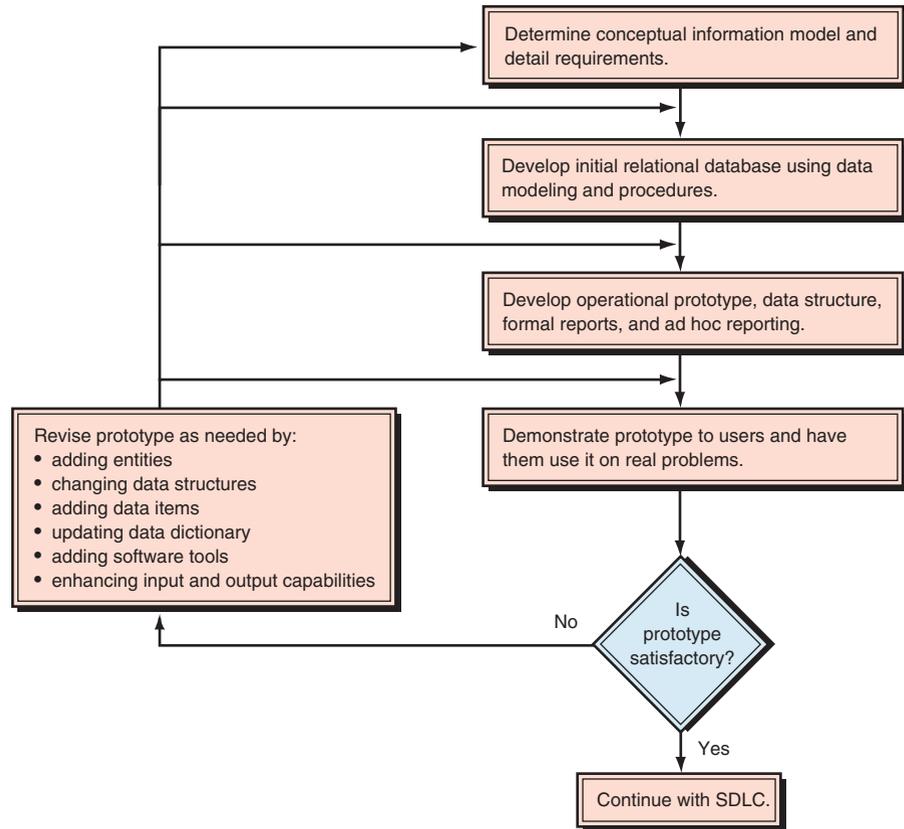


FIGURE 14.4 Model of prototyping process.

major commitment to development. Users should also consider prototyping if it is necessary to start using the system as soon as possible, even before it is complete.

Prototyping does have some disadvantages. It largely replaces the formal analysis and design stage of a conventional SDLC. As a result, the systems analysts may not need to produce much formal documentation for the programmers during the project. If managers do not follow up on this, the documentation may be inadequate years later when the system needs maintenance. Another problem is that users, after working with the final prototype, may not understand why additional work and associated changes are necessary to bring the system up to organizational standards.

Joint Application Design

Joint application design (JAD) is a group-based method for collecting user requirements and creating system designs. JAD is most often used within the systems analysis and systems design stages of the SDLC.

In the traditional SDLC, systems analysts interview or directly observe potential users of the new information system individually to understand each user's needs. The analysts will obtain many similar requests from users, but also many conflicting requests. The analysts must then consolidate all requests and go back to the users to resolve the conflicts, a process that usually requires a great deal of time.



In contrast to the SDLC requirements analysis, JAD has a meeting in which all users meet simultaneously with analysts. During the meeting, all users jointly define and agree upon systems requirements. This process saves a tremendous amount of time.

The JAD approach to systems development has several advantages. First, the group process involves more users in the development process while still saving time. This involvement leads to greater support for and acceptance of the new system and can produce a system of higher quality. This involvement also may lead to easier implementation of the new system and lower training costs.

The JAD approach also has disadvantages. First, it is very difficult to get all users to the JAD meeting. For example, large organizations may have users literally all over the world; to have all of them attend a JAD meeting would be prohibitively expensive. Second, the JAD approach has all the problems caused by any group process (e.g., one person can dominate the meeting, some participants may be shy and not contribute in a group setting, or some participants may sit back and let others do the work). To alleviate these problems, JAD sessions usually have a facilitator, who is skilled in systems analysis and design as well in managing group meetings and processes.

JOINT APPLICATION DESIGN AND WEB SITE DESIGN. The emphasis now for e-business Web sites is to improve customer satisfaction and to make the users experience at the site simple, intuitive, and efficient. Companies that invest in designing solutions that make Web site navigation easy for their users are more likely to achieve customer retention—the key to the success or failure of any business on the Web.

Critical design features are those requirements that a Web site must support to allow a user to complete a task in an enjoyable and efficient way. For users to accept and adopt the interface of a Web site, it is useful to have them involved in its design. An electronic JAD session can be conducted offsite/online with technology support. This brings the key representatives of users (customers), managers, systems designers, and other stakeholders together for requirements determination. The initial set of requirements can serve as the basis for the development of a larger survey to determine user (customer) preferences and priorities. JAD is thus of particular interest to Web site designers (see Kendall and Kendall, 2002).

Rapid Application Development

Rapid application development (RAD) methodologies and tools make it possible to develop systems faster, especially systems where the user interface is an important component. RAD can also improve the process of rewriting legacy applications. An example of how quickly experienced developers can create applications with RAD tools is provided in *IT At Work 14.2*.

What are the components or tools and capabilities of a RAD system? Typical packages include the following.

- **GUI development environment:** the ability to create many aspects of an application by “drag-and-drop” operations. For example, the user can create a report by clicking on file names, and then clicking and dragging fields from these files to the appropriate locations in the report.



IT At Work 14.2

BLUE CROSS & BLUE SHIELD DEVELOPS AN AWARD-WINNING APPLICATION USING RAD



A Y2K problem without a solution led to the development of an innovative customer-service application in less than a year at Blue Cross & Blue Shield of Rhode Island (BCBSRI). The new system is based on an internally developed architecture that the Application Development Trends' 2000 Innovator Awards judges lauded as modular and flexible enough to easily allow for system upgrades and the incorporation of new technology.

BCBSRI decided in mid-1998 to build a new customer-service system, a mission-critical application that monitors and records communications with policyholders. The internal work on the project began in January 1999 after the development plan and blueprint were validated by outside consultants.

The development team adhered to a phased-rollout approach and rapid application development (RAD) methodology. Developers used several productivity tools (including the Sybase EAServer, Sybase PowerBuilder, and

Riverton HOW), as well as performance monitoring techniques and heavy user involvement to ensure the quality of the system throughout its life cycle. By September 1, 1999, the application was available to more than a hundred Windows 98-based clients. Since then, the customer-service unit has averaged about 1,800 daily calls and more than 20,000 transactions a day over the system.

By early 2000, the new customer-service system had already realized an ROI of \$500,000, boosts in user productivity, significant strides in system performance, and increased data accuracy. The integration, power, and scalability of the BCBSRI solution are truly exemplary.

Sources: Condensed from Bucken (2000) and from paper published at *adtmag.com* (April 2000).

For Further Exploration: To what extent do you think the adoption of the RAD methodology contributed to the success of the BCBSRI project?

- **Reusable components:** a library of common, standard “objects” such as buttons and dialog boxes. The developer drags-and-drops these items into the application.
- **Code generator.** After the developer drags-and-drops the standard objects into the design, the package automatically writes computer programs to implement the reports, input screens, buttons, dialog boxes, and so forth.
- **Programming language:** such as BASIC (in Visual Basic), Object Pascal (in Delphi), or C++. This component includes an integrated development environment (IDE) for creating, testing, and debugging code. It may be possible to use drag-and-drop operations to create up to 80 percent of the code for a system.

As Figure 14.5 shows, the same phases followed in the traditional SDLC are also followed in RAD, but the phases in RAD are combined to produce a more streamlined development technique. The emphasis in RAD is generally less on the sequence and structure of processes in the life cycle and more on doing different tasks in parallel with each other and on using prototyping extensively.

In addition to the benefits of speed and portability, RAD is used to create applications that are easier to maintain and to modify. However, RAD packages also have some disadvantages. Like prototyping, the iterative development process can continue indefinitely if there is no unambiguous criterion for ending it. RAD packages may have capabilities to document the system, but having these features does not guarantee that developers will produce appropriate documentation.

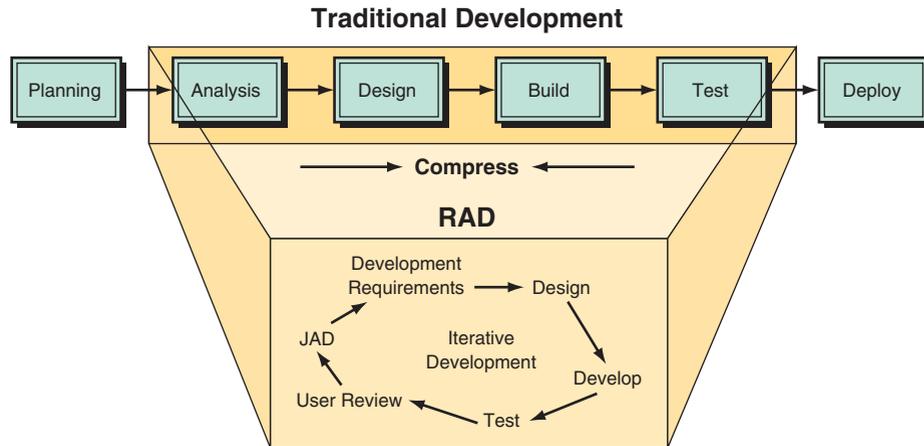


FIGURE 14.5 A rapid application development SDLC. (Source: datawarehouse-training.com/Methodologies/rapid-application-development/.)

RAPID APPLICATION DEVELOPMENT IN THE AGE OF THE INTERNET. RAD has been a key component of client/server systems development. According to Yourdon (2000), WWW applications are likely to accelerate the RAD process to the point where it becomes “FAD,” or frantic application development. The technology-driven nature of the Internet is forcing developers to deliver applications that use these new technologies, such as streaming video and audio, in shorter and shorter time spans. This is spurred further by the development efforts of vendors, including Netscape and Microsoft, who continually release new versions of their Web browser software. Pressure arising from the constant introduction of new technology has introduced a FAD approach into organizations that are developing Web-based solutions. It appears that the FAD approach will become more prevalent as organizations become increasingly aware of the strategic value of an Internet presence.

Object-Oriented Development

Object-oriented development (see Technology Guide 2) is based on a fundamentally different view of computer systems than that found in traditional SDLC approaches. Traditional approaches provide specific step-by-step instructions in the form of computer programs, in which programmers must specify every procedural detail. They usually result in a system that performs the original task but may not be suited for handling other tasks, even when the other tasks involve the same real-world entities.

An object-oriented (OO) system begins not with the task to be performed, but with the aspects of the real world that must be modeled to perform that task. Therefore, if a firm has a good model of its customers and its interactions with them, this model can be used equally well for billings, mailings, and sales leads. Object technology enables the development of purchasable, sharable, and reusable information assets (objects) existing in a worldwide network of interoperable inter-organizational information systems.

BENEFITS AND LIMITATIONS OF THE OBJECT-ORIENTED APPROACH. The OO approach to software development can lead to many benefits. First, it reduces

the complexity of systems development and leads to systems that are easier and quicker to build and maintain, because each object is relatively small, self-contained, and manageable. Second, the OO approach improves programmers' productivity and quality. Once an object has been defined, implemented, and tested, it can be reused in other systems. Third, systems developed with the OO approach are more flexible. These systems can be modified and enhanced easily, by changing some types of objects or by adding new types. A fourth benefit is that the OO approach allows the systems analyst to think at the level of the real-world system (as users do) and not at the level of the programming language.

On the other hand, there are some disadvantages to the OO approach. OO systems (especially those written in Java) generally run more slowly than those developed in other programming languages. By all appearances, object-oriented systems development (OOSD) is in the throes of a dilemma. Dozens of well-known experts claim the advantages of OOSD make it vastly superior to conventional systems development. But some of them also point to OOSD's disadvantages and question whether it will ever be a dominant approach to systems development. *Online Files W14.2 and W14.3* show some of the advantages and disadvantages of OOSD. For a more detailed discussion of the ups and downs of the object-oriented approach, see Johnson (2000).



UNIFIED MODELING LANGUAGE. The techniques and notations that are incorporated into a standard object-oriented language are called *unified modeling language* (UML). The UML allows a developer to specify, visualize, and construct the artifacts of software systems, as well as business models. Figure 14.6 provides an example of two UML artifacts, class and object diagrams.

Figure 14.6a shows two object classes: Student and Course, along with their attributes and operations. Objects belonging to the same class may also participate in similar relationships with other objects. For example, all students register

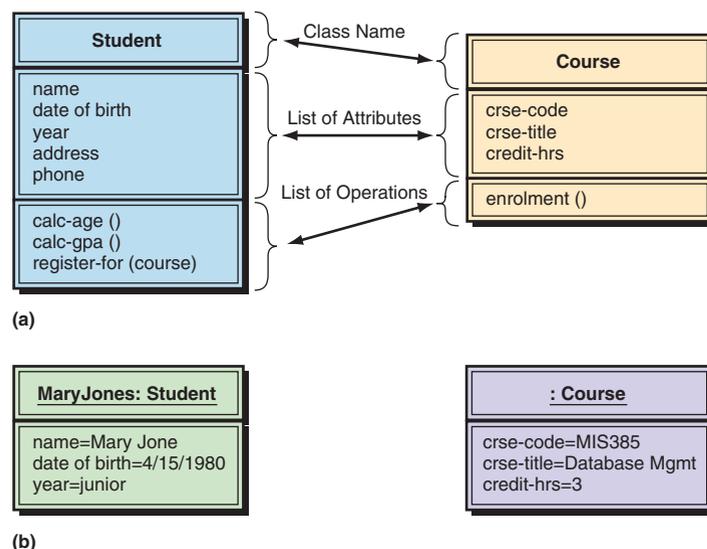


FIGURE 14.6 UML class and object diagrams. (Source: Valacich, et al., *Essentials of Systems Analysis and Design*, Prentice-Hall, 2001, p. 375. *Essentials of Systems Analysis and Design* by Valacich/Hoffer. Reprinted by permission of Pearson Education, Inc. Upper Saddle River, NJ.)



for courses, and therefore the Student class can participate in a relationship called “register-for” with another class called Course. Figure 14.6b shows two object instances (think examples), one for each of the classes that appears in Figure 14.6a. The object instance’s attributes and their values are shown in the second compartment. An operation such as “calc-gpa” in the Student class (see Figure 14.6a) is a function or a service that is provided for all the instances of a class. It is only through such operations that other objects can access or manipulate the information stored in an object.

OBJECT TECHNOLOGY AND WEB-BASED SYSTEMS DEVELOPMENT. The object-oriented approach is ideal for developing Web applications. First, the data and code of object-oriented systems are encapsulated into reusable components, each of which can be developed and enhanced independently. This increases development speed and flexibility, as well as reducing system maintenance. Object technology allows companies to share business applications on the Internet.

A second reason why the object-oriented approach is ideal for developing Web applications is that as the Web evolves from static data to active data, it is moving toward object-based software systems. Objects become useful in this context because, by definition, they join software code and data. Objects provide a modular way of organizing, configuring, and reusing code instead of “reinventing the wheel” each time a new routine is written. When users click on a Web page, for example, they are downloading objects into their client machines. This combination of data and code can be configured in new ways, manipulated, and operated actively.

Extreme Programming

Extreme programming (XP) is a discipline of software development based on values of simplicity, communication, feedback, and courage. It works by bringing the whole team together in the presence of simple practices, with enough feedback to enable the team to see where they are and to tune the practices to their unique situation.

In extreme programming, every contributor to the project is an integral part of the “whole team.” The team forms around a business representative called “the customer,” who sits with the team and works with them daily. Extreme programming teams use a simple form of planning and tracking to decide what should be done next and to predict when the project will be done. Focused on business value, the team produces the software in a series of small, fully integrated releases that pass all the tests the customer has defined.

Extreme programmers work together in pairs and as a group, with simple design and obsessively tested code, improving the design continually to keep it always just right for the current needs. The extreme programming team keeps the system integrated and running all the time. The programmers write all production code in pairs, and all work together all the time. They code in a consistent style so that everyone can understand and improve all the code as needed. The extreme programming team shares a common and simple picture of what the system looks like. Everyone works at a pace that can be sustained indefinitely. Figure 14.7 shows the practices and the main “cycles” of extreme programming.

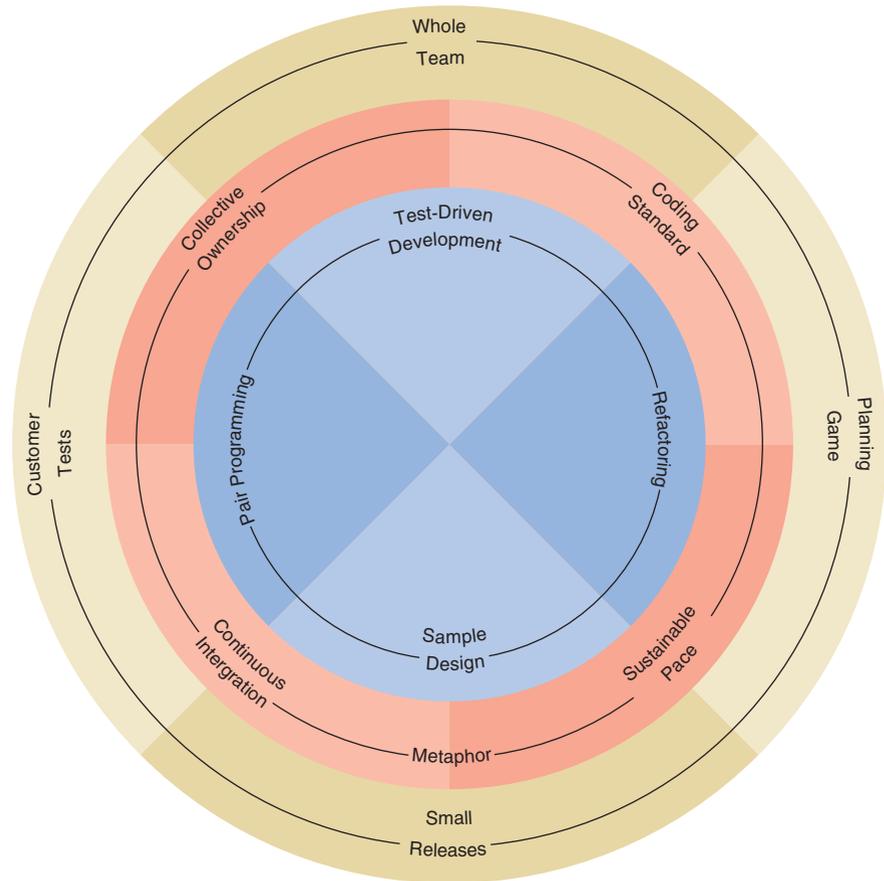


FIGURE 14.7 Extreme programming practices.

14.3 COMPONENT-BASED DEVELOPMENT AND WEB SERVICES

The efficient development of software reuse, as discussed in Section 14.2, has become a critical aspect in the overall IS strategies of many organizations. An increasing number of companies have reported reuse successes. While the traditional reuse paradigm *allows changes* to the code that is to be reused (white-box reuse), component-based software development advocates that components are reused *as is* (black-box reuse). Currently emerging Web services are also aiming at improving application development by leveraging existing software; however, they go an entirely different route. Instead of requiring the Web service user to own the component, Web services reside on the provider's host. Program-to-program communication between the existing application and the web service is enabled through a set of standardized interfaces, thus taking the black-box reuse concepts one step further. The importance of these trends is reflected by the growing interest of the IS community in the component-base software development and web services research areas.

Component-Based Development

Object technology, as discussed in Section 14.2, however, does have its downside, including a steep learning curve. Business objects, though they represent things in the real world, become unwieldy when they are combined and



recombined in large-scale commercial applications. What is needed are suites of business objects that provide major chunks of application functionality (e.g., pre-programmed workflow, transaction processing, and user event notification) that can be snapped together to create complete business applications.

This approach is embodied in the next step in the evolution beyond objects, **component-based development**. *Components* are self-contained packages of functionality that have clearly defined, open interfaces that offer high-level application services. Components can be distributed dynamically for reuse across multiple applications and heterogeneous computing platforms. Components take the best features of objects to a higher level of abstraction, thus enabling mainstream commercial software developers to learn and use the technology more easily.

User interface icons (small), word processing (a complete software product), a GUI, online ordering (a business component), and inventory reordering (a business component) are a few examples of components. Search engines, firewalls, Web servers, browsers, page displays, and telecommunication protocols are examples of intranet-based components.

Code reusability, which makes programming faster and more accurate, is the first of several reasons for using components-based development. Others include: support for heterogeneous computing infrastructure and platforms; rapid assembly of new business applications; and the ability of an application to scale.

Components used in distributed computing need to possess several key characteristics to work correctly, and they can be viewed as an extension of the object-oriented paradigm. The two main traits borrowed from the world of object-oriented technology are *encapsulation* and *data hiding*.

Components *encapsulate* the routines or programs that perform discrete functions. In a component-based program, one can define components with various published interfaces. One of these interfaces might be, for example, a date-comparison function. If this function is passed to two date objects to compare, it returns the results. All manipulations of dates are required to use the interfaces defined by the date object, so the complete function is encapsulated in this object, which has a distinct interface to other systems. Now, if the function has to be changed, only the program code that defines the object must be changed, and the behavior of the date comparison routine is updated immediately, a feature known as *encapsulation*.

Data hiding addresses a different problem. It places data needed by a component object's functions within the component, where it can be accessed only by specially designated functions in the component itself. Data hiding is a critical trait of distributed components. The fact that only designated functions can access certain data items, and outside "requestors" have to query the component, simplifies maintenance of component-oriented programs.

A component-based application architecture provides the business benefits of rapid applications development for quick time to market, enterprise-wide consistency of business rules, and quick response to changing business requirements. And because major software vendors are committed to a component architecture, applications can mix and match best-of-breed solutions. Components hide the complexity of the underlying systems technology. Plug-and-play business application components can be assembled or "glued together" rapidly to develop complex distributed applications needed for e-commerce. The execution of component-based development, however, requires special training and skill. For a methodology of evaluating component-based systems see Dahanayake et al. (2003).

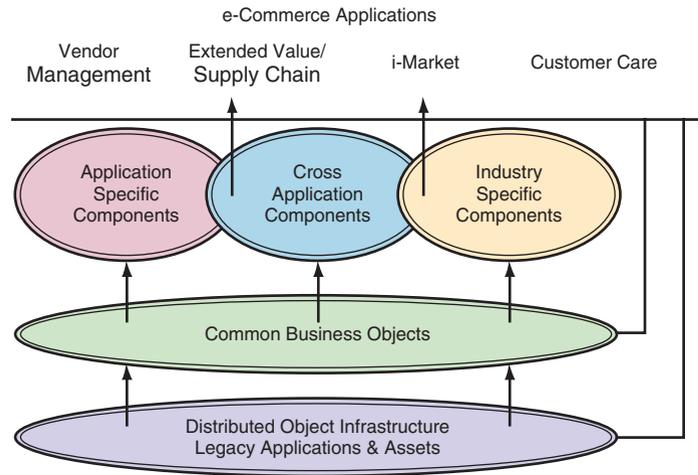


FIGURE 14.8
E-commerce applications
and component logical
architecture. (Source:
Drawn by E. Turban.)

COMPONENT-BASED DEVELOPMENT OF E-COMMERCE APPLICATIONS. Component-based EC development is gaining momentum. It is supported by Microsoft and the Object Management Group (OMG), which have put in place many of the standards needed to make component-based development a reality. A logical architecture for component-based development of e-commerce applications can be described in layers as shown in Figure 14.8.

Component-based development for e-commerce applications is a process of assembly and refinement. The process begins with *cross-application components* that provide functionality common to most types of e-commerce applications. Typical of such core components are user-profile management, authentication, authorization, data management, and so on. These cross-application components can be customized and extended to form *application-specific components*. For example, in a procurement application, a profiling component will contain attributes for identifying a user's role and buying power.

When applied to an I-market (Internet market) application, the profiling component will be extended to hold information that can be used to track customer buying patterns. In addition to the tailored cross-application components, application-specific components will include best-of-breed search engines, shopping carts, catalogs, or other elements required for the application. These may be built in-house or purchased. Cross-application components also can be extended to develop *industry-specific components*. For example, in a manufacturing industry a workflow component can be extended to handle work-in-progress and integrate workflows across enterprises to make "just-in-time" a reality.

The final step in the component-based development process is the configuration of the components to incorporate the organization's unique business rules and user presentation and navigation. It is in this step that a company's competitive advantage is built. Components come in many shapes and can be purchased from special vendors. For ways to combine them into meaningful applications, see Arsanjani (2002).

There are several methods that developers can use for integrating components (e.g., see Linthicum, 2001). These methods can have limitations. For example, they can be vendor or platform dependent, expensive, complex to learn, and inflexible. A potential solution is Web services.



Web Services in System Development

As described in Chapter 2, the major application of Web services is systems integration. System integration is one of the major activities done in system development. From example, the whole concept of components is based on the idea of gluing them together. Applications need to be integrated with databases and with other applications. Users need to interface with the data warehouse to conduct analysis, and almost any new system needs to be integrated with old ones. Finally, the increase of B2B and e-business activities requires the integration of application and databases of business partners (external integration). Let us examine the essential of Web services.

BASIC CONCEPTS. There are several definitions of Web services. Here is a typical one: Web services are self-contained, self-describing business and consumer modular applications, delivered over the Internet, that users can select and combine through almost any device from personal computers to mobile phones. By using a set of shared protocols and standards, these applications permit disparate systems to “talk” with one another—that is, to share data and services—without requiring human beings to translate the conversations.

The following definition provides a preview of some of the functionalities of Web services: “Web service is a URL-addressable software resource that performs functions and provides answers. A Web Service is made by taking a set of software functionalities and wrapping it up so that the services it performs are visible and accessible to other software applications. Web services can request services from other Web services, and they can expect to receive the results or responses from those requests. Web Services may interoperate in a loosely-coupled manner; they can request services across the Net and wait for a response. Web services may be combined to create new services. And they may be recombined, swapped or substituted, or replaced at runtime” (Seybold, 2002).

Specifically, a Web service fits the following three criteria: (1) It is able to expose and describe itself to other applications, allowing those applications to understand what the service does. (2) It can be located by other applications via an online directory, if the service has been registered in a proper directory. (3) It can be invoked by the originating application by using standard protocols.

The Key Protocols: The Building Blocks of the Web Services Platforms. Web services are based on a family of key protocols (standards). The major protocols are:

- **The XML Language. Extensible Markup Language (XML)** is an open standard, a universal language for defining data schemes. XML makes it easier to exchange data amongst a variety of applications as well as to validate and interpret such data. An XML document describes a Web Service and includes information detailing exactly how the Web Service can be run.
- **SOAP. Simple Object Access Protocol (SOAP)** is a set of rules that facilitate XML exchange between network applications. SOAP defines a common standard that allows different Web services to interoperate (i.e., it enables communications, such as allowing Visual Basic clients to access JAVA server). It is a platform-independent specification that defines how messages can be sent between two software systems through the use of XML. These messages typically follow a Request/Response pattern (computer-to-computer).
- **WSDL.** The *Web Services Description Language (WSDL)* is a protocol is used to create the XML document that describes tasks performed by a Web services. It actually defines the programmatic interface of the Web services. Tools such



as VisualStudio.Net automate the process of accessing the WSDL, read it and code the application to reference the specific Web Service.

- **UDDI.** *Universal Description, Discovery and Integration (UDDI)* is a protocol that allows for the creation of public, or private searchable directories of Web services. It is the registry of Web services descriptions.
- **Security protocols.** Several security standards are in development such as *Security Assertion Markup Language (SAML)*, which is a standard for authentication and authorization. Other security standards are XML signature, XML encryption, XKMS, and XACML.

See Cerami (2002) for a list of other protocols that are under development.

THE NOTION OF SERVICES AS COMPONENTS. Traditionally, people view information system and IT, including the Web as dealing with information (or data) processing. Web services enable the Web to become a platform for applying *business services*. By services we mean components in IT applications that are well defined and perform a useful task. For example, user authentication, currency conversion, and shipping arrangement are building blocks of broad business processes or applications, such as e-commerce ordering or e-procurement systems. For discussion see Stal, 2002.

The idea of taking elementary services and gluing them together to create new applications is not new. As a matter of fact, the approach of using components for system development has become very popular in recent years due to savings that can be gained from usability (e.g., see Allen and Frost, 1998). The problem is that earlier approaches were cumbersome and expensive. According to Tabor (2002) existing technologies used for component integration exhibit problems with data format, data transmission, interoperability, inflexibility (they are platform specific), and security. Web services offer a fresh approach to integration. Furthermore, business processes that are comprised of Web services are much easier to adapt to changing customer needs and business climates than are today's home-grown or purchased applications (Seybold, 2002). For further understanding of how this approach works, see the description of Web services building process in *Online File W14.4*.



WHAT WEB SERVICES CAN DO. The major functionalities of Web services are as follows: (1) They provide for faster and cheaper integration. (2) Web Services communicate with other programs automatically without human intervention. (3) They can be deployed for use over the Internet, or on an intranet inside a corporate firewall. (4) They can run in a protected environment set up by business partners. (5) They can be written using a wide variety of development tools. These development tools can perform a wide variety of tasks including: automating business processes, integrating disparate components of an enterprise-wide system, delivering alerts to individuals about stock prices and the weather, and streamlining online buying and selling.

Key to the promise of Web services is that, in theory, they can be used by anyone, anywhere, any time, using any hardware and any software, as long as the modular software components of the services are built using the set of standards described earlier (see Fremantle et al., 2002 and Patton, 2002). The generic types of Web services are described in *Online File W14.5*.

A Web Service Example. As a simple example of how Web services operate, consider an airline Web site that provides consumers with the opportunity



**TABLE 14.1 Web Services: Advantages and Limitations**

Advantages	Limitations
<p>Web services rely on universal, open, text-based standards that greatly simplify the problems posed by interoperability and lower the IT costs of collaborating with external partners, vendors, or clients.</p>	<p>Web services are not a silver bullet. The standards underlying Web services are still being defined, so interoperability is not automatic. Even in those instances where the standards are relatively stable, it still requires programming skill and effort to implement and deploy Web services.</p>
<p>Web services enable software running on different platforms to communicate, reducing the cost and headaches of multiple platforms running on everything from mainframes to servers to desktops to PDAs.</p>	<p>One area where the Web services standards are not well-defined is security. The good news is that Web services enable distributed applications to communicate with ease. The bad news is that Web services also enable applications to bypass security barriers (such as firewalls) with ease. Standards such as XML, SOAP, WSDL and UDDI say nothing about privacy, authentication, integrity, or non-repudiation. In an effort to bridge the gap between these standards and existing security standards (such as Public Key encryption), several vendors and organizations have proposed and are currently debating a number of Web service security standards. One of these is WS-Security proposed by Microsoft, IBM, and Verisign.</p>
<p>Web services promote modular programming which enables reuse by multiple organizations.</p>	<p>While Web services rely on XML as the mechanism for encoding data, higher-level standards are still required especially in B2B applications. For example, if two banks want to communicate, they still need standards to define the specific content that is being communicated. This is where standards such as OFX (Open Financial Exchange), which defines the content of transactions between financial institutions, come into play. The lack of coordination among all interested parties for high-level standards is why Web services will first be adopted within organizations and later across organizations.</p>
<p>Web services are easy and inexpensive to implement because they operate on the existing Internet infrastructure. They also offer a way to maintain and integrate legacy IT systems at a lower cost than typical Enterprise Application Integration (EAI) efforts.</p>	
<p>Web services can be implemented incrementally, rather than all at once.</p>	
<p><i>Sources:</i> Dietel et al. (2003); Shirky (2003).</p>	

to purchase tickets online. The airline recognizes that customers also might want to rent a car and reserve a hotel as part of their travel plans. The consumer would like the convenience of logging onto only one system rather than three, saving time and effort. Also, the same consumer would like to input personal information only once.

The airline does not have a car rental or hotel reservation system in place. Instead, the airline relies on car rental and hotel partners to provide Web service access to their systems. The specific services the partners provide are defined by a series of WSDL documents. When a customer makes a reservation for a car or hotel on the airline's Web site, SOAP messages are sent back and forth in the background between the airline's and the partners' servers. In setting up their systems, there is no need for the partners to worry about the hardware



or operating systems each is running. Web services overcome the barriers imposed by these differences. An additional advantage for the hotel and car reservation systems is that their Web services can be published in a UDDI so that other businesses can take advantage of their services.

ADVANTAGES AND LIMITATIONS OF WEB SERVICES. Over the years, there have been a number of programming initiatives aimed at solving the problem of interoperability (i.e., getting software and applications from different vendors running on different hardware and operating systems to communicate with one another in a transparent fashion). Web services is the latest of these initiatives. Why is this initiative different from its predecessors? Table 14.1 cites advantages (Dietel et al., 2003; Shirky, 2003) and limitations of Web services.

14.4 SYSTEMS DEVELOPED OUTSIDE THE IS DEPARTMENT

The methodologies presented earlier are usually used by the information systems department (ISD). Their execution requires highly skilled employees, and the methodologies are fairly complex. The result is a backlog in application development, and a high failure rate. Therefore, many organizations are using approaches that shift the construction task from the ISD to others. Of the various ways of doing this, three are most common: Let users build their own systems; outsource the entire systems development process; or let end users use packages. These options and model are described next.

End-User Development

In the early days of computing, an organization housed its computer in a climate-controlled room, with locked doors and restricted access. The only people who interacted with the computer (most organizations had only one computer) were specialists: programmers, computer operators, and data entry personnel. Over the years, computers became cheaper, smaller, and more widely dispersed throughout the organization. Now almost everybody who works at a desk has a computer.

Along with this proliferation of hardware, many computer-related activities shifted out into the work area. Users now handle most of their own data entry. They create many of their own reports and print them locally, instead of waiting for them to arrive in the interoffice mail after a computer operator has run them at a remote data center. They provide unofficial training and support to other workers in their area. Users also design and develop an increasing proportion of their own applications, sometimes even relatively large and complex systems. *Online Files W14.6 and W14.7* on the Web site provides a detailed discussion of the reasons favoring end-user development and types of end-user computing.



END-USER COMPUTING AND WEB-BASED SYSTEMS DEVELOPMENT. The development of client/server applications in the 1980s and 1990s was characterized by user-driven systems development. End users have been directly or indirectly making decisions for systems designers and developers on how the programs should operate. Web-based systems development in the twenty-first century, however, is application driven rather than user driven. The end user can still determine what the requirements will be and has some input into the design of the applications. But because of the nature of the technologies used



IT At Work 14.3

ANSETT AUSTRALIA AND IBM SIGN END-USER COMPUTING DEAL



Ansett Australia, one of Australia's leading airlines, announced on January 4, 1999, that it had appointed IBM Global Services Australia to manage its end-user computing support functions. Ansett (ansett.com.au), based in Melbourne, Australia, operates an extensive range of domestic airline services and also flies to Japan, Hong Kong, Taiwan, Bali, and Fiji.

Ansett Australia General Manager for IT Infrastructure and Operations, Hal Pringle, said, "IBM Global Services Australia's appointment would significantly improve desktop services to the airline's end users while at the same time delivering substantial cost savings." Such service was previously delivered by a mixture of external contractors and in-house staff.

Mr. Pringle said the decision to hire an external provider of end-user computing (EUC) support arose from a benchmarking study conducted by Ansett earlier this year. The study showed that a move to a single external provider of the caliber of IBM Global Services Australia would: achieve a more consistent end-to-end delivery of applications; assist the implementation of best-practice EUC support at the best cost; deliver substantial cost savings; allow Ansett to

better manage EUC supply and demand; and deliver a more consistent and better quality support service to end users.

"The study highlighted the fact that Ansett had in effect 'outgrown' the level of end-user service provided at that time, and that a quantum leap in service was required to ensure a full return on our end-user computing investment," Pringle said.

"Improving delivery of services to end users and enhancing end-user productivity are becoming key focus areas for many Australian corporations. I am very pleased that we have been chosen to deliver these additional services to Ansett," said Mr. Bligh, General Manager of IBM Global Services Australia, Travel and Transportation Services.

Sources: Sachdeva (2000) and ansett.com.au (2003).

For Further Exploration: What strategic advantages can Ansett Australia gain by ensuring consistent and reliable supports to its end-user computing? Is it worth it for a company to invest in end-user computing?

in Web-based application design, the function, not the user, determines what the application will look like and how it will perform. An innovative way of managing end-user computing is shown in *IT At Work 14.3*.

Outsourcing **Outsourcing**, in its broadest sense, is the purchase of any product or service from another company (see Chapter 13). In general, companies outsource the products and services they are unable or unwilling to produce themselves. IS departments have outsourced computer hardware, telecommunications services, and systems software (such as operating systems) for some time. They also purchase end-user software (e.g., Microsoft Office) because there is no reason to reinvent tools that a software company specializing in these products can provide more cheaply.

Recently, information technology has hired outside organizations to perform functions that in the past have been performed internally by IS departments. Common areas for outsourcing have included maintaining computer centers and telecommunications networks. Some companies, however, outsource most of the IT functions, including systems and applications development, leaving only a very small internal information systems department. This department develops IS plans and negotiates with the vendors performing the outsourced functions.

Typically, the outsourcing firm hires the IS employees of the customer and buys the computer hardware. The outsourcer provides IT services under a



contract that specifies a baseline level of services, with additional charges for higher volumes or services not identified in the baseline contract. Many smaller firms provide limited-scale outsourcing of individual services, but only the largest outsourcing firms can take over large parts of the IT functions of major organizations. The benefits and problems of outsourcing are listed in *Online File W14.8* at the Web site of this chapter.

TRENDS TO OUTSOURCE WEB-BASED SYSTEMS DEVELOPMENT. There is a growing trend to outsource Web-based systems development. This includes planning, Web site design and development, installation of the hardware and software, and more. A principal reason for outsourcing all or part of a Web project is that few companies are fully equipped to do everything themselves, and many demand proof that their online presence will pay off before hiring additional staff. There are many skills needed to develop a Web site and get it up and running. You need people who know graphic design, marketing, networking, HTML, programming, copywriting, public relations, database design, account management, and sales. In addition, issues dealing with the back-end job of running a real business require office managers, accountants, lawyers, and so forth. Outsourcing provides a one-stop shopping alternative to customers who do not have the expertise or time to develop and maintain a commercial site. Consulting providers are broadening their skill sets and geographic reach to try to fill their clients' needs.

Outsourcing Web work means establishing a new, long-term relationship with a stranger. Careful questioning can minimize the risk of making a mistake. Look at the vendor's home page and the home pages it has created for others. Then ask questions:

ABOUT CAPABILITIES

- What portion of the work did you do? What was outsourced to subcontractors?
- What services can you provide?
- Who are your graphic designers, and what are their backgrounds?
- What can you do to publicize my Web site?

ABOUT TECHNICAL MATTERS

- What computer resources do you provide?
- Are your systems backed up?
- Do you have an alternate site in case of hardware failure?
- If you do the programming, how much of the code will be proprietary?
- What provisions do you make for security?

ABOUT PERFORMANCE

- What bandwidth do you provide? How much is dedicated to my home page?
- How much experience do you have managing high-traffic Web sites?
- How high is the volume at your most active site?

ABOUT THE BUSINESS RELATIONSHIP

- What statistical reports do you provide?
- What provisions do you make for handling complaints and problems?

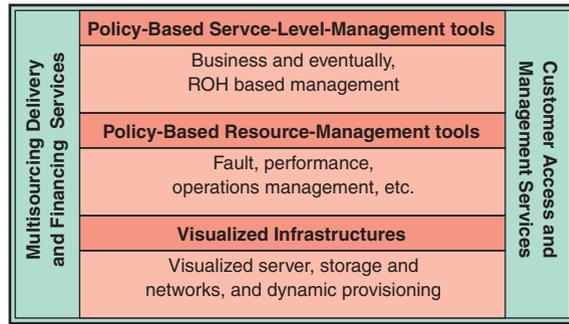


FIGURE 14.9 The five elements of a successful utility-computing value proposition.

Utility Computing

Tapping into compute resources with a simplicity equal to plugging a lamp into an outlet has been a goal of pervasive computing efforts from the start. Known as **utility computing**, the idea is to provide unlimited computing power and storage capacity that can be used and reallocated for any application—and billed on a pay-per-use basis.

Utility computing consists of a virtualized pool of “self-managing” IT resources that can be dynamically provisioned via policy-based tools that ensure these resources are easily and continually reallocated in a way that addresses the organization’s changing business and service needs. These resources can be located anywhere and managed by anyone (an organization’s IT staff or a third-party service provider), and the usage of these resources can be tracked and billed down to the level of an individual user or group.

As shown in Figure 14.9, the utility-computing value proposition consists of three layers of tools and two types of value-added services. Each tool must be seamlessly integrated to create a comprehensive solution, but will usually be implemented separately and tactically—often with little advance planning for the ultimate solution. These tools are:

- **Virtualization tools** that allow server, storage and network resources to be deployed and managed as giant pools, and seamlessly and dynamically reprovisioned as needs change;
- **Policy-based resource-management tools** that automate and standardize all types of IT management best practices, from initial configuration to ongoing fault management and asset tracking; and
- **Policy-based service-level-management tools** that coordinate, monitor and report on the ways in which multiple infrastructure components come together to deliver a business service.

Utility computing still faces daunting obstacles. These include the immaturity of the tools; the difficult economy; and the fact that each of the vendors prefers to tout its own unique variation on the vision with different, often confusing, names and terminology—not to mention cloudy value propositions. However, utility computing will, as discussed in the opening case, inevitably prompt considerable consolidation, as industry giants seek to acquire myriad technologies that they cannot develop themselves. It will also accelerate acceptance of the long-simmering service-provider value proposition, as all providers offer choices of utility-computing implementation models, and migration paths among them.



External Acquisition of Software

The choice between developing proprietary software in-house and purchasing existing software is called the *make-or-buy decision*. Developing (building) proprietary application software gives the organization exactly what it needs and wants, as well as a high level of control in the development process. In addition, the organization has more flexibility in modifying the software during the development process to meet new requirements. On the other hand, developing proprietary software requires a large amount of resources (time, money, personnel) that the in-house staff may have trouble providing. The large quantity of resources needed for this software increases the risk of the decision to “make” the software in-house.

The initial cost of off-the-shelf software is often lower because a software development firm can spread the cost over a number of customers. There is lower risk that the software will fail to meet the firm’s business needs, because the software can be examined prior to purchase. The software should be of high quality, because many customers have used and helped debug it. However, buying off-the-shelf software may mean that an organization has to pay for features and functions that are not needed. Also, the software may lack necessary features, causing the buyer to have to make expensive modifications to customize the package. Finally, the buyer’s particular IT infrastructure may differ from what the software was designed for, and require some additional modification to run properly.

SELECTING VENDORS AND COMMERCIAL SOFTWARE PACKAGES. Externally acquired systems should be evaluated to ensure that they provide the organization with the following advantages. If they do not provide most of these advantages, then the organizations may be better off developing proprietary systems. The most prominent considerations are:

- **On-time.** Completion and implementation of the system on or before the scheduled target date.
- **On-budget.** The system cost is equal to or less than the budget.
- **Full functionality.** The system has all the features in the original specifications.

These outcomes are very desirable, especially because fewer than half of all systems projects achieve all three. However, it is possible to succeed on each of these criteria but still have a system that does not increase the effectiveness of the organization. Other important considerations for selecting vendors and commercial software packages are listed in the *Online File W14.9* at the book’s Web site.



Criteria that may be used to select an application package to purchase include those listed in Table 14.2. Several independent organizations and magazines conduct software package comparisons from time to time. For smaller packages, you can use “trialware” from the Internet before purchase is made. Most vendors will give you the software for a limited testing time. Also, they will come and demonstrate the software. (Be sure to let them use your data in the demo.)

ENTERPRISE SOFTWARE. A recent trend in the software business is **enterprise software**, integrated software that supports enterprise computing. These systems include accounting and finance, human resources, sales and procurement,



Table 14.2 Criteria for Selecting an Application Package

- Cost and financial terms
- Upgrade policy and cost
- Vendor's reputation and availability for help
- Vendor's success stories (visit their Web site, contact clients)
- System flexibility
- Ease of Internet interface
- Availability and quality of documentation
- Necessary hardware and networking resources
- Required training (check if provided by vendor)
- Security
- Learning (speed of) for developers and users
- Graphical presentation
- Data handling
- Environment and hardware

inventory management, production planning and control, and so on. One of the major attractions of enterprise packages is that they incorporate many of the "best practices" in the various functional areas. Organizations thus have the opportunity to upgrade their processes at the same time they install the new software. Major suppliers in this category include SAP/AG, Oracle, Baan, and PeopleSoft. Since these companies sell their products to a large number of customers, they can hire more specialized personnel and spend more on development than an individual organization would spend to develop its own systems.

The implementation and integration of enterprise software represents the single largest information system project ever undertaken by an organization. It can cost tens of millions of dollars and require an army of managers, users, analysts, technical specialists, programmers, and consultants. Most enterprise software vendors provide their methodology and consulting partners to help their customers implement such a massive software solution. For discussion on enterprise resource planning (ERP) systems development, see Ahituv et al. (2002).

E-COMMERCE SOFTWARE. E-commerce software is a powerful yet affordable e-commerce solution that is geared toward Web entrepreneurs of varying skill levels and can greatly reduce the development time needed to launch an effective site. It can provide a comprehensive fix for the rapid construction and deployment of database-driven applications. Its back-end integration capabilities, combined with wizards and templates, make it both powerful and easy to integrate. E-commerce software also facilitates sales by sending orders to the warehouse, adjusting inventory tracking, and even e-mailing stock replenishment alerts to the merchant. Real-time credit card verification and processing is also a great advantage and can also be optimized for use with CyberCash from *Verisign.com*. The software will also provide comprehensive detailed statistics on sales, users, product categories, and browser types.

With all these options and capabilities provided with just one software package, many companies opt to go with e-commerce software instead of developing their own system. Most e-commerce software is fully customizable for your particular company and is easily integrated into your business processes. This



IT At Work 14.4

BILL BROADBENT, THE T-SHIRT KING



Bill Broadbent has been involved in the T-shirt business for over twenty years. Less than six months after he opened his online store, T-Shirt King (www.t-shirtking.com) had already achieved startling results. In this interview Bill explains why he decided to take his bricks-and-mortar store online and how he went about it.

INTERVIEWER: What made you decide to take your business online?

BROADBENT: In discussing the advantages of cybersales we realized that we could show thousands of designs to anyone with Internet access. Also the Internet gave us the world as a market and the ability to bring any design we wanted into a huge online catalogue. Finally, the cost of overhead in a bricks-and-mortar store is sinful. The advantages of selling online are truly unfair. Bricks-and-mortar retailers are not prepared for the inevitable growth of online sales.

INTERVIEWER: What server and shopping-cart software are you using and why?

BROADBENT: We began T-Shirt King as a Yahoo! Store while we were still in the experimental mind. Launching

the store cost less than \$1,000, maintenance less than \$500. Now that we are serious, our new site will be about \$50,000 and our marketing and maintenance (hard to separate these on the Internet) will be in the six figures per month. We have still to choose an e-commerce software solution for this second phase.

INTERVIEWER: What are your top tips for anyone considering opening his or her own Web store?

BROADBENT: Start with Icat or Yahoo to test the waters. Plan on growing, and go for it. This is the new frontier of retailing, and it is going to grow a lot over the next decade. New fortunes are being made right now. Cost of entry is minimal, and the opportunity to support growth through revenue created is a dream.

Source: Condensed from Paul, 1999 and tshirtking.com, 2003.

For Further Exploration: What are the advantages and disadvantages of buying instant e-commerce solutions from software vendors?

trend of using commercially available software will rapidly increase as more merchants go online. As illustrated in *IT At Work 14.4*, an organization can set up its online store on the Web instantly and at minimal cost.

Management Considerations

Because organizations and their systems requirements vary along many dimensions, it is not possible to neatly match all types of systems projects with the acquisition approaches identified in this chapter. Therefore, in many cases it might be advisable to use a combination of approaches.

In this section we provide general considerations related to the different approaches. These considerations should be reviewed in the context of the desirable outcomes discussed earlier. If coupled with good judgment, these considerations may help managers make better decisions regarding new systems' acquisition.

TRADITIONAL SDLC METHODOLOGY. The SDLC approach often works well for large projects with well-defined requirements, where there is *not* a lot of pressure to finish the project quickly. Use of this approach requires appropriate and effective management, possibly including an end user as the leader if the project is not highly technical.

PROTOTYPING. Prototyping is especially useful in situations where the requirements (and therefore the costs) are poorly defined or when speed is needed. However, it requires effective management to make sure that the iterations of



prototyping do not continue indefinitely. It is important to have tools such as 4GLs and screen generators when using this approach. If the project is large, it is probably better to establish the information requirements through prototyping and then use a more formal SDLC to complete the system.

RAPID APPLICATION DEVELOPMENT (RAD). This is an obvious candidate when new systems are needed very quickly. RAD tools can work well for developing client/server systems or front-ends for mainframe systems. RAD may be less appropriate than conventional programming languages for larger projects, or for developing systems with a lot of calculations or real-time processing.

JOINT APPLICATION DESIGN (JAD). JAD is easy for senior management to understand. The methodology also provides the needed structure to the process of collecting user requirements. However, it is difficult and expensive to get all people to the same place at the same time. Another disadvantage of JAD is its potential to have dysfunctional groups.

OBJECT-ORIENTED DEVELOPMENT. OO development is becoming increasingly popular, but usage is limited by a shortage of personnel with OO skills. Java is an OO language that is especially suitable for developing network applications. However, OO languages in general, and Java in particular, tend to run slowly. Reusability of code is a potential advantage of OO development, but reuse will not occur without appropriate cataloging, search engines, and experienced and motivated employees.

END-USER DEVELOPMENT. Although most appropriate for small projects, end-user development is also a possibility for larger projects whose priorities are not high enough to lead to a timely response from the central IS unit. Managers should beware of end-user development in situations where problems with the system can lead to significant risks for the organization, such as system failures, inaccurate results, disclosure of confidential data, inefficiency, incompatibility with other systems, and inability to maintain the system if the developer leaves.

PURCHASING OR OUTSOURCING. For large and complex systems with a significant risk of failure, organizations should *always* consider using an outside vendor (e.g., see Lee et al., 2003). The exception to this rule is that in-house development may be necessary if the system is highly strategic or incorporates critical proprietary information. If scalability is important to the organization, it may be advisable to buy systems rather than make them, even for smaller systems. However, managers need to be aware of relatively high additional implementation costs when purchasing enterprise software packages.

EXTREME PROGRAMMING. The fundamental idea of extreme programming is to start simply. Build something real that works in its limited way. Then fit it into a design structure that is built as a convenience for further code building rather than as an ultimate and exhaustive structure.

UTILITY COMPUTING. Although not a development methodology, utility computing promises a way to cut technology management expenses while consolidating resources. However, it is believed that technology has a lot of catching



up to do before utility computing will become a reality for a company with many computing needs.

14.5 BUILDING E-BUSINESS APPLICATIONS

The diversity of e-business models and applications, which vary in size from a small store to a global exchange, requires a variety of development methodologies and approaches. Small storefronts can be developed with HTML, Java, or other programming languages. They can also be quickly implemented with commercial packages or leased from application service providers (ASPs) for a small monthly fee. Some packages are available for a free trial period ranging from 30 to 90 days. Larger applications can be outsourced or developed in-house. Building medium to large applications requires extensive integration with existing information systems such as corporate databases, intranets, enterprise resource planning (ERP), and other application programs.



The development process of e-business applications consists of five major steps which are discussed in more detail at the *Online File W14.10* of the Web site of this chapter. The five steps of the development process can be fairly complex and therefore they must be managed properly. A project team is usually created to manage the progress of the development and the vendors. Collaboration with business partners is critical. Some e-business failures are the results of delays and lack of cooperation by business partners. For instance, you can install a superb e-procurement system, but if your vendors will not use it, the system will collapse.

Development Strategies for E-Business Applications

There are several options for developing e-business (e-biz) applications: buy, lease, or develop in-house.

BUY THE E-BIZ APPLICATIONS. Standard features required by e-business applications can be found in commercial packages. Buying an existing package can be cost-effective and timesaving in comparison to in-house application development. The *buy* option should be carefully considered and planned for, to ensure that all critical features for current and future needs are included in the selected package. Otherwise such packages may quickly become obsolete.



In addition, business needs can rarely be fully satisfied by buying a single package. It is sometimes necessary to acquire multiple packages to fulfill different needs. Integration may then be required amongst these packages as well as with existing software. Major criteria for consideration in buying e-business applications are listed in *Online File 14.11*. The buy option may not be attractive in cases of high obsolescence rate or high software cost. In such a case, one should consider leasing.

LEASE THE E-BIZ APPLICATIONS. As compared to the buy option and to an in-house development, the *lease* option can result in substantial savings of both cost and time. Though the packages for lease may not always exactly fit with the application requirements (the same is true with the buy option), many common features that are needed by most organizations are often included.

Leasing is advantageous over buying in those cases where extensive maintenance is required, or where the cost of buying is very high. Leasing can be



especially attractive to SMEs (small to medium enterprises) that cannot afford major investments in eBiz. Large companies may also prefer to lease packages in order to test potential e-commerce solutions before committing to heavy IT investments. Also, since there is a shortage of IT personnel with appropriate skills for developing novel e-commerce applications, several companies lease instead of develop. Even those companies that have in-house expertise may decide they cannot afford to wait for strategic applications to be developed in-house. Hence they may buy or lease applications from external resources in order to establish a quicker presence in the market.

Types of Leasing Vendors. Leasing can be done in two major ways. One is to lease the application from an outsourcer and install it on the company's premises. The vendor can help with the installation, and frequently will offer to contract for the operation and maintenance of the system. Many conventional applications are leased this way. Vendors that lease e-Biz applications are sometimes referred to as *commerce system providers* (CSPs). However, in e-business a second leasing option is becoming popular: leasing from an application service provider, who provides both the software and hardware at its site.

DEVELOP E-BIZ APPLICATIONS IN-HOUSE: INSOURCING. The third option to develop an e-business application is to *build it in-house*. Although this approach is usually more time-consuming and may be more costly than buying or leasing, it often leads to better satisfaction of the specific organizational requirements. Companies that have the resources to develop their e-business application in-house may follow this approach in order to differentiate themselves from the competition, which may be using standard applications that can be bought or leased. The in-house development of e-Biz applications, however, is a challenging task, as most applications are novel, have users from outside of the organization, and involve multiple organizations.

Development Options. Three major options exist: Program from scratch, use components, or use enterprise application integration.

- **Build from scratch.** This is a rarely used option that should be considered only for specialized applications for which components are not available. It is expensive and slow. But it can provide the best fit.
- **Build from components.** Those companies with experienced IT staff can use standard components (e.g., a secure Web server), some software languages (e.g., C++, Visual Basic, or Perl), and third-party APIs (application program interfaces) and subroutines to create and maintain an electronic storefront solely on their own.

Alternatively, companies can outsource the entire development process using components. From a software standpoint, this alternative offers the greatest flexibility and is the least expensive. However, it can also result in a number of false starts and wasted experimentation. For this reason, even those companies with experienced staff are probably better off customizing one of the packaged solutions. (For details about using components, see Section 14.3.)

- **Enterprise application integration.** The **enterprise application integration (EAI)** option is similar to the previous one, but instead of components, one uses an entire application. This is an especially attractive option when applications from several business partners need to be integrated.



Application Service Providers

OTHER DEVELOPMENT STRATEGIES. Besides the three major options for developing e-Biz applications (buy, lease, and develop in-house), several others are in use and are appropriate under certain circumstances. See *Online File W14.12* on the book's Web site for a detailed discussion of these options.

In developing e-business systems, outsourcing is a most valuable option since these systems need to be built quickly and special expertise is needed. EC software delivery from ASPs is another very popular option.

An **application service provider (ASP)** is an agent or vendor who assembles functionality needed by enterprises, and packages it with outsourced development, operation, maintenance, and other services. Although several variations of ASPs exist, in general, monthly fees are paid by the client company. ASP fees for services include the application software, hardware, service and support, maintenance, and upgrades. The fees can be fixed, or based on utilization.

The essential difference between an ASP and an outsourcer is that an ASP will manage application servers in a centrally controlled location, rather than on a customer's site. Applications are accessed via the Internet or WANs through a standard Web browser interface. In such an arrangement, applications can be scaled, upgrades and maintenance can be centralized, physical security over the applications and servers can be guaranteed, and the necessary critical mass of human resources can be efficiently utilized.

ASPs are especially active in enterprise computing and e-commerce. These areas are often too complex to build and too cumbersome to modify and maintain on one's own (e.g., see Ward, 2000). Therefore, the major providers of ERP software, such as SAP and Oracle, are offering ASP options. Microsoft, and Computer Associates, Ariba, and other major vendors of e-business also offer such services.

BENEFITS OF LEASING FROM ASPs. Leasing from ASPs is a particularly desirable option for SMEs, for which in-house development and operation of e-business applications can be time-consuming and expensive. Leasing from ASPs not only saves various expenses (such as labor costs) in the initial development stage, but also helps to reduce software maintenance and upgrading and user training costs in the long run. A company can always select another software package from the ASP to meet its changing needs and does not have to further invest in upgrading the existing one. In this way, overall business competitiveness can be strengthened through reducing the time-to-market and enhancing the ability to adapt to changing market conditions. This is particularly true of e-commerce applications for which timing and flexibility are crucial. A detailed list of the benefits and potential risks of leasing from ASPs is provided in *Online File W14.13* at the book's Web site.

Leasing from ASPs is not without disadvantages. Many companies are particularly concerned with the adequacy of protection offered by the ASP against hackers, theft of confidential information, and virus attacks. Also, leased software may not provide a perfect fit for the desired application.

It is important to ensure that the speed of Internet connection is compatible with that of the application in order to avoid distortions to the performance of the application. For example, it is not advisable to run heavy-duty applications on a modem link below a T1 line or a high-speed DSL. Some criteria for selecting an ASP vendor are listed in *Online File W14.14* at the book's Web site.





IT At Work 14.5

SNAP-ON'S APPROACH TO SETTING UP AN E-BUSINESS SITE

Snap-On, a tool and equipment maker in Washington State, wanted to set up an e-commerce site, and do so quickly. The problem the company faced was whether to build the site in-house, or buy the services of an outside contractor to set up the site.

Brad Lewis, e-commerce manager for Snap-On, decided to hire application service provider (ASP) OnLink Technologies to implement a catalog for the company's e-commerce site. Lewis wanted his industrial customers to navigate easily through the 17,000 products listed in Snap-On's paper catalog, and he wanted to integrate the site with Snap-On's ERP system. If we developed this application in-house, we would have spent six to nine months just designing and implementing it," he said. By using an ASP, Snap-On was able to get the entire catalog up and running in four months.

What was unusual is that Lewis integrated his staff with OnLink's to help transfer those catalog-building skills. Lewis himself spent several days a week during the four-month development period at OnLink's headquarters, where he had his own office. He concentrated on developing application features and integration with back-end systems. "By spending so much time at OnLink, I became a member of their engineering group, and other members of my staff became temporary members of their professional services catalog group," Lewis says.

The result was that Lewis created an in-house ASP consulting service for Snap-On, providing guidance to other departments and subsidiaries that want to put up catalogs

on their own Web sites. "One of the first questions we pondered before we outsourced was whether we could later bring that expertise in-house," Lewis says. "We didn't want to do it any other way." The desire to have expertise in-house was fostered by Snap-On's desire for control of their Web site. "When e-commerce solutions become a mission-critical application, companies can become uncomfortable outsourcing them. If the outsourcer's site goes down, the company's business goes down," says Leah Knight, an analyst for the Gartner-Group. Snap-On found a way to both buy and build its e-commerce applications.

Snap-On.com is an example of what end users and analysts say is the newest trend in constructing e-commerce sites. With this approach, the site would already be in a host environment, and components are already there, so you can quickly add to the site. Most companies, feeling the "Internet-speed" pressure to get their sites up fast, need the experience and resources of outside vendors. At the same time, however, these end users are taking charge of those sites as soon as possible. Local control enables them to make improvements faster and save money on expensive hourly fees each time they need to make a small change to the site.

Sources: Compiled from Mullich (2000) and *snap-on.com* (2003.)

For Further Exploration: As Web sites evolve, e-businesses find that moving programming talent in-house is the way to go. Do you agree?

IT At Work 14.5 shows a successful story of a using an ASP as a contracted partner to develop an e-biz application. For a study about satisfaction with ASP services see Susarla et al. (2003).

Java, a Promising Tool

Internet and intranet Web pages are coded primarily in *HTML* (hypertext markup language), a simple language that is most useful for displaying static content to viewers. HTML has very limited capabilities for interacting with viewers, or for providing information that is continually being updated. It is not suitable for collecting information, such as names and addresses, or for providing animation or changing information such as stock quotes. To do these types of things it is necessary to add programs (written in some form of programming language) to the HTML for a Web site.

Java (see Technology Guide 2) is relatively new, but it has already established itself as the most important programming language for putting extra features into Web pages. It has many similarities to C and C++, but omits some



of the more complex and error-prone features of the programming languages. Java was specifically designed to work over networks: Java programs can be sent from a Web server over the Internet and then run on the computer that is viewing the Web page. It has numerous security features to prevent these downloaded programs from damaging files or creating other problems on the receiving computer.

Java is an object-oriented language, so the concepts of object-oriented development are relevant to its use. However, the Java Web-page programs, called **applets**, need to be relatively small to avoid delays in transmitting them over the Internet. Java programs run more slowly than programs in other languages, which is another reason to keep them small. Therefore it is not necessary that Java developers use the very formal development methodologies appropriate for large system projects. Prototyping is probably the most suitable approach for developing Java applets, because it provides for a high level of interaction between the developers and users in regard to the critical issues of the appearance and ease-of-use of the Web page.

Managerial Issues in E-Business Applications

Several managerial issues apply specifically to building e-business applications:

- ***It is the business issues that count.*** When one thinks of the Web, one immediately thinks of the technology. Some of the most successful sites on the Web rely on basic technologies—freeware Web servers, simple Web-page design, and few bells and whistles. What makes them successful is not the technology but their understanding of how to meet the needs of their online customers.
- ***Build in-house or outsource.*** Many large-scale enterprises are capable of running their own publicly accessible Web sites for advertisement purposes. However, Web sites for online selling may involve complex integration, security, and performance issues. For those companies venturing into such Web-based selling, a key issue is whether the site should be built in-house, thus providing more direct control, or outsourced to a more experienced provider. Outsourcing services, which allow companies to start small and evolve to full-featured functions, are available through many ISPs, telecommunications companies, Internet malls, and software vendors who offer merchant server and e-biz applications.
- ***Consider an ASP.*** The use of ASPs is a must for SMEs and should be considered by any company. However, due to the newness of the concept, care must be used in selecting a vendor (see Chapter 13).

14.6 SOME IMPORTANT SYSTEMS DEVELOPMENT ISSUES

Building information systems, either by the ISD or by end users, involves many issues not discussed in the preceding sections. Some additional issues that may be of interest to managers and end users are discussed here.

CASE Tools

For a long time, computer programmers resembled the cobbler in the old story. He was so busy mending his customers' shoes that he didn't have time to repair the holes in his own children's shoes. Similarly, programmers were so busy developing systems to increase the productivity of other functions, such as accounting and marketing, that they didn't have time to develop tools to



enhance their own productivity. However, this situation has changed with the emergence of **computer-aided software engineering (CASE)** tools. These are marketed as individual items or in a set (toolkit) that automates various aspects of the development process. For example, a systems analyst could use a CASE tool to create data-flow diagrams on a computer, rather than drawing them manually (see Technology Guide 2).

MANAGERIAL ISSUES REGARDING CASE. Individual system personnel or IS groups may use a variety of specific CASE tools to automate certain SDLC activities on a piecemeal basis. Or the IS group may acquire an integrated (I-CASE) package, whose components are tightly integrated and which often embodies a specific systems development methodology. (See Technology Guide 2.) These two approaches are quite different in terms of their implications for the organization.

Using tools independently can provide some significant productivity benefits. Because the tools are acquired on an individual basis, the organization has many options and can select the ones that offer the best performance for the cost and are best suited to the organization's needs. The tools can be used independently as needed, so developers have the option of learning, at their own pace, the tools that are most helpful to them.

On the other hand, the components in integrated packages are specifically designed to work together, and therefore they offer the potential for higher productivity gains. However, the learning pace for these packages is much slower than for individual tools. This means that after adoption, productivity may decline in the short term, which may be unacceptable for an organization with a large backlog of high-priority IS projects. In addition to productivity issues, some components of an I-CASE package may not be as good as corresponding tools that can be purchased separately.

The relatively high turnover rate among systems personnel also creates problems for use of I-CASE systems. New employees will need time to learn the integrated package. Existing employees may resist using the package, because they feel it will reduce their opportunities to move to other organizations that use either traditional development methods, or some other I-CASE package that is incompatible with the one at the present organization.

In addition to the costs of training and productivity losses, organizations need to purchase the actual I-CASE systems. In the past, this often required purchasing workstations in addition to software. Now, with the availability of much more powerful PCs and servers in client/server systems, many organizations may not find it necessary to buy any additional hardware (except possibly a plotter for printing large diagrams). Even without additional hardware costs, buying an I-CASE system may still cost more than buying a few of the most helpful individual tools.

Software Quality Improvement and ISO-9000

The success of quality management in manufacturing suggests that quality management could also be helpful in dealing with the problems of IS development. To implement this concept for systems development, the Software Engineering Institute at Carnegie Mellon University developed the *Capability Maturity Model (CMM)*. The original purpose of this model was to provide guidelines for the U.S. Department of Defense in selecting contractors for software development. The CMM identifies five levels of maturity in the software development process, as summarized in Table 14.3.

**TABLE 14.3** Levels of the Capability Maturity Model

Level	Characteristics
1. Initial	Processes are ad hoc, undefined, possibly chaotic. Success depends on individual efforts and heroics.
2. Repeatable	Basic project management tracks cost, schedule, and functionality. On similar applications, organization is able to repeat earlier successes.
3. Defined	Project management and software engineering activities are documented, standardized, and integrated into development through an organization-specific process (i.e., an SDLC).
4. Managed	Both software process activities and quality are measured in detail and are quantitatively understood and controlled
5. Optimizing	Processes are improved continuously based on feedback from quantitative measures, and from pilot projects with new ideas and technologies.

Source: Compiled from J. Herbsleb et al., "Software Quality and the Capability Maturity Model," *Communications of the ACM*, June 1997, p. 32. ©1997 Association for Computing Machinery, Inc. Reprinted by permission.

As an organization moves to higher maturity levels of the CMM, both the productivity and the quality of its software development efforts will improve. Results of a case study, summarized in Table 14.4, verified substantial gains in both areas through software process improvement (SPI) programs based on the capability maturity model. Organizations need to understand, however, that software process improvement requires significant spending and organizational effort.

ISO 9000 STANDARDS. Another approach to software quality is to implement the *ISO 9000* software development standards. The International Organization for Standardization (ISO) first published its quality standards in 1987, revised them in 1994, and then republished an updated version in 2000. The new standards are referred to as the "ISO 9001:2000 Standards." These international standards are very extensive: they identify a large number of actions that must be performed to obtain certification. In addition, they define software developer responsibilities, as well as the responsibilities of the purchaser or client, in developing quality software. The purchaser needs to clearly identify the requirements and have an established process for requesting changes in these requirements. However, the specifications do offer a substantial amount of leeway in many areas. (For an example of ISO 9000 Standards, see *Online File W14.15* at the book's Web site.)

**TABLE 14.4** Improvements from Capability Maturity Model Implementations

Category	Range	Median	# of Cases
Productivity gain	9–67%	35%	4
Faster time to market	15–23%	NA	2
Reduction in defects	10–94%	39%	5

Source: Compiled from J. Herbsleb et al., "Software Quality and the Capability Maturity Model," *Communications of the ACM*, June 1997, pp. 30–40. ©1997 Association for Computing Machinery, Inc. Reprinted by permission.



An ISO 9001:2000 Quality Management System is made up of many processes that are glued together by means of many input-output relationships. This turns a simple list of processes into an integrated system. Under ISO standards, the supplier needs to have documented processes for developing software. The supplier's senior management is responsible for developing the *quality policy* document, a short statement that requires employees to use generally accepted quality practices in all areas of the organization. This quality policy is implemented through a *quality system*, the development and quality-control processes that implement the quality policy. The quality system requires preparation of *quality plans* for types of products and processes. An internal auditing process is required to ensure compliance with the plans. ISO 9000 requires appropriate funding for quality activities, and appointment of personnel and assignment of responsibilities necessary to implement the program.

Reverse Engineering for Legacy Systems

Legacy systems are very large software systems that have been developed and are being maintained by many different people. They were developed using traditional methods, such as structured analysis and design, or even individual programming techniques and styles. Over time, maintenance may have changed the original program structure and specifications. Often, the specifications are not maintained, and the current design and program understanding cannot be determined. Maintenance of these systems becomes so costly that they become candidates for reverse engineering.

Reverse engineering aims at discovering design and specifications of existing software programs. The technology reads the program code for an existing database, application program, and user interface, and automatically generates an equivalent system model. The resulting model can then be edited and improved by systems analysts and users to provide a blueprint for a new and improved system. The goal of reverse engineering is to achieve a sufficient understanding of the whats, hows and whys of the legacy system as a whole so that its code can be reengineered to meet new user requirements. For additional information see Martin (2003).

Project Planning

Project planning can mitigate the risk of failure and provide a structure for managing development risk. Chapter 9 provided a four-stage model for information systems planning for IT infrastructure projects. The final stage of this process, **project planning**, is also used in development of individual applications. Project planning provides an overall framework in which the systems development life cycle can be planned, scheduled, and controlled. Milestones are one of the more effective project management tools used by managers in the project planning process.

MILESTONES. Milestone planning techniques allow projects to evolve as they are developed. Rather than try to predict all project requirements and problems in advance, management allows the project to progress at its own pace. **Milestones**, or checkpoints, are established to allow periodic review of progress so that management can determine whether a project merits further commitment of resources, requires adjustments, or should be discontinued.

Milestones can be based on time, budget, or deliverables. For example, a project's progress might be evaluated weekly, monthly, or quarterly. It might be evaluated after a certain amount of resources are used, such as \$50,000.

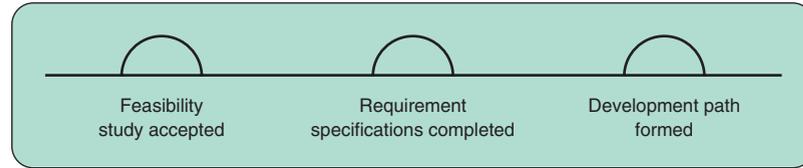


FIGURE 14.10
Milestones.

However, milestones are most effective when they identify that specific events have occurred, such as the completion of a feasibility study. Figure 14.10 illustrates the simplicity of a milestone chart.

PROJECT PROPERTIES AND PRIORITIES. Setting budget and time frames *prior* to defining the system design constraints is perhaps the greatest mistake made in project planning. For example, management may decide to install a new order entry system in nine months, for which it is willing to spend \$1 million. This leaves one important issue undefined: What will the new system do? By setting a budgetary constraint, management has, *de facto*, limited the functionality of the new system.

The proper sequence for managing a project is first to get a good functional definition of what the system is designed to do, and then to have people with experience and expertise in information systems and in project management develop a budget and schedule. If management cannot accept the schedule or budget, then the capabilities of the new system can be scaled down to meet the schedule and/or budget constraints.

In developing a budget, schedule, and specifications for a system, managers need to consider and understand several properties of projects and their management. The following five properties most significantly influence the overall nature of an IT project.

1. **Predefined structure.** The more predefined the structure of a project is, the more easily it can be planned and controlled.
2. **Stability of technology.** The greater the experience with a given technology to be used for a new system, the more predictable the development process.
3. **Size.** The larger the project, the more difficult it is to estimate the resources (time and costs) required to complete it.
4. **User proficiency.** The more knowledgeable and experienced users and managers are in their functional areas and in developing systems, the more proficient they will be relative to information technology and the easier it will be to develop systems for them.
5. **Developer proficiency.** The more knowledge and experience the systems analyst assigned to a project has, the easier the project will go, and vice versa.

Projects can possess variations of each of the preceding properties. For example, a project can have predefined structure but use unstable technology, or it can be a massive undertaking and have low user and developer proficiencies (e.g., most initial online airline reservations systems could be described this way).

WEB-BASED PROJECT MANAGEMENT. Web-based project management provides a central Web site, or project portal, where everyone involved in a



project can get up-to-date project information, share documents, and participate in planning and problem-solving using such collaboration features as shared notebooks, threaded discussion groups, and chat forums. By making it easy for team members and managers to exchange information and ideas, Web-based project management promises to reduce mistakes caused by poor communication. It also can minimize or eliminate delays due to the time it takes to move documents and people around for approvals and meetings. Examples of Web-based project management packages include: TeamCenter (from Invoice Software), TeamPlay (from Primavera Systems), and WebProject (from WebProject).



MANAGERIAL ISSUES

1. **Importance.** Some general and functional managers believe that system development is a technical topic that should be of interest only to technical people. This is certainly not the case. Appropriate construction of systems is necessary for their success. Functional managers must participate in the development process and should understand all the phases. They must also participate in the make-or-buy decisions and software selection decisions. Inappropriate development methodologies can result in the system's failure.
2. **Building interorganizational and international information systems.** Building systems that connect two or more organizations, or one organization that operates in different countries, can be very complicated. (See Tractinsky and Jarvenpaa, 1995.) As seen in Chapter 9, you need to carefully plan for such systems, considering different requirements and cultures. In addition to planning, the analysis, design, and other phases of system development must take into account the information needs of the various parties. (See Minicase 2.) One of the major problems with international systems is that what is ethical or legal in one country may be unethical or illegal in another.
3. **Ethical and legal issues.** Developing systems across organizations and countries could result in problems in any phase of system development. For example, in developing the Nagano Olympics system in 1998, IBM found at the last minute that pro-North-Korea groups in Japan took offense at a reference to the Korean War written on the Web site. Although the material was taken from the *World Book Encyclopedia*, it offended some people. IBM had to delete the reference and provide an apology. IBM commented, "Next time we're going to do a ton of research first versus just do it and find out the hard way." A special difficulty exists with Internet-related projects, where legislation is still evolving.
4. **User involvement.** The direct and indirect users of a system are likely to be the most knowledgeable individuals concerning requirements and which alternatives will be the most effective. Users are also the most affected by a new information system. IS analysts and designers, on the other hand, are likely to be the most knowledgeable individuals concerning technical and data-management issues as well as the most experienced in arriving at viable systems solutions. The right mixture of user involvement and information systems expertise is crucial.





5. **Traditional approaches vs. prototyping.** The traditional development approach stresses detailed, lockstep development with established decision points. Prototyping stresses flexible development based on actual use of partially functional systems. Experience has shown that the traditional approach can be better for low-risk, environmentally stable, and technology-simple situations; prototyping is often better under the opposite conditions.
6. **Tool use by developers.** Development tools and techniques can ensure that developers consider all necessary factors and standardize development, documentation, and testing. Forcing their use, on the other hand, may unnecessarily constrain innovation, development efficiency, and personnel productivity.
7. **Quality assurance vs. schedules.** Quality counts in the short term and the long term, but it can lengthen development and increase developmental costs. Trying to meet tight development schedules can induce poor quality with even worse schedule, cost, and morale problems.
8. **Behavior problems.** People use information systems and often become quite used to how existing systems work. They may react to new systems in unexpected ways, making even the best technically designed systems useless. Changes brought about by information systems need to be managed effectively. Of special interest is the issue of motivating programmers to increase their productivity by learning new tools and reusing preprogrammed modules.
9. **Perpetual development.** Information systems are designed to meet organizational needs. When they don't accurately meet these needs, or these needs change, information systems need to be redeveloped. Developing a system can be a major expense, but perpetually developing a system to maintain its usefulness is usually a much more expensive.
10. **Risk level.** Building information systems involves risk. Systems may not be completed, completed too late, or require more resources than planned. The risk is large in enterprise systems. For how to manage such risk see Scott and Vessey (2002).



ON THE WEB SITE... Additional resources, including quizzes; online files of additional text, tables, figures, and cases; and frequently updated Web links to current articles and information can be found on the book's Web site (wiley.com/college/turban).

KEY TERMS

Applets (Java) •••	Enterprise application integration (EAI) •••	Light methodology •••
Application service provider (ASP) •••	Enterprise software •••	Logical design •••
Component-based development •••	Extreme programming (XP) •••	Milestones •••
Computer-aided software engineering (CASE) •••	Feasibility study •••	Object-oriented development •••
Direct cutover •••	Information center •••	Outsourcing •••
E-business application •••	Java •••	Parallel conversion •••
End-user computing •••	Joint application design (JAD) •••	Phased conversion •••
	Legacy systems •••	Physical design •••
		Pilot conversion •••



Post-audit •••

Project planning •••

Prototyping •••

Rapid application development
(RAD) •••

Reverse engineering •••

Systems analysis •••

Systems development •••

Systems development life cycle
(SDLC) •••

Utility Computing •••

Waterfall method •••

Web services •••

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 A systems development life cycle (SDLC) identifies the major steps, or stages, in the development or acquisition of an information system. Organizations may use a proprietary SDLC methodology to help manage systems projects. Traditional SDLCs try to complete much of their analysis and design activities before starting development and are more appropriate where requirements are easier to identify.
- 2 Various methods can be used to develop complex or quickly needed systems. The prototyping approach is an iterative process that creates simple versions of a system to help users identify their requirements. Rapid application development (RAD) packages can speed development. Joint application design (JAD) is a structured process in which users, managers, and analysts work together to specify or review systems requirements. Object-oriented development makes it easier to develop very complex systems rapidly and with relatively few errors.
- 2 Extreme programming (XP) is a pragmatic approach to program development that emphasizes business results first and takes an incremental approach to building the product.
- 3 Many e-business applications are assembled from a set of components, rather than being constructed from scratch. Components have evolved from the objects of object-oriented methodology. However, they are much larger, providing a kind of plug-and-play building blocks that help in developing large complex systems, such as ERP or e-commerce.
- 3 Web services are URL-addressable software resources that perform functions and provide answers to users. A Web service is made by taking a set of software functionality and wrapping it up so that the services it performs are visible and accessible to other software applications.
- 4 End-user developed systems, on a whole, can be completed more rapidly than those developed through the conventional systems lifecycle.
- 5 Outsourcing custom development or purchasing generic systems are alternatives to in-house development. Utility computing vendors are looking toward a future in which computing capacity is as easy to acquire as electricity.
- 5 Web-based applications are easy to develop and implement. However, organizations need to establish consistent policies and practices to make sure that Web-page development activities support organizational goals.
- 5 There are several options for developing e-business applications. The major applications are buy, lease, and develop in-house. Application service providers manage e-business application services for customers from a central location.
- 6 CASE tools can substantially increase programmer productivity. However, the more integrated packages are difficult to learn, which initially reduces productivity and can lead to resistance to implementation within IS groups.
- 6 Software quality can be improved by implementing the capability maturity model (CMM) or ISO 9001:2000 standards.

QUESTIONS FOR REVIEW

1. Describe the major stages of the SDLC.
2. Explain why it is important to understand the concept of SDLC.
3. List four different approaches to converting from one system to another. Which is most risky? Least risky?
4. Describe the tools that are commonly included in rapid application development (RAD) packages. What capabilities can they provide?
5. Why do many companies use the prototyping approach to develop their e-business applications? What are the limitations of the prototyping approach?
6. Describe object-oriented development and its increasing importance.
7. Describe the architecture of component-based development of e-commerce applications.
8. Define Web services.



9. List the major areas of Web services Applications.
10. List five major advantages and three major disadvantages of Web services.
11. List the advantages and disadvantages of purchasing generic software versus using in-house staff or out-sourcers to develop customized applications.
12. Identify the major reasons why utility computing tools will become the next big thing.
13. List the e-business application options.
14. Describe an application service provider (ASP).
15. Describe Java and its role in Internet development.
16. Identify and explain the five levels of the capability maturity model (CMM).
17. List the issues in controlling the quality of systems development. What is the role of IS-9000?

QUESTIONS FOR DISCUSSION

1. Why is it advisable in some systems development projects to use prototyping to find information needs? Why can't the analyst just ask the users what they want and use the SDLC?
2. What types of incentives could an IS group provide to its programmers to encourage reuse of objects and other software they develop?
3. What type of development approaches would be most appropriate for developing small systems? For very large systems? Why? What other factors need to be considered?
4. Is extreme programming (XP) really "extreme"?
5. Discuss the use of Web services for systems development. What kind of systems are especially amenable to Web services?
6. End-user systems developers usually work for managers whose IT knowledge is limited. Discuss the types of problems to which this situation could lead, and suggest possible ways of dealing with these problems.
7. Do you think technology has a lot of catching up to do before utility computing will become a reality for companies with many computing needs?
8. Although the CASE concept—automated tools to increase programmer productivity—seems valid, many IS organizations do not use integrated (I-CASE) packages. Discuss the barriers to the increasing use of I-CASE.
9. Some programmers feel that implementing the capability maturity model (CMM) will make the development process too rigid and bureaucratic, thus stifling their creativity. Discuss the pros and cons of this issue.
10. Building Web-based systems such as intranets can be a fast and fairly easy process. Based on Chapters 4 and 5 can you explain why? What are the long-term implications of this for IS professionals? For end-user systems developers? For outsourcing firms?
11. Discuss the advantages of a lease option over a buy option in e-business applications development.
12. Compare component-based development to enterprise application integration.
13. A large company with a number of products wants to start selling on the Web. Should it use a merchant server or an electronic suite? Assuming the company elects to establish an electronic storefront, how would you determine whether it should outsource the site or run it itself?

EXERCISES

1. Contact a major information systems consulting firm and ask for literature on its systems development life cycle methodology (or search for it on the Internet). Compare and contrast the proprietary methodology to the eight-stage SDLC described in this chapter.
2. Identify and interview some end users who develop systems at their organizations. Ask them whether their organization has any standards for documenting and testing systems developed by end users. If it has such policies, are they enforced? If not, what do the end users do to ensure the accuracy and maintainability of the systems they develop?
3. Contact an administrator at your university or work place and find out what purchased systems, especially larger ones, are in use. Do these systems meet the organization's needs, or are some important features missing that should be included in these packages?
4. Contact IS managers at some large organizations, and find out whether their IS developers use any CASE tools. If the IS units use an integrated (I-CASE) tool, what things do they like and dislike about it? If the units do not use I-CASE tools, what are the reasons for not using them?



GROUP ASSIGNMENTS

1. Divide the class into two teams. Have both teams collect information on SAP's integrated enterprise management software, and on Oracle's comparable software packages. After the teams analyze the data, stage a debate with one team arguing that the SAP products are the more desirable and with the other team supporting Oracle (or other vendor).
2. Several vendors offer products for creating online stores. The Web sites of each vendor usually list those online stores using their software. Assign one or more vendors to each team member. Visit the online stores using each vendor's software. Prepare a report comparing the similarities and differences among the sites. Do the sites take advantage of the functionality provided by the various products?

INTERNET EXERCISES



1. Explore the General Electric site at ge.com, and then compare it to the Kodak site at kodak.com. Try to identify the organizational objectives for these two different types of sites. In the context of these objectives, discuss the advantages and disadvantages of having either: (1) a relatively simple site with limited graphics, or (2) a site that contains extensive graphics.
2. Go to the site at geocities.com/~rfinney/case.htm. Follow the links on the page to look at the features of several CASE tool packages. Prepare a report on the capabilities of one or two packages with multiple features.
3. Look at the Netron Corporation site (netron.com). Examine the tools they have for working with legacy systems (gap analysis) and for rapid application development. Write a report. Prepare a report on Netron's approach and tools for renovating and maintaining legacy systems.
4. StoreFront (storefront.net) is the leading vendor of e-Biz software. At their site they provide demonstrations illustrating the types of storefronts that they can create for shoppers. They also provide demonstrations of how their software is used to create a store.
 - a. Run either the StoreFront 5.0 or StoreFront 6.0 demonstration to see how this is done.
 - b. What sorts of features are provided by StoreFront 5.0?
 - c. Does StoreFront 5.0 support larger or smaller stores?
 - d. What other products does StoreFront offer for creating online stores? What types of stores do these products support?



Minicase 1

Do or Die

A direct cutover from an existing system to a new one is risky. If the system is critical to the operations of the organization, the risks are magnified to an even higher level. Yet Quantum Corp. (*quantum.com*), a Milpitas, California, disk-drive manufacturer, did just that—and lived to tell about it. The vendors and consultants on the project claim that this was one of the largest-ever direct cutovers of a distributed business system.

Quantum realized that it had to take action. The limitations of its existing systems were making it difficult for the company to compete in the disk-drive market. Sales representatives needed to determine how much of a specific item—in inventory or in production—had not yet been committed to other customers. However, because databases did not share information, it was very difficult for them to get this information.

Quantum was especially interested in a piece of information known as available-to-promise (ATP). This indicates how many units of a given item could be delivered, by what date, to specific locations throughout the world. Calculating these values require coordination and real-time processing of sales, inventory, and shipping data. If Quantum implemented its new system by phasing in the modules one at a time, the conversion would take much longer. Furthermore, the system would not be able to provide this key information until the end of the transition.

Quantum felt that the business risks of this kind of delay were greater than the technical risks of a direct cutover. The company was also concerned about possible resistance in some departments if the full implementation took a long time. The departments had enough autonomy to implement other systems if they lost confidence in the new system and, if they did, Quantum would lose the benefits of having an integrated system.

Although the actual cutover took eight days, the planning and preparation required over three years. The initial analysis was in October 1992, and Quantum sent out requests for proposals in April 1993. In March 1994, the company chose Oracle, Hewlett-Packard, and Price Waterhouse as its business partners on the project.

Quantum created a project team of 100 people, composed of key employees from each business unit and the IS department, and moved them into a separate building. The purchase of the disk-drive business of Digital Equipment Corp. in October 1994, which brought in another set of legacy applications and assorted hardware platforms, set the project back by about four months.

In February 1995, Quantum started a public relations campaign with a three-day conference for the users. The

following month, “project evangelists” made presentations at all organizational locations.

In August 1995, the team conducted a systems validation test. It failed. The team worked intensely to solve the problems and then tested the system again for four weeks starting in December 1995. This time, it was successful.

In March 1996, Quantum provided a very extensive and absolutely mandatory user-training program. In April, it conducted final briefings, tested the system at all locations throughout the world, and set up a “mission control” center.

At 5 p.m. on April 26, Quantum shut down the old system. Hank Delavati, the CIO, said, “Business as we know it stopped . . . we could not place an order, we could not receive material, we could not ship products. We could not even post cash.” Data records from the old system were loaded into the new system. At 4 p.m. on May 5, the new system started up successfully.

Mark Jackson, an executive vice president at Quantum, noted afterward that the relatively large project budget was not the company’s primary concern. He said, “We could have figured out how to save 10 percent of the project’s cost . . . but that would have raised the risk to an unacceptable level. To succeed, you have to spend the money and take care of the details.”

Source: Condensed from Radosevich (1997) and *quantum.com* (2003).

Questions for Minicase 1

1. Estimate Quantum Corporation’s chances of survival if this project failed. Provide some reasons to support your estimate.
2. What did Quantum do to minimize the risks of this direct cutover?
3. Evaluate the claim that, because of business and organizational issues, this direct cutover was less risky than a phased conversion.
4. Under what, if any, circumstances would you recommend this kind of direct cutover for critical operational systems?
5. Discuss the impact of this project on the internal power relationships between the IS department and the other departments in the organization.
6. It appears that Quantum spent a substantial amount of money on this project and was willing to increase spending when it seemed necessary for the success of the project. Discuss the risks of a “whatever it takes” approach.



Minicase 2

Implementing SAP R/3 at the University of Nebraska

On a Monday morning in August 1998, Jim Buckler, project manager of the University of Nebraska's Administrative System Project (ASP), was preparing for his weekly meeting with the project's steering committee, the Financial System Task Force (FSTF). The ASP is an effort charged with implementing SAP's R/3 client/server enterprise resource planning (ERP) product for the University of Nebraska's multicampus system.

As a result of mapping the University's future business processes to the SAP R/3 system, a number of gaps were identified between these processes and those offered by the SAP R/3 system. These critical gaps were tracked as one of

the project's critical success factors. Project management and the FSTF had to consider all factors that could potentially be impacted by the critical gaps. Such factors include the scope of the project, resources (human and budgetary), the timeline, and previous configuration of the system, to name a few.

Four options have been developed as possible solutions to resolve the 14 critical gaps. Table 14.5 summarizes the options presented to the FSTF by project management.

With a number of constraints and issues in mind, Buckler contemplated which one or combination of the four options was the best course of action. Should SAP and IBM be

TABLE 14.5 Possible Solutions to Critical Gaps (for Minicase 2)

Option	Description	Gaps Affected	Risk	Costs
SAP provides on-site developer(s)	SAP provides on-site developers to edit the R/3 system's core program code and incorporate the changes in future R/3 system releases.	This option would resolve all gaps.	Moderate risk, as solutions will be incorporated in future R/3 system releases; however, developers must begin immediately.	Expected low cost to the University as SAP would be asked to absorb most of the costs.
IBM provides developers to create workarounds	IBM creates temporary workaround solutions that are "bolted on" to the system and are not part of the core SAP R/3 system code	This option would resolve most gaps as attempts to develop workarounds for some gaps would not be feasible.	High risk, as solutions are not guaranteed to be in future R/3 system releases.	High cost to the University for the consulting resources. Needed to complete the workarounds.
Extend project timeline until July 1, 1999, to implement the next version of SAP R/3	Push project timeline three months, resulting in some implementation activities being conducted simultaneously to meet the July 1 "Go live" date	SAP validates that all critical gaps are resolved in the next R/3 system release.	High risk, as new version must be delivered on time and resolution of critical gaps must be supported.	Moderate cost for some additional resources; potential for high cost if gaps are not resolved in new version.
University delays payroll until the next phase of implementing functionality	"Go live" with non-HR modules as outlined in the project scope and interface the R/3 system with the University's current human resource management system.	This option addresses only those gaps related to the human resources (HR) application module.	Low risk, as current payroll system is functional.	Moderate cost for some additional resources and to address change management issues; potential for high cost if payroll system has to be updated for Y2K compliance.



working concurrently on resolving the gaps (i.e., options 1 and 2)? This seemed to be the safest course of action, but it would be very costly. Should the project timeline be extended until July 1, 1999? What if SAP could not resolve all the gaps by that time? Would that deter the University from transitioning smoothly into the new millennium? Should the implementation of the HR/Payroll module be delayed? These options would have to be carefully considered and a recommendation made at Buckler's meeting with the FSTF in a few hours' time.

Sources: Condensed from Sieber et al. (1999) and *sap.com* (2003).

Questions for Minicase 2

1. Which of the four options or combination of options would you recommend to project management and the steering committee? What are the risks involved in your recommendation? How would you manage the risks?
2. Discuss the advantages and disadvantages of a purchased system that forces different organizational units to change their business processes and policies to conform to the new system. Identify situations where this standardization would be desirable, and other situations where it would be undesirable.
3. Can you think of circumstances where a company might want to install an enterprise management system, such as SAP R/3, even though it appears that this would be significantly more expensive than developing a comparable system in-house? Discuss.
4. Go to the site at *sap.com*. Follow the links on the page to look at the features of some cross-industry solutions. Prepare a report on the capabilities of the SAP solutions.



Virtual Company Assignment

Building Information Systems

Barbara and Jeremy have done some serious economic justification of the myriad technologies that could benefit their business, and they have chosen CRM as the top priority. They feel that they have grown to a point where they will need a full-time project manager to oversee the acquisition and implementation of the CRM, and they have asked you to describe how you would proceed on this project. At the start of your internship, you were hopeful it might lead to a full-time job offer after graduation, so you see this as your opportunity to impress Barbara and Jeremy with your business education and your systems expertise.

1. Propose a system development life cycle for implementing a CRM at The Wireless Café (TWC). Consider methodologies that are well-suited to rapid development of Web-based applications.
2. Once a CRM system is identified, should its implementation be outsourced? Assuming you do decide to outsource the entire implementation of the selected CRM, how would you manage the outsourcer to make sure the implementation is successful?
3. As TWC expands its utilization of IT, the concept of an application service provider becomes increasingly attractive. What are some risks and benefits to a small business of using an ASP for major applications?

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PART V
Implementing and Managing



- 13. Information Technology Economics
- 14. Building Information Systems
- ▶ 15. Managing Information Resources and Security
- 16. Impacts of IT on Organizations, Individuals, and Society (online)

CHAPTER

15

Managing Information Resources and Security

Cybercrime in the New Millennium

15.1

The IS Department and End Users

15.2

The CIO in Managing the IS Department

15.3

IS Vulnerability and Computer Crimes

15.4

Protecting Information Resources: From National to Organizational Efforts

15.5

Securing the Web, Intranets, and Wireless Networks

15.6

Business Continuity and Disaster Management

15.7

Implementing Security: Auditing and Risk Analysis

Minicases: (1) Home Depot / (2) Managing Security

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Recognize the difficulties in managing information resources.
- 2 Understand the role of the IS department and its relationships with end users.
- 3 Discuss the role of the chief information officer.
- 4 Recognize information systems' vulnerability, attack methods, and the possible damage from malfunctions.
- 5 Describe the major methods of defending information systems.
- 6 Describe the security issues of the Web and electronic commerce.
- 7 Describe business continuity and disaster recovery planning.
- 8 Understand the economics of security and risk management.



CYBERCRIME IN THE NEW MILLENNIUM

On January 1, 2000, the world was relieved to know that the damage to information systems due to the YK2 problem was minimal. However, only about six weeks into the new millennium, computer systems around the world were attacked, unexpectedly, by criminals.

On February 6, 2000, the biggest e-commerce sites were falling like dominos. First was Yahoo, which was forced to close down for three hours. Next were eBay, Amazon.com, E*Trade, and several other major EC and Internet sites that had gone dark.

The attacker(s) used a method called *denial of service (DoS)*. By hammering a Web site's equipment with too many requests for information, an attacker can effectively clog a system, slowing performance or even crashing a site. All one needs to do is to get the DoS software (available for free in many hacking sites), break into unrelated unprotected computers and plant some software there, select a target site, and instruct the unprotected computers to repeatedly send requests for information to the target site. It is like constantly dialing a telephone number so that no one else can get through. It takes time for the attacked site to identify the sending computers and to block e-mails from them. Thus, the attacked site may be out-of-service for a few hours.

The magnitude of the damage was so large that on February 9, the U.S. Attorney General pledged to track down the criminals and ensure that the Internet remains secure. This assurance did not last too long, as can be seen from the following story told by Professor Turban:

When I opened my e-mail on May 4, 2000, I noticed immediately that the number of messages was larger than usual. A closer observation revealed that about 20 messages were titled I LOVE YOU, and most of them came from faculty, secretaries, and administrators at City University of Hong Kong. It was not my birthday and there was no reason to believe that so many people would send me love messages the same day. My initial thought was to open one message to find out what's going on. But, on second thought I remembered the "Melissa" virus and the instructions not to open any attachment of a strange e-mail. I picked up the telephone and called one of the senders, who told me not to open the attachment since it contained a deadly virus.

Although Professor Turban's system escaped the virus, thousands of users worldwide opened the "love" attachment and released the bug. It is interesting to note that the alleged attacker, from the Philippines, was not prosecuted because he did not break any law in the Philippines. The damage, according to Zetter and Miastkowski (2000), was estimated at \$8.7 billion worldwide.

Sources: Compiled from news items during May 3–11, 2000, and from Zetter and Miastkowski (2000).

➡ LESSONS LEARNED FROM THIS CASE

Since May 2000 there have been more than a dozen major virus attacks, and hundreds of small ones, causing damages to organizations and individuals. (see Richardson, 2003).

Clearly, information resources, including computers, networks, programs, and data, are vulnerable to unforeseen attacks. Attackers can zero in on a single



company, or can attack many companies and individuals without discrimination, using various attack methods. Although variations of the attack methods are known, the defense against them is difficult and/or expensive. As the story of the “love” virus demonstrated, many countries do not have sufficient laws to deal with computer criminals. For all of these reasons, protection of networked systems can be a complex issue.

The actions of people or of nature can cause an information system to function in a way different from what was planned. It is important, therefore, to know how to ensure the continued operation of an IS and to know what to do if the system breaks down. These and similar issues are of concern to the management of information resources, the subject of this chapter.

In this chapter we look at how the IS department and end users work together; the role of the chief information officer; the issue of information security and control in general and of Web systems in particular. Finally, we deal with plans of business continuity after a disaster, and the costs of preventing computer hazards.

15.1 THE IS DEPARTMENT AND END USERS

Throughout this book, we have seen that information systems are used to increase productivity and help achieve quality, timeliness, and satisfaction for both employees and customers. Most large, many medium, and even some small organizations around the world are strongly dependent on IT. Their information systems have considerable strategic importance.

The IS Department in the Organization

IT resources are very diversified; they include personnel assets, technology assets, and IT relationship assets. The management of information resources is divided between the information services department (ISD) and the end users. **Information resources management (IRM)** encompasses all activities related to the planning, organizing, acquiring, maintaining, securing, and controlling of IT resources. The division of responsibility depends on many factors, beginning with the amount of IT assets and nature of duties involved in IRM, and ending with outsourcing policies. Decisions about the roles of each party are made during the IS planning (Chapter 9). (For some insights, see Sambamurthy et al., 2001.)

A major decision that must be made by senior management is where the ISD is to report in the organizational hierarchy. Partly for historical reasons, a common place to find the ISD is in the accounting or finance department. In such situations, the ISD normally reports to the controller or the chief financial officer. The ISD might also report to one of the following: (1) a vice president of technology, (2) an executive vice president (e.g., for administration), or (4) the CEO.

THE IS DIRECTOR AS A “CHIEF.” To show the importance of the IS area, some organizations call the director of IS a **chief information officer (CIO)**, a title similar to chief financial officer (CFO) and chief operating officer (COO). Typically, only important or senior vice presidents receive this title. Other common titles are: *vice president for IS*, *vice president for information technology*, or *director of information systems*. Unfortunately, as Becker (2003) reports, some companies provide the title CIO, but do not accord the position the importance other



“chiefs” are getting.) The *title* of CIO and the position to whom this person reports reflect, in many cases, the degree of support being shown by top management to the ISD. The *reporting relationship* of the ISD is important in that it reflects the focus of the department. If the ISD reports to the accounting or finance areas, there is often a tendency to emphasize accounting or finance applications at the expense of those in the marketing, production, and logistics areas. In some organizations the IS functions are distributed, depending on their nature (see Minicase 1). To be most effective, the ISD needs to take as broad a view as possible.

THE NAME AND POSITION OF THE IS DEPARTMENT. The *name* of the ISD is also important. Originally it was called the Data Processing (DP) Department. Then the name was changed to the Management Information Systems (MIS) Department and then to the Information Systems Department (ISD). In addition, one can find names such as Information Technology Department, Corporate Technology Center, and so on. In very large organizations the ISD can be a division, or even an independent corporation (such as at Bank of America and at Boeing Corp.).

Some companies separate their e-commerce activities, creating a special online division. This is the approach taken by Qantas Airways, for example. In others, e-commerce may be combined with ISD in a technology department or division. Becker (2003) reports on a study that shows that companies get the largest return from IT when they treat the ISD like any other important part of their business.

The status of the ISD also depends on its mission and internal structure. Agarwal and Sambamurthy (2002) found in a survey that companies usually organize their IT function in one of the following: making IT an active partner in business innovation, providing IT resources for innovation and global reach, or seeking flexibility via considerable amount of outsourcing.

The increased role and importance of IT and its management both by a centralized unit and by end users, require careful understanding of the manner in which ISD is organized as well as of the relationship between the ISD and end users. These topics are discussed next. Also, for more on the connection between the ISD and the organization, see the IRM feedback model in *Online File W15.1* at the book’s Web site.



The IS Department and End Users

It is extremely important to have a good relationship between the ISD and end users. Unfortunately, though, this relationship is not always optimal. The development of end-user computing and outsourcing was motivated in part by the poor service that end users felt they received from the ISD. (For the issue of how to measure the quality of IS services, see Jiang et al., 2002). Conflicts occur for several reasons, ranging from the fact that priorities of the ISD may differ from those of the end users to lack of communication. Also, there are some fundamental differences between the personalities, cognitive styles, educational backgrounds, and gender proportion of the end users versus the ISD staff (generally more males in the ISD) that could contribute to conflicts. An example of such conflict is illustrated in *IT At Work 15.1*.

The Minnesota situation is fairly common. One of this book’s authors, when acting as a consultant to an aerospace company in Los Angeles, found that end users frequently bought nonstandard equipment by making several smaller purchases instead of one large, because the smaller purchases did not require



IT At Work 15.1

MINNESOTA'S DEPARTMENT OF TRANSPORTATION VIOLATES PROCEDURES

The Department of Transportation in Minnesota (dot.state.mn.us) had come across a hybrid PC system that would allow road surveys to be accomplished with less time and effort, and greater accuracy. The system would require two people to conduct a survey instead of the usual three, and because of the precision of the computer-based system, the survey could be done in half the time.

The department ran into a problem because the ISD for the State of Minnesota had instituted standards for all PCs that could be purchased by any state agency. Specifically, a particular brand of IBM PC was the only PC purchase allowed, without going through a special procedure. The red tape, as well as the unwillingness of the ISD to allow any deviation from the standard, caused a great deal of frustration.

As a last resort, the Department of Transportation procured the hybrid PC and camouflaged the transaction as engineering equipment for conducting surveys. From that point on, its staff decided they would do what they needed to do to get their jobs done, and the less the ISD knew about what they were doing, the better. When asked why they behaved this way, the administrator of the Department of Transportation simply said, "We have to do it this way because the ISD will either try to stop or hold up for a long period of time any decision we want to make, because they just are not familiar enough with the issues that we are facing in our department."

For Further Exploration: What are the organizational risks when the Transportation Department takes this attitude? How can the conflict be resolved?

authorization by the ISD. When asked if the ISD knew about this circumventing of the rules, a violating manager answered, "Of course they know, but what can they do—fire me?"

Generally, the ISD can take one of the following four approaches toward end-user computing:

1. **Let them sink or swim.** Don't do anything, let the end user beware.
2. **Use the stick.** Establish policies and procedures to control end-user computing so that corporate risks are minimized, and try to enforce them.
3. **Use the carrot.** Create incentives to encourage certain end-user practices that reduce organizational risks.
4. **Offer support.** Develop services to aid end users in their computing activities.

Each of these responses presents the IS executive with different opportunities for facilitation and coordination, and each has its advantages and disadvantages.

Fostering the ISD/End-User Relationships

The ISD is a *service organization* that manages the IT infrastructure needed to carry on end-user IT applications. Therefore, a partnership between the ISD and the end user is a must. This is not an easy task since the ISD is basically a technical organization that may not understand the business and the users. The users, on the other hand, may not understand information technologies. Also, there could be differences between the ISD (the provider) and the end users in terms of agreement on how to measure the IT services provided (quality, quantity) difficulties (see Jiang et al., 2002). Another major reason for tense relationships in many organizations are the difficulties discussed in Chapter 13 regarding the evaluation of IT investment (Seddon et al., 2002).

To improve collaboration, the ISD and end users may employ three common arrangements: the steering committee, service-level agreements, and the information center. (For other strategies, see *Online File W15.2*.)





THE STEERING COMMITTEE. The corporate **steering committee** is a group of managers and staff representing various organizational units that is set up to establish IT priorities and to ensure that the ISD is meeting the needs of the enterprise (see Minicase 1). The committee's major tasks are:

- **Direction setting.** In linking the corporate strategy with the IT strategy, planning is the key activity (see Chapter 9 and Willcocks and Sykes, 2000).
- **Rationing.** The committee approves the allocation of resources for and within the information systems organization. This includes outsourcing policy.
- **Structuring.** The committee deals with how the ISD is positioned in the organization. The issue of centralization–decentralization of IT resources is resolved by the committee.
- **Staffing.** Key IT personnel decisions involve a consultation-and-approval process made by the committee. Notable is the selection of the CIO and major IT outsourcing decisions.
- **Communication.** It is important that information regarding IT activities flows freely.
- **Evaluating.** The committee should establish performance measures for the ISD and see that they are met. This includes the initiation of *service-level agreements*.

The success of steering committees largely depends on the establishment of **IT governance**, a formally established set of statements that should direct the policies regarding IT alignment with organizational goals, risk determination, and allocation of resources (Cilli, 2003).

SERVICE-LEVEL AGREEMENTS. **Service-level agreements (SLAs)** are formal agreements regarding the division of computing responsibility between end users and the ISD and the expected services to be rendered by the ISD. A service-level agreement can be viewed as a *contract* between each end-user unit and the ISD. If a chargeback system exists, it is usually spelled out in the SLA. The process of establishing and implementing SLAs may be applied to each of the *major* computing resources: hardware, software, people, data, networks, and procedures.

The divisions of responsibility in SLAs are based on critical computing decisions that are made by *end-user managers*, who agree to accept certain computing responsibilities and to turn over others to the ISD. Since end-user managers make these decisions, they are free to choose the amount and kind of support they feel they need. This freedom to choose provides a check on the ISD and encourages it to develop and deliver support services to meet end-user needs.

An approach based on SLAs offers several advantages. First, it reduces “finger pointing” by clearly specifying responsibilities. When a PC malfunctions, everyone knows who is responsible for fixing it. Second, it provides a structure for the design and delivery of end-user services by the ISD. Third, it creates incentives for end users to improve their computing practices, thereby reducing computing risks to the firm.

Establishing SLAs requires the following steps: (1) Define service levels. (2) Divide computing responsibility at each level. (3) Design the details of the service levels including measurement of quality (see Jiang et al. 2002). (4) Implement service levels. Kesner (2002) add to these: (5) Assign SLA owner (the person or department that who gets the SLA), (6) monitor SLA compliance, (7) analyze performance, (8) refine SLAs as needed, and (9) improve service to the department or company.

Due to the introduction of Web-based tools for simplifying the task of monitoring enterprise networks, more attention has recently been given to service-level agreements, (Adams, 2000). (For an overview of SLAs, see Pantry and Griffiths, 2002; for suggestions how to control SLAs, see Diao et al., 2002.)

THE INFORMATION CENTER. The concept of **information center (IC)** (also known as the user's service center, technical support center or IS help center) was conceived by IBM Canada in the 1970s as a response to the increased number of end-user requests for new computer applications. This demand created a huge backlog in the IS department, and users had to wait several *years* to get their systems built. Today, ICs concentrate on end-user support with PCs, client/server applications, and the Internet/intranet, helping with installation, training, problem resolution, and other technical support.

The IC is set up to help users get certain systems built quickly and to provide tools that can be employed by users to build their own systems. The concept of the IC, furthermore, suggests that the people in the center should be especially oriented toward the users in their outlook. This attitude should be shown in the training provided by the staff at the center and in the way the staff helps users with any problems they might have. There can be one or several ICs in an organization, and they report to the ISD and/or the end-user departments.

Further information on the purpose and activities of the IC is provided in *Online File W15.3*.



The New IT Organization

To carry out its mission in the digital economy, the ISD needs to adapt. Rockart et al. (1996) proposed eight imperatives for ISDs, which are still valid today. These imperatives are summarized in Table 15.1.

Information technology, as shown throughout this book, is playing a critical role in the livelihood of many organizations, small and large, private and

TABLE 15.1 The Eight Imperatives for ISDs in the Digital Age

Imperative	Description
Achieve two-way strategic alignment	You must align IT and organization's strategies (Chapter 9).
Develop effective relations with line management	An efficient partnership must be cultured between the end users and the ISD.
Develop and deploy new systems quickly	When companies compete on time, the speed of installing new applications and having them run properly are critical needs (Chapter 14).
Build and manage infrastructure	Infrastructure is a shared resource. Therefore its planning, architecture, and policy of use must be done properly (Chapter 9).
Manage vendor relationships	As more vendors are used in IT projects, their management becomes critical. Vendor relations must be not only contractual, but also strategic and collaborative (Chapter 13).
Reskill the IT organization	The skills of IT managers, staff, and technical people must be constantly updated. Using the Web, e-training is popular (Chapters 5, 7).
Build high performance	With shrinking IT budgets and need for new equipment, systems must be very reliable and of high performance, as well as justifiable in terms of cost (Chapter 13). Using a six-sigma approach is recommended.
Redesign and manage the centralized IT organization	The ISD, its role, power sharing with end user, and outsourcing strategies must be carefully crafted.

Source: Compiled from Rockart et al. (1996).



public, throughout the world. Furthermore, the trend is for even more IT involvement. Effective ISDs will help their firms apply IT to transform themselves to e-businesses, redesign processes, and access needed information on a tight budget. For more on managing IT in the digital era, see Sambamurthy et al. (2001).

15.2 THE CIO IN MANAGING THE IS DEPARTMENT

Managing the ISD is similar to managing any other organizational unit. The unique aspect of the ISD is that it operates as a service department in a rapidly changing environment, thus making the department's projections and planning difficult. The equipment purchased and maintained by the ISD is scattered all over the enterprise, adding to the complexity of ISD management. Here we will discuss only one issue: the CIO and his or her relationship with other managers and executives.

The Role of the Chief Information Officer

The changing role of the ISD highlights the fact that the CIO is becoming an important member of the organization's top management team (Ross and Feeny, 2000). Also, the experience of 9/11 changed the role of the CIO, placing him or her in a more important organizational position (see Ball, 2002) because of the organization's realization of the need for IT-related disaster planning and the importance of IT to the organization's activities.

A survey conducted in 1992 found that the prime role of the CIO was to align IT with the business strategy. Secondary roles were to implement state-of-the-art solutions and to provide and improve information access. These roles are supplemented today by several strategic roles because IT has become a strategic resource for many organizations. Coordinating this resource requires strong IT leadership and ISD/end-user collaboration within the organization. In addition, CIO–CEO relationships are crucial for effective, successful utilization of IT, especially in organizations that greatly depend on IT, where the CIO joins the top management “chiefs” group.

The CIO in some cases is a member of the corporate *executive committee*, the most important committee in any organization, which has responsibility for strategic business planning. Its members include the chief executive officer and the senior vice presidents. The executive committee provides the top-level oversight for the organization's information resources. It guides the IS steering committee that is usually chaired by the CIO. Related to the CIO is the emergence of the chief knowledge officer (CKO, see Chapter 10). A CIO may report to the CKO, or the same person may assume both roles, especially in smaller companies.

Major responsibilities that are part of the CIO's evolving role are listed in *Online File W15.4*.



The CIO in the Web-Based Era

According to Ross and Feeny (2000) and Earl (1999–2000), the CIO's role in the Web-based era is influenced by the following three factors:

- **Technology and its management are changing.** Companies are using new Web-based business models. Conventional applications are being transformed to Web-based. There is increasing use of B2B e-commerce, supply chain management, CRM, ERP (see Willcocks and Sykes, 2000) and knowledge management applications. The application portfolio includes more and more Web-based applications.



- **Executives' attitudes are changing.** Greater attention is given to opportunities and risks. At the very least, CIOs are the individuals to whom the more computer literate executives look for guidance, especially as it relates to e-business. Also, executives are more willing to invest in IT, since the cost-benefit ratio of IT is improving with time.
- **Interactions with vendors are increasing.** Suppliers of IT, especially the major ones (HP, Cisco, IBM, Microsoft, Sun, Intel, and Oracle), are influencing the strategic thinking of their corporate customers.

The above factors shape the roles and responsibilities of the CIO in the following seven ways: (1) The CIO is taking increasing responsibility for defining the strategic future. (2) The CIO needs to understand (with others in the organization) that the Web-based era is more about fundamental business change than about technology. (3) The CIO is responsible for protecting the ever increasing IT assets, including the Web infrastructure, against ever-increasing hazards including terrorists' attacks. (4) The CIO is becoming a *business visionary* who drives business strategy, develops new business models on the Web, and introduces management processes that leverage the Internet, intranets, and extranets. (5) The CIO needs to argue for a greater measure of central control. For example, placing inappropriate content on the Internet or intranets can be harmful and needs to be monitored and coordinated. (6) The IT asset-acquisition process must be improved. The CIO and end users must work more closely than ever before. (7) The increased networked environment may lead to disillusionment with IT—an undesirable situation that the CIO should help to avoid. These seven challenges place lots of pressure on CIOs, especially in times of economic decline (see Leidner et al. 2003).

As a result of the considerable pressures they face, CIOs may earn very high salaries (up to \$1,000,000/year in large corporations), but there is high turnover at this position (see Earl, 1999/2000 and Sitonis and Goldberg, 1997). As technology becomes increasingly central to business, the CIO becomes a key mover in the ranks of upper management. For example, in a large financial institution's executive committee meeting, attended by one of the authors, modest requests for additional budgets by the senior vice presidents for finance and for marketing were turned down after long debate. But, at the same meeting the CIO's request for a tenfold addition was approved in only a few minutes.

It is interesting to note that CEOs are acquiring IT skills. According to Duffy (1999), a company's best investment is a CEO who knows technology. If both the CIO and the CEO have the necessary skills for the information age, their company has the potential to flourish. For this reason some companies promote their CIOs to CEOs.

According to *eMarketer Daily* (May 12, 2003), CEOs see security as the second most important area for IT over the next two to three years. We will now turn our attention to one area where the CIO is expected to lead—the security of information systems in the enterprise.

15.3 IS VULNERABILITY AND COMPUTER CRIMES

Information resources are scattered throughout the organization. Furthermore, employees travel with and take home corporate computers and data. Information is transmitted to and from the organization and among the organization's

**TABLE 15.2 IT Security Terms**

Term	Definition
Backup	An extra copy of the data and/or programs, kept in a secured location(s).
Decryption	Transformation of scrambled code into readable data after transmission.
Encryption	Transformation of data into scrambled code prior to its transmission.
Exposure	The harm, loss, or damage that can result if something has gone wrong in an information system.
Fault tolerance	The ability of an information system to continue to operate (usually for a limited time and/or at a reduced level) when a failure occurs.
Information system controls	The procedures, devices, or software that attempt to ensure that the system performs as planned.
Integrity (of data)	A guarantee of the accuracy, completeness, and reliability of data. System integrity is provided by the integrity of its components and their integration.
Risk	The likelihood that a threat will materialize
Threats (or hazards)	The various dangers to which a system may be exposed.
Vulnerability	Given that a threat exists, the susceptibility of the system to harm caused by the threat.

components. IS physical resources, data, software, procedures, and any other information resources may therefore be vulnerable, in many places at any time.

Before we describe the specific problems with information security and some proposed solutions, it is necessary to know the key terminology in the field. Table 15.2 provides an overview of that terminology.

Information Systems Breakdowns

Most people are aware of some of the dangers faced by businesses that are dependent on computers. Information systems, however, can be damaged for many other reasons. The following incidents illustrate representative cases of breakdowns in information systems.

INCIDENT 1. On September 12, 2002, Spitfire Novelties fell victim to what is called a “brute force” credit card attack. On a normal day, the Los Angeles-based company generates between 5 and 30 transactions. That Thursday, Spitfire’s credit card transaction processor, Online Data Corporation, processed 140,000 fake credit card charges, worth \$5.07 each. Of these, 62,000 were approved. The total value of the approved charges was around \$300,000. Spitfire found out about the transactions only when they were called by one of the credit card owners who had been checking his statement online and had noticed the \$5.07 charge.

Brute force credit card attacks require minimal skill. Hackers simply run thousands of small charges through merchant accounts, picking numbers at random. (For details on a larger credit card scam see money.cnn.com/2003/02/18/technology/creditcards/index.htm.)

INCIDENT 2. In January 2003 a hacker stole from the database of Moscow’s MTS (mobile phone company) the personal details (passport number, age, home



address, tax ID number and more) of 6 million customers, including Russia's president V. V. Putin, and sold them on CD ROMs for about \$15 each. The database can be searched by name, phone number, or address. The information can be used for crimes such as **identity theft**, where someone uses the personal information of others to create a false identify and then uses it for some fraud. (e.g., get a fake credit card). In Russia neither the theft of such information nor its sale was illegal (see Walsh, 2003).

INCIDENT 3. Destructive software (viruses, worms, and their variants, which are defined and discussed more fully later in the chapter) is flooding the Internet. Here are some examples of the 2003 vintage: SQL Slammer is a worm that carries a self-regenerating mechanism that enable it to multiply quickly across the Internet. It is so good at replicating, that it quickly generates a massive amount of data, which slowed Internet traffic mainly in South Korea, Japan, Hong Kong, and some European countries in January 2003. It is a variation of Code Red, that slowed traffic on the Internet in July 2001. On May 18, 2003, a new virus that masqueraded as an e-mail from Microsoft technical support attacked computers in 89 countries. In June 2003, a high-risk virus w32/Bugbear started to steal VISA account information (see "Bugbear worm steals..." 2003).

INCIDENT 4. On March 15, 2003, a student hacked into the University of Houston computer system and stole Social Security numbers of 55,000 students, faculty, and staff. The student was charged with unauthorized access to protected computers using someone else's ID, with intent to commit a federal crime. The case is still in the courts, and prison time is a possibility.

INCIDENT 5. On February 29, 2000, hundreds of automated teller machines (ATMs) in Japan were shut down, a computer system at a nuclear plant seized up, weather-monitoring devices malfunctioned, display screens for interest rates at the post offices failed, seismographs provided wrong information, and there were many other problems related to programming for "leap year." The problem was that years that end in "00" do not get the extra day, added every four years, unless they are divisible by 400 (2000 is such a leap year, but not 1900, or 2100). This rule was not programmed properly in some old programs in Japan, thus creating the problems. In May 2001, a glitch in Japan's air-traffic systems grounded 1,600 domestic flights for 30 minutes while the system was operated manually.

INCIDENT 6. For almost two weeks, a seemingly legitimate ATM operating in a shopping mall near Hartford, Connecticut, gave customers apologetic notes that said, "Sorry, no transactions are possible." Meanwhile, the machine recorded the card numbers and the personal identification numbers that hundreds of customers entered in their vain attempts to make the machine dispense cash. On May 8, 1993, while the dysfunctional machine was still running in the shopping mall, thieves started tapping into the 24-hour automated teller network in New York City. Using counterfeit bank cards encoded with the numbers stolen from the Hartford customers, the thieves removed about \$100,000 from the accounts of innocent customers. The criminals were successful in making an ATM machine do what it was supposedly designed not to do: breach its



own security by recording bank card numbers together with personal security codes.

INCIDENT 7. Netscape security is aimed at scrambling sensitive financial data such as credit card numbers and sales transactions so they would be safe from break-ins, by using a powerful 128-bit program. However, using 120 powerful workstations and two supercomputers, in 1996 a French student breached the encryption program in eight days, demonstrating that no program is 100 percent secure.

INCIDENT 8. In 1994 a Russian hacker (who did not know much English) broke into a Citibank electronic funds transfer system and stole more than \$10 million by wiring it to accounts around the world. Since then, Citibank, a giant bank that moves about a trillion dollars a day, increased its security measures, requiring customers to use electronic devices that create new passwords very frequently.

INCIDENT 9. On April 30, 2000, the London Stock Exchange was paralyzed by its worst computer system failure, before finally opening nearly eight hours late. A spokesman for the exchange said the problem, which crippled the supply of prices and firm information, was caused by corrupt data. He gave no further details. Dealers were outraged by the fault, which came on the last day of the tax year and just hours after violent price swings in the U.S. stock markets. The British Financial Services Authority said it viewed the failure seriously, adding it would insist any necessary changes to systems be made immediately and that lessons were “learned rapidly” to ensure the breakdown was not repeated.

These incidents and the two in the opening case illustrate the vulnerability of information systems, the diversity of causes of computer security problems, and the substantial damage that can be done to organizations anywhere in the world as a result. The fact is that computing is far from secure (e.g., see Austin and Darby, 2003, and the 2003 FBI report in Richardson, 2003).

System Vulnerability

Information systems are made up of many components that may be housed in several locations. Thus, each information system is vulnerable to many potential *hazards* or *threats*. Figure 15.1 presents a summary of the major threats to the security of an information system. Attacks on information systems can be either on internal systems (suffered by about 30% of the responding organizations in the CSI/FBI survey, as reported in Richardson, 2003), or via remote dial-ins (18%), or on Internet-based systems (78%). (See also *sons.org/top20*, for the most critical Internet security vulnerabilities.)

According to CVE (Common Vulnerabilities and Exposure, an organization based at Mitre Corp. that provides information, educations, and advice regarding IT vulnerabilities and exposure, along with solutions)(cve.mitre.org/about/terminology.html), there is a distinction between vulnerability and exposure:

A universal **vulnerability** is a state in a computing system (or set of systems) which either: allows an attacker to execute commands as another user; allows an attacker to access data that is contrary to the specified access restrictions for that data; allows an attacker to pose as another entity; or allows an attacker to conduct a denial of service.

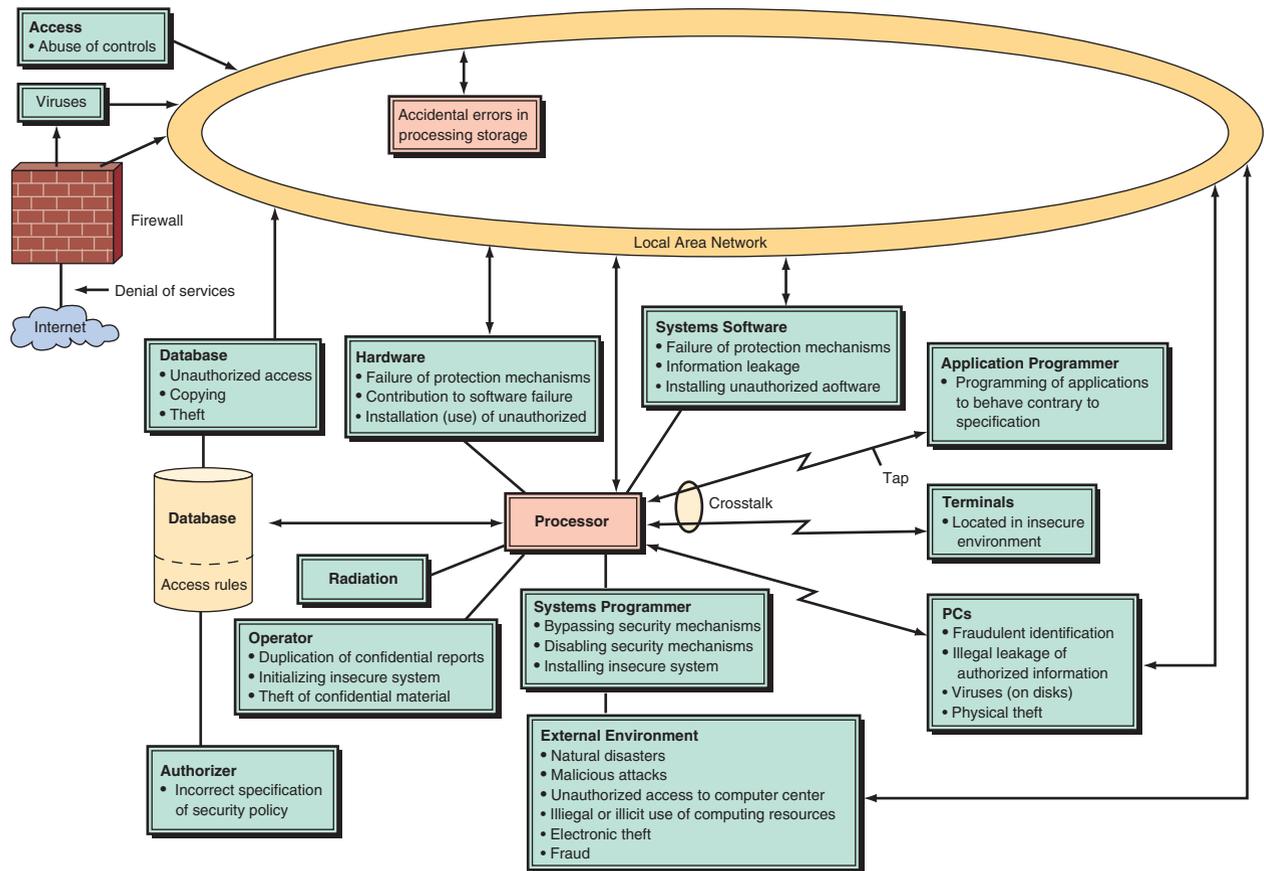


FIGURE 15.1 Security threats.

An **exposure** is a state in a computing system (or set of systems) which is not a universal vulnerability, but either: allows an attacker to conduct information gathering activities; allows an attacker to hide activities; includes a capability that behaves as expected, but can be easily compromised; is a primary point of entry that an attacker may attempt to use to gain access to the system or data; and is considered a problem according to some reasonable security policy.

We will use the term vulnerability here to *include* exposure as well (including unintentional threats). Incidentally, by 2002 the CVE identified more than 5,000 different security issues and problems (see Mitre, 2002).

The vulnerability of information systems is increasing as we move to a world of networked and especially wireless computing. Theoretically, there are hundreds of points in a corporate information system that can be subject to some threats. And actually, there are thousands of different ways that information systems can be attacked or damaged. These threats can be classified as *unintentional* or *intentional*.

UNINTENTIONAL THREATS. Unintentional threats can be divided into three major categories: human errors, environmental hazards, and computer system failures.



A CLOSER LOOK

15.1 COMPUTER GLITCHES DELAY AIRPORT OPENINGS

When the multibillion-dollar airport was opened in Hong Kong on July 6, 1999, a combination of computer glitches and unprepared personnel turned the airport into chaos. Both travelers and cargo were affected. For example, one software bug erased all inventory records, leaving no clue as to who owned what. Another software bug erased flight information from monitors, preventing passengers from finding flights. Computer problems in the baggage system resulted in 10,000 lost bags. Fresh food and seafood being shipped to restaurants

and hotels got spoiled, and considerable business was lost. In the United States, Denver's airport, which opened in 1995, had been plagued by computer glitches as well (see Chapter 14). Similarly, in Malaysia, when a new facility opened on July 1, 1999, a computerized total airport management system collapsed on the first day.

In all these airport cases, the problem was not external hackers' attacks or internal intentional acts. The bugs resulted from poor IS planning, lack of coordination, and insufficient testing.

Many computer problems result from *human errors*. Errors can occur in the design of the hardware and/or information system. They can also occur in the programming, testing, data collection, data entry, authorization, and instructions. Human errors contribute to the *vast majority* (about 55 percent) of control- and security-related problems in many organizations.

Environmental hazards include earthquakes, severe storms (e.g., hurricanes, snow, sand, lightning, and tornadoes), floods, power failures or strong fluctuations, fires (the most common hazard), defective air conditioning, explosions, radioactive fallout, and water-cooling-system failures. In addition to damage from combustion, computer resources can incur damage from other elements that accompany fire, such as smoke, heat, and water. Such hazards may disrupt normal computer operations and result in long waiting periods and exorbitant costs while computer programs and data files are recreated.

Computer systems failures can occur as the result of poor manufacturing or defective materials. Unintentional malfunctions can also happen for other reasons, ranging from lack of experience to inappropriate testing. See *A Closer Look 15.1* for the story about recent systems failures at airport.

INTENTIONAL THREATS. As headlines about computer crime indicate, computer systems may be damaged as a result of intentional actions as well. These account for about 30 percent of all computer problems, according to the Computer Security Institute (*gocsi.com*), but the monetary damage from such actions can be extremely large. Examples of intentional threats include: theft of data; inappropriate use of data (e.g., manipulating inputs); theft of mainframe computer time; theft of equipment and/or programs; deliberate manipulation in handling, entering, processing, transferring, or programming data; labor strikes, riots, or sabotage; malicious damage to computer resources; destruction from viruses and similar attacks; and miscellaneous computer abuses and Internet fraud. In addition, while terrorists' attacks do not usually directly target computers, the computers and information systems can be destroyed in such cases, as happened in the 9/11 disaster in New York and Washington, D.C. Intentional



threats can even be against whole countries. Many fear the possibility of *cyber-attacks* by some countries against others.

Computer Crimes

According to the Computer Security Institute (*gocsi.com*), 64 percent of all corporations experienced computer crimes in 1997. The figures in the years 1998 through 2003 were even higher—about 96 percent in 2003 (per Richardson, 2003). The number, magnitude, and diversity of computer crimes are increasing. Lately, increased fraud related to the Internet and e-commerce is in evidence. For an overview of computer crime, see Loundy, 2003; for FBI statistics for 2002/2003, see Richardson, 2003.

TYPES OF COMPUTER CRIMES AND CRIMINALS. In many ways, computer crimes resemble conventional crimes. They can occur in various ways. First, the computer can be the *target* of the crime. For example, a computer may be stolen or destroyed, or a virus may destroy data. The computer can be the *medium* or *tool* of the attack, by creating an environment in which a crime or fraud can occur. For example, false data are entered into a computer system to mislead individuals examining the financial condition of a company. Finally, the computer can be used to *intimidate* or *deceive*. For instance, a stockbroker stole \$50 million by convincing his clients that he had a computer program with which he could increase their return on investment by 60 percent per month. Crimes done on the Internet, called cybercrimes (discussed later), can fall into any of these categories.

Crimes can be performed by *outsiders* who penetrate a computer system (frequently via communication lines) or by *insiders* who are authorized to use the computer system but are misusing their authorization. **Hacker** is the term often used to describe an outside person who penetrated a computer system. For an overview of hacking and the protection against it, see Fadia (2002). A **cracker** is a *malicious hacker*, who may represent a serious problem for a corporation. Hackers and crackers may involve unsuspecting insiders in their crimes. In a strategy called **social engineering**, computer criminals or corporate spies build an inappropriate trust relationship with insiders for the purpose of gaining sensitive information or unauthorized access privileges. For description of social engineering and some tips for prevention see Damle (2002) and *Online File W15.5*.

Computer criminals, whether insiders or outsiders, tend to have a distinct profile and are driven by several motives (see *Online File W15.6*). Ironically, many employees fit this profile, but only a few of them are criminals. Therefore, it is difficult to predict who is or will be a computer criminal. Criminals use various and frequently innovative attack methods.

A large proportion of computer crimes are performed by insiders. According to Richardson (2003) the likely sources of attacks on U.S. companies are: independent hackers (82%), disgruntled employees (78%), U.S. competitors (40%), foreign governments (28%), foreign corporations (25%).

In addition to computer criminals against organizations there is an alarming increase of fraud done against individuals, on the Internet. These are a part of cybercrimes.

CYBERCRIMES. The Internet environment provides an extremely easy landscape for conducting illegal activities. These are known as **cybercrimes**, meaning they are executed on the Internet. Hundreds of different methods and





“tricks” are used by innovative criminals to get money from innocent people, to buy without paying, to sell without delivering, to abuse people or hurt them, and much more.

According to Sullivan (2003), between January 1, and April 30, 2003, agencies of the U.S. government uncovered 89,000 victims from whom Internet criminals bilked over \$176 million. As a result, on May 16, 2003, the U.S. Attorney General announced that 135 people were arrested nationwide and charged with cybercrime. The most common crimes were investment swindles and identity theft. The Internet with its global reach has also resulted in a growing amount of cross-border fraud (see *A Closer Look 15.2*).

Identity Theft. A growing cybercrime problem is *identity theft*, in which a criminal (the *identity thief*) poses as someone else. The thief steals Social Security numbers and credit card numbers, usually obtained from the Internet, to commit fraud (e.g., to buy products or consume services) that the victim is required to pay for later. The biggest damage to the person whose identity was stolen is to restore the damaged credit rating. For details and commercial solutions see *idthief.com*.

CYBERWAR. There is an increasing interest in the threat of **cyberwar**, in which a country’s information systems could be paralyzed by a massive attack of destructive software. The target systems can range from the ISs of business, industry, government services, and the media to military command systems.

One aspect of cyberwar is *cyberterrorism*, which refers to Internet terrorist attacks. These attacks, like cyberwar, can risk the national information infrastructure. The U.S. President Critical Infrastructure Protection Board (CIPB) is preparing protection plans, policies, and strategies to deal with cyberterrorism. The CIPB is recommending investment in cybersecurity programs. Some of the areas of the CIPB report are: a general policy on information security; asset protection requirements, including controls to ensure the return or destruction of information; technology insurance requirements; intellectual property rights; the right to monitor, and revoke, user activity; specification of physical and technical security standards; and communication procedures in time of emergency. (For more details and debates, see cdt.org/security/critinfra and cia.gov. For more details on cyberterrorism, see Verton and Brownlow, 2003.)

Methods of Attack on Computing Facilities

There are many methods of attack, and new ones appear regularly. Of the many methods of attack on computing facilities, the CSI/FBI reports (per Richardson, 2003) the following as most frequent (percentage of responding companies): virus (82%), insider abuse of Internet access (80%), unauthorized access by insiders (45%), theft of laptop (59%), denial of service (DoS) attack (42%), system penetration (36%), sabotage (21%), and theft of proprietary information (21%). In this section we look at some of these methods. Two basic approaches are used in deliberate attacks on computer systems: data tampering and programming attack.

Data tampering, the most common means of attack, refers to entering false, fabricated, or fraudulent data into the computer or changing or deleting existing data. This is the method often used by insiders. For example, to pay for his wife’s drug purchases, a savings and loan programmer transferred \$5,000 into his personal account and tried to cover up the transfer with phony debit and credit transactions.



A CLOSER LOOK

15.2 CROSS-BORDER CYBERCRIMES

As the Internet grows, so do cross-border scams. According to the U.S. Federal Trade Commission (FTC), there was an increase in the complaints filed by U. S. consumers about cross-border scams, of 74 percent in 2002 (to 24,213) (Davidson, 2003). Most complaints involved advance-fee loans, foreign cash offers, and sweepstakes. Scammers based in one country elude authorities by victimizing residents of others, using the Internet.:

For example, David Lee, a 41-year-old Hong Kong resident, replied to an advertisement in a respected business magazine that offered him free investment advice. After he replied, he received professional-looking brochures and a telephone sales speech. Then he was directed to the Web site of Equity Mutual Trust (Equity) where he was able to track the impressive daily performance of a fund that listed offices in London, Switzerland, and Belize. From that Web site he was linked to sister funds and business partners. Lee also was linked to what he believed was the well-known investment-fund evaluator company Morningstar (*morningstar.com*). Actually, the site was an imitation that replicated the original site. The imitation site provided a very high, but false, rating on the Equity Mutual Trust funds. Finally, Lee was directed to read about Equity and its funds in the respected *International Herald Tribune's* Internet edition; the article appeared to be news but was actually an advertisement.

Convinced that he would receive super short-term gains, he mailed US\$16,000, instructing Equity to invest in the Grand Financial Fund. Soon he grew suspicious when letters from Equity came from different countries, telephone calls and e-mails were not answered on time, and the daily Internet listings dried up.

When Lee wanted to sell, he was advised to increase his investment and shift to a Canadian company, Mit-Tec, allegedly a Y2K-bug troubleshooter. The Web site he was directed to looked fantastic. But this time Lee was careful. He contacted the financial authorities in the Turks and Caicos Islands—where Equity was based at that time—and was referred to the British police.

Soon he learned that chances were slim that he would ever see his money again. Furthermore, he learned that several thousand victims had paid a total of about \$4 billion to Equity. Most of the victims live in Hong Kong, Singapore, and other Asian countries. Several said that the most convincing information came from the Web sites, including the “independent” Web site that rated Equity and its funds as safe, five-star funds.

According Davidson (2003) the FTC admitted that the laws in the United States and other countries) are set up based on an old-economy view and are not effective enough in cross-border cases involving new-economy realities. To solve the problem, some countries (e.g., Germany, Netherlands) rely on self-regulatory business groups that can merely urge an offending company to change its practice. Some countries try to bar rogue marketers from conducting unethical or even illegal marketing activities, but cannot even impose financial sanctions. Offending companies are simply looking for jurisdictions of convenience. (Incidentally, the same situation exists with companies that support free *file sharing*, such as Kaaza; they are operating from outside the United States and so are not subject to U.S. laws, however outdated they may be.)

What can be done? In June 2003, 29 nations belonging to the Organization for Economic Cooperation and Development (OECD) announced an agreement on unified guidelines for far greater cooperation in persecuting online scammers, and in enforcement of existing laws. There will be information sharing and collaboration among investigators from different countries (e.g., relaxing privacy rules that in most nations, including the United States, now strictly limit the information that can be shared). Participating countries will try to pass laws adopting the guidelines. For example, in the United States, which has the most victims of cross-border fraud, a pending bill in Congress would give the FTC new authority to prosecute cross-border fraud.

Sources: Compiled from Davidson (2003), from *fic.org*, and a news item in *South China Morning Post* (Hong Kong, May 21, 1999).

Programming attack is popular with computer criminals who use *programming techniques* to modify a computer program, either directly or indirectly. For this crime, programming skills and knowledge of the targeted systems are essential. *Programming attacks* appear under many names, as shown in

**TABLE 15.3** Methods of Programming Attack on Computer Systems

Method	Definition
Virus	Secret instructions inserted into programs (or data) that are innocently run during ordinary tasks. The secret instructions may destroy or alter data, as well as spread within or between computer systems.
Worm	A program that replicates itself and penetrates a valid computer system. It may spread within a network, penetrating all connected computers.
Trojan horse	An illegal program, contained within another program, that “sleeps” until some specific event occurs, then triggers the illegal program to be activated and cause damage.
Salami slicing	A program designed to siphon off small amounts of money from a number of larger transactions, so the quantity taken is not readily apparent.
Superzapping	A method of using a utility “zap” program that can bypass controls to modify programs or data.
Trap door	A technique that allows for breaking into a program code, making it possible to insert additional instructions.
Logic bomb	An instruction that triggers a delayed malicious act.
Denial of services	Too many requests for service, which crashes the site.
Sniffer	A program that searches for passwords or content in a packet of data as they pass through the Internet.
Spoofing	Faking an e-mail address or Web page to trick users to provide information or send money.
Password cracker	A password that tries to guess passwords (can be very successful).
War dialing	Programs that automatically dial thousands of telephone numbers in an attempt to identify one authorized to make a connection with a modem; then one can use that connection to break into databases and systems.
Back doors	Invaders to a system create several entry points; even if you discover and close one, they can still get in through others.
Malicious applets	Small Java programs that misuse your computer resources, modify your file, send fake e-mail, etc.

Table 15.3. Several of the methods were designed for Web-based systems. Viruses merit special discussion here due to their frequency, as do denial of service attacks, due to the effects they have had on computer networks.

VIRUSES. The most publicized and most common attack method is the **virus**. It receives its name from the program’s ability to attach itself to (“infect”) other computer programs, without the owner of the program being aware of the infection (see Figure 15.2). When the software is used, the virus spreads, causing damage to that program and possibly to others.

According to Bruno (2002), 93 percent of all companies experienced virus attacks in 2001, with an average loss of \$243,845 per company. A virus can spread throughout a computer system very quickly. Due to the availability of public-domain software, widely used telecommunications networks, and the Internet, viruses can also spread to many organizations around the world, as shown in the incidents listed earlier. Some of the most notorious viruses are “international,” such as Michelangelo, Pakistani Brain, Chernobyl, and Jerusalem. (For the history of viruses and how to fight them, see Zetter and Miastkowski, 2000.)

When a virus is attached to a legitimate software program, the legitimate software is acting as a **Trojan horse**, a program that contains a hidden function that presents a security risk. The name is derived from the Trojan horse in

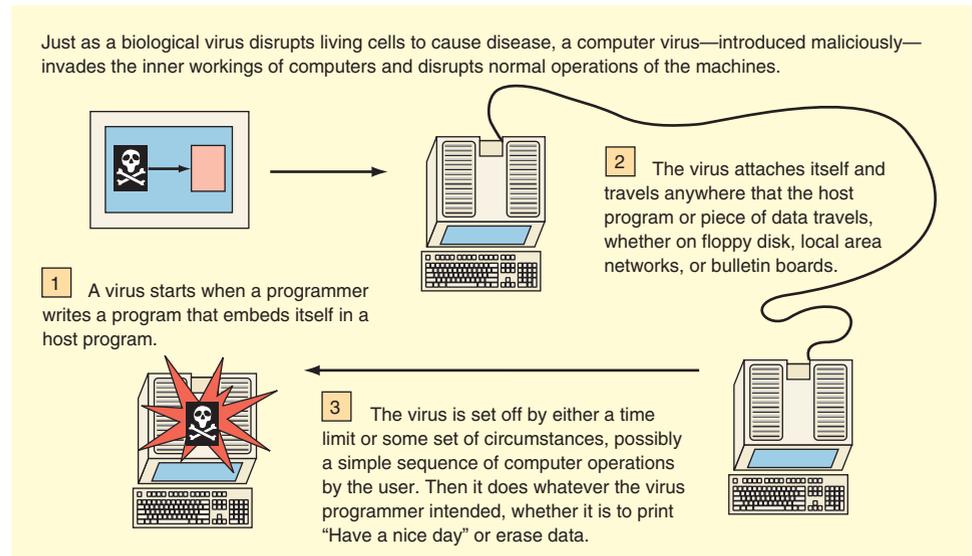


FIGURE 15.2 How a computer virus can spread.

Greek legend. The Trojan horse programs that present the greatest danger are those that make it possible for someone else to access and control a person's computer over the Internet.

We'll look at viruses and how to fight them later in the chapter, when we describe security on networks.

DENIAL OF SERVICE. The opening case of this chapter described a denial of service incident. In a **denial-of-service (DoS)** attack, an attacker uses specialized software to send a flood of data packets to the target computer, with the aim of overloading its resources. Many attackers rely on software that has been created by other hackers and made available free over the Internet.

With a **distributed denial of service (DDoS)** attack, the attacker gains illegal administrative access to computers on the Internet. With access to a large number of computers, the attacker loads the specialized DDoS software onto these computers. The software lies in wait for a command to begin the attack. When the command is given, the distributed network of computers begins sending out requests to one or more target computers. The requests can be legitimate queries for information or can be very specialized computer commands designed to overwhelm specific computer resources.

The machines on which DDoS software is loaded are known as **zombies** (Karagiannis, 2003). Zombies are often located at university and government sites. Increasingly, with the rise of cable modems and DSL modems, home computers that are connected to the Internet and left on all the time have become good zombie candidates.

DoS attacks are not new. In 1996, a New York Internet service provider had service disrupted for over a week by a DoS attack, denying service to over 6,000 users and 1,000 companies. A recent example of a DoS attack is the one on RIAA (Recording Industry Association of America) whose site (*riaa.org*) was rendered largely unavailable for a week starting January 24, 2003. The attack was done mainly by those who did not like the RIAA's attempts to fight pirated



music done by file sharing. Due to the widespread availability of free intrusion tools and scripts and the overall interconnectivity on the Internet, the intruder population now consists of virtually anyone with minimal computer experience (often a teenager with time on his hands). Unfortunately, a successful DoS attack can literally threaten the survival of an EC site, especially for SMEs.

ATTACKS VIA MODEMS. In many companies employees who are on the road use modems for dial-in access to the company intranet. Two types of modems exist: authorized and not authorized (known as *rogue modems*). The latter are installed by employees when there are no authorized modems, when it is inconvenient to use the authorized modems, or when the authorized modems provide only limited access.

Modems are very risky. It is quite easy for attackers to penetrate them, and it is easy for employees to leak secret corporate information to external networks via rogue modems. In addition, software problems may develop, such as downloading programs with viruses or with a “back door” to the system. Back doors are created by hackers to repenetrate a system, once a successful penetration is made. For ways to protect systems that use modems, see White (1999).

15.4 PROTECTING INFORMATION RESOURCES: FROM NATIONAL TO ORGANIZATIONAL EFFORTS

Organizations and individuals can protect their systems in many ways. Let’s look first at what protections the national efforts can provide. Then we will look at what organizations can do to protect information resources.

Representative Federal Laws Dealing with Computer Crime and Security

A “crime” means breaching the law. In addition to breaking regular law related to physically stealing computers or conducting fraud, computer criminals may break the specially legislated computer crime laws. According to the FBI, an average robbery involves about \$3,000; an average white-collar crime involves \$23,000; but an average computer crime involves about \$600,000. Table 15.4 lists some key U.S. federal statutes dealing with computer crime. (For more on these laws, see epic.org/security.)

Legislation can be helpful but not sufficient. Therefore, the FBI has formed the *National Infrastructure Protection Center (NIPC)*. This joint partnership between government and private industry is designed to prevent and protect the nation’s infrastructure—its telecommunications, energy, transportation, banking and finance, and emergency, and governmental operations. The FBI has also established *Regional Computer Intrusion Squads*, which are charged with the task of investigating violations of the Computer Fraud and Abuse Act. The squads’ activities are focused on intrusions to public switched networks, major computer network intrusions, privacy violations, industrial espionage, pirated computer software, and other cybercrimes.

Another national organization is the *Computer Emergency Response Team (CERT)* at Carnegie Mellon University (cert.org). The CERT Coordination Center (CC) consists of three teams: the Incident Handling Team, the Vulnerability Handling Team, and the Artifact Analysis Team. The Incident Handling Team receives incident reports of cyberattacks from Internet sites and provides information and

**TABLE 15.4 Key U.S. Federal Statutes Dealing with Computer Crime**

Federal Statute	Key Provisions
Counterfeit Access Device and Computer Crime Control Act (passed in October 1984)	
Computer Fraud and Abuse Act (1986), 18 USC, section 1030	
Computer Abuse Amendment Act of 1994	Prohibits knowing transmission of computer viruses
Computer Security Act of 1987	
Digital Privacy Act of 2000	
Electronic Communications Privacy Act of 1986	
Electronic Freedom of Information Act, 1996	
Gramm Leach Bliley Act of 1999	
National Information Infrastructure Protection Act of 1996	
Patriot Act of 2001	
Privacy Act of 1974	
Electronic Funds Transfer Act of 1980	
Video Privacy Protection Act of 1988	

guidance to the Internet community on combatting reported incidents. The Vulnerability Handling Team receives reports on suspected computer and network vulnerabilities, verifies and analyzes the reports, and works with the Internet community to understand and develop countermeasures to those vulnerabilities. The Artifacts Analysis Team focuses on the code used to carry out cyberattacks (e.g., computer viruses), analyzing the code and finding ways to combat it.

Organizing for Information Security

Information security problems are increasing rapidly, causing damages to many organizations. Protection is expensive and complex. Therefore, companies must not only use controls to prevent or detect security problems, they must do so in an organized way, assigning responsibilities and authority throughout the organization (e.g., see Talleur, 2001 and Atlas and Young, 2002). Any program that is adopted must be supported by three organizational components: people, technology, and process (see Doughty, 2003).

One way to approach the problem of organizing for security is similar to the familiar total quality management approach—namely, recognizing the importance of a corporatewide security program, which will deal with all kinds of security issues, including protecting the information assets. Doll et al. (2003), presents this approach as having six major characteristics:

- **Aligned.** The program must be aligned with the organizational goals.
- **Enterprise-wide.** Everyone in the organization must be included in the security program.

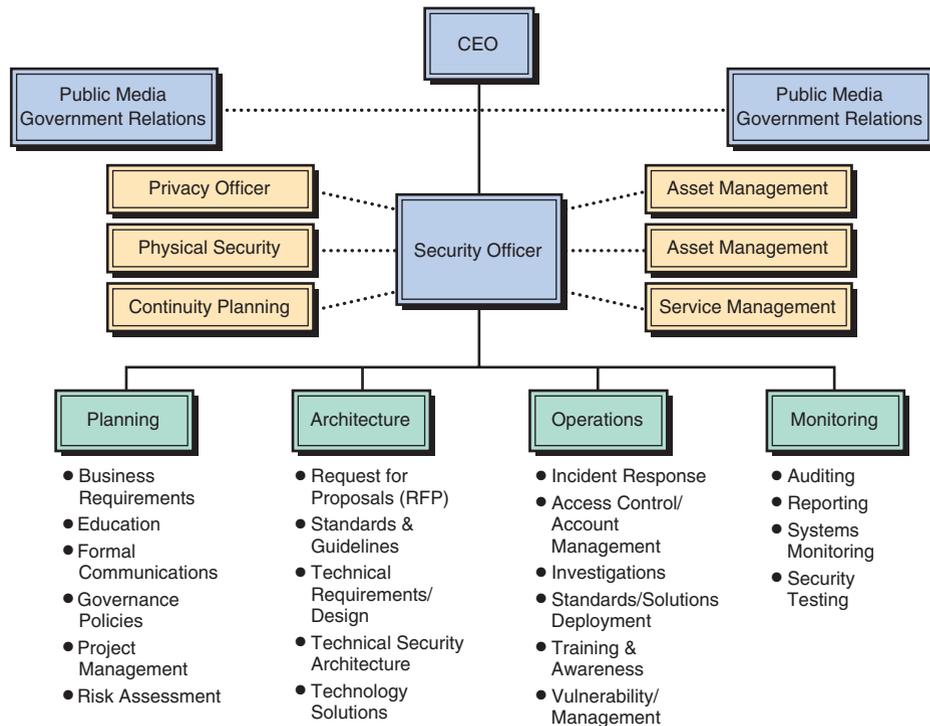


FIGURE 15.3 Corporate security plan. (Source: Doll et al., 2003.)

- **Continuous.** The program must be operational all the time.
- **Proactive.** Do not wait for trouble; be aware and ready; use innovative, preventive, and protective measures.
- **Validated.** The program must be tested and validated to ensure it works.
- **Formal.** It must be a formal program with authority, responsibility, and accountability.

A corporate security model proposed by Doll et al. (2003) is illustrated in Figure 15.3. Obviously, only very large organizations can afford such a comprehensive security model. We will present several of the components and concepts in the figure in the remaining portions of this chapter. A case study for implementing enterprise security is provided by Doughty (2003). A major issue is the role the person responsible for security (the chief security officer) is going to assume (see Robinson, 2003).

Controls and Awareness

Knowing about major potential threats to information systems is necessary, but understanding ways to defend against these threats is equally critical (see *cert.org* and *sans.com*). Defending information resources is not a simple nor inexpensive task. The major difficulties of protecting information are listed in Table 15.5. Because of its importance to the entire enterprise, organizing an appropriate defense system is one of the major activities of any prudent CIO and of the functional managers who control information resources. As a matter of fact, IT security is the business of *everyone* in an organization. (see Pooley, 2002).

Protection of information resources is accomplished mostly by inserting *controls* (defense mechanisms) intended to prevent accidental hazards, deter

TABLE 15.5 The Difficulties in Protecting Information Resources

- Hundreds of potential threats exist.
- Computing resources may be situated in many locations.
- Many individuals control information assets.
- Computer networks can be outside the organization and difficult to protect.
- Rapid technological changes make some controls obsolete as soon as they are installed.
- Many computer crimes are undetected for a long period of time, so it is difficult to learn from experience.
- People tend to violate security procedures because the procedures are inconvenient.
- Many computer criminals who are caught go unpunished, so there is no deterrent effect.
- The amount of computer knowledge necessary to commit computer crimes is usually minimal. As a matter of fact, one can learn hacking, for free, on the Internet.
- The cost of preventing hazards can be very high. Therefore, most organizations simply cannot afford to protect against all possible hazards.
- It is difficult to conduct a cost-benefit justification for controls before an attack occurs since it is difficult to assess the value of a hypothetical attack.

intentional acts, detect problems as early as possible, enhance damage recovery, and correct problems. Controls can be integrated into hardware and software during the system development phase (a most efficient approach). They can also be added on once the system is in operation, or during its maintenance. The important point is that defense should stress *prevention*; defense does no good *after the crime*.

In addition to controls a good defense system must include security *awareness*. All organizational members must be aware of security threats and watch for potential problems and crimes constantly. Suggestions of how to develop such programs are offered by security consultants (e.g., see Wiederkehr, 2003). Awareness training is recommended by Talleur (2001).

Since there are many security threats, there are also many defense mechanisms. Controls are designed to protect all the components of an information system, specifically data, software, hardware, and networks. In the next section, we describe the major ones.

Defense Strategy: How Do We Protect?

The selection of a specific defense strategy depends on the objective of the defense and on the perceived cost-benefit. The following are the major objectives of *defense strategies*:

1. **Prevention and deterrence.** Properly designed controls may prevent errors from occurring, deter criminals from attacking the system, and better yet, deny access to unauthorized people. Prevention and deterrence are especially important where the potential damage is very high. (see Scalet, 2003).
2. **Detection.** It may not be economically feasible to prevent all hazards, and deterrence measures may not work. Therefore, unprotected systems are vulnerable to attack. Like a fire, the earlier an attack is detected, the easier it is to combat, and the less damage is done. Detection can be performed in many cases by using special diagnostic software.



3. **Limitation of damage.** This strategy is to minimize (limit) losses once a malfunction has occurred. This can be accomplished by including a *fault-tolerant system* that permits operation in a degraded mode until full recovery is made. If a fault-tolerant system does not exist, a quick (and possibly expensive) recovery must take place. Users want their systems back in operation as quickly as possible.
4. **Recovery.** A recovery plan explains how to fix a damaged information system as quickly as possible. Replacing rather than repairing components is one route to fast recovery.
5. **Correction.** Correcting the causes of damaged systems can prevent the problem from occurring again.
6. **Awareness and compliance.** All organization members must be educated about the hazards and must comply with the security rules and regulations.

Any defense strategy that aim to attain one or more of these objectives, may involve the use of several controls. The defense controls are divided in our discussion into two major categories: *general controls* and *application controls*. Each has several subcategories, as shown in Figure 15.4. **General controls** are established to protect the system regardless of the specific application. For example, protecting hardware and controlling access to the data center are independent of the specific application. **Application controls** are safeguards that are intended to protect specific applications. In the next two sections, we discuss the major types of these two groups of information systems controls.

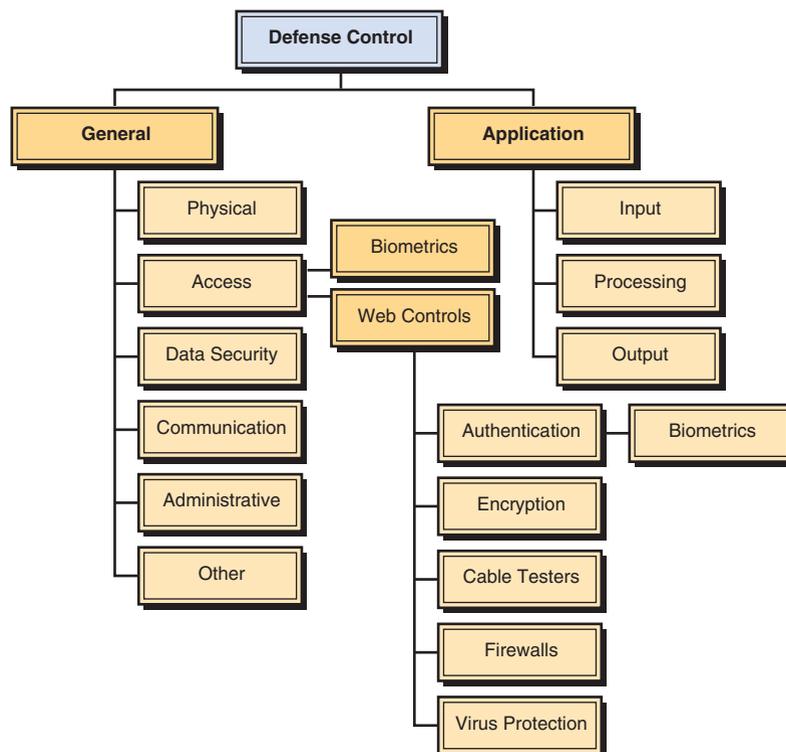


FIGURE 15.4 Major defense controls.

General Controls The major categories of general controls are physical controls, access controls, data security controls, communications (networks) controls, and administrative controls.

PHYSICAL CONTROLS. Physical security refers to the protection of computer facilities and resources. This includes protecting physical property such as computers, data centers, software, manuals, and networks. Physical security is the first line of defense and usually the easiest to construct. It provides protection against most natural hazards as well as against some human hazards. Appropriate physical security may include several controls such as the following:

- Appropriate design of the data center. For example, the site should be non-combustible and waterproof.
- Shielding against electromagnetic fields.
- Good fire prevention, detection, and extinguishing systems, including sprinkler system, water pumps, and adequate drainage facilities. A better solution is fire-enveloping Halon gas systems.
- Emergency power shutoff and backup batteries, which must be maintained in operational condition.
- Properly designed, maintained, and operated air-conditioning systems.
- Motion detector alarms that detect physical intrusion.

Another example of physical controls is the need to protect against theft of mobile computers. Such protection is important not only because of the loss of the computer but also because of loss of data. Several interesting protection devices are offered by *targus.com*.

ACCESS CONTROL. Access control is the restriction of unauthorized user access to a portion of a computer system or to the entire system. It is the major defence line against unauthorized insiders as well as outsiders. To gain access, a user must first be *authorized*. Then, when the user attempts to gain access, he or she must be *authenticated*.

Access to a computer system is basically consists of three steps: (1) physical access to a terminal, (2) access to the system, and (3) access to specific commands, transactions, privileges, programs, and data within the system. Access control software is commercially available for large mainframes, personal computers, local area networks, mobile devices and dial-in communications networks. Access control to *networks* is executed through firewalls and will be discussed later.

Access procedures match every valid user with a *unique user-identifier (UID)*. They also provide an authentication method to verify that users requesting access to the computer system are really who they claim to be. User identification can be accomplished when the following identifies each user:

- Something only the user *knows*, such as a password.
- Something only the user *has*, for example, a smart card or a token.
- Something only the user *is*, such as a signature, voice, fingerprint, or retinal (eye) scan. It is implemented via *biometric controls*, which can be physiological or behavioral (see Alga, 2002) and whose cost is relatively very small.



Biometric Controls. A **biometric control** is an automated method of verifying the identity of a person, based on physiological or behavioral characteristics. The most common biometrics are the following:

- **Photo of face.** The computer takes a picture of your face and matches it with a prestored picture. In 2002, this method was successful in correctly identifying users except in cases of identical twins.
- **Fingerprints.** Each time a user wants access, matching a fingerprint (finger scan) against a template containing the authorized person's fingerprint identifies him or her. Note that in 2001 Microsoft introduced a software program, now a part of Windows, that allows users to use Sony's fingerprint recognition device. Computer manufacturers will start shipping laptops secured by fingerprint-scanning touchpads in 2004. These devices will reject unauthorized access. (see *synaptics.com*).
- **Hand geometry.** This biometric is similar to fingerprints except that the verifier uses a television-like camera to take a picture of the user's hand. Certain characteristics of the hand (e.g., finger length and thickness) are electronically compared against the information stored in the computer.
- **Iris scan.** This technology uses the colored portion of the eye to identify individuals (see *irisscan.com*). It is a noninvasive system that takes a photo of the eye and analyzes it. It is a very accurate method.
- **Retinal scan.** A match is attempted between the pattern of the blood vessels in the back-of-the-eye retina that is being scanned and a prestored picture of the retina.
- **Voice scan.** A match is attempted between the user's voice and the voice pattern stored on templates.
- **Signature.** Signatures are matched against the prestored authentic signature. This method can supplement a photo-card ID system.
- **Keystroke dynamics.** A match of the person's keyboard pressure and speed against prestored information.

Several other methods, such as *facial thermography*, exist.

Biometric controls are now integrated into many e-commerce hardware and software products (e.g., see *keywaretechnologies.com*). For an overview and comparison of technologies, see Jain et al. (1999 and 2000) and Alga (2002). Biometric controls do have some limitations: they are not accurate in certain cases, and some people see them as an invasion of privacy (see Caulfield, 2002).

DATA SECURITY CONTROLS. Data security is concerned with protecting data from accidental or intentional disclosure to unauthorized persons, or from unauthorized modification or destruction. Data security functions are implemented through operating systems, security access control programs, database/data communications products, recommended backup/recovery procedures, application programs, and external control procedures. Data security must address the following issues: confidentiality of data, access control, critical nature of data, and integrity of data.

Two basic principles should be reflected in data security.

- **Minimal privilege.** Only the information a user needs to carry out an assigned task should be made available to him or her.

TABLE 15.6 Representative Administrative Controls

- Appropriately selecting, training, and supervising employees, especially in accounting and information systems
- Fostering company loyalty
- Immediately revoking access privileges of dismissed, resigned, or transferred employees
- Requiring periodic modification of access controls (such as passwords)
- Developing programming and documentation standards (to make auditing easier and to use the standards as guides for employees)
- Insisting on security bonds or malfeasance insurance for key employees
- Instituting separation of duties, namely dividing sensitive computer duties among as many employees as economically feasible in order to decrease the chance of intentional or unintentional damage
- Holding periodic random audits of the system

- **Minimal exposure.** Once a user gains access to sensitive information, he or she has the responsibility of protecting it by making sure only people whose duties require it obtain knowledge of this information while it is processed, stored, or in transit.

Data integrity is the condition that exists as long as accidental or intentional destruction, alteration, or loss of data *does not* occur. It is the preservation of data for their intended use.

COMMUNICATIONS AND NETWORKS CONTROLS. Network protection is becoming extremely important as the use of the Internet, intranets, and electronic commerce increases. We will discuss this topic in more detail in Section 15.5.

ADMINISTRATIVE CONTROLS. While the previously discussed general controls were technical in nature, administrative controls deal with issuing guidelines and monitoring compliance with the guidelines. Representative examples of such controls are shown in Table 15.6.

OTHER GENERAL CONTROLS. Several other types of controls are considered general. Representative examples include the following:

Programming Controls. Errors in programming may result in costly problems. Causes include the use of incorrect algorithms or programming instructions, carelessness, inadequate testing and configuration management, or lax security. Controls include training, establishing standards for testing and configuration management, and enforcing documentation standards.

Documentation Controls. Manuals are often a source of problems because they are difficult to interpret or may be out of date. Accurate writing, standardization updating, and testing are examples of appropriate documentation control. Intelligent agents can be used to prevent such problems.

System Development Controls. System development controls ensure that a system is developed according to established policies and procedures. Conformity with budget, timing, security measures, and quality and documentation requirements must be maintained.



Application Controls

General controls are intended to protect the computing facilities and provide security for hardware, software, data, and networks regardless of the specific application. However, general controls do not protect the *content* of each specific application. Therefore, controls are frequently built into the applications (that is, they are part of the software) and are usually written as validation rules. They can be classified into three major categories: *input controls*, *processing controls*, and *output controls*. Multiple types of application controls can be used, and management should decide on the appropriate mix of controls.

INPUT CONTROLS. Input controls are designed to prevent data alteration or loss. Data are checked for accuracy, completeness, and consistency. Input controls are very important; they prevent the GIGO (garbage-in, garbage-out) situation.

Four examples of input controls are:

1. **Completeness.** Items should be of a specific length (e.g., nine digits for a Social Security number). Addresses should include a street, city, state, and Zip code.
2. **Format.** Formats should be in standard form. For example, sequences must be preserved (e.g., Zip code comes after an address).
3. **Range.** Only data within a specified range are acceptable. For example, Zip code ranges between 10,000 to 99,999; the age of a person cannot be larger than say, 120; and hourly wages at the firm do not exceed \$50.
4. **Consistency.** Data collected from two or more sources need to be matched. For example, in medical history data, males cannot be pregnant.

PROCESSING CONTROLS. Processing controls ensure that data are complete, valid, and accurate when being processed and that programs have been properly executed. These programs allow only authorized users to access certain programs or facilities and monitor the computer's use by individuals.

OUTPUT CONTROLS. Output controls ensure that the results of computer processing are accurate, valid, complete, and consistent. By studying the nature of common output errors and the causes of such errors, security and audit staff can evaluate possible controls to deal with problems. Also, output controls ensure that outputs are sent only to authorized personnel.

15.5 SECURING THE WEB, INTRANETS, AND WIRELESS NETWORKS

Some of the incidents described in Section 15.3 point to the vulnerability of the Internet and Web sites (see Sivasailam et al. 2002). As a matter of fact, the more networked the world becomes, the more security problems we may have. Security is a race between "lock makers" and "lock pickers." Unless the lock makers have the upper hand, the future of the Internet's credibility and of e-business is in danger.

Over the Internet, messages are sent from one computer to another (rather than from one network to the other). This makes the network difficult to protect, since at many points people can tap into the network and the users may never know that a breach had occurred. For a list of techniques attackers can

TABLE 15.7 Attacking Web Applications

Category	Description
SQL injection	Passing SQL code into an application that was not intended to receive it
Parameter tampering	Manipulating URL strings to retrieve information
Cookie poisoning	Altering the content of a cookie
Hidden manipulation	Changing hidden field values
Backdoor and debug options	Executing debug syntax on URLs
Buffer overflow	Sending large numbers of characters to a Web site form/field
Stealth commanding	Attempting to inject Trojan horses in form submissions and run malicious or unauthorized code on the Web server
Third-party misconfiguration	Attempting to find programming errors and exploit them to attack system vulnerabilities
Known vulnerability	Exploiting all publicly known vulnerabilities
Cross-site scripting	Entering executable commands into Web site buffers
Forceful browsing	Attempting to browse know/default directories that can be used in constructing an attack

Source: Modified from Stasiak (2002), Table 2.

use to compromise Web applications, in addition to what was described in Section 15.3, see Table 15.7. The table covers the major security measures of the Internet. Security issues regarding e-business are discussed in Chapters 5 and 6.

McConnell (2002) divides Internet security measures into three layers: *border security* (access), *authentication*, and *authorization*. Details of these layers are shown in Figure 15.5. Several of these are discussed in some detail in the remainder of this chapter. Some commercial products include security measure for all three levels all—in one product (e.g., WebShield from McAfee, and Firewall/VPN Appliance from Symantec).

Many security methods and products are available to protect the Web. We briefly describe the major ones in the following sections.

Border Security

The major objective of border security is access control, as seen in Figure 15.5. Several tools are available. First we consider firewalls.

FIREWALLS. Hacking is a growing phenomenon. Even the Pentagon's system, considered a very secure system, experiences more than 250,000 hacker infiltrations per year, many of which are undetected (*Los Angeles Times*, 1998). It is

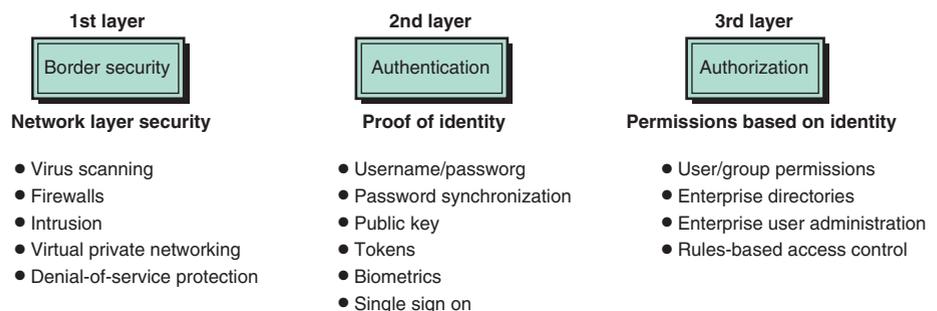


FIGURE 15.5 Three layers of Internet security measures. (Source: McConnell, 2002.)



believed that hacking costs U.S. industry several billion dollars each year. Hacking is such a popular activity that over 80,000 Web sites are dedicated to it. Firewalls provide the most cost-effective solution against hacking. (see Fadia, 2002).

A **firewall** is a system, or group of systems, that enforces an access-control policy between two networks. It is commonly used as a barrier between the secure corporate intranet, or other internal networks, and the Internet, which is assumed to be unsecured.

Firewalls are used to implement control-access policies. The firewall follows strict guidelines that either permit or block traffic; therefore, a successful firewall is designed with clear and specific rules about what can pass through. Several firewalls may exist in one information system.

Firewalls are also used as a place to store public information. While visitors may be blocked from entering the company networks, they can obtain information about products and services, download files and bug-fixes, and so forth. Useful as they are, firewalls do not stop viruses that may be lurking in networks. Viruses can pass through the firewalls, usually hidden in an e-mail attachment.

VIRUS CONTROLS. Many viruses exist (about 100,000 known in 2003) and the number is growing by 30 percent a year according to the International Computer Security Association (reported by *statonline*, 2003). So the question is, What can organizations do to protect themselves against viruses? Some solutions against virus penetrations are provided in Zenkin (2001) and in Table 15.8. The most common solution is to use antivirus software is (e.g., from *symantec.com*). However, antivirus software provides protection against viruses only after they have attacked someone and their properties are known. New viruses are difficult to detect in their first attack.

The best protection against viruses is to have a comprehensive plan such as shown in *A Closer Look 15.3*.

INTRUSION DETECTING. Because protection against denial of service (see the opening vignette) is difficult, the sooner one can detect an unusual activity, the better. Therefore, it is worthwhile to place an *intrusion detecting* device near the

TABLE 15.8 Protecting Against Viruses

Possible Mode of Entrance	Countermeasure
<ul style="list-style-type: none"> ● Viruses pass through firewalls undetected (from the Internet). ● Virus may be resident on networked server; all users are at risk. ● Infected floppy; local server system at risk; files shared or put on server can spread virus. ● Mobile or remote users exchange or update large amounts of data; risk of infection is greater. ● Virus already detected. 	<ul style="list-style-type: none"> ● User must screen all downloaded programs and documents before use. ● Run virus scan daily; comprehensive backup to restore data; audit trail. ● Use virus checker to screen floppies locally. ● Scan files before upload or after download; make frequent backups. ● Use a clean starter disk or recovery disk.

Source: Compiled from Nance (1996, updated 2003), p. 171.



A CLOSER LOOK

15.3 HOW TO MINIMIZE THE DAMAGE FROM VIRUSES

To minimize the damage from viruses, take the following preventive actions:

1. Install a good antivirus program. These are also known as *gateway virus scanners*. (e.g., Norton AntiVirus, McAfee, VirusScan).
2. Scan the hard drive for viruses at least weekly.
3. Write-protect your floppy disks and scan them before using them.
4. Write-protect your program disks.
5. Back up data fully and frequently.
6. Don't trust outside PCs.
7. Virus scan before "laplinking" or synchronizing files.
8. Develop an antivirus policy.
9. Identify the areas of risk in case of virus attack. These are:
 - a. Direct losses (e.g., time spent to restore systems)
 - b. Losses your customers and suppliers suffer when your system is down
 - c. Losses to a third party to which your company had passed on a virus, possibly due to your employees' negligence
10. Minimize losses by the following measures:
 - a. Install strict employees' guidelines dealing with e-mail viruses.
 - b. Use a service provider to handle virus detection and control. This way you get the latest technology, make it more difficult for insiders to perform crimes, and may transfer the risk to the service provider.
 - c. Have contracts that will protect you from a legal action by your customers/suppliers who suffer damage when your systems are damaged (called a "force majeure" clause).
 - d. Instruct your employees on how to scan all outgoing e-mails to your business partners.
11. The SANS Institute (*sans.org*) is an IT cooperative research and education organization for system administrators and security professionals; it has more than 96,000 members. SANS recommends the following guidelines for action during virus attacks:
 - a. **Preparation.** Establish policy, design a form to be filed when a virus is suspected (or known), and develop outside relationships.
 - b. **Identification.** Collect evidence of attack, analyze it, notify officials (e.g., at *cert.org*).
 - c. **Containment.** Back up the system to capture evidence, change passwords, determine the risk of continuing operations.
 - d. **Eradication.** Determine and remove the cause, and improve the defense.
 - e. **Recovery.** Restore and validate the system.
 - f. **Follow up.** Write a follow-up report detailing lessons learned.
12. Get information and sometimes free software at the following sites:

<i>Antivirus.com</i>	<i>cert.org</i>	<i>pgp.com</i>
<i>symantec.com</i>	<i>nca.com</i>	<i>rsa.com</i>
<i>mcafee.com</i>	<i>iss.net</i>	<i>tis.com</i>

entrance point of the Internet to the intranet (close to a firewall). The objective is early detection, and this can be done by several devices (e.g., BladeRunner from Raytheon, Praesidium from HP, Caddx from Caddx Controls, and IDS from Cisco). Intrusion detecting is done by different tools, such as statistical analysis or neural networks. Biermann et al. (2001) provide a comparison of 10 different methods and discuss which methods are better at detecting different types of intrusions.

PROTECTING AGAINST DENIAL OF SERVICE ATTACKS. After the February 6, 2000, DOS attack, the industry started to find solutions. A special task force of experts was formed at the Internet Engineering Task Force (IETF); it included vendors and companies that were attacked. The IETF group developed procedures on what to do in the event of such attack. One approach suggested was



tracking the attacker in real time (e.g., by tracking the flow of data packets through the Net).

Automated Attack Traceback. Investigation to find attackers can be done manually, or can be automated. **Attack traceback** refers to a system that would identify the person responsible for a virus, DOS, or other attacks. For example, it would identify the computer host that is the source of the attack. Attackers usually try to hide their identity. The automatic traceback attempts to circumvent the methods used by attackers (such as zombies, discussed earlier). According to Lee and Shields (2002), however, the use of automatic attack traceback programs may raise legal issues (e.g., what data you can legally track).

VIRTUAL PRIVATE NETWORKING (VPN). The last major method of border security is a Virtual Private Network (VPN). A VPN uses the Internet to carry information within a company that has multiple sites and among known business partners, but it increases the security of the Internet by using a combination of encryption, authentication, and access control. It replaces the traditional private leased line and/or remote access server (RAS) that provide direct communication to a company's LAN (see Technology Guide 4). According to Prometheus Technologies (2003), costs can be reduced by up to 50 percent by using the VPN which can also be used by remote workers (here the savings can reach 60–80 percent). Confidentiality and integrity are assured by the use of protocol tunneling for the encryption. McKinley (2003). For further details on VPNs, see Garfinkel (2002), Fadia (2002), and McKinley (2003).

Authentication

As applied to the Internet, an authentication system guards against unauthorized dial-in attempts. Many companies use an access protection strategy that requires authorized users to dial in with a preassigned personal identification number (PIN). This strategy is usually enhanced by a unique and frequently changing password. A communications access control system authenticates the user's PIN and password. Some security systems proceed one step further, accepting calls only from designated telephone numbers. Access controls also include biometrics.

HOW AUTHENTICATION WORKS. The major objective of authentication is the proof of identity (see Figure 15.5). The attempt here is to identify the legitimate user and determine the action he/she is allowed to perform, and also to find those posing as others. Such programs also can be combined with authorization, to limit the actions of people to what they are authorized to do with the computer once their identification has been authenticated.

Authentication systems have five key elements (Smith, 2002): (1) a person (or a group) to be authenticated; (2) a distinguishing characteristic that differentiates the person (group) from others; (3) a proprietor responsible for the system being used; (4) an authentication mechanism; and (5) an access control mechanism for limiting the actions that can be performed by the authenticated person (group).

A stronger system is *two-factor-authentication*, which combines something one knows (password, answer to a query) with something one has (tokens,

biometrics). An access card is an example of a passive token, carried to enter into certain rooms or to gain access to a network. *Active tokens* are electronic devices that can generate a one-time password after being activated with a PIN. Note that public key systems (PKI, see Chapter 5) include an authentication feature.

Authorization **Authorization** refers to permission issued to individuals or groups to do certain activities with a computer, usually based on verified identity. The security system, once it authenticates the user, must make sure that the user operates within his/her authorized activities. This is usually done by monitoring user activities and comparing them to the list of authorized ones.

Other Methods of Protection Other methods of protecting the Web and intranets include the following.

ENCRYPTION. As discussed in Chapter 5, **encryption** encodes regular digitized text into unreadable scrambled text or numbers, which are decoded upon receipt. Encryption accomplishes three purposes: (1) identification (helps identify legitimate senders and receivers), (2) control (prevents changing a transaction or message), and (3) privacy (impedes eavesdropping). Encryption is used extensively in e-commerce for protecting payments and for privacy.

A widely accepted encryption algorithm is the Data Encryption Standard (DES), produced by the U.S. National Bureau of Standards. Many software products also are available for encryption. *Traffic padding* can further enhance encryption. Here a computer generates random data that are intermingled with real data, making it virtually impossible for an intruder to identify the true data.

To ensure secure transactions on the Internet, VeriSign and VISA developed encrypted digital certification systems for credit cards. These systems allow customers to make purchases on the Internet without giving their credit card number. Cardholders create a digital version of their credit card, called *virtual credit card* (see Chapter 5) VeriSign confirms validity of the buyer's credit card, and then it issues a certificate to that effect. Even the merchants do not see the credit card number. For further discussion of encryption, see *sra.co* and *verisign.com*.

TROUBLESHOOTING. A popular defense of local area networks (LANs) is troubleshooting. For example, a *cable tester* can find almost any fault that can occur with LAN cabling. Another protection can be provided by *protocol analyzers*, which allow the user to inspect the contents of information packets as they travel through the network. Recent analyzers use *expert systems*, which interpret the volume of data collected by the analyzers. Some companies offer integrated LAN troubleshooting (a tester and an intelligent analyzer).

PAYLOAD SECURITY. *Payload security* involves encryption or other manipulation of data being sent over networks. *Payload* refers to the contents of messages and communication services among dispersed users. An example of payload security is Pretty Good Privacy (PGP), which permits users to inexpensively create and encrypt a message. (See *pgp.com* for free software.)



HONEYNETS. Companies can trap hackers by watching what the hackers are doing. These traps are referred to as **honeypots**; they are traps designed to work like real systems and attract hackers. A network of honeypots is called a **honeynet**. For details, see Piazza (2001) and *honeynet.org*.

Securing Your PC

Your PC at home is connected to the Internet and needs to be protected (Luhn and Spanbauer, 2002). Therefore, solutions such as antivirus software (e.g., Norton Antivirus 2002) and a personal firewall are essential. (You can get a free Internet connection firewall with Microsoft Windows or pay \$30–\$50 for products such as McAfee Firewall).

If you use a gateway/router at home, you need to protect them as well, if they do not have built-in protection. You need protection against stealthware as well. **Stealthware** refers to hidden programs that comes with free software you download. These programs track your surfing activities, reporting it to a marketing server. Programs such as Pest Control and Spy Blocker can help. Finally you need an antispam tool (e.g., SpamKiller).

All of the tools just mentioned can be combined in suites (e.g., Internet Security from McAfee or Symantec).

Securing Wireless Networks

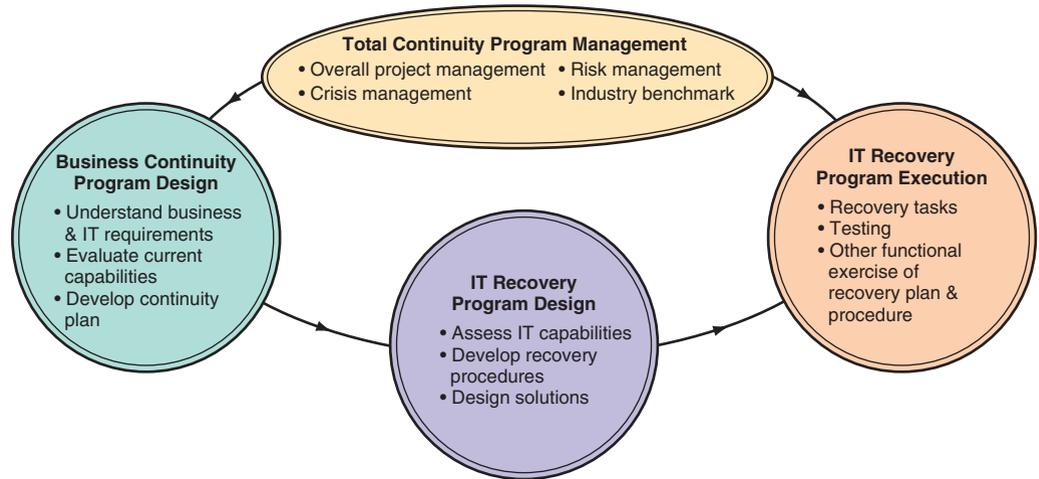
Wireless networks are more difficult to protect than wireline ones. While many of the risks of desktop Internet-based commerce will pervade m-commerce, m-commerce itself presents new risks. This topic was discussed in Chapter 6. In addition, lately there is a recognition that malicious code may penetrate wireless networks. Such a code has the ability to undermine controls such as authentication and encryption (Ghosh and Swaminatha, 2001 and Biery and Hager, 2001). For a comprehensive commercial suite to protect wireless networks, see MebiusGuard at *symbal.com*.

SUMMARY. It should be clear from this chapter how important it is for organizations to secure networks. What do organization actually do? What security technologies are used the most? According to CSI/FBI report (Richardson, 2003), 99 percent of all companies use anti-virus software, 92 percent use access control, 98 percent use firewalls, 91 percent use physical security, 73 percent use intrusion detection, 69 percent use encrypted files, 58 percent use encrypted login, 47 percent use reusable passwords, and only 11 percent use biometrics. While some measures are commonly used, others, especially new ones such as biometrics, are not yet in regular use.

15.6 BUSINESS CONTINUITY AND DISASTER RECOVERY PLANNING

Disasters may occur without warning. According to Strassman (1997), the best defense is to be prepared. Therefore, an important element in any security system is the **business continuity plan**, also known as the **disaster recovery plan**. Such a plan outlines the process by which businesses should recover from a major disaster. Destruction of all (or most) of the computing facilities can cause significant damage. Therefore, it is difficult for many organizations to obtain insurance for their computers and information systems without showing a satisfactory disaster prevention and recovery plan. It is a simple

FIGURE 15.6
Business continuity services managed by IBM. (Source: IBM, Business Continuity and Recovery Services, January 2000, produced in Hong Kong. Courtesy of IBM.)



concept, an advance crisis planning can help minimize losses (Gerber and Feldman, 2002). The comprehensiveness of a business recovery plan is shown in Figure 15.6.

Business Continuity Planning

Disaster recovery is the chain of events linking the business continuity plan to protection and to recovery. The following are some key thoughts about the process:

- The purpose of a business continuity plan is to keep the business running after a disaster occurs. Both the ISD and line management should be involved in preparation of the plan. Each function in the business should have a valid recovery capability plan.
- Recovery planning is part of *asset protection*. Every organization should assign responsibility to management to identify and protect assets within their spheres of functional control.
- Planning should focus first on recovery from a total loss of all capabilities.
- Proof of capability usually involves some kind of what-if analysis that shows that the recovery plan is current (see Lam 2002).
- All critical applications must be identified and their recovery procedures addressed in the plan.
- The plan should be written so that it will be effective in case of disaster, not just in order to satisfy the auditors.
- The plan should be kept in a safe place; copies should be given to all key managers; or it should be available on the Intranet and the plan should be audited periodically.

For a methodology of how to conduct business continuity planning, see *A Closer Look 15.4*. Other methodologies can be found in Devargas (1999) and Rothstein (2002).

Disaster recovery planning can be very complex, and it may take several months to complete (see Devargas, 1999). Using special software, the planning job can be expedited.



A CLOSER LOOK

15.4 HOW TO CONDUCT BUSINESS CONTINUITY PLANNING

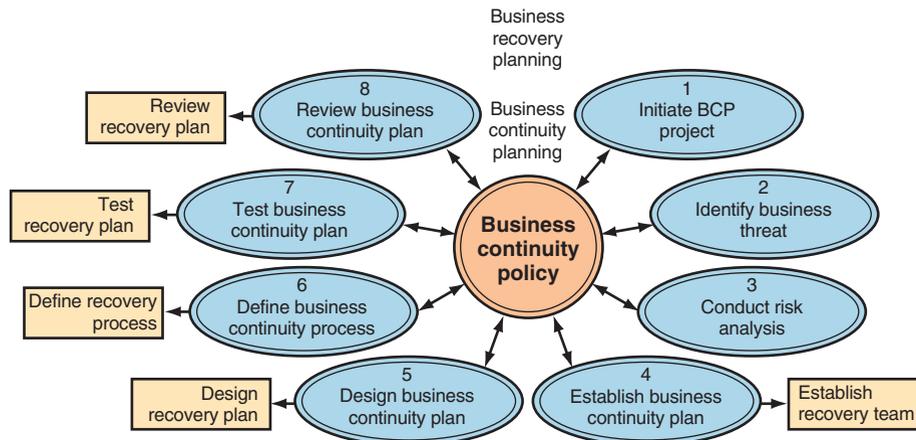
There are many suggestions of how to conduct business continuity planning (BCP). Lam (2002) suggests an 8-step cyclical process shown in the figure below.

In conducting BCP one should devise a policy which is central to all steps in the process. One also must test the plan on a worst-case scenario, for each potential disaster (e.g., system failure, information hacking, terrorist attack). Disruptions are analyzed from their impact on technology, information, and people.

Finally, it is important to recognize the potential pitfalls of BCP. These include:

- An incomplete BCP (may not cover all aspects).
- An inadequate or ineffective BCP (unable to provide remedy).
- An impractical BCP (e.g., does not have enough time and money).
- Overkill BCP (usually time consuming and costly).
- Uncommunicated BCP (people do not know where to find it, or its details).
- Lacking defined process (not clearly defined, chain of needed events not clear).
- Untested (may look good on paper, but no one knows, since it was never tested).
- Uncoordinated (it is not a team's work, or the team is not coordinated).
- Out of date (it was good long ago, but what about today?).
- Lacking in recovery thinking (no one thinks from A to Z how to do it).

For details see Lam (2002).



Business Continuity Plan

Backup Arrangements

One of the most logical ways to deal with loss of data is to *back it up*. A business continuity plan includes backup arrangements. We all make a copy of all or important files and keep them separately. In addition to backing up data we are interested in quick recovery. Also, as part of business continuity one can back up an entire computer or data centers. Let's look at these two arrangements.

BACKING UP DATA FILES. While everyone knows how important it is to back up data files, many neglect to do so because the process is cumbersome and time consuming. Several programs make this process easier, and some restore

data as well (e.g., Ontrack.com provide EasyRecovery and File repair, 10mega.com provides QuickSync, and Officerecovery.com provides for office recovery). For tips how to avoid data loss by backing up data files, see Spector (2002). Backup arrangements may also include the use of network attached storage (NAS) and storage area networks (SAN) (see Technology Guide 4 and Hunton, 2002).

BACKING UP COMPUTER CENTERS. As preparation for a major disaster, such as in the 9/11 case, it is often necessary for an organization to have a *backup location*. External *hot-site* vendors provide access to a fully configured backup data center.

To appreciate the usefulness of a hot-site arrangement, consider the following example: On the evening of October 17, 1989, when a major earthquake hit San Francisco, Charles Schwab and Company was ready. Within a few minutes, the company's disaster plan was activated. Programmers, engineers, and backup computer tapes of October 17 transactions were flown on a chartered jet to Carlstadt, New Jersey. There, Comdisco Disaster Recovery Service provided a hot site. The next morning, the company resumed normal operations. Montgomery Securities, on the other hand, had no backup recovery arrangement. On October 18, the day after the quake, the traders had to use telephones rather than computers to execute trades. Montgomery lost revenues of \$250,000 to \$500,000 in one day.

A less costly alternative arrangement is external *cold-site* vendors that provide empty office space with special flooring, ventilation, and wiring. In an emergency, the stricken company moves its own (or leased) computers to the site.

One company that did its disaster planning right is Empire Blue Cross and Blue Shield, as explained in *IT At Work 15.2*.

Physical computer security is an integral part of a total security system. Cray Research, a leading manufacturer of supercomputers (now a subsidiary of Silicon Graphics, Inc.), has incorporated a corporate security plan, under which the corporate computers are automatically monitored and centrally controlled. *Graphic displays* show both normal status and disturbances. All the controlled devices are represented as icons on floor-plan graphics. These icons can change colors (e.g., green means normal, red signifies a problem). The icons can flash as well. Corrective-action messages are displayed whenever appropriate. The alarm system includes over 1,000 alarms. Operators can be alerted, even at remote locations, in less than one second.



Of special interest is disaster planning for Web-based systems, as shown in an example in *Online File W15.7*. For some interesting methods of recovery, see the special issue of *Computers and Security* (2000). Finally, according to Brassil (2003) mobile computing and other innovations are changing the business continuity industry by quickly reaching a large number of people, wherever they are, and by the ability of mobile devices to help in quick restoration of service.

DISASTER AVOIDANCE. **Disaster avoidance** is an approach oriented toward *prevention*. The idea is to minimize the chance of avoidable disasters (such as fire or other human-caused threats). For example, many companies use a device called *uninterrupted power supply (UPS)*, which provides power in case of a power outage.



IT At Work 15.2

9/11 DISASTER RECOVERY AT EMPIRE BLUE CROSS/BLUE SHIELD

Empire Blue Cross and Blue Shield provides health insurance coverage for 4.7 million people in the northeastern United States. It is a regional arm of the Blue Cross/Blue Shield Association (*bchs.com*). On September 11, 2001, the company occupied an entire floor of the World Trade Center (WTC). Information assets there included the e-business development center as well as the enterprise network of 250 servers and a major Web-enabled call center. Unfortunately, nine employees and two consultants lost their lives in the terrorist attack. But, the company's operations were not interrupted. Let's see why.

The company had built redundancy into all its applications and moved much of its business to Internet technology, for connecting workforce, clients, and partners. Forty applications are available on its corporate intranet; Web-enabled call centers handle 50,000 calls each day; and Web-based applications connect the huge system of hospitals and health-care providers. Michael Galvin, chief infrastructure officer of the company, evacuated his 100 employees from the thirtieth floor and tried to contact staff at other locations to initiate the disaster recovery plan. It was well over an hour later when he was finally able to get through jammed communication lines to find out that a quick decision made by a senior server specialist in Albany, NY, had already switched the employee profiles to the Albany location. This action saved the company days of downtime and the need to rebuild the profiles by hand. As employees moved to temporary offices,

they were able to log on as if they were sitting at their desks in the WTC.

The disaster recovery protocol, which is shown in the nearby figure, worked without a glitch. Calls to the customer support center in the WTC were rerouted to centers in Albany and Long Island; customers accessing the Web site experienced no interruptions; and 150 servers, 500 laptops, and 500 workstations were ordered within an hour of the attack. In off-facility sites, the main data center was not affected; the backup tapes allowed full restoration of data; the network restructured automatically when the private enterprise network was destroyed; and, all necessary information needed at the main off-site data center was rerouted, bypassing the WTC.

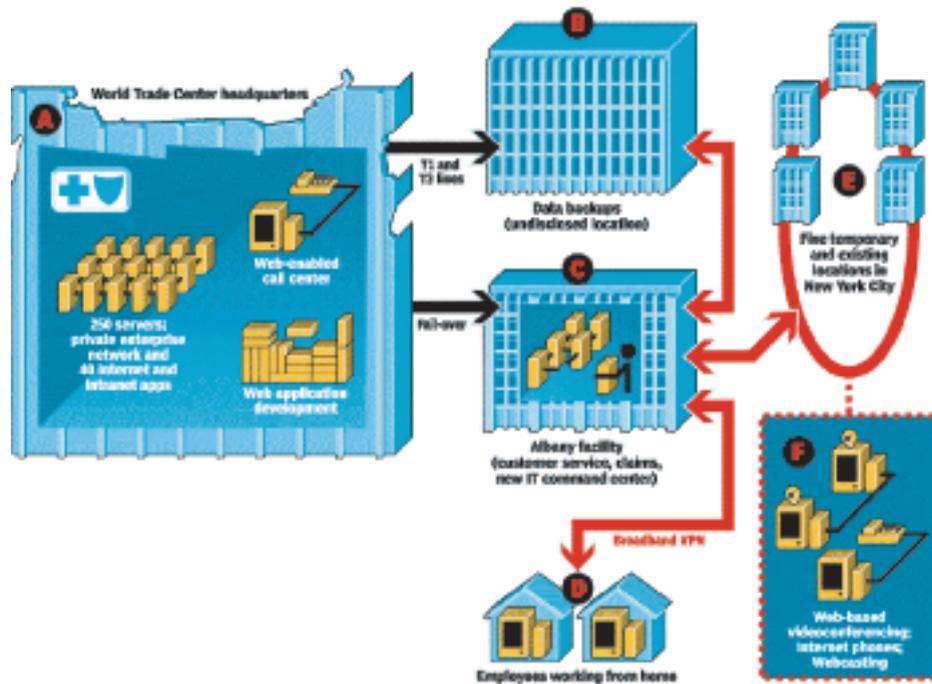
Besides building in the redundancy in the system, the company had also been testing different disaster scenarios frequently, making sure everything worked. As a result, the company and the technology were prepared to deal with the disaster. Everything was backed up, so once the servers were rebuilt, all information was available and all applications were functioning within days thanks to a 300-member IT team working around the clock. Three days after the attack, a new VPN was running enabling employees to work at home.

Since that experience, Empire has made even more use of Internet technology to connect the staff that is dispersed among five temporary offices in Manhattan, and does more business by Internet-based videoconferencing, Webcasting, and IP-based phones.

15.7 IMPLEMENTING SECURITY: AUDITING AND RISK ANALYSIS

Implementing controls in an organization can be a very complicated task, particularly in large, decentralized companies where administrative controls may be difficult to enforce. Of the many issues involved in implementing controls, three are described here: auditing information systems, risk analysis, and advanced intelligent systems.

Controls are established to ensure that information systems work properly. Controls can be installed in the original system, or they can be added once a system is in operation. Installing controls is necessary but not sufficient. It is also necessary to answer questions such as the following: Are controls installed as intended? Are they effective? Did any breach of security occur? If so, what actions are required to prevent reoccurrence? These questions need to be answered by independent and unbiased observers. Such observers perform the information system *auditing* task.



Blue Cross

Galvin emphasized that the most important part of this, or any disaster is the people who act within minutes to get things done without direct guidance of senior management. The new corporate headquarter was open in May 2003 in Brooklyn, NY.

Source: Compiled from Levin (2002).

For Further Exploration: Explore the usefulness of Internet technology for disaster planning. What is its advantage over older technology? Why are people the most important part when a disaster strikes?

Auditing Information Systems

An **audit** is an important part of any control system. In an organizational setting, it is usually referred to as a periodical *examination and check* of financial and accounting records and procedures. Specially trained professionals execute an audit. In the information system environment, auditing can be viewed as an additional layer of controls or safeguards. Auditing is considered as a deterrent to criminal actions (Wells, 2002), especially for insiders.

TYPES OF AUDITORS AND AUDITS. There are two types of auditors (and audits): internal and external. An *internal auditor* is usually a corporate employee who is not a member of the ISD.

An *external auditor* is a corporate outsider. This type of auditor reviews the findings of the internal audit and the inputs, processing, and outputs of information systems. The external audit of information systems is frequently a part of the overall external auditing performed by a certified public accounting (CPA) firm.



IT auditing can be very broad, so only its essentials are presented here. Auditing looks at all potential hazards and controls in information systems. It focuses attention on topics such as new systems development, operations and maintenance, data integrity, software application, security and privacy, disaster planning and recovery, purchasing, budgets and expenditures, chargebacks, vendor management, documentation, insurance and bonding, training, cost control, and productivity. Several guidelines are available to assist auditors in their jobs. *SAS No. 55* is a comprehensive guide provided by the American Institute of Certified Public Accountants. Also, guidelines are available from the Institute of Internal Auditors, Orlando, Florida. (See Frownfelter-Lohrke and Hunton, 2002 for a discussion of new directions in IT auditing.)

Auditors attempt to answer questions such as these:

Are there sufficient controls in the system? Which areas are not covered by controls?

Which controls are not necessary?

Are the controls implemented properly?

Are the controls effective; that is, do they check the output of the system?

Is there a clear separation of duties of employees?

Are there procedures to ensure compliance with the controls?

Are there procedures to ensure reporting and corrective actions in case of violations of controls?

Other items that IT auditors may check include: the data security policies and plans, the business continuity plan (Von-Roessing, 2002), the availability of a strategic information plan, what the company is doing to ensure compliance with security rules, the responsibilities of IT security, the measurement of success of the organization IT security scheme, the existence of security awareness program, and the security incidents reporting system.

Two types of audits are used to answer these questions. The *operational audit* determines whether the ISD is working properly. The *compliance audit* determines whether controls have been implemented properly and are adequate. In addition, auditing is geared specifically to general controls and to application controls (see Sayana, 2002). For details on how auditing is executed, see *Online File W15.8*.



AUDITING WEB SYSTEM AND E-COMMERCE. According to Morgan and Wong (1999), auditing a Web site is a good preventive measure to manage the legal risk. Legal risk is important in any IT system, but in Web systems it is even more important due to the content of the site, which may offend people or be in violation of copyright laws or other regulations (e.g., privacy protection). Auditing EC is also more complex since in addition to the Web site one need to audit order taking, order fulfillment and all support systems (see Blanco, 2002). For more about IT auditing see Woda (2002).

Risk Management and Cost-Benefit Analysis

It is usually not economical to prepare protection against every possible threat. Therefore, an IT security program must provide a process for assessing threats and deciding which ones to prepare for and which ones to ignore, or provide reduced protection. Installation of control measures is based on a balance

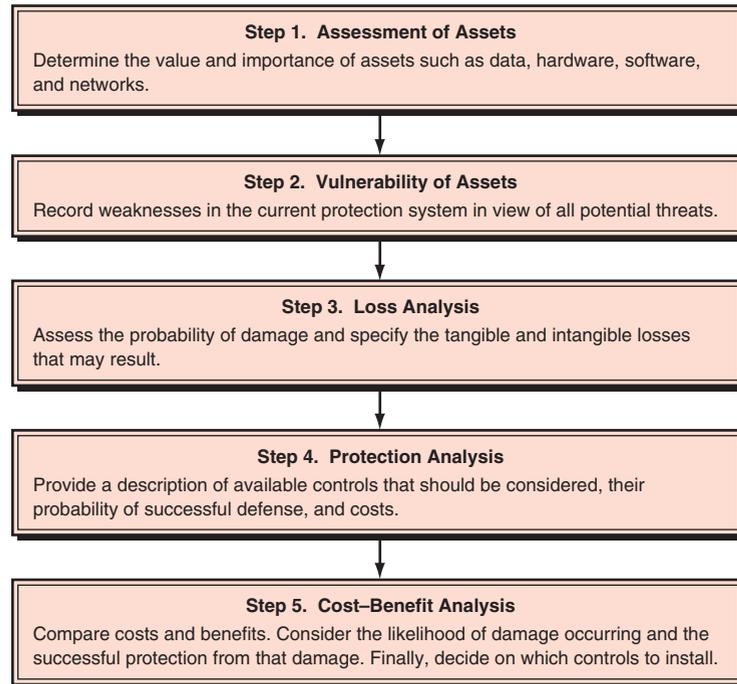


FIGURE 15.7 The risk management process.



between the cost of controls and the need to reduce or eliminate threats. Such analysis is basically a **risk-management** approach, which helps identify threats and selects cost-effective security measures (see Hiles, 2002).

Major activities in the risk-management process can be applied to existing systems as well as to systems under development. These are summarized in Figure 15.7. A more detailed structure for a strategic risk management plan suggested by Doughty (2002) is provided in *Online File W15.9*.

RISK-MANAGEMENT ANALYSIS. Risk-management analysis can be enhanced by the use of DSS software packages. A simplified computation is shown here:

$$\text{Expected loss} = P_1 \times P_2 \times L$$

where:

P_1 = probability of attack (estimate, based on judgment)

P_2 = probability of attack being successful (estimate, based on judgment)

L = loss occurring if attack is successful

Example:

$$P_1 = .02, P_2 = .10, L = \$1,000,000$$

Then, expected loss from this particular attack is:

$$P_1 \times P_2 \times L = 0.02 \times 0.1 \times 1,000,000 = \$2,000$$

The expected loss can then be compared with the cost of preventing it. The value of software programs lies not only in their ability to execute complex computations, but also in their ability to provide a structured, systematic framework for ranking both threats and controls.



HOW MUCH TO SECURE? The National Computer Security Center (NCSC) of the Department of Defense published guidelines for security levels. The government uses these guidelines in its requests for bids on jobs where vendors must meet specified levels. The seven levels are shown in *Online File W15.10* at the book's Web site. Vendors are required to maintain a certain security level depending on the security needs of the job. The decision of how much to secure can be treated as an insurance issue (see Kolodzinski, 2002, and Gordon et al., 2003).

IT Security in the Twenty-first Century

Computer control and security have recently received increased attention. For example, the story of the "I Love You" bug captured the headlines of most newspapers, TV, and computer portals in May 2000, and other wide-scale viruses since then have received similar media play. Almost 97 percent of the world's major corporations battled computer viruses in 2002. Several important IT-security trends are discussed in this section.

INCREASING THE RELIABILITY OF SYSTEMS. The objective relating to reliability is to use **fault tolerance** to keep the information systems working, even if some parts fail. Compaq Computer and other PC manufacturers provide a feature that stores data on more than one disk drive at the same time; if one disk fails or is attacked, the data are still available. Several brands of PCs include a built-in battery that is automatically activated in case of power failure.

Some systems today have 10,000 to 20,000 components, each of which can go million hours without failure, but a combined system may go only 100 hours until it fails. With future systems of 100,000 components, the mathematical odds are that systems will fail every few minutes—clearly, an unacceptable situation. Therefore, it is necessary to improve system reliability.

SELF-HEALING COMPUTERS. As computing systems become more complex, they require higher amounts of human intervention to keep operating. Since the level of complexity is accelerating (e.g., see Grid Computing in Chapter 2), there is an increasing need for **self-healing computers**. Ideally, recovery can be done instantly if computers can find their problems and correct them themselves, before a system crashes.

According to Van (2003), IBM is engaged in a project known as *automatic computing*, which aims at making computers more self-sufficient and less fragile. The basic idea is borrowed from the human body and its immune system. IBM's first known self-healing computer is called eLiza; it is attached to a huge supercomputer, called Blue Sky, at the National Center for Atmospheric Research in the United States. For further discussion see Pescovitz (2002).

INTELLIGENT SYSTEMS FOR EARLY INTRUSION DETECTION. Detecting intrusion in its beginning is extremely important, especially for classified information and financial data. Expert systems and neural networks are used for this purpose. For example, *intrusion-detecting systems* are especially suitable for local area networks and client/server architectures. This approach compares users' activities on a workstation network against historical profiles and analyzes the significance of any discrepancies. The purpose is to detect security violations.

The intrusion-detecting approach is used by several government agencies (e.g., Department of Energy and the U.S. Navy) and large corporations (e.g.,

Citicorp, Rockwell International, and Tracor). It detects other things as well, for example, compliance with security procedures. People tend to ignore security measures (20,000–40,000 violations were reported each month in a large aerospace company in California). The system detects such violations so that improvements can be made.

INTELLIGENT SYSTEMS IN AUDITING AND FRAUD DETECTION. Intelligent systems are used to enhance the task of IS auditing. For example, expert systems evaluate controls and analyze basic computer systems while neural networks and data mining are used to detect fraud (e.g., see Sheridan, 2002).

ARTIFICIAL INTELLIGENCE IN BIOMETRICS. Expert systems, neural computing, voice recognition, and fuzzy logic can be used to enhance the capabilities of several biometric systems. For example, Fujitsu of Japan developed a computer mouse that can identify users by the veins of their palms, detecting unauthorized users.

EXPERT SYSTEMS FOR DIAGNOSIS, PROGNOSIS, AND DISASTER PLANNING. Expert systems can be used to diagnose troubles in computer systems and to suggest solutions. The user provides the expert systems with answers to questions about symptoms. The expert system uses its knowledge base to diagnose the source(s) of the trouble. Once a proper diagnosis is made, the computer provides a restoration suggestion. For example, Exec Express (*e-exec.co.uk*) sells intranet-based business recovery planning expert systems that are part of a bigger program called Self-Assessment. The program is used to evaluate a corporation's environment for security, procedures, and other risk factors.

SMART CARDS. Smart card technology can be used to protect PCs on LANs. An example is Excel MAR 10 (from MacroArt Technology, Singapore), which offers six safety levels: identification of authorized user, execution of predetermined programs, authentication, encryption of programs and files, encryption of communication, and generation of historical files. This product can also be integrated with a fingerprint facility. The user's smart card is authenticated by the system, using signatures identified with a secret key and the encryption algorithm. Smart cards containing embedded microchips can generate unique passwords (used only once) that confirm a person's identity.

FIGHTING HACKERS. Several products are available for fighting hackers. Secure Networks (*snc-net.com*) developed a product that is essentially a honeynet, a decoy network within network. The idea is to lure the hackers into the decoy to find what tools they use and detect them as early as possible.



ETHICAL ISSUES. Implementing security programs raises many ethical issues (see Azari, 2003). First, some people are against any monitoring of individual activities. Imposing certain controls is seen by some as a violation of freedom of speech or other civil rights. Reda (2002) cited a Gartner Group study that showed that even after the terrorist attacks of 9/11/2001, only 26 percent of Americans approved a national ID database. Using biometrics is considered by many a violation of privacy. Finally, using automated traceback programs, described earlier, may be unethical in some cases or even illegal (Lee and Shields, 2002).



➔ MANAGERIAL ISSUES

1. ***To whom should the IS department report?*** This issue is related to the degree of IS decentralization and to the role of the CIO. Having the IS department reporting to a functional area may introduce biases in providing IT priorities to that functional area, which may not be justifiable. Having the IS report to the CEO is very desirable.
2. ***Who needs a CIO?*** This is a critical question that is related to the role of the CIO as a senior executive in the organization. Giving a title without authority can damage the ISD and its operation. Asking the IS director to assume a CIO's responsibility, but not giving the authority and title, can be just as damaging. Any organization that is heavily dependent on IT should have a CIO.
3. ***End users are friends, not enemies, of the IS department.*** The relationship between end users and the ISD can be very delicate. In the past, many ISDs were known to be insensitive to end-user needs. This created a strong desire for end-user independence, which can be both expensive and ineffective. Successful companies develop a climate of cooperation and friendship between the two parties.
4. ***Ethical issues.*** The reporting relationship of the ISD can result in some unethical behavior. For example, if the ISD reports to the finance department, the finance department will have access to information about individuals or other departments that could be misused.
5. ***Responsibilities for security should be assigned in all areas.*** The more organizations use the Internet, extranets, and intranets, the greater are the security issues. It is important to make sure that employees know who is responsible and accountable for what information and that they understand the need for security control. The vast majority of information resources is in the hands of end users. Therefore, functional managers must understand and practice IT security management and other proper asset management tasks.
6. ***Security awareness programs are important for any organization, especially if it is heavily dependent on IT.*** Such programs should be corporatewide and supported by senior executives. In addition, monitoring security measures and ensuring compliance with administrative controls are essential to the success of any security plan. For many people, following administrative controls means additional work, which they prefer not to do.
7. ***Auditing information systems should be institutionalized into the organizational culture.*** Organizations should audit IS not because the insurance company may ask for it, but because it can save considerable amounts of money. On the other hand, overauditing is not cost-effective.
8. ***Multinational corporations.*** Organizing the ISD in a multinational corporation is a complex issue. Some organizations prefer a complete decentralization, having an ISD in each country or even several ISDs in one country. Others keep a minimum of centralized staff. Some companies prefer a highly centralized structure. Legal issues, government constraints, and the size of the IS staff are some factors that determine the degree of decentralization.





ON THE WEB SITE... Additional resources, including quizzes; online files of additional text, tables, figures, and cases; and frequently updated Web links to current articles and information can be found on the book's Web site (wiley.com/college/turban).

KEY TERMS

Application controls •••	Disaster avoidance •••	Programming attack •••
Attack traceback •••	Disaster recovery •••	Risk management •••
Audit •••	Encryption •••	Self-healing computers •••
Authorization •••	Exposure •••	Service-level agreement (SLA) •••
Biometric control •••	Fault tolerance •••	Social engineering •••
Business continuity plan •••	Firewall •••	Steering committee •••
Chief information officer (CIO) •••	General controls •••	Stealthware •••
Cracker •••	Hacker •••	Virus •••
Cybercrime •••	Honeynets •••	Vulnerability •••
Cyberwar •••	Honeypots •••	Zombies •••
Data integrity •••	Identity theft •••	
Data tampering •••	Information center (IC) •••	
Denial of service (DoS) •••	Informations resources management (IRM) •••	
Distributed denial of service (DDoS) •••	IT governance •••	

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- Information resources scattered throughout the organization are vulnerable to attacks, and therefore are difficult to manage.
- The responsibility for IRM is divided between the ISD and end users. They must work together.
- Steering committees, information centers, and service-level agreements can reduce conflicts between the ISD and end users.
- ISD reporting locations can vary, but a preferred location is to report directly to senior management.
- The chief information officer (CIO) is a corporate-level position demonstrating the importance and changing role of IT in organizations.
- Data, software, hardware, and networks can be threatened by many internal and external hazards.
- The attack to an information system can be caused either accidentally or intentionally.
- There are many potential computer crimes; some resemble conventional crimes (embezzlement, vandalism, fraud, theft, trespassing, and joyriding).
- Computer criminals are driven by economic, ideological, egocentric, or psychological factors. Most of the criminals are insiders, but outsiders (such as hackers, crackers, and spies) can cause major damage as well.
- A virus is a computer program hidden within a regular program that instructs the regular program to change or destroy data and/or programs. Viruses spread very quickly along networks worldwide.
- Information systems are protected with controls such as security procedures, physical guards, or detecting software. These are used for *prevention, deterrence, detection, recovery, and correction* of information systems.
- General controls include physical security, access controls, data security controls, communications (network) controls, and administrative controls.
- Biometric controls are used to identify users by checking physical characteristics of the user (e.g., fingerprints and retinal prints).
- Application controls are usually built into the software. They protect the data during input, processing, or output.
- Encrypting information is a useful method for protecting transmitted data.
- The Internet is not protected; therefore anything that comes from the Internet can be hazardous.



- 6 Firewalls protect intranets and internal systems from hackers, but not from viruses.
- 6 Access control, authentication, and authorization are in the backbone of network security.
- 7 Disaster recovery planning is an integral part of effective control and security management.
- 7 Business continuity planning includes backup of data and computers and a plan for what to do when disaster strikes.
- 8 It is extremely difficult and expensive to protect against all possible threats to IT systems. Therefore, it is necessary to use cost-benefit analysis to decide how many and which controls to adopt.
- 8 A detailed internal and external IT audit may involve hundreds of issues and can be supported by both software and checklists.

QUESTIONS FOR REVIEW

1. What are possible reporting locations for the ISD?
2. Why has the ISD historically reported to finance or accounting departments?
3. List the mechanisms for ISD—end users cooperation.
4. Summarize the new role of the CIO.
5. List Rockart's eight imperatives.
6. What is a steering committee?
7. Define SLAs and discuss the roles they play.
8. What are the services to end users that are usually provided by an information (help) center?
9. Define controls, threats, vulnerability, and backup.
10. What is a computer crime?
11. List the four major categories of computer crimes.
12. What is a cybercrime?
13. What is the difference between hackers and crackers?
14. Explain a virus and a Trojan horse.
15. Explain a corporatewide security system.
16. Define controls.
17. Describe prevention, deterrence, detection, recovery, and correction.
18. Define biometrics; list five of them.
19. Distinguish between general controls and application controls.
20. What is the difference between authorized and authenticated users?
21. Explain DOS and how to defend against it.
22. How you protect against viruses?
23. Define firewall. What is it used for?
24. Explain encryption.
25. Define a business continuity plan.
26. Define and describe a disaster recovery plan.
27. What are "hot" and "cold" recover sites?
28. Describe auditing of information systems.
29. List and briefly describe the steps involved in risk analysis of controls.

QUESTIONS FOR DISCUSSION

1. What is a desirable location for the ISD to report to, and why?
2. What information resources are usually controlled by the ISD, and why?
3. Discuss the new role of the CIO and the implications of this role to management.
4. Why should information control and security be a prime concern to management?
5. Compare the computer security situation with that of insuring a house.
6. Explain what firewalls protect and what they do not protect. Why?
7. Why is the purpose of biometrics? Why they are popular?
8. Describe how IS auditing works and how it is related to traditional accounting and financial auditing.
9. Why are authentication and authorization important in e-commerce?
10. Some insurance companies will not insure a business unless the firm has a computer disaster recovery plan. Explain why.
11. Explain why risk management should involve the following elements: threats, exposure associated with each threat, risk of each threat occurring, cost of controls, and assessment of their effectiveness.
12. Some people have recently suggested using viruses and similar programs in wars between countries. What is the logic of such a proposal? How could it be implemented?



13. How important is it for a CIO to have an extensive knowledge of the business?
14. Why is it necessary to use SLAs with vendors? What are some of the potential problems in such situations?
15. Compare TQM to a corporatewide security plan. What is similar? What is different?
16. Why do intelligent systems play an increasing role in securing IT?
17. Why is cross-border cybercrime expanding rapidly? Discuss some possible solutions.
18. Discuss the relationships between grid computing and self-healing computers.

EXERCISES

1. Examine *Online File W15.4*. Read some new material on the CIO and add any new roles you find in your reading. Which of the roles in the table seem to have gained importance and which seem to have lost importance?
2. Assume that the daily probability of a major earthquake in Los Angeles is .07%. The chance of your computer center being damaged during such a quake is 5%. If the center is damaged, the average estimated damage will be \$1.6 million.
 - a. Calculate the expected loss (in dollars).
 - b. An insurance agent is willing to insure your facility for an annual fee of \$15,000. Analyze the offer, and discuss it.
3. The theft of laptop computers at conventions, hotels, and airports is becoming a major problem. These categories of protection exist: physical devices (e.g., *targus.com*), encryption (e.g., *networkassociates.com*), and security policies (e.g., at *ebay.com*). Find more information on the problem and on the solutions. Summarize the advantages and limitations of each method.
4. Expert systems can be used to analyze the profiles of computer users. Such analysis may enable better intrusion detection. Should an employer notify employees that their usage of computers is being monitored by an expert system? Why or why not?
5. Ms. M. Hsieh worked as a customer support representative for the Wollongong Group, a small software company (Palo Alto, California). She was fired in late 1987. In early 1988, Wollongong discovered that someone was logging onto its computers at night via a modem and had altered and copied files. During investigation, the police traced the calls to Ms. Hsieh's home and found copies there of proprietary information valued at several million dollars. It is interesting to note that Ms. Hsieh's access code was canceled the day she was terminated. However, the company suspects that Ms. Hsieh obtained the access code of another employee. (*Source: Based on BusinessWeek, August 1, 1988, p. 67.*)
 - a. How was the crime committed? Why were the controls ineffective? (State any relevant assumptions.)
 - b. What can Wollongong, or any company, do in order to prevent similar incidents in the future?
6. Guarding against a distributed denial of service attack is not simple. Examine the major tools and approaches available. Start by downloading software from *nipc.gov*. Also visit *cert.org*, *sans.org*, and *ciac.llnl.gov*. Write a report summarizing your findings.
7. Twenty-five thousand messages arrive at an organization each year. Currently there are no firewalls. On the average there are 1.2 successful hackings each year. Each successful hacking results in loss to the company of about \$130,000.

A major firewall is proposed at a cost of \$66,000 and a maintenance cost of \$5,000. The estimated useful life is 3 years. The chance that an intruder will break through the firewall is 0.0002. In such a case, the damage will be \$100,000 (30%) or \$200,000 (50%), or no damage. There is annual maintenance cost of \$20,000 for the firewall.

 - a. Should management buy the firewall?
 - b. An improved firewall that is 99.9988 percent effective costs \$84,000, with a life of 3 years and annual maintenance cost of \$16,000, is available. Should this one be purchased instead of the first one?
8. In spring 2000 the U.S. government developed an internal intrusion detection network (*fidnet.gov*) to protect itself from hackers. The Center for Democracy and Technology (*cdt.org*) objected, claiming invasion of privacy. Research the status of the project (FIDNet) and discuss the claims of the center.

GROUP ASSIGNMENTS

1. With the class divided into groups, have each group visit an IS department. Then present the following in class: an organizational chart of the department; a discussion on the department's CIO (director) and her or his reporting status; information on a steering committee (composition, duties); information on any SLAs the department has; and a report on the extent of IT decentralization in the company.



2. Each group is to be divided into two parts. The first part will interview students and business people and record the experiences they have had with computer security problems. The second part of each group will visit a computer store (and/or read the literature or use the Internet) to find out what software is available to fight different computer security problems. Then, each group will prepare a presentation in which they describe the problems and identify which of the problems could have been prevented with the use of commercially available software.
3. Create groups to investigate the latest development in IT and e-commerce security. Check journals such as *CIO.com* (available free online), vendors, and search engines such as *techdata.com* and *google.com*.
4. Research the Melissa attack in 1999. Explain how the virus works and what damage it causes. Examine Microsoft's attempts to prevent similar future attacks. Investigate similarities between the 2003 viruses (Slammer, Bugbear, etc.) and earlier ones (e.g., "I Love You" and Melissa). What preventive methods are offered by security vendors?

INTERNET EXERCISES



1. Explore some job-searching Web sites (such as *brassring.com*, and *headhunter.com*), and identify job openings for CIOs. Examine the job requirements and the salary range. Also visit *google.com* and *cio.com*, and find some information regarding CIOs, their roles, salaries, and so forth. Report your findings.
2. Enter *scambusters.org*. Find out what the organization does. Learn about e-mail scams and Web site scams. Report your findings.
3. Access the site of *comdisco.com*. Locate and describe the latest disaster recovery services.
4. Enter *epic.org/privacy/tools.html*, and examine the following groups of tools: Web encryption, disk encryption, and PC firewalls. Explain how these tools can be used to facilitate the security of your PC.
5. Access the Web sites of the major antivirus vendors (*symantec.com*, *mcafee.com*, and *antivirus.com*). Find out what the vendors' research centers are doing. Also download VirusScan from McAfee and scan your hard drive with it.
6. Many newsgroups are related to computer security (*groups.google.com*; *alt.comp.virus*; *comp.virus*; *maous.comp.virus*). Access any of these sites to find information on the most recently discovered viruses.
7. Check the status of biometric controls. See the demo at *sensar.com*. Check what Microsoft is doing with biometric controls.
8. Enter *v.l.nai.com/vil/default.asp*. Find information about viruses. What tips does McAfee (*mcafee b2b.com*) give for avoiding or minimizing the impact of viruses?
9. You have installed a DSL line in your home. You read in this chapter that you need a personal firewall. Enter *securitydogs.com*, *mcafee.com*, or *symantec.com*. Find three possible products. Which one do you like best? Why?
10. Access a good search engine (e.g., *google.com* or *findarticles.com*). Find recent articles on disaster planning. Prepare a short report on recent developments in disaster recovery planning.
11. The use of smart cards for electronic storage of user identification, user authentication, changing passwords, and so forth is on the rise. Surf the Internet and report on recent developments. (For example, try the Web sites *microsoft.com/windows/smartcards*, *litronic.com*, *gemplus.com*, or *scia.org*.)
12. Access the Web site *2600.com* and read the *2600 Magazine*. Also try *waregone.com* and *skynamic.com*. Prepare a report that shows how easy it is to hack successfully.
13. Enter *ncsa.com* and find information about "why hackers do the things they do." Write a report.
14. Enter *biopay.com* and other vendors of biometrics and find the devices they make that can be used to access control into information systems. Prepare a list of major capabilities.



Minicase 1

Putting IT to Work at Home Depot

Home Depot is the world's largest home-improvement retailer, a global company that is expanding rapidly (about 200 new stores every year). With over 1,500 stores (mostly in the United States and Canada, and now expanding to other countries) and about 50,000 kinds of products in each store, the company is heavily dependent on IT, especially since it started to sell online.

To align its business and IT operations, Home Depot created a business and information service model, known as the Special Projects Support Team (SPST). This team collaborates both with the ISD and business colleagues on new projects, addressing a wide range of strategic and tactical needs. These projects typically occur at the intersection of business processes. The team is composed of highly skilled employees. Actually, there are several teams, each with a director and a mix of employees, depending on the project. For example, system developers, system administrators, security experts, and project managers can be on a team. The teams exist until the completion of a project; then they are dissolved and the members are assigned to new teams. All teams report to the SPST director, who reports to a VP of Technology.

To ensure collaboration among end-users, the ISD and the SPST created structured (formal) relationships. The basic idea is to combine organizational structure and process flow which is designed to do the following:

- Achieve consensus across departmental boundaries with regard to strategic initiatives.
- Prioritize strategic initiatives.
- Bridge the gap between business concept and detailed specifications.
- Result in the lowest possible operational costs.
- Achieve consistently high acceptance levels by the end-user community.
- Comply with evolving legal guidelines.
- Define key financial elements (cost-benefit analysis, ROI, etc.).
- Identify and render key feedback points for project metrics.
- Support very high rates of change.
- Support the creation of multiple, simultaneous threads of work across disparate time lines.
- Promote known, predictable, and manageable workflow events, event sequences, and change management processes.

- Accommodate the highest possible levels of operational stability.
- Leverage the extensive code base, and leverage function and component reuse.
- Leverage Home Depot's extensive infrastructure and IS resource base.

Online File W15.11 shows how this kind of organization works for Home Depot's e-commerce activities. There is a special EC steering committee which is connected to the CIO (who is a senior VP), to the VP for marketing and advertising, and to the VP for merchandising (merchandising deals with procurement). The SPST is closely tied to the ISD, to marketing, and to merchandising. The data center is shared with non-EC activities.

The SPST migrated to an e-commerce team in August 2000 in order to construct a Web site supporting a national catalog of products, which was completed in April 2001. (This catalog contains over 400,000 products from 11,000 vendors.) This project required the collaboration of virtually every department in Home Depot. (e.g., see finance/accounting, legal, loss prevention, etc., in the figure). Also contracted services were involved. (The figure in *Online File W15.11* shows the workflow process.)

Since 2001, SPST has been continually busy with EC initiatives, including improving the growing Home Depot online store. The cross-departmental nature of the SPST explains why it is an ideal structure to support the dynamic, ever-changing work of the EC-related projects. The structure also considers the skills, strengths, and weaknesses of the IT employees. The company offers both online and offline training aimed at improving those skills. Home Depot is consistently ranked among the best places to work for IT employees.

Sources: Compiled from Alberts (2001) and from *homedepot.com* (2003).

Questions for Minicase 1

1. Read Chapter 9 (Sections 9.9 and 9.10) regarding team-based organizations. Explain why the team-based structure at Home Depot is so successful.
2. The structure means that the SPST reports to both marketing and technology. This is known as a matrix structure. What are the potential advantages and problems?
3. How is collaboration facilitated by IT in this case?
4. Why is the process flow important in this case?



Minicase 2

Managing Security

The Internet Security Alliance (*isalliance.org*) was formed in April 2001. The alliance is a collaborative endeavor of Carnegie Mellon University's Software Engineering Institute (SEI); its CERT Coordination Center (CEDRT/CC); the Electronics Industries Alliance (EIA), a federation of trade groups; and other private and public member organizations and corporations. Their goal is to provide information sharing and leadership on information security and to represent its members and regulators.

On September 9, 2002, the alliance released results from a recent security survey conducted jointly with the National Association of Manufacturers (NAM) and RedSiren Technologies Inc. (Durkovich, 2002). The survey asked 227 information security specialists worldwide to compare their current attitudes towards information security with their attitudes prior to the 9/11 terrorist attacks. Overall, the results showed that the security specialists view information security as more of an issue now and that they see it as crucial to the survival of their organization or business. However, most answered that they still feel inadequately prepared to meet their current security challenges, and just as importantly, that most lacked senior management commitment to address these challenges.

The following are some of the specific survey findings:

- 91 percent recognize the importance of information security.
- Most of the organizations reported at least one attack in the past year, with approximately 30 percent reporting more than six attacks.
- 48 percent said that the 9/11 attacks made them more concerned about information security, while 48 percent said there had been no change in their attitudes.
- 47 percent said that their organization had increased spending on information security since the attacks.
- 40 percent said that they had improved their physical security, electronic security, network security, and security policies since the attacks.
- 30 percent indicated that their companies are still inadequately prepared to deal with security attacks.

The Internet Security Alliance has identified 10 of the highest priority and most frequently recommended practices necessary for implementation of a successful security process. The practices encompass policy, process, people, and technology. They include (IS Alliance, 2002):

1. **General management.** Information security is a normal part of everyone's responsibilities — managers and employees alike. Managers must ensure that there are adequate resources, that security policies are well defined, and that the policies are reviewed regularly.
2. **Policy.** Security policies must address key areas such as security risk management, identification of critical assets, physical security, network security, authentication, vulnerability and incident management, privacy, and the like. Policies need to be embedded in standard procedures, practices, training, and architectures.
3. **Risk management.** The impacts of various risks need to be identified and quantified. A management plan needs to be developed to mitigate those risks with the greatest impact. The plan needs to be reviewed on a regular basis.
4. **Security architecture and design.** An enterprised-wide security architecture is required to protect critical information assets. High-risk areas (e.g., power supplies) should employ diverse and redundant solutions.
5. **User issues.** The user community includes general employees, IT staff, partners, suppliers, vendors, and other parties who have access to critical information systems.
6. **System and network management.** The key lines of defense include access control for all network devices and data, encrypted communications and VPNs where required, and perimeter protection (e.g., firewalls) based on security policies. Any software, files, and directories on the network should be verified on a regular basis. Procedures and mechanisms must be put in place that ensure that software patches are applied to correct existing problems; adequate levels of system logging are deployed; systems changes are analyzed from a security perspective; and vulnerability assessments are performed on a periodic basis. Software and data must also be backed up on a regular schedule.
7. **Authentication and authorization.** Strict policies must be formulated and implemented for authenticating and authorizing network access. Special attention must be given to those employees accessing the network from home and on the road and to partners, contractors, and services who are accessing the network remotely.
8. **Monitor and audit.** Security-breaching events and changing conditions must be monitored, and the network must be inspected on a regular basis. Standards should be in place for responding to suspicious or unusual behavior.

9. **Physical security.** Physical access to key information assets, IT services, and resources should be controlled by two-factor authentication.
10. **Continuity planning and disaster recovery.** Business continuity and recovery plans need to be implemented and periodically tested to ensure that they are effective.

Sources: Compiled from Durkovich (2002) and ISAlliance (2002).

Questions for Minicase 2

1. Why does the Internet Security Alliance include both private and public members?
2. What is the mission of the Alliance?
3. Why is it beneficial to prioritize issues?
4. How would you justify the existence of the Alliance? Who should pay its costs?



Virtual Company Assignment

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PART V
Implementing and Managing



- 13. Information Technology Economics
- 14. Building Information Systems
- 15. Managing Information Resources and Security
- ▶ 16. Impacts of IT on Organizations, Individuals, and Society (online)

CHAPTER

16

Impacts of IT on Organizations, Individuals, and Society

16.1

Does IT Have Only
 Positive Effects?

16.2

Impacts of IT on
 Organizations

16.3

Impacts of IT on
 Individuals at Work

16.4

Societal Impacts

16.5

Virtual Communities

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- 1 Understand the major impacts of information technology on organizations, individuals, and society.
- 2 Consider some negative impacts of people by computers, and other potential negative impacts of information technology.
- 3 Identify the major impacts of information technology on the manager's job and on organizational structure, power, jobs, supervision, and decision making.
- 4 Discuss the impacts of IT and individuals at work.
- 5 Identify some of the major societal impacts of the Web including the digital divide and computer crime.
- 6 Describe the impacts of IT on social issues as a result of 9/11.
- 7 Understand the role and impact of virtual communities.



MP3.COM, NAPSTER, AND INTELLECTUAL PROPERTY RIGHTS

➔ THE PROBLEM

Before the advent of the Web, people made audiotape copies of music and videos. They either gave these copies to friends and family or used them for their own personal enjoyment. Few individuals had either the interest or the means to create and distribute copies to larger populations. For the most part, these activities were ignored by the producers, distributors, and artists who had the legal rights to the content (Spaulding, 2000).

Then came the Web and a variety of enterprising sites such as MP3.com and Napster.com. MP3.com enabled users to listen to music from any computer with an Internet connection, without paying royalties. Using peer-to-peer (P2P) technology, Napster supported the distribution of music and other digitized content among millions of users. When asked whether they were doing anything illegal, MP3.com and Napster claimed that they were simply supporting what had been done for years and, like most private individuals, were not charging for their services. Other companies extended the concept to other digitizable media such as videos and movies.

The popularity of MP3.com and P2P services was too great for the content creators and owners to ignore. Music sales declined (and are still declining as of 2003). To the creators and owners, the Web was becoming a vast copying machine for pirated software, CDs, movies, and the like. If left undeterred, MP3.com's and Napster's services could result in the loss of many thousands of jobs and millions of dollars in revenue.

➔ THE SOLUTION

In December 2000, EMusic (*emusic.com*) filed a copyright infringement lawsuit against MP3.com. They claimed ownership of the digital rights to some of the music made available at MP3.com. Other companies—Warner Brothers Music Group, EMI Group PLC, BMG Entertainment, and Sony Music Entertainment—followed suit. A year later, Napster faced similar legal claims, lost the legal battle, and was forced to pay royalties for each piece of music it supported. This resulted in its collapse. As described in previous chapters, some P2P companies moved to other countries, trying to escape U.S. copyright laws, but the legal problems follow them.

Copyright laws and copyright infringement cases have been in existence for decades. However, the legal system can be picky and slow to resolve legal difficulties and close loopholes. First, existing copyright laws were written for physical, not digital, content. Second, the Copyright Infringement Act states, “the defendant must have willfully infringed the copyright and gained financially.” With respect to the second point, a MIT student named David LaMacchia was sued for offering free copies of Excel, Word, and other software titles on the Internet. The suit was settled in his favor because there was no financial gain. (Note: This loophole in the Copyright Infringement Act was later closed.)

➔ THE RESULTS

In 1997, the No Electronic Theft Act (NET) was passed, making it a crime for anyone, including individuals, to reproduce and distribute copyrighted works.

16.1 DOES IT HAVE ONLY POSITIVE EFFECTS? 16W3

The Act further clarified that it applies to reproduction or distribution accomplished by electronic means. It also stated that even if copyrighted products are distributed without charge, financial harm is experienced by the authors or creators of a copyrighted work.

Given the precedents and laws, MP3.com and Napster had little recourse but to capitulate. MP3.com suspended operations in April 2000 and settled the lawsuit against itself, paying the litigants \$20 million each. Napster suspended service and settled its lawsuits for \$26 million. With the backing of the record company Bertelsmann AG's BMG, Napster tried—with little success—to resurrect itself as an online music subscription service. Napster eventually filed for bankruptcy in June 2002. Its assets were purchased by Roxio (*roxio.com*). Roxio is planning to revive Napster, in a royalty-paying framework, in early 2004.

Sources: Spaulding (2000), Olavsrud (2000), and *roxio.com* (2002).

LESSONS LEARNED FROM THIS CASE

All commerce involves a number of legal, ethical, and regulatory issues. Copyright, trademark, and patent infringement, freedom of thought and speech, theft of property, and fraud are not new issues in the world of commerce. However, as this opening case illustrates, e-commerce adds to the scope and scale of these issues. It also raises a number of questions about what constitutes illegal behavior versus unethical, intrusive, or undesirable behavior.

E-commerce is one of many IT phenomena that have affected individuals, organizations, and society. This chapter examines the impacts IT has made on these groups. We present some of the legal and ethical issues related to the emerging electronic technologies and discuss various legal and technical remedies and safeguards. The chapter also looks at the impacts of IT and the Web and the growth of virtual communities.

16.1 DOES IT HAVE ONLY POSITIVE EFFECTS?

Concern about technology's effect on people, organizations, and society is not new. In the 1830s, English intellectuals expressed philosophical arguments about the effects on society of the Industrial Revolution that had begun some 60 to 70 years earlier. In Samuel Butler's 1872 book *Erewhon* (anagram for *nowhere*), a man loses his way in a strange land and wanders into a society that has rejected machines. The people have "frozen" technology at a predetermined level and outlawed all further technological development; they have made a conscious decision to reject new technology.

While there are many philosophical, technological, social, and cultural differences between society at the start of the Industrial Revolution and today, there are nevertheless people who do believe that humankind is threatened by the evolution of technology. Overall, though, our society has not rejected technology but, rather, has embraced it. Most of us recognize that computers and technology are essential to maintaining and supporting many aspects of our culture. We are involved in a symbiotic relationship with technology. All the same, we must be aware of its effect on us as individuals and as members of organizations and society.



Throughout this book, we have noted how information systems are being justified, constructed, used, and maintained. In all these discussions we have assumed that members of an organization will reap the fruits of new technology and that computers have no major negative impact.

But is this really true? There are people today who do reject the advances of technology—refusing to use the Internet, for example. A more critical issue, however, involves questions such as: Will society have any control over the decisions to deploy technology? Where will technology critics be able to make their voices heard? Who will investigate the costs and risks of technologies, and who is going to pay for that investigation? For discussion on these and similar items, see the Roundtable discussion organized by *Interactive Week* on January 10, 2000, at zdnet.com/intweek/filter/@online.

Information technology *has* raised a multitude of negative issues, ranging from illegal copying of software programs to surveillance of employees' e-mail files. Health and safety issues are also of major concern, as are the impact of IT on employment levels and the quality of life. One major area of concern is the impact of the Internet. Here are some examples:

- In the online environment, criminal acts can be performed with unusual speed, and without any physical contact. This has led to a large increase in fraud and security crimes. *The Computer Crime and Security Survey* reported that fraud on the Web and other information security breaches are widespread and diverse. In one study, 92 percent of respondents reported attacks, with a total of over \$200 million financial losses (Richardson, 2003 and Chapter 15). More information on Internet fraud can be found in fraud.org/internet/intset.htm.
- There are increasing reported cases of Internet addiction. A survey conducted by the Commission on Youth Protection (2001) found that up to 11 percent of the respondents report that they might be addicted to the Internet. Excessive Internet use can result in insomnia, nightmares, withdrawal from society, and stress. Addictions linked to online shopping and gambling have economic impacts. Some experts even worry that Internet addiction will seriously undermine students' ability to adapt to society. Moreover, teenagers can easily access poisonous information through the Internet. For example, 43 percent of 1,135 elementary students in Korea have visited pornography Web site (news item from *The Korean Times*, August 24, 2002). Negative impacts can be felt by organizations as well. One example is the non-work-related use of the Internet on company time.

In this chapter, some of these negative issues will be discussed as well as the many positive ones. We concentrate on the impact of IT on organizations, individuals at work, and society. Ethical issues, which are an important part of these impacts, have been discussed throughout the book as well as in the ethics appendix (Appendix 1A) and in the online Ethics Primer (see Online Chapter 1). (Also see Hamelink, 2001, and Spinello and Tavani, 2001.)

16.2 IMPACTS OF IT ON ORGANIZATIONS

The use of computers and information technology has brought many changes to organizations. These changes are being felt in different areas including the manager's job, structure, authority, power, and job content; employee career ladders and supervision. A brief discussion of these issues follows.

The Manager's Job

The most important task of managers is making decisions. IT can change the manner in which many decisions are made, and consequently change managers' jobs. The most probable areas of organizational change are:

- Automation of routine decisions (e.g., frontline employees, as discussed in Chapter 12).
- Less expertise required for many decisions.
- More rapid identification of problems and opportunities (Huber, 1990).
- Less reliance on experts to provide support to top executives.
- Empowerment of lower and middle levels of management due to knowledge bases.
- Decision making undertaken by nonmanagerial employees.
- Power redistribution among managers, and power shifts down the organization. Fewer organizational levels typically are required to authorize action (Huber, 1990).
- Organizational intelligence that is more timely, comprehensive, accurate, and available (Huber, 1990).
- Electronic support of complex decisions (the Web, intelligent agents, DSS).

Many managers have reported that the computer has finally given them time to “get out of the office and into the field.” They also have found that they can spend more time planning activities instead of “putting out fires.” The ability of IT to support the process of decision making changes the decision-making process and even decision-making styles. For example, information gathering for decision-making can be done much more quickly. Web-based intelligent agents can monitor the environment, and scan and interpret information (see Liu et al., 2000). Most managers currently work on a large number of problems simultaneously, moving from one to another as they wait for more information on their current problem or until some external event interrupts them. IT tends to reduce the time necessary to complete any step in the decision-making process. Therefore, managers can work on fewer tasks during each day but complete more of them.

Another possible impact on the manager's job is a change in leadership requirements. What are generally considered to be good qualities of leadership may be significantly altered with the use of IT. For example, when face-to-face communication is replaced by e-mail and computerized conferencing, leadership qualities attributed to physical appearance and dress codes could be minimized.

Structure, Authority, Power, Job Content, and Personnel Issues

The IT revolution may result in many changes in structure, authority, power, and job content, as well as personnel management and human resources management. Details of these changes are shown in Table 16.1.

In addition, other changes are expected in organizations. For example, as the corporate culture in the Internet age is changing (see Kleiner, 2000), IT managers assuming a greater leadership role in making business decisions (see Dalton, 1999). For a comprehensive analysis of business leadership in the information age, see Nevins and Stumpf (1999). Moreover, the impact goes beyond one company or one supply chain, to influence entire industries. For example, the use of profitability models and optimization is reshaping retailing, real estate, banking, transportation, airlines, and car renting, to mention just a few. For more on organizational issues see Mora (2002) and Huang (2001).

16W6  **CHAPTER 16** IMPACTS OF IT ON ORGANIZATIONS, INDIVIDUALS, AND SOCIETY

TABLE 16.1 Impacts of IT on Structure, Authority, Power, and Job Content

Impact	Effect of IT
Flatter organizational hierarchies	IT increases span of control (more employees per supervisor), increases productivity, and reduces the need for technical experts (due to expert systems). Fewer managerial levels will result, with fewer staff and line managers. Reduction in the total number of employees, reengineering of business processes, and the ability of lower-level employees to perform higher-level jobs may result in flatter organizational hierarchies.
Change in blue-to-white-collar staff ratio	The ratio of white- to blue-collar workers increases as computers replace clerical jobs, and as the need for information systems specialists increases. However, the number of professionals and specialists could <i>decline</i> in relation to the total number of employees in some organizations as intelligent and knowledge-based systems grow.
Growth in number of special units	IT makes possible technology centers, e-commerce centers, decision support systems departments, and/or intelligent systems departments. Such units may have a major impact on organizational structure, especially when they are supported by or report directly to top management.
Centralization of authority	Centralization may become more popular because of the trend toward smaller and flatter organizations and the use of expert systems. On the other hand, the Web permits greater empowerment, allowing for more decentralization. Whether use of IT results in more centralization or in decentralization may depend on top management's philosophy.
Changes in power and status	Knowledge is power, and those who control information and knowledge are likely to gain power. The struggle over who controls the information resources has become a conflict in many organizations. In some countries, the fight may be between corporations that seek to use information for competitive advantage and the government (e.g., Microsoft vs. the Justice Dept.). Elsewhere, governments may seek to hold onto the reins of power by not letting private citizens access some information (e.g., China's restriction of Internet usage).
Changes in job content and skill sets	<i>Job content</i> is interrelated with employee satisfaction, compensation, status, and productivity. Resistance to changes in job skills is common, and can lead to unpleasant confrontations between employees and management (see Routt, 1999).

These and other changes are impacting personnel issues, as shown in Table 16.2. Many additional personnel-related questions could surface as a result of using IT. For example: What will be the impact of IT on job qualifications and on training requirements? How can jobs that use IT be designed so that they

TABLE 16.2 Impacts of IT on Personnel Issues

Impact	Effect of IT
Shorter career ladders	In the past, many professionals developed their abilities through years of experience and a series of positions that exposed them to progressively more complex situations. The use of IT, and especially Web-based computer-aided instruction, may short-cut this learning curve.
Changes in supervision	IT introduces the possibility for greater electronic supervision. In general, the supervisory process may become more formalized, with greater reliance on procedures and measurable (i.e., quantitative) outputs and less on interpersonal processes. This is especially true for knowledge workers and telecommuters.
Job mobility	The Web has the potential to increase job mobility. Sites such as <i>techjourney.com</i> can tell you how jobs pay in any place in the U.S. Sites like <i>monster.com</i> offer places to post job offerings and resumes. Using videoconferencing for interviews and intelligent agents to find jobs is likely to increase employee turnover.

present an acceptable level of challenge to users? How might IT be used to personalize or enrich jobs? What can be done to make sure that the introduction of IT does not demean jobs or have other negative impacts from the workers' point of view? What principles should be used to allocate functions to people and machines, especially those functions that can be performed equally well by either one? Should cost or efficiency be the sole or major criterion for such allocation? All these and more issues could be encountered in any IT implementation.

16.3 IMPACTS OF IT ON INDIVIDUALS

Information systems affect individuals in various ways. What is a benefit to one individual may be a curse to another. This section discusses some of the ways that IT may affect individuals, their perceptions, and their behaviors.

Job Satisfaction, Dehumanization, and Information Anxiety

Although many jobs may become substantially more “enriched” with IT, other jobs may become more routine and less satisfying. For example, as early as 1970, researchers predicted that computer-based information systems would reduce managerial discretion in decision making and thus create dissatisfied managers. This dissatisfaction may be the result of perceived dehumanization.

DEHUMANIZATION AND OTHER PSYCHOLOGICAL IMPACTS. A frequent criticism of traditional data processing systems was their impersonal nature and their potential to *dehumanize* and depersonalize the activities that have been computerized. Many people felt, and still feel, a loss of identity, a **dehumanization**, because of computerization; they feel like “just another number” because computers reduce or eliminate the human element that was present in the non-computerized systems. Some people also feel this way about the Web.

On the other hand, while the major objective of newer technologies, such as e-commerce, is to increase productivity, they can also create *personalized*, flexible systems that allow individuals to include their opinions and knowledge in the system. These technologies attempt to be people-oriented and user-friendly.

The Internet threatens to have an even more isolating influence than has been created by television. If people are encouraged to work and shop from their living rooms, then some unfortunate psychological effects, such as depression and loneliness, could develop. Some people have become so addicted to the Web that they have dropped out of their regular social activities, at school or work or home, creating new societal and organizational problems.

Another possible psychological impact relates to distance learning. In some countries, it is legal to school children at home through IT. Some argue, however, that the lack of social contacts could be damaging to the social, moral, and cognitive development of school-age children who spend long periods of time working alone on the computer.

INFORMATION ANXIETY. One of the negative impacts of the information age is **information anxiety**. This disquiet can take several forms, such as frustration with our *inability to keep up with the amount of data* present in our lives. Information anxiety can take other forms as well. One is frustration with the quality of the information available on the Web, which frequently is not up-to-date



or is incomplete. Another is frustration or guilt associated with not being better informed, or being informed too late (“How come others knew this before I did?”). A third form of information anxiety stems from information overload (too many online sources). For some Internet users, anxiety resulting from information overload may even result in inadequate or poor sleep. (For some possible solutions, see *sleepfoundation.org*.)

According to Wurman (2000), between 60 and 80 percent of the people searching for specific information on the Web cannot find what they want among the various types of information available. This adds to anxiety, as does the data glut that obscures the distinction between data and information, and between facts and knowledge. Wurman (2001) prescribes solutions to ease the problem of information anxiety, ranging from better access to data to better design of Web sites.

Impacts on Health and Safety

Computers and information systems are a part of the environment that may adversely affect individuals’ health and safety. To illustrate, we will discuss the effects of three issues: *job stress*, *video display terminals*, and *long-term use of the keyboard*. (For further discussion see the *Wall Street Journal*, April 9, 1996, p. 1.)

JOB STRESS. An increase in workload and/or responsibilities can trigger job stress. Although computerization has benefited organizations by increasing productivity, it has also created an ever-increasing workload for some employees. Some workers, especially those who are not proficient with computers but who must work with them, feel overwhelmed and start feeling anxious about their jobs and their performance. These feelings of anxiety can adversely affect workers’ productivity. Management’s responsibility is to help alleviate these feelings by providing training, redistributing the workload among workers, or by hiring more individuals.

VIDEO DISPLAY TERMINALS. Exposure to video display terminals (VDTs) raises the issue of the risk of radiation exposure, which has been linked to cancer and other health-related problems. Exposure to VDTs for long periods of time is thought to affect an individual’s eyesight, for example. Also, lengthy exposure to VDTs has been blamed for miscarriages in pregnant women. However, results of the research done to investigate these charges have been inconclusive.

REPETITIVE STRAIN (STRESS) INJURIES. Other potential health and safety hazards are repetitive strain injuries such as backaches and muscle tension in the wrists and fingers. *Carpal tunnel syndrome* is a painful form of repetitive strain injury that affects the wrists and hands. It has been associated with the long-term use of keyboards. According to Kome (2001), 6 million Americans suffered repetitive strain injuries on the job between 1991 and 2001.

LESSENING THE NEGATIVE IMPACT ON HEALTH AND SAFETY. Designers are aware of the potential problems associated with prolonged use of computers. Consequently, they have attempted to design a better computing environment. Research in the area of **ergonomics** (the science of adapting machines and work environments to people) provides guidance for these designers. For instance, ergonomic techniques focus on creating an environment for the worker that is safe, well lit, and comfortable. Devices such as antiglare screens have helped alleviate problems of fatigued or damaged eyesight, and chairs that contour the human body have helped decrease backaches (see *A Closer Look 16.1*).



A CLOSER LOOK

16.1 ERGONOMIC PRODUCTS AND CORRECT SITTING PROTECT COMPUTER USERS

Many products are available to improve working conditions for people who spend much of their time at a computer. The following pictures illustrate some ergonomic solutions:



Proper sitting position.



Wrist support.



Eye-protection filter (optically coated glass).



Adjustable foot rest.

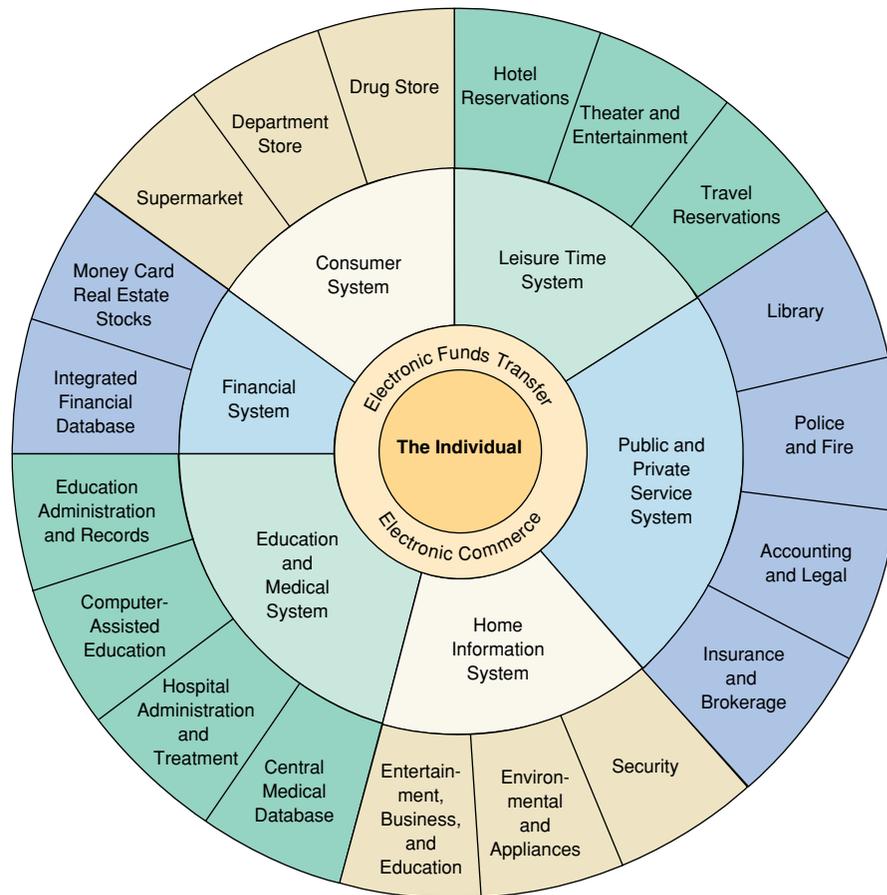


FIGURE 16.1 Information systems and the individual. (Source: Jerome Kanter, *Managing with Information*, 4th ed., 1992, p. 350. © Reprinted with permission of Pearson Education Inc., Upper Saddle River, NJ.)

Other Impacts Interactions between individuals and computers are so numerous that entire volumes can be written on the subject. An overview of such interactions is provided by Kanter (1992) and illustrated in Figure 16.1. The figure shows the individual encircled by the electronic transfer of money (as in e-commerce and smart cards) that allows purchase of products and services. The intermediate rings identify six areas or systems of human activity affected by computers (consumerism, education, and so on). Finally, the outer ring gives some examples of specific products or services in each system. For a review of individual acceptance of information technologies, see Agarwal (2000).

16.4 SOCIETAL IMPACTS

Several positive and some negative social implications of IT could be far-reaching. IT has already had many direct beneficial effects on society, being used for complicated human and social problems such as medical diagnosis, computer-assisted instruction, government-program planning, environmental quality control, and law enforcement. For an overview see Lubbe and Van Heerden (2003). This section discusses a number of societal impacts.

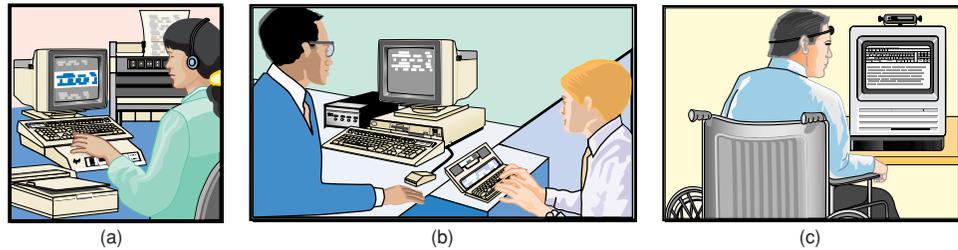


FIGURE 16.2 Enabling people with disabilities to work with computers. (Source: J. J. Lazzaro, "Computers for the Disabled," *Byte*, June 1993.)

(a) A PC for a sight-impaired user, equipped with an Oscar optical scanner and a Braille printer, both by TeleSensory. The optical scanner converts text into ASCII code or into proprietary word processing format. Files saved on disk can then be translated into Braille and sent to the printer. Visually impaired users can also enlarge the text on the screen by loading a TSR software magnification program.

(b) The hearing-impaired challenged user's PC is connected to a telephone via an Ultratec Intel-Modem Baudot/ASCH modem. The user is sending and receiving messages to and from someone at a remote site who is using a telecommunications device for deaf people (right).

(c) This motor-disabled person is communicating with a PC using a Pointer Systems optical head pointer to access all keyboard functions on a virtual keyboard shown on the PC's display. The user can "strike" a key in one of two ways. He can focus on the desired key for a user-definable time period (which causes the key to be highlighted), or he can click an adapted switch when he chooses the desired key.

Opportunities for People with Disabilities

The integration of artificial intelligence technologies, such as speech and vision recognition, into a computer and especially into Web-based information systems, can create new employment opportunities for people with disabilities. For example, those who cannot type are able to use a voice-operated keyboard, and those who cannot travel can work at home.

Adaptive equipment for computers permits people with disabilities to perform tasks they would not normally be able to do. Figure 16.2 shows a PC for a user with hearing impairment, a PC for a visually-challenged user, and a PC for a motor-disabled user. In Thailand, 18-year-old students at the Na Yai Arm Vocational School, in Chantaburi province, developed a special telephone for sight-impaired people because they wanted to help them to live on more equal terms with the rest of society and not need to depend on help from others (Boonnoon, 2000). In Taiwan, a group of researchers designed portable communication aids for people who have both sight and hearing impairments. The system comprises two major parts: First, the person types the messages on a Braille terminal. The messages will be converted to Mandarin phonetic symbols, which are then displayed on an LCD display to be read by a sighted partner. The sighted person can then send messages back by typing on a simple keyboard. The messages will be displayed on a Braille display to be "read" by the message recipient (Su et al., 2001).

Other devices provide help improve quality of life for disabled people in more mundane, but useful, ways. A two-way writing telephone, a robotic page-turner, a hair-brusher, and a hospital-bedside video trip to the zoo or the museum.

Some countries have developed more extensive legislative requirements than others so as to protect the rights of people with disabilities. In the United



States, since the summer of 1994, companies with 15 or more employees must comply with the Americans with Disabilities Act. This act requires companies to take reasonable steps to ensure that employees with disabilities will be able to work with specially adapted computers as well as with other equipment. In many countries, however, notably those in the developing world, no such legislative measures exist, and those with disabilities are very much undervalued and underemployed members of society.

INTERNET IMPLICATIONS. E-commerce sites are studying how to handle people with disabilities, “encouraged” by the legal authorities, which have shut down several e-tailing stores for not complying with the law (news item *New York Times*, January 1, 2001). In the United States, 300,000 to 500,000 sight-impaired people rely on screen-reader software and a speech synthesizer, which turn words to sound and can interpret images. But many Web sites are not designed to be compatible with screen readers. People with impaired motor skills need a special mouse, and people with hearing impairments need to see messages. This can be done by using closed-captioning devices, but is usually not done.

Several organizations deal with IT and people with disabilities. An example is *abletowork.org* (see Exercise 5). For a comprehensive discussion of Web sites and the visually impaired, including software and hardware, see Rogers and Rajkumar (1999).

Quality of Life Improvements

On a broader scale, IT has significant implications for the **quality of life**. An increase in organizational efficiency may result in more leisure time for workers. The workplace can be expanded from the traditional nine-to-five job at a central location to twenty-four hours a day at any location. This expansion provides a flexibility that can significantly improve the quality of leisure time, even if the total amount of leisure time is not increased.

Of course there can be negative effects as well. None of us wants to work round the clock, twenty-four hours a day, seven days a week, 365 days a year, but the pressure to do so could be considerable if the facility exists. Indeed, another pressure may be to work antisocial hours—night shifts, for example, or weekends. Furthermore, not all of us necessarily want to spend more leisure time at home. One investigation showed that more time at home can contribute to increased domestic violence and divorces.

Nevertheless, our quality of life can be improved in various ways by IT. For example, Japanese auto manufacturers are leading the way in the development of onboard GIS-GPS picture-map technology (e.g., see *toyota.com*), which makes it easier to drive to your destination. Some systems provide live data that is downloaded to you via a satellite link as you drive. Other systems require you to download information to a “card” before you start your trip, then to insert the card into the car’s navigation system. (For more details, see Lubbe and Van Heerden, 2003, Kageyama, 2000, and Flamma, 1999.) The use of robots is another way to improve quality of life with IT in certain uncomfortable or dangerous environments.

ROBOT REVOLUTION ON THE WAY. Robots will become ubiquitous, or so some people think. “Cyberpooches,” nursebots, and more may be our companions before we know it. Around the world, quasi-autonomous devices have become increasingly common on factory floors, in hospital corridors, and in farm fields. Military applications are being developed also: The Pentagon is researching



IT at Work 16.1

THE WORKING LIVES OF ROBOTS



LAYING FIBER OPTIC CABLES. Cities around the world are transforming themselves to the digital era by replacing copper wires with fiber-optic cables or by installing fiber optics where there were no wires before. Because fiber-optic cables are a choice method to deliver high-speed voice and data communication (see Technology Guide 4), demand for them is expanding. Cities know that in order to attract and hold on to high-tech business they must provide fiber-optic access to all commercial buildings. You may have seen this activity many times without realizing it: Workers cut up the street, creating noise, dust, and traffic problems. But the worst part of it is that the disruption to people may take weeks, or even months, just to complete one city block. Now, robots are changing it all.

One company that invented a technology to improve the situation is City Net Telecommunications (*citynettelecom.com*). The idea is to use the existing sewer system to lay the cables. This way no trenches need to be dug in the streets. Pioneering work has been done in Albuquerque, New Mexico, Omaha, Nebraska, and Indianapolis, Indiana (in spring 2001). How do the robots help? Robots are waterproof and do not have noses, and so they are not bothered by working in the sewer. They do not complain, nor do they get sick. As a matter of fact, they work faster than humans when it comes to laying the fiber-optic cables inside the sewer system.

What does it cost? The company claims that laying the fiber-optic cable with robots costs about the same as

the old method. The major advantage is that it can be done 60 percent faster and without disruption to people's lives.

CLEANING TRAIN STATIONS IN JAPAN. With growing amounts of rubbish to deal with at Japanese train stations and fewer people willing to work as cleaners, officials have started turning the dirty work over to robots. Since May 1993, the Central Japan Railway Company and Sizuko Company, a Japanese machinery maker, have been using robots programmed to vacuum rubbish. A railway official said the robots, which are capable of doing the work of ten people each, have been operating at the Sizuko station in Central Japan. The robots measure about 1.5 meters wide and 1.2 meters long. The railway and Sizuko spent 70 million yen to develop the machines and are planning to program them for other tasks, such as sweeping and scrubbing.

Sources: Compiled from the *New York Times* (March 6, 2001); from the *Wall Street Journal* (November 21, 2000); and from "Robots Used to Clean Train Station in Japan," the (Singapore) *Sunday Times* (June 6, 1993). See also "The Robot Revolution Is on the Way," *International Herald Tribune* (September 18, 2000).

For Further Exploration: If robots are so effective, what will be the impact on unemployment when more tasks are robotized? What will people do if robots take over?

self-driving vehicles and bee-like swarms of small surveillance robots, each of which would contribute a different view or angle of a combat zone.

Whether robots will be of R2D2 (the *Star Wars* android) quality is another issue. It probably will be a long time before we see robots making decisions by themselves, handling unfamiliar situations, and interacting with people. Nevertheless, robots are around that can do practical tasks. Carnegie Mellon University, for example, has developed self-directing tractors that harvest hundreds of acres of crops around the clock in California, using global positioning systems combined with video image processing that identifies rows of uncut crops. Robots are especially helpful in hazardous environments, as illustrated in the *IT at Work 16.1*.

IMPROVEMENTS IN HEALTH CARE. IT has brought about major improvements in health-care delivery, ranging from better and faster diagnoses, to expedited research and development of new drugs, to more accurate monitoring of critically ill patients. One technology that has made a special contribution is artificial intelligence. For example, expert systems support diagnosis of diseases, and

machine vision is enhancing the work of radiologists. Recently, surgeons started to use virtual reality to plan complex surgeries, and used a surgical robot to perform long distance surgery. Cardiologists also can interpret patients' hearts' vital signs from a distance (see *micromed.com*).

On June 26, 1998, the first China-America Internet medical video teleconferencing was initiated. Doctors in Xian Medical University communicated over the Internet with American doctors at Stanford Medical School. Now, doctors can discuss complex medical cases not only on the telephone, but also with the support of pictures and sound.

The medical industry has long been using advanced technologies to diagnose and treat health problems. For example, there is a small transistor that a sick person can wear on a necklace. If the person needs help, a computer chip automatically activates the telephone to notify an operator who can contact an emergency service or a physician. Of the thousands of other applications related to health care it is interesting to point out the administrative systems, which range from insurance fraud detection (e.g., by IBM's Fraud and Abuse Management System) to nursing scheduling and financial and marketing management. In 2002, the cardiac unit in Miami Children's Hospital introduced hand-held organizers to doctors and nurses for recording and tracking diagnoses and treatment (*International Herald Tribune*, August 24–25, 2002). Many other improvements in healthcare delivery are related to advanced technologies. For additional examples, see Landro (2002) and Weiss (2002).

The Internet is a gold mine of medical information. For example, a site about cancer (*cancer.med.upenn.edu*) features a huge array of documents, reviews, descriptions of personal experiences, suggested diets, and links to global resources for people who suffer from cancer, or who are interested in oncology. It offers information on the latest research studies and cancer pain management. It also helps families cope with emotional and financial burdens. The Web site has won numerous awards for its design and functionality. In 2001, the site had over 2 million visitors *each day* from all over the world.

There are numerous Web sites devoted to all kinds of specific health topics. For instances, iEmily (*iEmily.com*) provides information on the physical and mental health of teenage girls. TeenGrowth (*teengrowth.com*), KidsHealth (*kidshealth.org*), and ZapHealth (*zaphealth.com*) articles on general, sexual, emotional health, as well as fitness, sports, family and safety issues. Organized like interactive magazines, these sites also offer discussion forums, chat rooms, and hyperlinks to other related resources.

Finally, the outbreak of Severe Acute Respiratory Syndrome (SARS) demonstrated the use of IT in supporting the social and psychological needs of patients. Technologies such as Web cameras, audiovideo phones, and Web-conferencing software enabled patients to stay in touch with their relatives and friends while under quarantine.

CRIME FIGHTING AND OTHER BENEFITS. Other quality of life improvements brought about by IT relate to crime fighting and other government-services benefits. Here are some examples of how computer applications can benefit society:

- Since 1997, information about sex offenders has been available on the Internet, so that people can be aware of whether previously convicted offenders are living in their localities.

- Los Angeles County has a sophisticated computer program for reporting and tracking over 150,000 gang members in the county. The program significantly helps reduce gang crime.
- Electronic imaging and electronic fax enhance searches for missing children. In addition to its Web site (*missingkids.com*), which attracts more than a million hits each day, the Center for Missing and Exploited Children can send high-quality photos plus text to many fax machines and to portable machines in police cars. Computers have improved the quality of fax transmission and increased the number of people who receive the announcements.
- A geographical information system helps the San Bernardino Sheriff's Department to better visualize crime patterns and allocate resources.
- Electronic Sensors and computers reduce traffic congestion in many major cities, from Los Angeles to Tokyo.
- A computerized voice-mail system used in Rochester, New York, helps homeless and other needy people find jobs, access health care resources, and gain independent living skills.
- Police can now track emergency (911) calls made from cell phones equipped with GPS systems (see Chapter 6, and Fujimoto, 2002).

Technology and Privacy

Throughout the book we have provided examples of invasion of privacy by IT applications. Here are some examples.



SCANNING CROWDS FOR CRIMINALS. One major debates involves situations in which police are using technology to reduce crime. In January 2001, for example, during the Super Bowl game in Tampa, Florida, video cameras took a picture of each of 100,000 fans when they entered the stadium. No one knew about it, so permissions were not obtained. Within seconds, thousands of photos were compared with digital portraits of known criminals and suspected terrorists; several matches were found. The technology is not new, but its magnitude and speed is. Never before had such a large number of people been photographed and the photos analyzed in such a short time. Is this technology Big Brother watching over you, or just a friendly uncle? The ACLU says it is Big Brother. The police say it is the uncle, trying to protect the public. Who do you think is right?

COOKIES AND INDIVIDUAL PRIVACY. A Microsoft product called *Passport* has raised some of the same concerns as cookies. Passport is an Internet strategy that lets consumers permanently enter a profile of information along with a password and use this information and password repeatedly to access services at multiple sites. Critics say that Passport affords the same opportunities as cookies to invade an individual's privacy by permitting unauthorized people (e.g., Microsoft employees or vendors) to look at your personal data. (Critics also feel that the product gives Microsoft an unfair competitive edge in EC.)

DIGITAL MILLENNIUM COPYRIGHT ACT AND PRIVACY CONCERNS. The Recording Industry Association of America (RIAA) blames online music piracy for falling sales of CDs and has tried to use the Digital Millennium Copyright Act (DMCA) to get ISPs to reveal the identity of customers who illegally swap



pirated files. This act has raised some public concern about giving too much power to copyright holders at the expense of Internet users.

For more on technology's relation to privacy see Buchholz and Rosenthal (2002) and Rykere et al. (2002). Tynan (2002) gives examples about how to protect your privacy, as do discussions in Chapters 5 and 6 of this textbook.

SOCIAL SERVICES AND PRIVACY. Conflicting public pressures may rise to suppress the use of IT because of concerns about privacy and “Big Brother” government. The absence of public pressure, or government intransigence, may see such concerns pushed aside. For example, for many years Hong Kong citizens have had to carry an identity card. One cogent justification for this requirement relates to the ongoing fight against illegal immigration into Hong Kong, as officers of the Hong Kong Police Force randomly spot-check ID cards in the street. The Hong Kong government now proposes to reissue all ID cards as smart ID cards—cards that will be able to capture significantly more data, such as driving permit and health information. Such a card may raise many privacy concerns. See the discussion at pco.org.hk/. While some can see many benefits, others are concerned about their privacy.

Virtual Society

The term **virtual society** refers to all components that are part of a society's culture based on a *functional* rather than a physical structure. It includes significant IT-enhanced effects or actions, behavior of nonphysical entities, and remotely located members. Companies no longer talk about “work at home” programs. Rather, they talk about “work anywhere, anytime,” with laptops, fax machines, mobile devices, networks, e-mail, and voice mail transforming work and communication into a virtual society. Societal changes are coming with the new generation who has grown up online (Roberts-Witt, 2000). (For more on the IT-related implications of the transformation to a virtual society, see Igarria, 1999.)

Information Technology and Employment Level

In the last 30 years, there has been an ongoing debate regarding the possibility of massive unemployment resulting from the increased use of IT. The debate is between economists who believe that massive IT-caused unemployment will occur and those who believe that it will not occur. Very prominent economists are marshalled on either side in this debate, including Nobel Prize recipients Leontief (1986) arguing for the massive unemployment and Simon (1977) arguing against it. The arguments are summarized in Table 16.3.

The debate about how IT will affect employment raises a few other questions: Is unemployment really socially undesirable? Should the government intervene more in the distribution of income and in the determination of the employment level? Can the “invisible hand” in the economy, which has worked so well in the past, continue to be successful in the future? Will IT make most of us idle? (Robots will do the work, and people will enjoy life.) Should the issue of income be completely separated from that of employment?

The answers to these questions will be provided in part by the developments in future IT, but they must also be influenced by cultural differences. While some countries have governments rich enough to make income taxes a thing of the past (e.g., Brunei), this is not the case for most. Some countries (or communities within countries) have unemployment rates of 50 percent or more (e.g., East Timor, Kosovo). While the rates in others may seem



TABLE 16.3 Is Mass Unemployment Coming? Arguments on Both Sides of the Question

Massive Unemployment Will Come	No Massive Unemployment
<ul style="list-style-type: none"> ● Benefit/cost advantage of computers increases with time. ● Less skillful employees are needed. ● Shifting displaced employees to services is getting difficult. ● Many employees lost their jobs in the 1990s. ● Hidden unemployment exists in many organizations. ● Millions of help-desk employees will be replaced by intelligent agents. ● E-commerce will cause millions of intermediaries and agents to lose their jobs. ● The unemployment levels in certain countries is high and is increasing. 	<ul style="list-style-type: none"> ● New occupations and jobs have always been created by automation. ● There is much less unemployment in countries that use more automation. ● Work can be expanded to accommodate everyone. ● Conversion to automation is slow, and the economy can adjust. ● There will always be some areas where people are better than machines. ● People will work less but will have more money. ● E-commerce reduces the cost of many goods and services; thus their consumption will increase, resulting in more buying and more jobs. ● There is an upper limit to customer consumption.

low, these must be measured against the need of people in society for work, as well as the ability or intention of the government to provide a social safety net. For example, Hong Kong lacks such a comprehensive safety net, and many who would be eligible claimants believe it below their dignity to claim anyway—they would prefer to *earn* a living rather than to depend on the government. When unemployment reaches 3 or 4 percent in Hong Kong, as during the recent Asian financial crisis, this is considered a very high rate. In other countries, for example, in North America and Western Europe, 3 to 4 percent may be considered very low.

Digital Divide The term **digital divide** refers to the gap in computer technology in general, and now in Web technology in particular, between those who have such technology and those who do not. A digital divide exists both within and among countries. According to UN and ITU reports, more than 90 percent of all Internet hosts are in developed countries, where only 15 percent of the world's population resides. In 2001, the city of New York, for example, had more Internet hosts than the whole continent of Africa. Venkat (2002) asserted that the digital divide has consistently followed the income divide all over the world. More than 96 percent of those with Internet access are in the wealthiest nations, representing 15 percent of the world's population. Nearly 60 percent of the U.S. population has Internet access, with a distribution highly correlated with household income (Venkat, 2002).

The U.S. federal and state governments are attempting to close this gap within the country, by encouraging training and by supporting education and infrastructure improvements (see *ecommerce.gov*). Many other government and international organizations are also trying to close the digital divide around the world. As technologies



develop and become less expensive, the speed at which the gap can be closed will accelerate. For example, it is still expensive to have a DSL-based broadband line to access the Internet today (2003), but some predict that it could cost as little as \$10/month in 2005. Yet even this amount would be expensive in some countries where wages are only several dollars a day. Cell phones will also increase inexpensive access to the Internet as will Web TV.

According to Narayana Murthy, CEO of Infosys Technologies of India, IT and the Web can turn poor countries such as India into economic powerhouses. They can also help dissolve rigid social barriers (see Bodwo, 2000). For other strategies and discussion about how to close the digital divide, see Iyer et al. (2002) and Compaine (2001).

CYBERCAFÉS AND PUBLIC WEB TERMINALS. One of the developments that can help close the digital divide is Internet kiosks in public places and cybercafés. For example, CityKi, an online kiosk installed in a Boston supermarket, aims to provide public access to the Internet for people who ordinarily would not have such access (Fox, 2002). In the United States, computers with Internet access usually are also available at public libraries.

Similarly, **cybercafés** are public places such as a coffee house in which Internet terminals are available, usually for a small fee. Cybercafés come in all shapes and sizes, ranging from a chain of cafés (*easyeverything.com*, and *easy.com*) that include hundreds of terminals in one location (e.g., 760 in one New York setting), to a single computer in a corner of many restaurants. When you travel today, even to remote places such as the town of Shigatze in Tibet, Phi Phi island in Thailand, or the country of Ghana in Africa, you are likely to see a sign: *Internet café*, or *cybercafé*. According to search engine *cybercaptive.com*, there were more than 6,000 cybercafés, public Internet access point, and kiosks in 169 countries, in 2003.

Computers have popped up in many other public locations: discos, laundromats, karaoke bars, bookstores, CD stores, hotel lobbies, and convenience stores. Some facilities give free access to patrons; others charge a small fee. The number of publicly accessed Wi-Fi's is increasing rapidly, and some do not charge fees (see Chapter 6).

International Impacts

As a result of advancements in information technology, such as the increased speed of communications and information flow, we are living in a shrinking world. In fact, more than 35 years ago, Marshall McLuhan coined the term "global village" to refer to this very concept. The power of the media is also growing as a result of cable television, electronic publishing, and networking through computer modems.

Many countries, willingly or unwillingly, knowingly or unknowingly, are being westernized as a result of information about western ways of life and values flowing freely across borders. This has the potential to fuel the fires of political unrest, especially in nondemocratic or poor countries. Access to IT technology such as facsimile machines, computer disks, and electronic publishing could be used to assist in planning revolts and attempting to overthrow governments. Therefore, how advancements in technology are viewed depends upon where one's affiliations lie.

As an example, in 1996 China blocked hundreds of western Web sites from being viewed on the Internet in China. This is not difficult to achieve, as the Chinese government maintains a strict control over Internet service providers

(ISPs). Any ISP that failed to follow government guidelines about which Web sites to block would at the very least lose its license to operate—and at the worst, its owners might be judged undesirable, reactionary, and antisocial elements. The punishment for such a charge varies from hard labor to execution, depending on the extent and severity of the crime. Following China's repressive Internet policies, several thousand Web sites, including pornography, violence, and in particular, criticism of China's Communist party, are blocked.

Free Speech versus Censorship



Several surveys indicate that the issue of censorship is one of the most important to Web surfers. Censorship usually ranks as the number one or number two concern in Europe and the United States; privacy is the other main issue (e.g., see the GVV User Surveys at gvu.gatech.edu/user_surveys/). On the Internet, *censorship* refers to government's attempt to control, in one way or another, material that is broadcast.

At a symposium on free speech in the information age, Parker Donham (1994) defined his own edict, called "Donham's First Law of Censorship." This semiserious precept states: "Most citizens are implacably opposed to censorship in any form—except censorship of whatever they personally happen to find offensive" (see ei.cs.vt.edu/~wwbtb/book/chap5/opine1.html).

Take, for example, the question, "How much access should children have to Web sites, newsgroups, and chat rooms containing 'inappropriate' or 'offensive' materials, and who should control this access?" This is one of the most hotly debated issues between the advocates of censorship and the proponents of free speech. The proponents of free speech contend that there should be no government restrictions on Internet content and that parents should be responsible for monitoring and controlling their children's travels on the Web. The advocates of censorship feel that government legislation is required to protect children from offensive material. According to Lee (2001), about 20 countries are filtering Internet pornography.

The Children's Online Protection Act (COPA) exemplifies the protection approach. Passed in 1998, this law required, among other things, that companies verify a viewer's age before showing online material that is deemed "harmful to minors" and that parental consent is required before personal information can be collected from a minor. The fact that the Act was ruled unconstitutional illustrates how hard it is to craft legislation that abridges freedom of speech in the United States. The fate of a modified Children's Internet Protection Act, which was ruled unconstitutional in Pennsylvania in 2001, is now in the hands of the U.S. Supreme Court.

In addition to concern for children, there is also a concern about hate sites (e.g., see Kopp and Suter, 2001), about defamation of character, and about other offensive material. On December 10, 2002, in a landmark case, Australia's highest court gave a businessman the right to sue in Australia for defamation over an article published in the United States and posted on the Internet. This reasoning basically equates the Net to any other published material. The publisher, Dow Jones & Co., said that it will defend those sued in a jurisdiction (Australia) that is far removed from the country in which the article was prepared (the United States).

The advocates of censorship also believe that it is the responsibility of ISPs to control the content of the data and information that flow across their networks and computers. The difficulty is that ISPs have no easy way of monitoring



A CLOSER LOOK

16.2 THE WORLD TRADE CENTER (WTC) DISASTER

The September 11, 2001, terrorists' attack on the World Trade Center (WTC) and Pentagon brought to our attention the impact of several IT topics. Here are some major ones.

THE ROLE OF THE INTERNET, SEARCH ENGINES, AND CHAT ROOMS, AND WEB LOGS (BLOGS). Following the disaster, the use of the Internet increased by about tenfold, with some sites (e.g., CNN) facing a volume increase of over 150-fold. The Internet and search engines were used provide news to millions around the globe and to enable people to find other people, public agencies, emergency services, and other important disaster relief information. The Internet also helped survivors, relatives, and other concerned individuals feel somewhat encouraged that they were not suffering alone. People were trying to reach out to each other to share some sense of community, and to vent fears, frustrations, and anger to a virtual community. Many special chat areas were created, and the front pages of search engines (e.g., Alta Vista, Lycos) and portals such as Yahoo were drastically altered to meet the users' needs.

Several Web sites were virtually unavailable in the hours immediately after the attack, due to traffic overload. Several search engines were available but brought back no listings relevant to the WTC catastrophe, while content providers scrambled to pull together information. Also, several blogs (Chapter 4) devoted considerable amounts of space to comforting people and sharing concerns.

WHY THE STOCK MARKETS WERE CLOSED FOR DAYS.

The IT operations of the New York Stock Exchange and Nasdaq were not damaged much because most of their facilities are outside New York and they had all the needed disaster recovery systems. Nasdaq, for example, had multiple communications carriers and a distributed IT infrastructure that helped keep its systems running after the attack (*InformationWeek.com*, Sept. 21, 2001).

However, the operations of many of the more than 100 securities-trading companies located in Manhattan were disrupted. Many of these had network problems, while

the content or determining the age of the person viewing the content. The only way to control "offensive" content is to block it from children and adults alike. This is the approach that America Online (AOL) has taken, for instance, in blocking sites pandering to hate crime and serial killer enthusiasts.

In general, in many societies it is believed that the right to freedom of speech needs to be balanced by a duty to protect people, or not to harm them. If in doubt, or if it is difficult to identify what types of material are likely to be harmful, people tend to err on the side of caution. Fundamentally, constitutions and their amendments are valid only so long as the majority of people in a given society believe that they are reasonable. At some point, they are changed as the society evolves and moves in new directions.

Controlling Spam **Spamming** refers to the practice of indiscriminately broadcasting messages over the Internet (e.g., junk mail and pop-up screens). One major piece of U.S. legislation addressing marketing practices in EC is the Electronic Mailbox Protection Act, passed in 1997. The primary thrust of this law is that commercial speech is subject to government regulation, and secondly, that spamming, which can cause significant harm, expense, and annoyance, should be controlled.

At some of the largest ISPs, spam now comprises 25 to 50 percent of all e-mail (Black, 2002). This volume significantly impairs an already-limited bandwidth, slowing down the Internet in general and, in some cases, shutting down

others needed to relocate operations to backup centers. Therefore, despite the help provided by the exchanges to the trading partners, it took 5 days to restore the overall operations.

ONLINE CROOKS EXPLOIT WTC DISASTER. The disaster proved that even in times of national crisis, crime and unethical behavior does not come to a standstill. Several shameless con artists attempted to profit from the situation, even using the Internet to do so. Attempts were made to solicit donations for the survivors of the attacks and relatives of the victims. As an example, a widespread e-mail solicited donations for the Red Cross, but the link led to an imitation of the popular relief organization's Web site. There were also unethical and offensive uses of the Internet for spinning the attacks into marketing events, for example, selling life insurance. Some even were selling commemorative products related to the disaster.

PRIVACY VERSUS SECURITY. A dramatic shift in the debate over IT privacy was observed after September 11: Before, the issue was a tug of war between protectors of civil liberties on one side and government intelligence gatherers on the other. In September 2001 it became an emotional weighing of personal rights ver-

sus national security, with a shift in favor of stepping up government eavesdropping. Some of the immediate changes were:

- The Data Protection Act was relaxed so ISPs were able to provide traffic data to the police in several countries.
- A global request was made for encryption software makers to let government authorities crack their tools.
- New anti-terrorist legislation was introduced in the United States that would make it easier for the FBI to wiretap phones and e-mails.
- The use of disposable cell phones (preloaded with a finite number of calling minutes and then useless) and telephone cards became a security risk since anonymous calls are difficult to track.
- ID smart cards, which are very difficult to forge, are becoming mandatory in some countries. The U.S. Congress is deliberating the issue.

The tradeoff between security and privacy sparks debate. Many people favor lots of security and are willing to sacrifice some amount of privacy for that "public good." Others favor greater privacy even if it means somewhat less security.

ISPs completely. The Electronic Mailbox Protection Act requires those sending spam to identify it as advertising, to indicate the name of the sender prominently, and to include valid routing information. Recipients may waive the right to receive such information. Also, ISPs are required to offer spam-blocking software, and recipients of spam have the right to request termination of future spam from the same sender and to bring civil action if necessary. For further details see Turban et al. (2004, Chapter 5).

We close our discussion of the impacts of IT by looking at some of the IT impacts of the September 11, 2001, terrorists' attacks in the United States, as discussed in *A Closer Look 16.2*.

16.5 VIRTUAL COMMUNITIES

Our final topic in the chapter is virtual communities, which demonstrate a somewhat difference form of the impact of IT on society. A *community* is a group of people with some interest in common who interact with one another. A **virtual (Internet) community** is one in which the interaction among group members takes place by using the Internet. Virtual communities parallel typical physical communities such as neighborhoods, clubs, or associations, except that people do not meet face-to-face. Instead, they meet online. Virtual communities

**TABLE 16.4** Elements of Interactions in Virtual Communities

Type of interaction	Elements that promote the interaction
Communication	Bulletin boards (discussion groups) Chat rooms/threaded discussions (string Q&A) E-mail and instant messaging Private mailboxes Newsletters, "netzines" (electronic magazines) Web postings Voting
Information	Directories and yellow pages Search engines Member-generated content Links to information sources Expert advice
E-commerce element	Electronic catalogs and shopping carts Advertisements Auctions of all types Bartering online Classified advertising

offer several ways for members to interact and collaborate (see Table 16.4). Similar to the click-and-mortar e-commerce model, many *physical communities* also have a Web site for Internet-related activities.

Characteristics of Communities

Pure-play Internet communities (those that exist solely online) may have thousands or even millions of members. This is one major difference from purely physical communities, which are usually smaller. Another difference is that off-line communities are frequently confined to one geographical location, whereas only a few online communities are geographically constrained.

Virtual communities can be classified in several ways. One possibility is to classify members as *traders*, *players*, *just friends*, *enthusiasts*, or *friends in need*. The most common classification is the one proposed by Armstrong and Hagel (1996) and Hagel and Armstrong (1997). They recognized four types of Internet communities: communities of *transactions*, communities of *interest*, communities of *practice* (or relations), and communities of *fantasy*. Examples of these communities are provided in Table 16.5. (For different classifications see those proposed by Hummel and Lechner, 2002.)

Many thousands of communities exist on the Internet. Several communities are independent and are growing rapidly. For instance, GeoCities grew to 10 million members in less than 2 years and had over 45 million members in 2002 (*geocities.yahoo.com*). GeoCities members can set up personal homepages on the site, and advertisers buy ad space targeted to community members. A number of examples of online communities are presented in Table 16.6.

Rheingold (1993) thinks that the Web can be transformed from a communication and information-transfer tool into a *social Web* of communities. He thinks that every Web site should incorporate a place for people to chat. He believes that it should be a place where discussions may range over many controversial topics, making community sites a kind of virtual community center.

Many issues are related to the operation of communities. For example, Mowbray (2001) raised the issue of freedom of speech and its control in a

TABLE 16.5 Types of Virtual Communities

Community Type	Description
Transactions	Facilitates buying and selling (e.g., <i>ausfish.com.au</i>). Combines information portal with infrastructure for trading. Members are buyers, sellers, intermediaries, etc. Focused on a specific commercial area (e.g., fishing).
Purpose or interest	No trading, just exchange of information on a topic of mutual interest. Examples: Investors consult The Motley Fool (<i>fool.com</i>) for investment advice; music lovers go to <i>mp3.com</i> <URL; <i>Geocities.yahoo.com</i> is a collection of several areas of interest in one place.
Relations or practice	Members are organized around certain life experiences. For example <i>ivillage.com</i> caters to women. Professional communities also belong to this category for examples <i>isworld.org</i> for information systems faculty, students, and professionals.
Fantasy	Members share imaginary environments. Examples: sport fantasy teams at <i>espn.com</i> ; Geocities members can pretend to be medieval barons at <i>geocities.com/timessquare/4076</i> .

Sources: Compiled from Armstrong and Hagel (1996) and Hagel and Armstrong (1997).

community. Malhotra (2002) raised the issue of knowledge exchange among community members. Blanchard and Markus (2002) examined the role of a sense of belonging in an online community.

Commercial Aspects of Communities

Virtual communities have commercial as well as social aspects. A logical step as a community site grows in number of members and influence may be to turn it into a commercial site. Examples of such community-commercial sites include *ivillage.com* and *geocities.yahoo.com*.

Virtual communities can be closely related to EC. For example, Champy et al. (1996) and Zetlin and Pflieger (2002) describe online, consumer-driven markets in which most of the consumers' needs, ranging from finding a mortgage to job hunting, are arranged from a community Web site. This gathering of needs in one place enables vendors to sell more and community members to get discounts. Internet communities will eventually have a massive impact on almost every

TABLE 16.6 Examples of Communities

Type of Communities	Examples
<i>Search communities</i>	<i>classmates.com, match.com, monster.com</i>
<i>Education communities</i>	<i>smartforce.com</i>
<i>Association communities</i>	<i>aria.com.au</i>
<i>Ethnic communities</i>	<i>elsitio.com, hongkong.com, sohu.com</i>
<i>Gender communities</i>	<i>women.com, she.com</i>
<i>Affinity portals</i>	<i>workingfamilies.com</i>
<i>Catering to young people (teens and people in their early 20s)</i>	<i>alloy.com, bolt.com, blueskyfrog.com</i>
<i>Online gaming communities</i>	<i>netfun.com, thesimsonline.com</i>
<i>Mega communities</i>	<i>geocities.com, MSN.com</i>
<i>B2B online communities</i>	<i>commerceone.com, exp.com, keen.com</i>

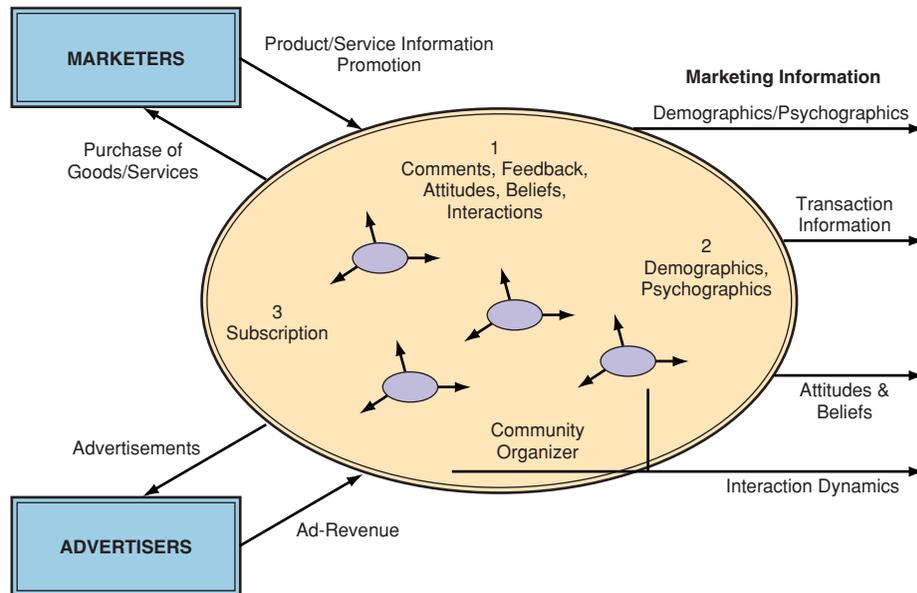


FIGURE 16.3 Value creation in virtual communities. (Source: Kannen et al., 1998, *Communications of the ACM*. P. K. Kannen © 1998 Association for Computing Machinery, Inc. Reprinted by permission.)

company that produces consumer goods or services, and they could change the nature of corporate advertising and community sponsorship strategies and the manner in which business is done. Although this process of change is slow, some of the initial commercial development changes can be observed.

Electronic communities can create value in several ways. This value-creation process is summarized in Figure 16.3. Members input useful information to the community in the form of comments and feedback, elaborating on their attitudes and beliefs and information needs. This information can then be retrieved and used by other members or by marketers. The community organizers may also supply their own content to communities, as AOL does.

Also, some communities charge members content fees for downloading certain articles, music, or pictures, thus producing sales revenue for the site. Finally, because many community members create their own homepages, it is easy to learn about them and reach them with targeted advertising and marketing. For more on this topic, see Lechner et al. (2001) and *A Closer Look 16.3*, which lists suggestions for transforming a community site into a commercial one.

Financial Viability of Communities

The revenue model of communities can be based on sponsorship, membership fees, sales commissions, and advertising, or some combination of these. The operating expenses for communities are very high due to the need to provide fresh content and free services. In addition, most communities initially provide free membership. The objective is to have as many registered members as possible and to build a strong brand in order to attract advertisers (see McWilliam, 2000, and Zetlin and Pflieger, 2002).

The model of self-financing communities (i.e., those without a sponsor) has not worked very well. Several communities that were organized for profit, such as *ivillage.com*, *china.com*, and *elsitio.com*, sustained heavy losses. Several other communities ceased operations in 2000 and 2001 (e.g., *esociety.com* and *renren.com*). However, the trend toward mergers and acquisitions among communities, started in 2001, is expected to improve the financial viability of some communities.



A CLOSER LOOK

16.3 HOW TO MAKE THE TRANSFORMATION FROM A COMMUNITY SITE TO A COMMERCIAL ONE

- Understand a particular niche industry, its information needs, and the step-by-step process by which it does the research needed to do business and try to match the industry with a potential or existing community.
- Build a site that provides that information, either through partnerships with existing information providers or by gathering it independently, or identify a community that can be sponsored.
- Set up the site to mirror the steps a user goes through in the information-gathering and decision-making process (e.g., how a chip designer whittles down the list of possible chips that will fit a particular product).
- Build a community that relies on the site for decision support (or modify an existing one).
- Start selling products and services that fit into the decision-support process (such as selling sample chips to engineers who are members of the community).

IT at Work 16.2 demonstrates how an online game company successfully generates profit through building an online community.

For more details and discussion of communities, see Raisch (2000), Preece (2000), Duffy (1999), and McWilliam (2000).



IT at Work 16.2

NET FUN: ONLINE GAME PLAYER COMMUNITY



Net Fun (*netfun.com*) is an online entertainment Web site founded in 1994. In 1996, the firm launched its flagship product, CyberCity. Installing CyberCity on the user's PC enables the user to access the variety of online games available from the Web site. CyberCity also provides other functions such as chat rooms, scoreboards, and searching for online game playing partners. The site provides a three-dimensional (3-D) virtual reality interface between the user and the games and other facilities available on the Web site.

Membership shot up quickly, reaching 180,000 within two years. At that time, the total Internet user population was only around one million. However, the firm was incurring substantial losses. By 1997 losses had mounted up to over US\$2.56 million, and the firm changed ownership. In 1998, the new owner of the firm, Peggy Chan, changed its revenue model from advertising-based to subscription-based. Membership dropped rapidly by almost 95 percent to a low of 10,000 but then gradually picked up again to 25,000 in 1999, 34,000 in May 2001, and about 45,000 in July 2003. As of April 2002, Net Fun became a profitable firm with a digital product delivered online.

Net Fun operates in the Chinese multi-players online games (MPOG) industry. Although there are numerous

players operating in the MPOG industry and many of them offer free online games, surprisingly almost none focus exclusively on classical Chinese games (e.g., Mahjong). The global Chinese online game player community is the target of Net Fun, as the user market was huge, and the competition was not keen.

In addition, the interactive multi-player nature of most online games would be conducive to the building up of an interactive online community. Indeed, Net Fun not only provides games, but it is also a virtual community in which game players can interact with each other through game competitions, chat rooms, private messaging, and even online voice messaging. The high level of customer "stickiness" to the online games Web site helped the firm successfully switch a failing advertising-based revenue model to a successful subscription-based model.

Sources: Lee (2002) and *netfun.com* (2003).

For Further Exploration: Why are advertisement revenue models generally ineffective (see Chapter 5)? Are the community aspects helpful? Why or why not? How could such a site be even more profitable?



MANAGERIAL ISSUES



1. **Supporting people with disabilities.** Lawsuits against employers for repetitive strain injuries are on the increase under the U.S. Federal Disabilities Act. Because this law is relatively new, court cases may be very costly.
2. **Culture is important.** Multinational corporations face different cultures in the different countries in which they are doing business. What might be ethical in country A may be unethical in country B—even if it is technically legal in both. Therefore, it is essential to develop a country-specific ethics code in addition to a corporate-wide one. Also, managers should realize that in some countries there is no legislation specifically concerned with computers and data.
3. **The impact of the Web.** The impacts of e-commerce and the Internet can be so strong that the entire manner in which companies do business will be changed. Impacts on procedures, people, organizational structure, management, and business processes may be significant.
4. **IT can cause layoffs.** The spread of IT may result in massive layoffs in some companies. Management should be aware of this possibility and have a contingency plan regarding appropriate reaction.
5. **Making money from electronic communities.** Electronic communities are not just a social phenomena. Many of these communities provide an opportunity for a business to generate sales and profits.
6. **Information anxiety may create problems.** Make sure that your employees do not suffer from information anxiety. Companies provide considerable on-site recreational facilities to ease stress and anxiety.

KEY TERMS

Cybercafés •••

Dehumanization •••

Digital divide •••

Ergonomics •••

Information anxiety •••

Quality of life •••

Span of control •••

Virtual community •••

Virtual society •••

CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

- 1 IT has significant impacts on organization (structure, operations, etc.), on individuals (negative and positive), and on society (positive and negative).
- 2 The major negative impacts of IT are in the areas of invasion of privacy, unemployment, and dehumanization.
- 3 Because of IT, organizational structure is changing, organizations are getting flatter, teams play a major role, power is redistributed (more power to those that control IT), jobs are restructured, supervision can be done from a distance, and decision making is supported by computers.
- 4 Information technology can change lines of authority, job content, and status of employees. As a result, the manager's job and methods of supervision and decision making may drastically change.
- 4 Dehumanization is a major concern that needs to be overcome by proper design and planning of information systems.
- 4 Computers can increase health risks to eyes, backs, bones, and muscles. Ergonomically designed computing facilities can greatly reduce the health risks associated with computers.
- 5 Many positive social implications can be expected from IT. They include providing opportunities to people with disabilities, improving health care, fighting crime, increasing productivity, and reducing people's exposure to hazardous situations.



- 5 In one view, IT will cause massive unemployment because of increased productivity, reduced required skill levels, and the potential reduction of employment in all sectors of the economy.
- 5 In another view, IT will increase employment levels because automation makes products and services more affordable, thus increasing demand; and the process of disseminating automation is slow enough to allow the economy to adjust to information technologies.
- 5 Quality of life, both at work and at home, is likely to improve as a result of IT.
- 6 The disaster of 9/11 revealed the importance of the Internet as a source of news and a medium of support as well as the importance of blogging. It also showed that some people exploit even national disasters by committing fraud.
- 6 People have become more tolerant of government invasion of privacy in order to increase national security and safety.
- 7 Virtual communities of different types are spreading over the Web, providing opportunities to some companies to increase revenues and profit.

QUESTIONS FOR REVIEW

1. Describe how IT can have negative effects on people.
2. Describe the impact of IT on the manager's job.
3. Describe the organizational impacts caused by IT.
4. What are some of the major impacts of IT on individuals?
5. Describe some of the potential risks to human health caused by extensive use of computers.
6. How does the use of IT relate to health and safety? What is information anxiety?
7. Discuss the following organizational impacts: flatter organizations, increased span of control, power redistribution, supervision, and decision making.
8. List the major societal impacts of IT that are described in this chapter, and categorize each of them as either negative or positive.
9. Present three major arguments of those who believe that IT will result in massive unemployment.
10. Present three major arguments of those who believe that IT will *not* result in massive unemployment.
11. How can IT improve the quality of life?
12. Define digital divide.
13. Define virtual society.
14. Define the Internet community and list four types of communities.

QUESTIONS FOR DISCUSSION

1. Consider the design features for a picture-map-based navigation system for private car owners. What kind of constraints exist? Is there a universal standard for user-friendliness? How safe is such a system—that is, do you have to stop concentrating on driving in order to use it? What ethical concerns might be raised through such a system? How could it be abused?
2. Clerks at 7-Eleven stores enter data regarding customers (gender, approximate age, and so on) into the computer. These data are then processed for improved decision making. Customers are not informed about this nor are they asked for permission. (Names are *not* keyed in.) Do you see any problems with the clerks' actions?
3. Will those managers whose jobs can be automated be eliminated?
4. Many hospitals, health maintenance organizations (HMOs), and federal agencies are converting, or plan to convert, all patients' medical records from paper to electronic storage (using imaging technology). Once completed, electronic storage will enable quick access to most records. However, the availability of these records in a database and on networks may allow people, some of whom are unauthorized, to view one's private data. To protect privacy fully may cost too much money and/or may considerably slow accessibility to the records. What policies could health-care administrators use in such situations? Discuss.
5. Discuss the relationship of IT and robots. Why is this issue controversial?
6. Northeast Utilities (Hartford, CT) has its meter readers gather information about services needed on its customers' homes, such as a driveway or fence requiring repairs. It sells the data to companies that would stand to gain from the information. Customers are then solicited via direct mail, telemarketing, and so on for the services that the meter readers record as being needed. While some customers welcome this approach, others consider it an annoyance because they are not interested in the particular repairs. Assess the value of the company's IT initiative against the potential negative effects of adverse public reaction.

16W28 CHAPTER 16 IMPACTS OF IT ON ORGANIZATIONS, INDIVIDUALS, AND SOCIETY

7. IT may have both positive and negative societal effects in the *same situation*. Give two examples, and explain how to reconcile such a case.
8. It is said that IT has raised many new privacy issues. Why is this so?
9. Relate virtual communities to virtual society.
10. Several examples in this book illustrate how information about individuals can help companies improve their businesses and also benefit customers. Summarize some examples, and explain why they may result in invasion of privacy.
11. Robots take jobs away from people. Describe the considerations that management will be faced with when it needs to decide whether to use robots in an organization.
12. Explore the effects of the U.S. Americans with Disabilities Act on productivity and cost as it relates to IT. Should this act also exist in all other countries around the world? Discuss.
13. Explain why organizations are becoming flatter, and what the implications are for management practices.
14. Discuss the benefits of a virtual community to its members, society, and agents of e-commerce.

EXERCISES

1. Review the wearable computers case in Chapter 6.
 - a. Identify all the issues in this case that involve changes to the way people work.
 - b. Advise Bell Canada's president as to any sensitivities that she or he may need to consider if extending this pilot program to the whole company.
2. Schafer (1996) pointed out that companies in industries such as the fishing industry must take advantage of IT to become intensely efficient. But as a result, they simply may run out of scarce natural resources. So, the technology that was a savior may wipe many people out of business. Discuss the dilemma, and examine the situation in other industries such as oil and coal. What are the possible solutions?
3. You want to set up a personal Web site. Using legal sites such as *cyberlaw.com*, prepare a report summarizing the types of materials you can and cannot use (e.g., logos, graphics, etc.) without breaking copyright law.
4. Visit the following virtual communities: *wbs.net*, *geocities.com*, *well.com*, *electricminds.com*, and *espn.go.com/malu.html*. Join one of the communities. Become a member of the community and report on your experiences.
5. Will the Web "eat" your job? Read Baatz's (1996) paper. What types of jobs are most likely to disappear or be drastically reduced? Why?
6. Research the status of IT helping people with disabilities. Visit the following sites: *abletowork.org*, *usdoj.gov/crt/ada/adahom1.htm*, *halftheplanet.com*, and *ican.com*. Write a status report on the latest innovations in this area.
7. Download freeware from *junkbuster.com* and learn how to prohibit unsolicited e-mail. Describe how your privacy is protected.

GROUP ASSIGNMENTS

1. China has strengthened its control of the Internet with an extension of its criminal laws to cover the revealing of state secrets and spreading of computer viruses. The new laws were drafted in order "to promote the healthy development of the Internet and protect national security." They also make it an offense "to use the Internet to promote religious cults, hurt national unity, or undermine the government." (Source: William Kazer, writing for the *South China Morning Post*, December 30, 2000.)

These laws raise as many concerns as they solve existing problems. Clearly governments have a strong need to protect their vital interests, but the new laws seem quite sweeping. The vagueness of expressions like "hurting national unity" may be particularly awkward—the intention is to prevent secession, but what constitutes a "nation" is itself arguable.

 - a. What impacts do you think these new laws will have for citizens of China?
 - b. Are the laws really enforceable? (Check the products of Safe Web Corporation that allow you to break Internet blockades.)
 - c. Do we need laws to promote the healthy development of the Internet? What aspects of Internet development do you find unhealthy? Would you want to regulate the Internet's development? Create groups that will debate these issues.
2. The State of California maintains a database of people who allegedly abuse children. (The database also includes names of the alleged victims.) The list is made available to dozens of public agencies, and it is considered in cases of child adoption and employment decisions. Because so many people have access to the list, its content is easily disclosed to outsiders. In 1996, an alleged abuser and her child, whose case was dropped but whose names had remained on the list, sued the State of California for invasion of privacy.



With the class divided into groups, debate the issues involved. Specifically:

- a. Is there a need to include names of people on the list in cases that were dismissed or declared unfounded?
- b. Who should make the decision about what names should be included, and what should the criteria be?
- c. What is the potential damage to the abusers (if any)?
- d. Should the State of California abolish the list? Why or why not?

INTERNET EXERCISES

1. There is considerable talk about the impact of the Internet on society. Concepts such as a global village, an Internet community, the Internet society, and the like are getting much attention (e.g., see *Harvard Business Review*, May/June 1996, and *Business Week*, May 5, 1997). Surf the Internet (e.g., try *google.com*), and prepare a report on the topic. How can companies profit from Internet communities?
2. The Internet and intranets are playing an important role in providing opportunities to people with disabilities. Find more about the topic by surfing the Internet.
3. Enter *internetwk.com/links*.
 - a. Get a listing of industry organizations with privacy initiatives.
 - b. Check out the W3C's Privacy Preferences Project (*w3c.org*).
4. Enter communities such as the following: *earthweb.com*, *dobedo.co.uk*, *hearme.com*, and *webmed.com*. Find common elements.
5. Investigate the services provided at *clubs.yahoo.com*.
6. Enter *google.com* and go to sources that deal with the "digital divide." Prepare a report on activities done within three countries.
7. Enter *china.com* and find the unique services provided there to members.
8. Enter *fool.com*. Why is this site considered to be a community?



Minicase 1 The Australian Fishing Community

Recreational fishing in Australia is popular both for residents and for international visitors. Over 700,000 Australians regularly fish. The Australian Fishing Shop (AFS) (*ausfish.com.au*) is a small e-tailer, founded in 1994, initially as a hobby site carrying information about recreational fishing. During the last few years the site has evolved into a fishing portal, and it has created a devoted community behind it.

A visit to the site will immediately show that the site is not a regular storefront, but that it actually provides considerable information to the recreational fishing community. In addition to sale of products (rods, reels, clothing, boats, and fishing-related books, software, and CDROMs) and services (fishing charters and holiday packages), the site provides the following information:

- Hints and tips for fishing
- What's new
- A photo gallery of people's catches

- Chat boards—general and specialized
- Directions of boat builders, tackle manufacturing, etc.
- Recipes for cooking fish
- Information about newsgroups and a mailing list
- Free giveaways, competitions
- Links to fishing-related government bodies, other fishing organizations (around the globe and in Australia), and daily weather maps and tides reports
- General information site and FAQs
- List of fishing sites around the globe
- Contact details by phone, post, and e-mail
- Free e-mail Web page hosting

In addition there is an auction mechanism for fishing equipment, and answers are provided to inquiries.

The company is fairly small (gross income of about AU\$500,000 a year). How can such a small company

16W30 CHAPTER 16 IMPACTS OF IT ON ORGANIZATIONS, INDIVIDUALS, AND SOCIETY

survive? The answer can be found in its strategy of providing value-added services to the recreational fishing community. These services attract over 1.6 million visitors each month, from all over the world, of which about 1 percent make a purchase. Also, several advertisers sponsor the site. This is sufficient to survive. Another interesting strategy is to aim at the *global market*. Most of the profit is derived from customers in the United States and Canada who buy holiday and fishing packages.

In terms of products, the company acts basically as a referral service to vendors, so it does not have to carry an inventory. When AFS receives an order, it orders the products from its suppliers. It then manually aggregates the orders from the suppliers and packs and sends them via a service delivery to customers. Some orders are shipped directly from vendors to the customers.

Source: Based on information found at ausfish.com.au (site accessed July 2003).

Questions for Minicase 1

1. Why is this considered an Internet community?
2. How does the community aspect facilitate revenue?
3. What is the survival CSF (critical success factor) of this company?
4. What is the advantage of being a referral service? What is the disadvantage?
5. Compare the services offered at the AFS Web site with services offered by companies in other countries such as: daytickets.co.uk, fishing-boating.com, pvisuals.com/fishing/online, and fishingtackleonline.co.nz.



Minicase 2 American Stock Exchange Seeks Wireless Trades

For about 120 years, traders at the American Stock Exchange (Amex) used hand signals to relay information about their trades. But in April 1993 Amex introduced a pilot project to test the use of handheld computers in trading. Previous attempts by the Chicago Board of Trade and by the Chicago Mercantile Exchange were not successful. Amex is using simple, off-the-shelf equipment instead of the highly customized terminals used by the Chicago exchanges. The project was the first in series designed to make Amex a paperless trading floor.

Omer F. Sykan, director of technical planning at Amex, said that the biggest benefit is to get a real-time position analysis to the 462 members of the exchange. Experiments are being done with two different devices. One device is used by market specialists to transmit option trades to a PC-based risk-analysis system. The second device is used for equity (stock) trading.

Wireless technologies are expected to be faster and more cost-effective than hand signals and the paper-and-pencil trading mechanism that has been in use for the past 70 years. In the old system, specialists receive orders by hand signals and scribble their trades on an order slip. Then a clerk manually enters the data into the computer. If the



The American Stock Exchange's handheld computer.



markets are moving rapidly, the information that the clerk gathers from the floor is often obsolete by the time it is put into the computers. Handheld devices transmit information instantaneously.

While the devices are extremely easy to use, many traders do not welcome them. "We old guys are faster than most of these computers," says Jack Maxwell, a veteran of 26 years with Amex. "To hell with it; I don't need the handhelds." Attitudes of traders like Maxwell are a big problem facing expanded use of computers.

By 1996, the Amex was in the process of implementing the system, first on a voluntary basis.

Sources: Based on *Computerworld* (May 17, 1993), p. 6; *Wall Street Journal* (July 19, 1993), p. C1; and *Fortune* (October 28, 1996), p. 52.

Questions for Minicase 2

1. As a consultant to Amex, you need to identify the problems of implementing the handheld computers. How would you approach your task?
2. The president of Amex was considering laying off traders like Maxwell. Would you support such a decision or not?
3. Find the status of the computerization that is going on in several stock and commodity exchanges in several countries.
4. How would you convince a trader, who may soon lose his or her job, to use the new device?



Virtual Company Assignment

Impacts of IT

It's been a fantastic internship—you've learned quite a lot about the application of information technologies in a small enterprise, and you've become somewhat of an expert on the restaurant business. Many of your IT recommendations are being considered by the owners, and you are anticipating a systems-related job offer from them after you graduate. As you consider the changes you have recommended and how the new systems would make The Wireless Café more efficient and effective, you also pause to think about some of the social consequences of these changes.

Instructions

1. Many people in the hospitality industry are people-oriented, and they enjoy the person-to-person interaction and helping people to enjoy themselves. Many of the recommended systems, such as the SCM, CRM, decision support, and intelligent applications you have recommended appear to dehumanize tasks. What are some of the social consequences of these changes, and how should Jeremy and Barbara address them with their employees?
2. What social opportunities do the new information systems at The Wireless Café present to management to contribute to their community? For example, can employment opportunities be expanded to people with disabilities who wouldn't otherwise be successful there? Can The Wireless Café provide Web site information and activities that would benefit community members on the "other side" of the digital divide? Propose some ways that you, as a member of a local civic organization, could leverage The Wireless Café's new technologies for the benefit of the community.
3. Discuss the expectations regarding responsibility, accountability, and liability for information by the wait-staff, the head cook, and the owners. *Responsibility* means that you accept the potential costs, duties, and obligations for the decisions you make. *Accountability* is a feature of systems and social institutions that allows the determination of who is responsible. *Liability* is a feature of political systems that permits individuals to recover damages done to them by responsible individuals or organizations.



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16W34  **CHAPTER 16** IMPACTS OF IT ON ORGANIZATIONS, INDIVIDUALS, AND SOCIETY

Technology Solutions Products				
Title	WebCT	Bb	eGrade	eGrade Plus
Business				
Accounting				
Jiambalvo, <i>Managerial Accounting, 2e</i>	Dec. ✓	Dec. ✓		
Jiambalvo, <i>Managerial Accounting</i>	✓	✓		
Kieso, <i>Intermediate Accounting, 11/e</i>	✓	✓		
Kieso, <i>Fundamentals of Intermediate Acc.</i>	✓	✓		
Kimmel, <i>Financial Accounting, 3/e</i>	✓	✓	✓	
Kimmel, <i>Principles of Financial Accounting, 1/e</i>			Demo 1/04	
Pratt, <i>Financial Accounting 5/e</i>	✓	✓		
Weygandt, <i>Accounting Principles, 6/e</i>	✓	✓		
Weygandt, <i>Financial Accounting, 4/e</i>	✓	✓		
Weygandt, <i>Managerial Accounting, 2/e</i>	✓	✓		
Decision Sciences				
Meredith, <i>Operations Management WSJ, 1/e</i>	Testbank only			
Pelosi, <i>Doing Stats for Business, 1/e</i>			✓	
Reid, <i>Operations Management, 1/e</i>	✓	✓		
Information Systems				
Dennis, <i>Systems Analysis & Design, 2/e</i>	✓	✓		
Turban, <i>Intro to Information Technology, 2/e</i>	✓	✓		
Turban, <i>Info Technology for Management 3/e</i>	✓	✓		
Computer Science				
Horstmann, <i>Big Java</i>			✓	
Horstmann, <i>Computing Concept Java Essentials, 3/e</i>			✓	
Engineering (courses denoted w/ an asterisk below are using the general fluid or circuits test bank)				
Callister, <i>Materials Science and Eng, 6/e</i>			✓	
Callister, <i>Fundamentals of Material Science</i>			✓	
*Crowe, <i>Engineering Fluid Mechanics, 7/e</i>			✓	
*Dorf, <i>Introduction to Electric Circuits, 6/e</i>			✓	
*Fox, <i>Introduction to Fluid Mechanics, 6/e</i>			✓	
*Irwin, <i>Basic Engineering Circuit Analysis, 7/e</i>			Ch 1-14 Avail.	
*Meriam, <i>Engineering Mechanics: Dynamics, 5/e</i>			✓	
*Meriam, <i>Engineering Mechanics: Statics, 5/e</i>			✓	
Montgomery, <i>Engineering Statistics, 2/e</i>			✓	
Montgomery, <i>Applied Stats & Probability, 3/e</i>			✓	
*Munson, <i>Fundamentals of Fluid Mechanics, 4/e</i>			✓	
*Paul, <i>Fundamentals of Electric Circuit Analysis</i>			✓	
*Smits, <i>Physical Intro to Fluid Mechanics</i>			✓	
*Street, <i>Elementary Fluid Mechanics, 7/e</i>			✓	
*Thomas, <i>Analysis and Design of Linear Circuits, 4/e</i>			✓	
*Young, <i>A Brief Intro Fluid Mechanics, 2/e</i>			✓	
Management/Finance				
Jones, <i>Investment, 8/e</i>	✓	✓		
Schermerhorn, <i>Organizational Behavior, 8/e</i>	✓	✓		
Schermerhorn, <i>Management, 7e</i>	✓	✓		

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These are icons to come

TS 16W34 to TS 16W47 has been keyed.

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Note: ✓ = full + demo course available.



Title	WebCT	Bb	Grade	Grade
Science				
Biology & Anatomy/Physiology				
Benjamini, <i>Immunology</i> , 4/e	✓			
Black, <i>Microbiology</i> , 5/e	✓	✓		
Tortora, <i>Principles of Anatomy & Physiology</i> , 10/e	✓	✓		
Tortora, <i>Principles of Human Anatomy</i> , 9/e	✓	✓		
Pruitt, <i>BioInquiry</i>	✓			
Chemistry				
Brady, <i>Chemistry: The Study of Matter</i> , 4/e			Demo	Demo
Brady, <i>Chemistry: The Study of Matter</i> , 3/e			✓	
Hein, <i>Foundations of College Chemistry</i> , 11/e			✓	
Malone, <i>Basic Concepts of Chemistry</i> , 7/e			✓	
Olmsted, <i>Chemistry</i> , 3/e	✓	Demo	✓	
Snyder, <i>Extraordinary Chemistry</i> , 1/e			✓	
Solomons, <i>Organic Chemistry</i> , 8/e			Ch 1-17 Avail.	
Voet, <i>Fundamentals of Biochemistry</i> , 2/e			✓	
Physics				
Cummings, <i>Physics 1e</i>				Demo 1/04
Cutnell, <i>Physics</i> , 6/e	✓	✓	✓	✓
Halliday, <i>Fundamentals of Physics</i> , 6/e	✓		✓	Demo 1/04
Trefil, <i>The Sciences</i> , 3/e	✓			
Social Science				
Education				
Ruddell, <i>Teaching Content Reading & Writing</i> , 3/e	✓			
Modern Languages				
Dawson, <i>Dicho y hecho</i> , 7/e	✓	✓		
Dawson, <i>Dicho y hecho</i> , 6/e	✓			
Psychology				
Davison, <i>Abnormal Psychology</i> , 9/e	✓	✓		
Huffman, <i>Psychology in Action</i> , 7/e	✓	✓		
Minium, <i>Statistical Reasoning in Psychology</i>			✓	
Westen, <i>Psychology</i>	✓	✓		
Witte, <i>Statistics</i> , 7/e			✓	
Mathematics & Statistics				
Advanced Math				
Anton, <i>Elementary Linear Algebra: Apps and 8e</i>			✓	
Anton, <i>Contemporary Linear Algebra</i> , 1/e			✓	
Epperson, <i>Intro Numerical Meth Anlys</i>			✓	
Math				
Anton, <i>Calculus: ET</i> , 7/e (Brief)			✓	
Anton, <i>Calculus: LT</i> , 7/e (Brief)			✓	
Anton, <i>Calculus: ET</i> , 7/e Update			✓	
Anton, <i>Calculus: LT</i> , 7/e Update			✓	
Anton, <i>Multivariable Calculus</i> , 7/e Update			✓	
Connally, <i>Functions Modeling (Pre-Calc)</i> 1/e			✓	
Connally, <i>Functions Modeling (Pre-Calc)</i> 2/e				more content Jan.
Gilbert, <i>Math Beyond the Numbers</i> , 2/e				Jan.
Himonas, <i>Calculus: Ideas and Applications</i> 1/e				Cancelled
Hughes Hallett, <i>Applied Calc</i> , 2/e			✓	
Hughes Hallett <i>Calculus SV</i> , 3/e			✓	
Hughes Hallett <i>Calculus Multi</i> , 3/e			✓	

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16W36  **CHAPTER 16** IMPACTS OF IT ON ORGANIZATIONS, INDIVIDUALS, AND SOCIETY

Title	WebCT	Bb	Grade	Grade
Hughes Hallett <i>Calculus SV</i> , 3/e Update			✓	
Hughes Hallett <i>Calculus Multi</i> , 3/e Update			✓	
Kime, <i>Expl College Algebra</i> , 2/e			✓	
McCallum, Hughes Hallett, <i>MV Calculus</i> , 3/e			✓	
Musser, <i>Math for Elementary Teachers Update</i> , 6/e			✓	
Musser, <i>Essentials of Math for Elementary Teachers</i> , 6e			✓	
Salas, <i>Calculus One/Several Variables</i> , 9/e				Semester 1 Nov. Semester 2 Jan.
Statistics				
Black, <i>Business Statistics</i> , 4/e	✓	✓	✓	
Chase, <i>General Statistics</i> , 4/e			✓	
Mann, <i>Introductory Statistics</i> 5/e				more content Jan.
Demo Central Demos http://www.wiley.com/college/democentral				
Calculus Machina				
Cutnell & Johnson, Physics, 6/e eGrade Plus Demo				
Cutnell & Halliday, Wiley Interactive Homework Editions				
Cutnell & Halliday, Wiley Physics New Media (Instructor's CD, WebCT, eGrade, Simulations)				
Dorf/Svaboda, Introduction to Electronic Circuits, 5/e				
e-Grade Demo				
Gries/Gries, ProgramLive in Java				
Lancraft, Interactions: Exploring the Function of the Human Body				
Olmsted/Williams, Chemistry, 3/e				
Pruitt et al., BioInquiry: Making Connections in Biology, 2/e				
Solomons/Fryhle, Organic Chemistry, 7/e				
Voet/Voet/Pratt, Fundamentals of Biochemistry				
Weygandt/Kieso/Kimmel, <i>Accounting Principles</i> , 6/e				
Blackboard Usernames & Passwords:		WebCT Usernames & Passwords:		
Student: wileystudent/wileystudent		Student: guest/guest		
Instructor: wileypub/wileypub		Instructor: universal/instructor		
Business Extra Select = www.wiley.com/college/bxs				
Sample CoursePack ISBN: 0-471-49996-X				
Username: rep[123] "rep" followed by last three digits of territory number				
Password: wileysales				
Website Username & Password for Reps (Student Companion Sites)				
<i>Username:</i> highered				
<i>Password:</i> eu1he5xy				



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Blackboard SLG	0471168653	\$15 net; FREE in packages/sets—check CPR for set ISBN's
eGrade Plus SLG for Cutnell, 6e	0471468878 (1 term)	\$30 net; FREE in packages/sets—check CPR for set ISBN's
eGrade Plus SLG for Cutnell, 6e	0471468886 (2 term)	\$60 net; FREE in packages/sets—check CPR for set ISBN's
IHE SLG (Halliday, 6e)	0471294365 (1 term)	\$15 net; \$5 in packages/sets—check CPR for set ISBN's
IHE SLG (Halliday, 6e)	0471269077 (2 term)	\$15 net; \$5 in packages/sets—check CPR for set ISBN's
IHE SLG (order on-line)	Halliday (1 term)	\$30 net http://www.wiley.com/marketbasket.cgi?isbn=0471447307

*Cutnell, Physics, 6e—eGrade Plus Demo CD 047146323X

Showcase Sites

Site	URL
Brady, <i>Chemistry Matter and It's Changes 4e</i>	http://www.wily.com/college/sc/brady
Comer, <i>Fund. of Electronic Circuit Design</i>	http://www.wiley.com/college/sc/comer/
Cutnell, <i>Physics, 6e</i>	http://www.wiley.com/legacy/college/sc/cutnell/
DeBlij, <i>Concepts</i>	http://www.wiley.com/college/sc/deblij
Dennis, <i>Systems Analysis & Design, 2/e</i>	http://www.wiley.com/college/sc/dennis
eLearning Showcase Site	http://www.wiley.com/legacy/college/sc/elearning/
Education website	http://www.wiley.com/college/sc/education
Galloway, <i>Vision y voz</i>	http://www.wiley.com/college/sc/vision/
Gallego, <i>Mas Alla (NEW)</i>	http://www.wiley.com/college/sc/gallego/
Horstmann Showcase Site	http://www.wiley.com/college/sc/horstmann/
Irwin, <i>Basic Engineering Circuit Analysis, 7/e</i>	http://www.wiley.com/college/sc/irwin/
Kieso, <i>Fundamentals of Intermediate Acct</i>	http://www.wiley.com/college/sc/kiesofund/
Lancraft, <i>Interactions</i>	http://www.wiley.com/college/sc/interactions/
Mann, <i>Intro Statistics, 5/e</i>	http://www.wiley.com/college/sc/mann/
McKeown, <i>Visual Basic.Net (NEW)</i>	http://www.wiley.com/college/sc/mckeown/
Meriam, <i>Engineering Mechanics</i>	http://www.wiley.com/college/sc/meriam/
Moran, <i>Fund. Eng. Thermodynamics, 5e</i>	http://www.wiley.com/legacy/college/sc/moran/
Musser, <i>Test Drive Site</i>	http://www.wiley.com/college/sc/musser
Olmsted, <i>Chemistry, 3/e</i>	http://www.wiley.com/college/sc/olmsted/
Pelosi, <i>Doing Stats for Business 2e</i>	http://www.wiley.com/college/sc/pelosi
Pruitt, <i>BioInquiry</i>	http://www.wiley.com/college/sc/bioinquiry/
Reys, <i>Helping Children Learn Math, 7/e</i>	http://www.wiley.com/college/sc/reys/
Schermerhorn, <i>Management 7e Ethical Leadership Update</i>	http://www.wiley.com/college/sc/scherm
Turban, <i>IT for Management, 4/e (NEW)</i>	http://www.wiley.com/college/sc/tmw/
Turban, <i>Introduction to Information Tech, 2/e</i>	http://www.wiley.com/college/sc/turban/
Weygandt, <i>Financial Accounting, 4/e</i>	http://www.wiley.com/college/sc/wkkfin/
Weygandt, <i>Managerial Accounting</i>	http://www.wiley.com/college/sc/wkkman/



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471467057	PROGRAMMING WITH C++ (STUDENT-comp restricted) IMPORTANT NOTE—as a special introductory promotion the price listed will be discounted 50%. This offer lasts through April 2004.	10/31/03	CD	76.95L
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<p>Business Logo to come</p> <p>Business Extra Select wiley.com/college/bxs</p>	<p>Business Extra Select is a custom publishing program that allows instructors to combine copyright cleared readings, articles, & cases from leading business publications with Wiley content in either a printed or digital CoursePack.</p>
<p>Web CT & Bb icon to come</p> <p>WebCT wiley.com/college/webct Blackboard wiley.com/college/blackboard</p>	<p>WebCT e-Packs & Blackboard Course Cartridges have book-specific content specially formatted to work in WebCT & Blackboard's easy-to-use course management software. They typically contain resources such as quiz & test banks, Power Point slides, Instructor Manuals, Solution Manuals, and links to other online resources.</p>
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<p>e-grade plus icon to come</p> <p>eGrade Plus wiley.com/college/democentral</p>	<p>eGrade Plus is a web-based platform that integrates the eGrade online homework and quiz management system with a multimedia version of the textbook.</p>
<p>e-Learning icon to come</p> <p>eLearning Courseware wiley.com/college/sc/elearning</p>	<p>eLearning is a new multimedia program that provides a full set of course material on a CD-ROM (Courseware). Courseware is a shift away from traditional textbook materials to a new "active learning content model" that integrates interactive content, dynamic feedback, self-assessment and a powerful learning management tool.</p>

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Faculty Issues/Needs it Addresses	Student Issues/Needs it Addresses	Questioning Strategy?
<p>Book Companion Sites provide easy online access to a book's supplement package such as Instructor's Manuals, Solutions, and Test Banks.</p>	<p>Student Companion Sites provide web-based self-assessments (allowing students to quickly determine their understanding of course material prior to their exams) and other online student resources in a single location.</p>	<p>As an instructor, do you use website resources that accompany your textbook and if so, what resources are most valuable?</p> <p>Do your students use the website resources that accompany the textbook?</p> <p>Are the student website resources required or optional?</p>
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<p>eGrade Plus helps students conquer problem-solving obstacles at the point of contact for immediate reinforcement.</p> <p>Places all instructor resources (such as the Instructor manual, Power Point slides, quiz & test banks) in one easy to use interface for maximum convenience and easy integration with Wiley content.</p>	<p>Integration of multimedia book with problem sets provide students with context-sensitive help, helping them develop problem-solving skills and conquer obstacles at the point of contact.</p>	<p>What are your biggest challenges in teaching Physics?</p> <p>Would you be interested in a text-specific solution that is aimed at getting students to read their book and complete their homework?</p> <p>See eGrade Plus interview guide for more detailed probe questions!</p>

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16W42  **CHAPTER 16** IMPACTS OF IT ON ORGANIZATIONS, INDIVIDUALS, AND SOCIETY

Faculty Issues/Needs it Addresses	Student Issues/Needs it Addresses	Questioning Strategy?
<p>eLearning Courseware has “Ready-to-go” courses with simple customization tools, making it easier to create an online course. Learning management tools help track student interaction/success with material to address retention issues.</p>	<p>CD delivery eliminates any bandwidth constraints for rich content, combined with web-based synchronization for true “anytime/anywhere” learning (online-offline access). Performance-based interactive content with dynamic feedback designed around student outcomes—compensating for the lack of face-to-face classroom interaction.</p>	<p>Would you like your online class to be taught with the same core materials as in the classroom?</p> <p>Are you using a Course Management System?</p> <p>Are you looking for more innovative ways to teach online?</p> <p>Are you looking for tools that will help your students stay engaged and on task?</p> <p>Do your students need new tools to compensate for the lack of face-to-face interaction?</p>



Technology Solutions Quick Reference Guide—August 2003

Product	Sales Resources & Walk Throughs
<p>Wiley Logo to come</p> <p>Book Companion Sites www.wiley.com/college/ author name</p>	<p>Use you camps username and password to access instructor companion sites.</p>
<p>Business Logo to come</p> <p>Business Extra Select wiley.com/college/bxs</p>	<p>Business Extra Select</p> <ol style="list-style-type: none"> 1) Sales folder (hard copy sheets & PDF versions on In Site) 2) BXS walkthrough on In Site 3) Listing of all available and forthcoming courses on Tech Solutions 4) Links to correlated CoursePacks from relevant Title Landing Pages
<p>Web CT & Bb icon to come</p> <p>WebCT wiley.com/college/webct Blackboard wiley.com/college/blackboard</p>	<p>WebCT e-Packs & Blackboard Course Cartridges</p> <p>Listing of available and forthcoming titles on Tech Solutions Individual Title Landing Pages with course descriptions, text/SLG ISBNs, product-specific demos and class trial & adoption forms</p>
<p>e-grade icon to come</p> <p>eGrade wiley.com/college/egrade</p>	<p>eGrade</p> <p>PowerPoint presentation on Demo Central Demo of eGrade question types on Tech Solutions Walkthrough on In Site Listing of all available and forthcoming courses on Tech Solutions Individual Title Landing Pages with course descriptions, text/SLG ISBNs, product-specific demos and class trial & adoption forms</p>
<p>e-grade plus icon to come</p> <p>eGrade Plus wiley.com/college/democentral</p>	<p>eGrade Plus</p> <p>Self-running demo on Demo Central/CD-ROM</p>
<p>e-Learning icon to come</p> <p>eLearning Courseware wiley.com/college/sc/elearning</p>	<p>eLearning Courseware</p> <p>Self-running product overview demo on showcase site www.wiley.com/college/sc/elearning/demo.html</p>

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16W44  **CHAPTER 16** IMPACTS OF IT ON ORGANIZATIONS, INDIVIDUALS, AND SOCIETY

Pricing and Packaging Options	Adoption Fulfillment	Who to call for what?
<p>Student subscription to Book Companion Sites come packaged free of charge with new books.</p> <p>Students who purchase a used book can purchase access online for \$10.</p>	<p>Professor registers for access on Instructor Companion Site, rep approves via Prof Val.</p>	<p>Instructor Companion Site Registration Troubleshooting: Reps use ProfVal Admin in Camps.com (Find Professor Module)</p>
<p>The digital/online price for Business Extra Select material is automatically calculated and is based on the amount and type of content selected. Print version is extra, price is confirmed by Wiley Custom Services.</p> <p>Print version is purchased in college bookstore. Access to digital form can either be purchased in the bookstore or online.</p>	<p>Adoption form on BXS website. Printed CoursePacks will be shipped to the college bookstore. Online CoursePacks can be accessed from any computer with web access.</p>	<p>Fulfillment: Wiley Custom Services Rep Support: Online Marketing & David Maltby (816.415.2015, dmaltby@xanedu.com) Customer Support: Xanedu customer support 800-521-0600 × 5204 Training: N/A</p>
<p>Student Access Code is contained in the WebCT/Bb Student Learning Guide and is free when packaged with a new book.</p> <p>\$15 net when SLG is purchased as a stand-alone item.</p> <p>WebCT Access Codes can also be purchased online at WebCT website.</p>	<p>Professor submits an “Adopt Now” form via the Title Landing Page.</p>	<p>Fulfillment: Online Marketing Rep Support: Online Marketing Customer Support: wiley.com/techsupport Training: FRN & Online Marketing</p>
<p>Student Access Code is contained in the eGrade Student Learning Guide.</p> <p>\$5 when the SLG is packaged with a new copy of the text.</p> <p>\$15 when it is sold as a stand-alone item.</p>	<p>Professor submits an “Adopt Now” form via the Title Landing Page.</p>	<p>Fulfillment: Online Marketing Rep Support: Online Marketing Customer Support: wiley.com/techsupport Training: FRN & Online Marketing</p>
<p>Student access code contained in eGrade Plus Student Learning Guide and is free when the SLG is packaged with a new book.</p> <p>\$60 when purchased as a stand-alone item.</p> <p>\$30 for one semester access when purchased online.</p>	<p>Professor submits an “Adopt Now” form via the Title Landing Page. Rep approves in Camps via Prof Val.</p>	<p>Fulfillment: Online Marketing Rep Support: Online Marketing Customer Support: wiley.com/techsupport Training: FRN & Online Marketing</p>
<p>eLearning Courseware has an introductory special price of 50% off for full courseware. Standard Courseware pricing is \$75–99.</p> <p>Students who purchase Courseware can buy companion textbook at 50% discount at www.wiley.com (bundled discount offer).</p>	<p>CDs ordered through bookstore or www.wiley.com. Special bundled discount companion textbooks sold through wiley.com</p>	<p>Fulfillment: WeL Group Rep Support: WeL Group Customer Support: wiley.com/techsupport Training: FRN & WeL Group</p>



Technology Solutions Fulfillment Reference Sheet—August 2003

Adopt	Alert	Approve	Notify	Follow-Up
<p>Black board logo to come</p> <p>Professor fills out and submits an “Adopt Now” form for one of our Blackboard Course Cartridges, which is accessed through a book’s Title Landing Page.</p> <p>Note: You may also submit an adoption request on behalf of your professor. If you do just be sure to include your name, phone number, email address, and territory # where it is asked for. Submitting a request on behalf of your professor will eliminate the “Approve” step.</p>	<p>Rep receives an email alert from online marketing containing the professor’s name, school, contact info, and title of Course Cartridge being adopted.</p>	<p>Rep verifies and approves the adoption request.</p> <p>Upon approval, online marketing processes the request.</p>	<p>An email notification is sent to the professor with instructions for adding the adopted Course Cartridge to their Blackboard course. The rep will be copied on this email.</p>	<p>Follow up with your professors and make sure they have the correct ISBN for their bookstore order, which is the textbook + Blackboard Student Learning Guide (SLG). The ISBN is located in your CPR as well as the Blackboard Title Landing Page for that book.</p> <p><i>Students will not be able to enter their course without an Access Code, which is contained in the Blackboard SLG!!!</i></p>
<p>WebCT Logo to come</p> <p>Professor fills out and submits an “Adopt Now” form for one of our WebCT e-Packs, which can be accessed either through a book’s Title Landing Page, or via WebCT’s Content Showcase (it is the same form).</p> <p>You may also submit a request on behalf of your professor by completing the above form.</p>	<p>Rep receives an email alert from the online marketing group, containing the professor’s name, school, contact info and title of e-Pack being adopted.</p>	<p>Rep verifies and approves the adoption request.</p> <p>Upon approval, online marketing processes the request.</p>	<p>An email notification is sent to the professor with instructions for downloading the e-ack (if the professor teaches at a school with a WebCT license) or accessing the hosted course (if the professor does not teach at a school with a WebCT license and requires WebCT to host his course for them).</p>	<p>Follow up with your professors and make sure they have the correct ISBN for their bookstore order, which is the textbook + WebCT Student Learning Guide (SLG). The ISBN is located in your CPR as well as the WebCT Title Landing Page for that book.</p> <p><i>Students will not be able to enter their course without an Access Code, which is contained in the WebCT SLG!!!</i></p>

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16W46  **CHAPTER 16** IMPACTS OF IT ON ORGANIZATIONS, INDIVIDUALS, AND SOCIETY

Adopt	Alert	Approve	Notify	Follow-up
<div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">eGrade Logo to come</div> <p>Professor or rep fills out and submits “Adopt Now” form for one of our <i>eGrade</i> courses. This form can be accessed through the Title Landing Pages of any books available with eGrade.</p>	<p>Rep receives an email alert from online marketing, containing the professor’s name, school, contact info, and title, and title of the <i>eGrade</i> course being adopted.</p>	<p>Rep verifies and approves the adoption request. Upon approval, online marketing processes the request.</p>	<p>An email notification is sent to the professor with instructions for accessing their <i>eGrade</i> course. The rep will be copied on this email.</p>	<p>Follow up with your professors and make sure they have the correct ISBN for their bookstore order, which is the textbook + <i>eGrade</i> Students Learning Guide (SLG). The ISBN is located in your CPR as well as the <i>eGrade</i> Title Landing Page for that book.</p> <p><i>Students will not be able to enter their course without an Access Code, which is contained in the eGrade SLG!!!</i></p>
<div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">eGrade plus Logo to come</div> <p>Professor fills out and submits “Adopt Now” form for one of our <i>eGrade Plus</i> courses. This form can be accessed through the Title Landing Pages of any books available with eGrade Plus.</p>	<p>—————></p>	<p>Rep approves pending requests in Camps.</p>	<p>An email notification is sent to the professor with instructions on adopting his <i>eGrade Plus</i> course the rep will be copied on this email.</p>	<p>Follow up with your professors and make sure they have the correct ISBN for their bookstore order, which is the textbook + <i>eGrade Plus</i> Student Learning Guide (SLG). The ISBN is located in your CPR as well as the <i>eGrade Plus</i> Title Landing Page for that book.</p> <p><i>Students will not be able to enter their course without an Access Code, which is contained in the eGrade Plus SLG!!!</i></p>

**Technology Solutions Fulfillment Reference Sheet—August 2003**

Business Logo
to come

BXS adoption process: Registration → Work-in-progress → Adoption

1. Professor registers for access to the Business Extra Select (BXS) website and you receive an email notification from David Maltby with professor name, school, contact info, etc.
2. The next step in *advancing the sale* is to get that professor to begin customizing his/her own CoursePack, called a “Work-in-Progress” (WIP). Professor starts a WIP. Rep receives an email notification from David Maltby, containing the same information as above plus the title of WIP that has been started. Rep follows up to encourage the professor to adopt.
3. The next step is to close the sale! Professor adopts CoursePack by clicking on the “Adopt” button in one of our CoursePacks and fills out & submits the online form. Rep receives an email from David Maltby.
4. **Rep follows up with the professor and verifies the specifics:**
 - a. Course start date
 - b. Format the professor wants the CoursePack in (print or digital)
 - c. Expected enrollment, etc.
5. **Rep fills out the WCS Project Information Profile and sends it to Jay Beck.**
6. Jay Beck
 - a. Activates the ISBN
 - b. Confirms the price
 - c. Confirms the order specifics (print and/or digital access, bundled with a Wiley text or stand-alone, etc)
7. The WCS office will provide the ISBN and price to the professor and to you. The professor will need to place their bookstore order for the CoursePack in the same manner that they place orders for all of their textbooks. **Rep follows up with professor to see that the order is placed in bookstore.**

NOTE ON REP SUPPORT: If you run into any issues or question at any point in this process you should contact David Maltby—who will help you!

Phone: 816.415.2015

Email: dmaltby@xanedu.com