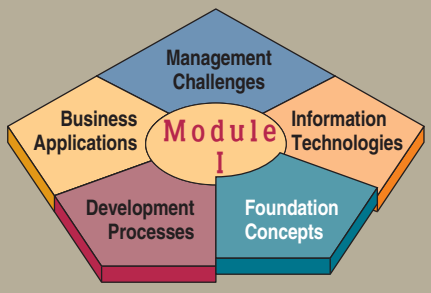
MODULE I



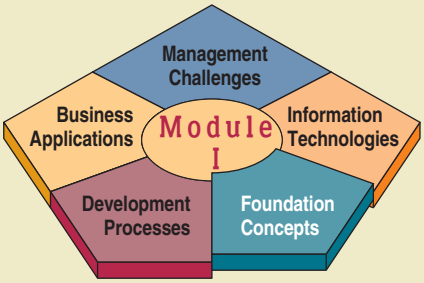
FOUNDATION CONCEPTS

Why study information systems? Why do businesses need information technology? What do you need to know about the use and management of information technologies in business? The introductory chapters of Module I are designed to answer these fundamental questions about the role of information systems in business.

- **Chapter 1: Foundations of Information Systems in Business** presents an overview of the five basic areas of information systems knowledge needed by business professionals, including the conceptual system components and major types of information systems. In addition, trends in information systems and an overview of the managerial challenges associated with information systems are presented.
- **Chapter 2: Competing with Information Technology** introduces fundamental concepts of competitive advantage through information technology and illustrates major strategic applications of information systems.

Completing these chapters will prepare you to move on to study chapters on information technologies (Module II), business applications (Module III), systems development processes (Module IV), and the management challenges of information systems (Module V).

CHAPTER 1



FOUNDATIONS OF INFORMATION SYSTEMS IN BUSINESS

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Learning Objectives

After reading and studying this chapter, you should be able to:

1. Understand the concept of a system and how it relates to information systems.
2. Explain why knowledge of information systems is important for business professionals, and identify five areas of information systems knowledge they need.
3. Give examples to illustrate how the business applications of information systems can support a firm's business processes, managerial decision making, and strategies for competitive advantage.
4. Provide examples of several major types of information systems from your experiences with business organizations in the real world.
5. Identify several challenges that a business manager might face in managing the successful and ethical development and use of information technology in a business.
6. Provide examples of the components of real world information systems. Illustrate that in an information system, people use hardware, software, data, and networks as resources to perform input, processing, output, storage, and control activities that transform data resources into information products.
7. Become familiar with the myriad of career opportunities in information systems.

SECTION I

Foundation Concepts: Information Systems in Business

Why study information systems and information technology? That's the same as asking why anyone should study accounting, finance, operations management, marketing, human resource management, or any other major business function. Information systems and technologies are a vital component of successful businesses and organizations—some would say they are business imperatives. They thus constitute an essential field of study in business administration and management. That's why most business majors include a course in information systems. Since you probably intend to be a manager, entrepreneur, or business professional, it is just as important to have a basic understanding of information systems as it is to understand any other functional area in business.

Information technologies, including Internet-based information systems, are playing a vital and expanding role in business. Information technology can help all kinds of businesses improve the efficiency and effectiveness of their business processes, managerial decision making, and workgroup collaboration, thus strengthening their competitive positions in a rapidly changing marketplace. This is true whether information technology is used to support product development teams, customer support processes, electronic commerce transactions, or any other business activity. Information technologies and systems are, quite simply, a necessary ingredient for business success in today's dynamic global environment.

The Real World of Information Systems

Let's take a moment to bring the real world into our discussion of the importance of information systems (IS) and information technology (IT). See Figure 1.1. Read the Real World Case about the successful use of information technology.

If we are to understand information systems and their functions, we first need to be clear on the concept of a system. In its simplest form, a system is a set of interrelated components, with a clearly defined boundary, working together to achieve a common set of objectives. Using this definition, it becomes easy to see that virtually everything you can think of is a system, and one system can be made up of other systems or can be a part of a bigger system. We will expand on this concept later in the next section but, for now, this definition gives us a good foundation for understanding the focus of this textbook: information systems.

What Is an Information System?

As above, we'll begin with a simple definition that we can expand upon later in the chapter. An **information system** (IS) can be any organized combination of people, hardware, software, communications networks, data resources, and policies and procedures that stores, retrieves, transforms, and disseminates information in an organization. People rely on modern information systems to communicate with each other using a variety of physical devices *(hardware)*, information processing instructions and procedures *(software)*, communications channels *(networks)*, and stored data *(data resources)*. While today's information systems are typically thought of as having something to do with computers, we have been using information systems since the dawn of civilization. Even today we make regular use of information systems that have nothing to do with a computer. Consider some of the following examples of information systems:

- **Smoke signals for communication** were used as early as recorded history can account for the human discovery of fire. The pattern of smoke transmitted valuable information to others who were too far to see or hear the sender.
- **Card catalogs in a library** are designed to store data about the books in an organized manner that allows for a particular book to be located by its title, author name, subject, or a variety of other approaches.

REAL WORLD CASE 1

Continental Airlines: This Call *Is* Being Monitored

If you've ever placed a call to any big company's customer service department, you've heard the caveat: "This call may be monitored for quality assurance purposes." But is anyone really listening? Someone is—or at least the computers are—at Continental Airlines.

Building customer loyalty has become crucial in the beleaguered airline industry, which is why Continental enlisted the help of Witness Systems, whose call-center software, CallMiner, does more than eavesdrop: It records conversations and captures every keystroke, so managers know whether the right actions were taken. And because the exchanges reveal what customers really want, Continental is also mining the data to help craft marketing plans and shape overall strategy. Fortunately for Witness, which saw its revenues jump 60 percent to $108 million in 2003, that trend is catching on: 53 percent of its clients are now using such data beyond the call center.

Continental Airlines is the world's seventh-largest airline and has more than 2,300 daily departures. With 134 domestic and 92 international destinations, Continental has the broadest global route network of any U.S. airline, including extensive service throughout the Americas, Europe, and Asia. Continental has hubs serving New York, Houston, Cleveland, and Guam and carries approximately 41 million passengers per year on the newest jet fleet among major U.S. airlines. With 42,000 employees, Continental is ranked one of the 100 Best Companies to Work For in America by *Fortune Magazine.* In 2003, *Fortune* ranked Continental highest among major U.S. carriers in the quality of its service and products, and No. 2 on its list of Most Admired Global Airlines.

FIGURE 1.1

Virtually no business or organization, large or small, can compete without information systems and information technology. We truly live in a wired world.

Source: Rick Maiman/Corbis

Despite these accolades, before the CallMiner software was installed in 2001, Continental's agents were unable to resolve about 6 percent of the 60 million calls they fielded annually. Instead, these problems were routed to an internal help desk. The Witness data revealed that some agents "weren't attempting to look up the answers on their own," says Andre Harris, director of reservations training and quality. New standards were put in place, and within a year, nearly 20 percent fewer calls were being sent to the help desk, saving the company $1 million. In addition, customer satisfaction rose by 10 percent, and e-ticket sales increased by 8 percent.

Harris soon realized that the data could be a treasure trove for marketing and service operations too. "We thought we were just replacing tape recorders," she says, "but it dawned on us that we could use this system to drive business decisions." Now if enough calls come in on one topic, Continental can respond. For instance, when the company learned that as many as 14 percent of customers were reconfirming flights, it ran a notice in its in-flight magazine to assure fliers that such calls were unnecessary.

To make the call monitoring more effective, Continental added CallMiner, a labor-saving Witness program that automatically transcribes conversations into text. "It gives me more time to analyze the data," Harris says, "rather than just collect it."

Tying speech systems to mainstream corporate IT systems, and the use of Internet-based voice systems such as Voice over IP (VoIP)[1], are making it easier to mine databases of voice records, much as companies have mined other customer records for years. Intelligent Voice Recognition (IVR) analysis tools usually can keep track of and report on a caller's choices based on which menu paths the caller has taken. But CallMiner and a few other tools can go into the voice record and look for specific words or word combinations. Continental recorded a sample of its 5 million monthly calls and then used CallMiner to turn the dialogues into text to mine for certain things. It discovered that about 10 percent of the calls contain the actual word *reconfirm*.

Calls to reconfirm a flight are, "quite frankly, low-value calls," says Harris. She says she used the CallMiner analysis to justify the deployment of a new IVR system just for flight confirmations.

Continental currently has eight people listening to samples of calls in order to manually prepare a "call-mix report," which is used for analytical purposes by marketers and business planners at the airline. "The pilot test [of CallMiner] helped me realize very quickly that I can do this with one person instead of eight," she says. And do it better.

[1]VoIP is a technique whereby telephone conversations can be transmitted via the Internet at greatly reduced costs relative to conventional telephone technologies.

Harris's efforts paid off and won her the Innovator of the Year award from Witness Systems. This award recognizes contact center managers and their respective companies for outstanding customer service accomplishments.

Harris was chosen for her leadership in developing and implementing Continental's "Call-Mix Survey" program for collecting and analyzing important data that can only be captured in the contact center and for using it to help support the strategic direction of the organization. While monitoring calls through CallMiner, team leaders complete online call-mix surveys to track the different types of calls coming into the reservation centers and review calls that were received by the help desk.

Within a few months, the survey results revealed a significant increase in customer reconfirmation calls—in some months the number almost doubled. Reconfirmation of flights is not a requirement for Continental's passengers. Therefore, the quality assurance task force presented their findings and enlisted other areas of the company, including marketing, corporate communications, and reservation operations, to educate customers that reconfirmation is unnecessary. Within two months of identifying the problem and launching the program, the company reduced the number of calls almost 5 percent and has maintained a lower level of reconfirmation calls.

The survey data also revealed areas in which agents needed more training. For example, the surveys pinpointed the most frequently asked questions and helped Continental identify issues with the navigation of its reservation system. Using the CallMiner enabled the airline to make technological improvements so agents can better navigate the system.

"By reducing the number of reconfirmation calls and the number of calls agents made to our support desk, we realized more than $1 million in annualized savings," states Harris. "With 60 million calls coming into our reservations centers each year, it's critical that we understand our interactions and how they're being handled by our agents so we can look for the root cause of any challenges our agents have in servicing customers. We believe in promoting and fostering excellence to remain leaders in our industry."

Since implementing these innovative processes and technology, Continental has become a leader in customer service and is recognized throughout the industry. Among its industry accolades, Continental has been named one of the top ten call centers in the industry by *Call Center Magazine*, listed as a top 100 training program for three consecutive years by *Training Magazine*, and ranked as one of the best companies to work for by *Fortune Magazine* for five years in a row.

"Continental is a perfect example of how companies can use workforce optimization software to capture customer intelligence and apply the information to improve performance in the contact center and throughout the overall business," states Nancy Treaster, senior vice president, global marketing for Witness Systems. "With eQuality, Continental has generated significant return on investment through cost savings, improved customer satisfaction and loyalty. Their organization and employees like Andre are true innovators in the customer service industry."

From the manually prepared call-mix report, Continental could see that it makes a sale on only half of all calls, but it couldn't tell why sales were lost. Telephone agents try to elicit the reasons, and soon automated call mining will enable the airline to analyze callers' responses, Harris says. It may also save passengers some money the next time they book a Continental flight.

CASE STUDY QUESTIONS

1. What are the business benefits of the CallMiner system? Provide some additional examples beyond those discussed in the case.
2. How can new technologies like CallMiner help companies improve their customer service and gain a competitive edge in the marketplace? Explain.
3. Andre Harris refers to calls to reconfirm a flight as "quite frankly, low-value calls." Why are they classified as low value? Why do you think so many customers are placing such calls?

REAL WORLD ACTIVITIES

1. Many organizations are using some form of call monitoring and data mining to improve customer service and to gain a greater understanding of their customers and their needs. Using the Internet, do some investigating into who is using this technology and in what form. In addition, see if you can find information suggesting the real value of these technologies to the firms who use them.
2. Although companies who use call monitoring tell the listener that their "call is being monitored for quality assurance purposes," some customers feel this to be an invasion of their privacy. Break into small groups with your classmates, and discuss the various reasons why some may feel their privacy is at stake with call-monitoring technologies. Also, discuss your thoughts regarding what you believe could be done to mitigate privacy concerns while improving the value of the technology.

- **Your book bag,** day planner, notebooks, and file folders are all part of an information system designed to assist you in organizing the inputs provided to you via handouts, lectures, presentations, and discussions. They also help you process these inputs into useful outputs: homework and good exam grades.
- **The cash register at your favorite fast-food restaurant** is part of a large information system that tracks the products sold, the time of a sale, the inventory levels, the amount of money in the cash drawer, and contributes to analysis of product sales between any combination of locations anywhere in the world!

We will explore many more examples and types of information systems throughout this text. Suffice to say that we are surrounded by information systems and, because of their importance in our everyday lives, we need to develop a clear understanding and appreciation of them.

Information Technologies

Business professionals rely on a variety of information systems that use various **information technologies** (ITs). While the terms *information system* and *information technology* are sometimes used interchangeably, they are two distinct concepts. As defined above, the term information system describes all of the components and resources necessary to deliver its information and functions to the organization. In contrast, the term information technology refers to the various hardware, software, networking, and data management components necessary for the system to operate. In theory, an information system could use simple hardware components such as pencil and paper or file folders to capture and store its data. For our purposes, however, we will concentrate on **computer-based information systems** and their use of the following information technologies:

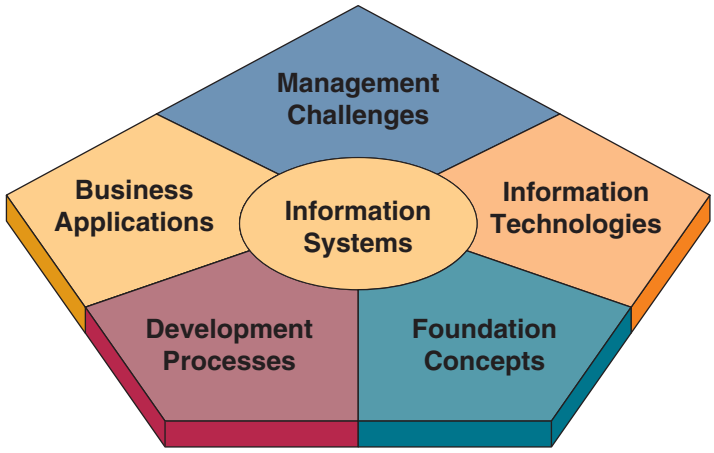
- **Computer hardware technologies,** including microcomputers, midsize servers, and large mainframe systems, and the input, output, and storage devices that support them.
- **Computer software technologies,** including operating system software, Web browsers, software productivity suites, software drivers, database management systems, software for business applications like customer relationship management and supply chain management, and other software-based components and modules.
- **Telecommunications network technologies,** including the telecommunications media, processors, and software needed to provide wire-based and wireless access and support for the Internet and private Internet-based networks such as intranets and extranets.
- **Data resource management technologies,** including database management system software for the development, access, and maintenance of the databases of an organization.

What You Need to Know

> *There is no longer any distinction between an IT project and a business initiative. IT at Marriott is a key component of the products and services that we provide to our customers and guests at our properties. As such, there's very little that goes on within the company that either I personally or one of my top executives is not involved in* [9].

Those are the words of Carl Wilson, executive vice president and CIO of the Marriott International chain of hotels. Employees at all levels of business, including top executives and managers, must learn how to apply information systems and technologies to their unique business situations. In fact, business firms depend on all of their managers and employees to help them apply and manage their use of information technologies. So the important question for any business professional or manager is: What do you need to know to help manage the hardware, software, data, and network resources of your business so they are used for the strategic success of your company?

FIGURE 1.2
This framework outlines the major areas of information systems knowledge needed by business professionals.



An IS Knowledge Framework for Business Professionals

The field of information systems encompasses many complex technologies, abstract behavioral concepts, and specialized applications in countless business and nonbusiness areas. As a manager or business professional, you do not have to absorb all of this knowledge. Figure 1.2 illustrates a useful conceptual framework that organizes the knowledge presented in this text and outlines areas of knowledge you need to know about information systems. It emphasizes that you should concentrate your efforts in the following five areas of IS knowledge:

- **Foundation Concepts.** Fundamental behavioral, technical, business, and managerial concepts about the components and roles of information systems. Examples include basic information system concepts derived from general systems theory, or competitive strategy concepts used to develop business applications of information technology for competitive advantage. Chapters 1 and 2 and other chapters of the text support this area of IS knowledge.
- **Information Technologies.** Major concepts, developments, and management issues in information technology—that is, hardware, software, networks, data management, and many Internet-based technologies. Chapters 3 and 4 provide an overview of computer hardware and software technologies, while Chapters 5 and 6 provide coverage of key data resource management and telecommunications network technologies for business.
- **Business Applications.** The major uses of information systems for the operations, management, and competitive advantage of a business. Thus, Chapter 7 covers applications of information technology in the functional areas of business like marketing, manufacturing, and accounting. Chapter 8 focuses on electronic commerce applications that most companies are using to buy and sell products on the Internet, while Chapter 9 covers the use of information systems and technologies to support decision making in business.
- **Development Processes.** How business professionals and information specialists plan, develop, and implement information systems to meet business opportunities. Several developmental methodologies are explored in Chapter 10, including the systems development life cycle and prototyping approaches to business application development.
- **Management Challenges.** The challenges of effectively and ethically managing information technology at the end user, enterprise, and global levels of a business. Thus, Chapter 11 focuses on security challenges and security management issues in the use of information technology, while Chapter 12 covers some of the key methods business managers can use to manage the information systems function in a company with global business operations.

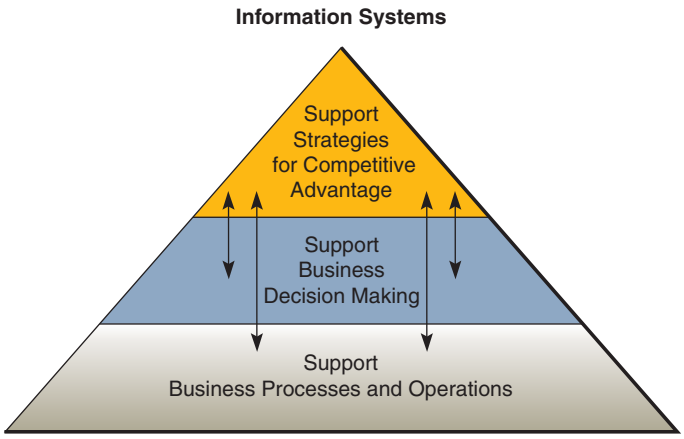


FIGURE 1.3
The three fundamental roles of the business applications of information systems. Information systems provide an organization with support for business processes and operations, decision making, and competitive advantage.

The Fundamental Roles of IS in Business

There are three fundamental reasons for all business applications of information technology. They are found in the three vital roles that information systems can perform for a business enterprise.

- Support of its business processes and operations.
- Support of decision making by its employees and managers.
- Support of its strategies for competitive advantage.

Figure 1.3 illustrates how the fundamental roles interact in a typical organization. At any moment, information systems designed to support business processes and operations may also be providing data to, or accepting data from, systems focused on business decision making or on achieving competitive advantage. The same is true for the other two fundamental roles of IS. Today's organization is constantly striving to achieve integration of their systems that allows for information to flow freely through its systems, thus adding even greater flexibility and business support than any of the individual system roles could provide.

Let's look at a typical retail store as a good example of how these **roles of IS in business** can be implemented.

The Fundamental Roles of IS in Business: Examples

Support Business Processes. As a consumer, you regularly encounter information systems that support the business processes and operations at the many retail stores where you shop. For example, most retail stores now use computer-based information systems to help their employees record customer purchases, keep track of inventory, pay employees, buy new merchandise, and evaluate sales trends. Store operations would grind to a halt without the support of such information systems.

Support Decision Making. Information systems also help store managers and other business professionals make better decisions. For example, decisions on what lines of merchandise need to be added or discontinued, or on what kind of investment they require, are typically made after an analysis provided by computer-based information systems. This not only supports the decision making of store managers, buyers, and others, but also helps them look for ways to gain an advantage over other retailers in the competition for customers.

Support Competitive Advantage. Gaining a strategic advantage over competitors requires innovative application of information technologies. For example, store management might make a decision to install touchscreen kiosks in all of their stores, with links to their e-commerce website for online shopping. This might attract new customers and build customer loyalty because of the ease of shopping and buying merchandise provided by such information systems. Thus, strategic information systems can help provide products and services that give a business a comparative advantage over its competitors.

WESCO International: e-Business Sales and Supplier System

WESCO Distribution (www.wescodist.com) is one of the world's largest distributors of electrical products and other MRO (maintenance, repair, and operating) products and advanced integrated supply procurement outsourcing services. Based in Pittsburgh, Pennsylvania, WESCO operates over 330 full-service branch offices in North America, employs 5,500 employees, and generates annual revenues in excess of $3.9 billion. Their revenue stems primarily from the sale of over 1 million industrial and construction products. While WESCO services all major industries, they concentrate their expertise in industries related to automotive manufacturing, petrochemicals, food and beverages, mining and minerals, and pulp and paper manufacturing.

WESCO strives to maintain an in-stock inventory of approximately 140,000 of their high-demand product items at all times. Despite this impressive in-stock line, WESCO also sells over 900,000 MRO products that they do not stock. While orders for nonstock items represent around 20 percent of annual revenues, until recently such orders occupied in excess of 40 percent of the time available to the WESCO sales force. This was due to the cumbersome process of having to call a nonstock product manufacturer regarding current pricing and availability and then relaying the product information back to the customer via another telephone call.

WESCO turned to effective use of information technology to address the problem. With the help of Austin, Texas-based Vignette Corporation, WESCO developed a new e-business system that connected the WESCO customer ordering and inventory systems to the inventory systems of its major suppliers. The real challenge to this initiative was figuring out how to pull information over the Internet from the myriad of supplier systems into its own 20-year-old proprietary, mainframe legacy systems. Once the system became operational, WESCO sales personnel in their 330-plus locations were able to directly access the finished goods inventory systems of their major suppliers. Now, when customers order a nonstock item, their WESCO salesperson can send a request over the system to the appropriate supplier's inventory system, receive an answer regarding current price and availability in about 30 seconds, and communicate the necessary information back to the customers while they are still on the telephone with WESCO.

The new Web-based procurement system at WESCO has not only resulted in increased sales of nonstock items, but has also reduced the duration of each customer call by at least 6 minutes. This time savings for WESCO sales personnel saves the company nearly an estimated $12 million annually [1, 12].

Trends in Information Systems

The business applications of information systems have expanded significantly over the years. Figure 1.4 summarizes these changes.

Until the 1960s, the role of most information systems was simple: transaction processing, record-keeping, accounting, and other *electronic data processing* (EDP) applications. Then another role was added, the processing of all this data into useful, informative reports. The concept of *management information systems* (MIS) was born. This new role focused on developing business applications that provided managerial end users with predefined management reports that would give managers the information they needed for decision-making purposes.

By the 1970s, it was evident that the prespecified information products produced by such management information systems were not adequately meeting many of the decision-making needs of management. So the concept of *decision support systems* (DSS) was born. The new role for information systems was to provide managerial end users with ad hoc and interactive support of their decision-making processes. This support

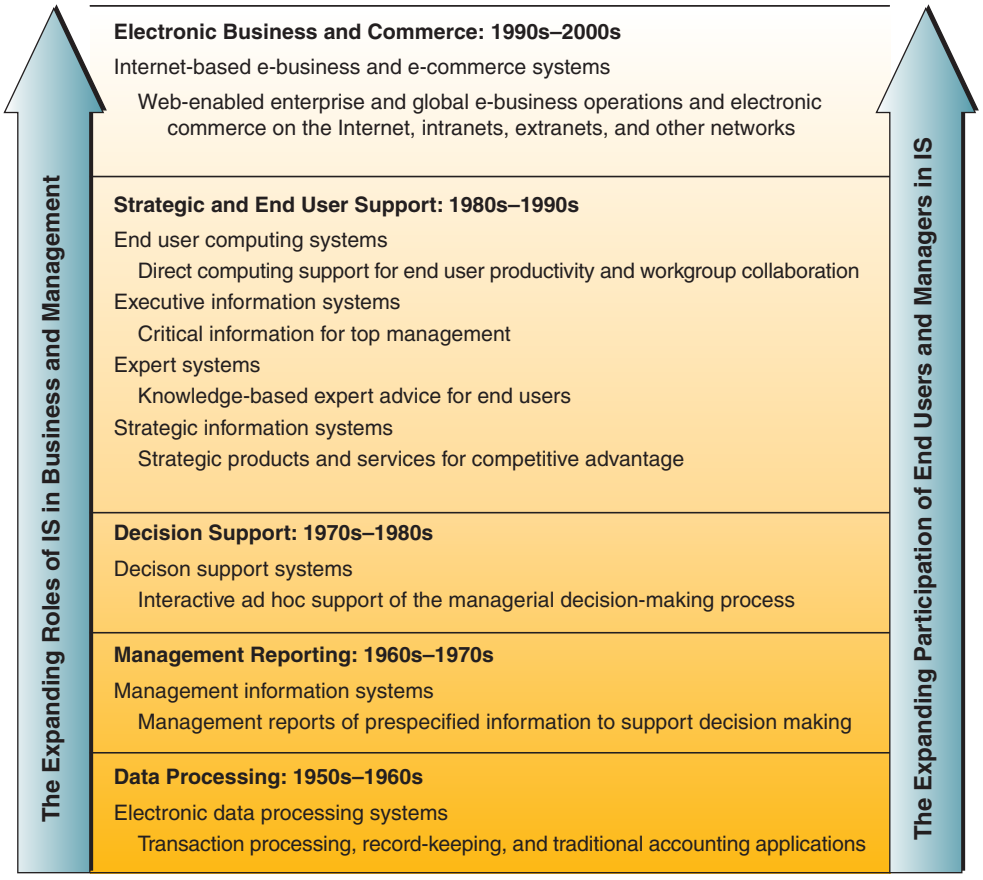


FIGURE 1.4
The expanding roles of the business applications of information systems. Note how the roles of computer-based information systems have expanded over time. Also, note the impact of these changes on the end users and managers of an organization.

would be tailored to the unique decisions, and decision-making styles, of managers as they confronted specific types of problems in the real world.

In the 1980s, several new roles for information systems appeared. First, the rapid development of microcomputer processing power, application software packages, and telecommunications networks gave birth to the phenomenon of *end user computing*. End users could now use their own computing resources to support their job requirements instead of waiting for the indirect support of centralized corporate information services departments.

Second, it became evident that most top corporate executives did not directly use either the reports of management information systems or the analytical modeling capabilities of decision support systems, so the concept of *executive information systems* (EIS) was developed. These information systems were created to give top executives an easy way to get the critical information they want, when they want it, tailored to the formats they prefer.

Third, breakthroughs occurred in the development and application of artificial intelligence (AI) techniques to business information systems. Today's systems include intelligent software agents that can be programmed and deployed inside a system to act on behalf of their owner, system functions that can adapt themselves based on the immediate needs of the user, virtual reality applications, advanced robotics, natural language processing, and a variety of applications where artificial intelligence can replace the need for human intervention, thus freeing up knowledge workers for more complex tasks. *Expert systems* (ES) and other *knowledge-based systems* also forged a new role for information systems. Today, expert systems can serve as consultants to users by providing expert advice in limited subject areas.

An important new role for information systems appeared in the 1980s and continued through the 1990s. This is the concept of a strategic role for information systems, sometimes called *strategic information systems* (SIS). In this concept, information technology becomes an integral component of business processes, products, and services that help a company gain a competitive advantage in the global marketplace.

The mid- to late 1990s saw the revolutionary emergence of *enterprise resource planning* (ERP) systems. This organization-specific form of a strategic information system integrates all facets of a firm, including its planning, manufacturing, sales, resource management, customer relations, inventory control, order tracking, financial management, human resources, and marketing—virtually every business function. The primary advantage of these ERP systems lies in their common interface for all computer-based organizational functions and their tight integration and data sharing needed for flexible strategic decision making. We will explore ERP and its associated functions in greater detail in Chapter 7.

Finally, the rapid growth of the Internet, intranets, extranets, and other interconnected global networks in the 1990s dramatically changed the capabilities of information systems in business at the beginning of the 21st century. Internet-based and Web-enabled enterprise and global electronic business and commerce systems are becoming commonplace in the operations and management of today's business enterprises.

A close look at Figure 1.4 suggests that while we have expanded our abilities with regard to using information systems for conducting business, today's information systems are still doing the same basic things that they began doing over 40 years ago. We still need to process transactions, keep records, provide management with useful and informative reports, and provide support to the foundational accounting systems and processes of the organization. What has changed, however, is that we now enjoy a much higher level of integration of system functions across applications, greater connectivity across both similar and dissimilar system components, and the ability to reallocate critical computing tasks such as data storage, processing, and presentation to take maximum advantage of business and strategic opportunities. Because of these increased capabilities, the systems of tomorrow will be focused on increasing both the speed and reach of our systems to provide even tighter integration combined with greater flexibility.

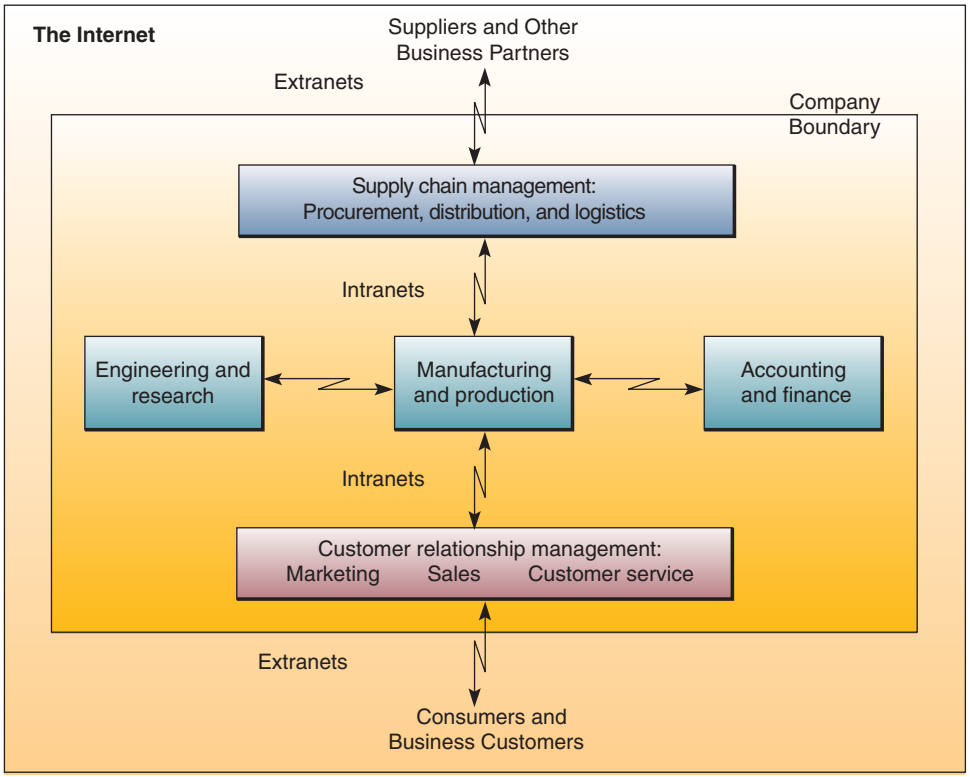
The Role of e-Business in Business

The Internet and related technologies and applications have changed the way businesses are operated and people work, and how information systems support business processes, decision making, and competitive advantage. Thus, many businesses today are using Internet technologies to Web-enable business processes and to create innovative **e-business applications**. See Figure 1.5.

In this text, we define **e-business** as the use of Internet technologies to work and empower business processes, electronic commerce, and enterprise collaboration within a company and with its customers, suppliers, and other business stakeholders. In essence, e-business can be more generally considered *an online exchange of value*. Any online exchange of information, money, resources, services, or any combination thereof, falls under the e-business umbrella. The Internet and Internet-like networks—inside the enterprise **(intranet),** and between an enterprise and its trading partners **(extranet)**—have become the primary information technology infrastructure that supports the e-business applications of many companies. These companies rely on e-business applications to (1) reengineer internal business processes, (2) implement electronic commerce systems with their customers and suppliers, and (3) promote enterprise collaboration among business teams and workgroups.

Enterprise collaboration systems involve the use of software tools to support communication, coordination, and collaboration among the members of networked teams

FIGURE 1.5
Businesses today depend on the Internet, intranets, and extranets to implement and manage innovative e-business applications.



and workgroups. A business may use intranets, the Internet, extranets, and other networks to implement such systems. For example, employees and external consultants may form a *virtual team* that uses a corporate intranet and the Internet for electronic mail, videoconferencing, electronic discussion groups, and Web pages of work-in-progress information to collaborate on business projects.

Electronic commerce is the buying, selling, marketing, and servicing of products, services, and information over a variety of computer networks. Many businesses now use the Internet, intranets, extranets, and other networks to support every step of the commercial process. This includes everything from advertising, sales, and customer support on the World Wide Web, to Internet security and payment mechanisms that ensure completion of delivery and payment processes. For example, electronic commerce systems include Internet websites for online sales, extranet access of inventory databases by large customers, and the use of corporate intranets by sales reps to access customer records for customer relationship management.

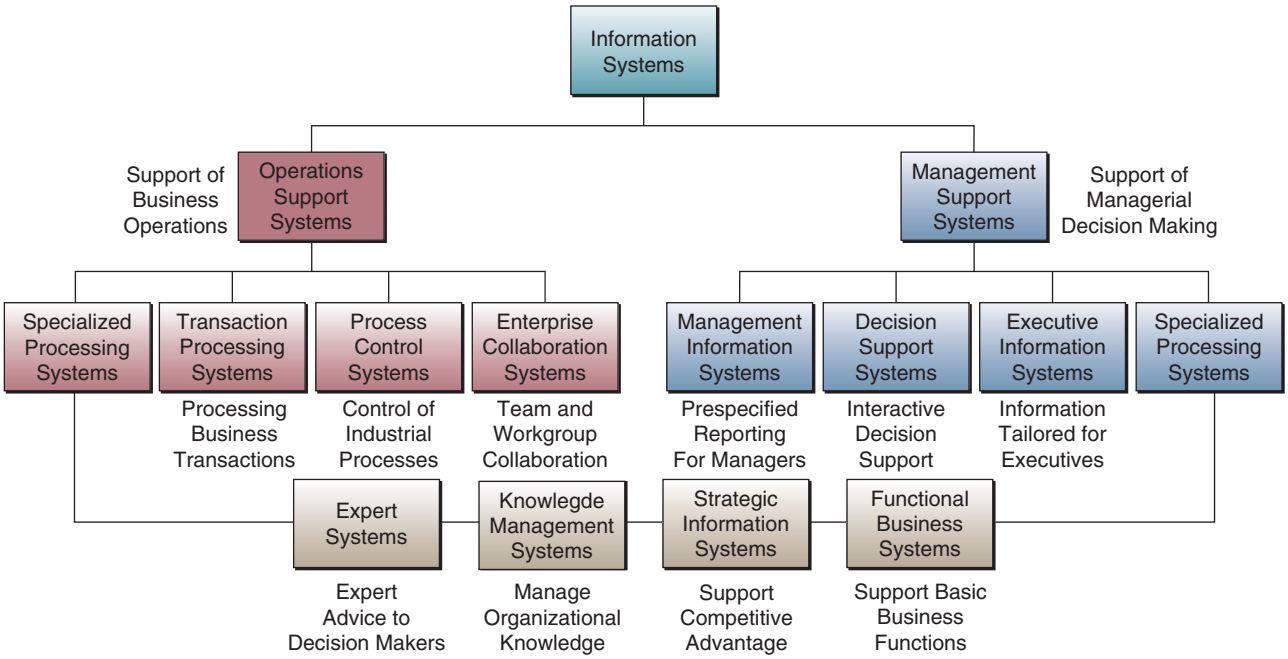
Types of Information Systems

Conceptually, the applications of information systems that are implemented in today's business world can be classified in several different ways. For example, several **types of information systems** can be classified as either operations or management information systems. Figure 1.6 illustrates this conceptual classification of information systems applications. Information systems are categorized this way to spotlight the major roles each plays in the operations and management of a business. Let's look briefly at some examples of such information systems categories.

Operations Support Systems

Information systems have always been needed to process data generated by, and used in, business operations. Such **operations support systems** produce a variety of information products for internal and external use. However, they do not emphasize producing the specific information products that can best be used by managers.

FIGURE 1.6 Operations and management classifications of information systems. Note how this conceptual overview emphasizes the main purposes of information systems that support business operations and managerial decision making.



Further processing by management information systems is usually required. The role of a business firm's operations support systems is to efficiently process business transactions, control industrial processes, support enterprise communications and collaboration, and update corporate databases. See Figure 1.7.

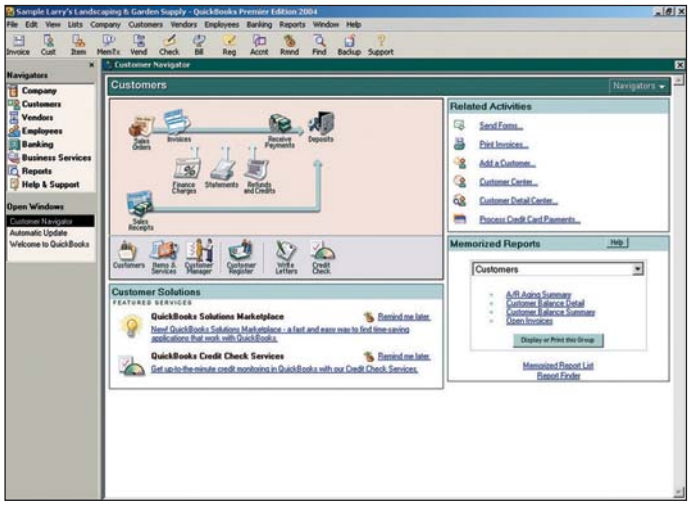
Transaction processing systems are an important example of operations support systems that record and process data resulting from business transactions. They process transactions in two basic ways. In *batch processing*, transactions data are accumulated over a period of time and processed periodically. In *real-time* (or *online*) processing, data are processed immediately after a transaction occurs. For example, point-of-sale (POS) systems at many retail stores use electronic cash register terminals to electronically capture and transmit sales data over telecommunications links to regional computer centers for immediate (real-time) or nightly (batch) processing. Figure 1.8 is an example of software that automates accounting transaction processing.

Process control systems monitor and control physical processes. For example, a petroleum refinery uses electronic sensors linked to computers to continually monitor

FIGURE 1.7 A summary of operations support systems with examples.

Operations Support Systems
• **Transaction processing systems.** Process data resulting from business transactions, update operational databases, and produce business documents. Examples: sales and inventory processing and accounting systems.
• **Process control systems.** Monitor and control industrial processes. Examples: petroleum refining, power generation, and steel production systems.
• **Enterprise collaboration systems.** Support team, workgroup, and enterprise communications and collaboration. Examples: e-mail, chat, and videoconferencing groupware systems.

FIGURE 1.8
QuickBooks is a popular accounting package that automates small business accounting transaction processing while providing business owners with management reports.



Source: Courtesy of QuickBooks.

chemical processes and make instant (real-time) adjustments that control the refinery process. **Enterprise collaboration systems** enhance team and workgroup communications and productivity, and include applications that are sometimes called *office automation systems*. For example, knowledge workers in a project team may use electronic mail to send and receive electronic messages, and use videoconferencing to hold electronic meetings to coordinate their activities.

Management Support Systems

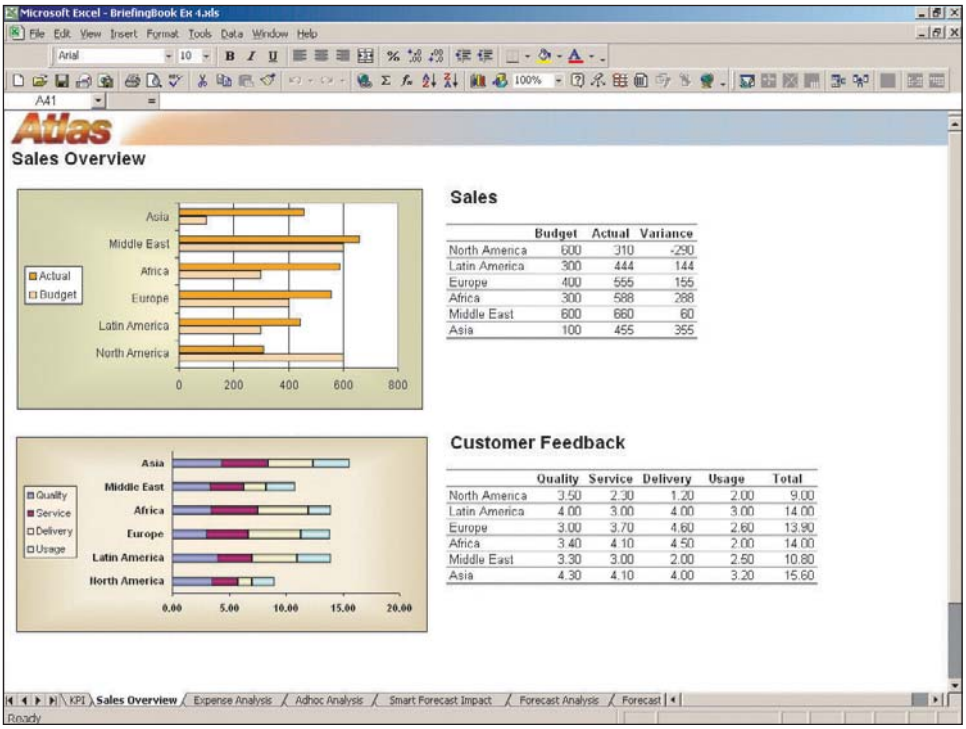
When information system applications focus on providing information and support for effective decision making by managers, they are called **management support systems.** Providing information and support for decision making by all types of managers and business professionals is a complex task. Conceptually, several major types of information systems support a variety of decision-making responsibilities: (1) management information systems, (2) decision support systems, and (3) executive information systems. See Figure 1.9.

Management information systems (MIS) provide information in the form of reports and displays to managers and many business professionals. For example, sales managers may use their networked computers and Web browsers to get instantaneous displays about the sales results of their products and to access their corporate intranet for daily sales analysis reports that evaluate sales made by each salesperson. **Decision support systems** (DSS) give direct computer support to managers during the decision-making process. For example, an advertising manager may use a DSS to perform a what-if analysis as part of a decision to determine where to spend advertising dollars. A production manager may use a DSS to decide how much product to manufacture

FIGURE 1.9 A summary of management support systems with examples.

Management Support Systems
• **Management information systems.** Provide information in the form of prespecified reports and displays to support business decision making. Examples: sales analysis, production performance, and cost trend reporting systems.
• **Decision support systems.** Provide interactive ad hoc support for the decision-making processes of managers and other business professionals. Examples: product pricing, profitability forecasting, and risk analysis systems.
• **Executive information systems.** Provide critical information from MIS, DSS, and other sources tailored to the information needs of executives. Examples: systems for easy access to analyses of business performance, actions of competitors, and economic developments to support strategic planning.

FIGURE 1.10
Management information systems provide information to business professionals in a variety of easy-to-use formats.



Source: Courtesy of Comshare.

based on the expected sales associated with a future promotion and the location and availability of the raw materials necessary to manufacture the product. **Executive information systems** (EIS) provide critical information from a wide variety of internal and external sources in easy-to-use displays to executives and managers. For example, top executives may use touchscreen terminals to instantly view text and graphics displays that highlight key areas of organizational and competitive performance. Figure 1.10 is an example of an MIS report display.

Other Classifications of Information Systems

Several other categories of information systems can support either operations or management applications. For example, **expert systems** can provide expert advice for operational chores like equipment diagnostics or for managerial decisions such as loan portfolio management. **Knowledge management systems** are knowledge-based information systems that support the creation, organization, and dissemination of business knowledge to employees and managers throughout a company. Information systems that focus on operational and managerial applications in support of basic business functions such as accounting or marketing are known as **functional business systems.** Finally, **strategic information systems** apply information technology to a firm's products, services, or business processes to help it gain a strategic advantage over its competitors. See Figure 1.11.

It is also important to realize that business applications of information systems in the real world are typically integrated combinations of the several types of information systems we have just mentioned. That's because conceptual classifications of information systems are designed to emphasize the many different roles of information systems. In practice, these roles are combined into integrated or **cross-functional informational systems** that provide a variety of functions. Thus, most information systems are designed to produce information and to support decision making for various levels of management and business functions, as well as to do record-keeping and transaction processing chores. Whenever you analyze an information system, you will probably see that it provides information for a variety of managerial levels and business functions.

FIGURE 1.11 A summary of other categories of information systems with examples.

Other Categories of Information Systems

- **Expert systems.** Knowledge-based systems that provide expert advice and act as expert consultants to users. Examples: credit application advisor, process monitor, and diagnostic maintenance systems.
- **Knowledge management systems.** Knowledge-based systems that support the creation, organization, and dissemination of business knowledge within the enterprise. Examples: intranet access to best business practices, sales proposal strategies, and customer problem resolution systems.
- **Strategic information systems.** Support operations or management processes that provide a firm with strategic products, services, and capabilities for competitive advantage. Examples: online stock trading, shipment tracking, and e-commerce Web systems.
- **Functional business systems.** Support a variety of operational and managerial applications of the basic business functions of a company. Examples: information systems that support applications in accounting, finance, marketing, operations management, and human resource management.

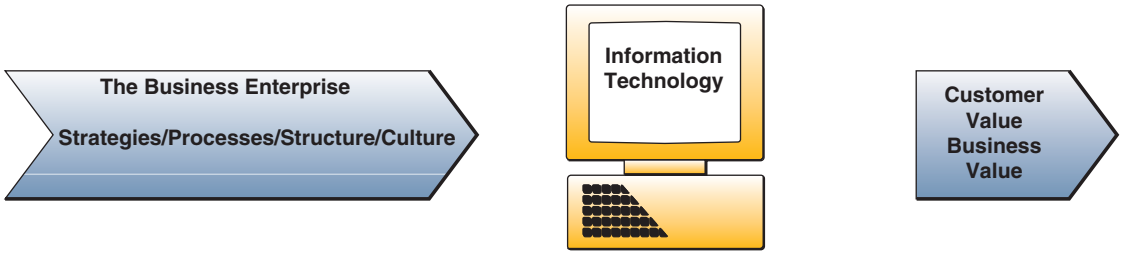
Managerial Challenges of Information Technology

Figure 1.12 illustrates the scope of the challenges and opportunities facing business managers and professionals in effectively managing information systems and technologies. Success in today's dynamic business environment depends heavily on maximizing the use of Internet-based technologies and Web-enabled information systems to meet the competitive requirements of customers, suppliers, and other business partners in a global marketplace. Figure 1.12 also emphasizes that information systems and their technologies must be managed to support the business strategies, business processes, and organizational structures and culture of a business enterprise. That's because computer-based information systems, though heavily dependent on information technologies, are designed, operated, and used by people in a variety of organizational settings and business environments. The goal of many companies today is to maximize their customer and business value by using information technology to support their employees in implementing cooperative business processes with customers, suppliers, and others.

Success and Failure with IT

By now you should be able to see that the success of an information system should not be measured only by its *efficiency* in terms of minimizing costs, time, and the use of information resources. Success should also be measured by the *effectiveness* of information

FIGURE 1.12 Examples of the challenges and opportunities that business managers face in managing information systems and technologies to meet business goals.



Business / IT Challenges

- Speed and flexibility requirements of product development, manufacturing, and delivery cycles.
- Reengineering and cross-functional integration of business processes using Internet technologies.
- Integration of e-business and e-commerce into the organization's strategies, processes, structure, and culture.

Business / IT Developments

- Use of the Internet, intranets, extranets, and the Web as the primary IT infrastructure.
- Diffusion of Web technology to internetwork employees, customers, and suppliers.
- Global networked computing, collaboration, and decision support systems.

Business / IT Goals

- Give customers what they want, when and how they want it, at the lowest cost.
- Coordination of manufacturing and business processes with suppliers and customers.
- Marketing channel partnerships with suppliers and distributors.

technology in supporting an organization's business strategies, enabling its business processes, enhancing its organizational structures and culture, and increasing the customer and business value of the enterprise.

It is important to realize, however, that information technology and information systems can be mismanaged and misapplied in such a way that IS performance problems create both technological and business failure. Let's look at an example of how information technology contributed to business failure and success at a major corporation.

Hershey Foods: Failure and Success with IT

During the late 1990s, it was common to hear about major problems being faced by companies deploying enterprise resource planning (ERP) software.[1] Such deployments were both complex and extremely time-consuming and often resulted in large productivity and resource losses early in the implementation—an outcome exactly the opposite of the goal. In 1999, Hershey Foods Corporation (www.hersheys.com) ran into many of the problems common to ERP deployments when it deployed SAP[2] AG's ERP software along with several other mission-critical business applications. Despite this early failure, however, the candy maker ultimately tasted sweet success with a major upgrade to the Web-enabled version of SAP's ERP software in 2002.

The Hershey, Pennsylvania, candy manufacturer lost a gamble in 1999 when it decided to install an ambitious number of SAP AG's R/3 enterprise resource planning applications simultaneously with supporting software applications from two other software vendors. While this decision was clearly risky, the company dramatically increased its risk by targeting the completion of this daunting task for July 1999—one of its busiest times of the year. During this period each year, retailers begin ordering large amounts of candy for sale during back-to-school days and Halloween. What was originally envisioned as a four-year project was rushed into just 30 months in an effort to begin reaping the benefits of the new system as soon as possible. Industry sources and analysts generally classified Hershey's decision as a bad one and the initial project, a failure.

Success was finally realized by Hershey, however. They worked out the problems with the original deployment and pursued an upgrade of the ERP system to a new R/3 version in July 2001. By May 2002 the upgrade was completed at a cost 20 percent under budget and without any of the order-processing and product-shipment disruptions that marred the initial $112 million rollout in 1999.

More than 30 major improvements to its core business processes were made within 60 days of going live with the system upgrade. Enhancements such as the automation of pick-list processing and materials management invoice verification, plus credit processing for distributors to military customers, yielded measurable time and cost savings for Hershey. While greatly reducing product processing time, Hershey simultaneously achieved nearly 100 percent quality in their production environment. Using the integrated business analysis tools in their ERP, Hershey has been able to effectively measure the impact of their various sales and marketing programs as they happen. Despite their early failures, Hershey attributed their ultimate success to their strong program management and executive leadership, diligent planning, and the development and implementation of an extensive testing and training plan. As they say, "Success is sweet" [10, 13].

[1]ERP stands for *enterprise resource planning*. This type of information system allows an organization to perform essentially all of their business functions by using a common interface, common data, and total connectivity across functions. We will focus more on ERPs in Chapter 7.
[2]SAP is a German company specializing in the development of ERP software.

FIGURE 1.13
Developing information systems solutions to business problems can be implemented and managed as a multistep process or cycle.

Developing IS Solutions

Developing successful information system solutions to business problems is a major challenge for business managers and professionals today. As a business professional, you will be responsible for proposing or developing new or improved uses of information technologies for your company. As a business manager, you will also frequently manage the development efforts of information systems specialists and other business end users.

Most computer-based information systems are conceived, designed, and implemented using some form of systematic development process. Figure 1.13 shows that several major activities must be accomplished and managed in a complete IS development cycle. In this development process, end users and information specialists *design* information system applications based on an *analysis* of the business requirements of an organization. Examples of other activities include *investigating* the economic or technical feasibility of a proposed application, acquiring and learning how to use any software necessary to *implement* the new system, and making improvements to *maintain* the business value of a system.

We will discuss the details of the information systems development process in Chapter 10. Many of the business and managerial challenges that arise in developing and implementing new uses of information technology will be explored in Chapters 11 and 12. Now let's look at an example of the challenges faced and overcome by a project team that developed and installed a major new information system application. This example emphasizes how important good systems development practices are to a business.

Electronic Birth Registration in Bangladesh: System Development Challenge of Starting Small and Thinking Big

The People's Republic of Bangladesh, a small South Asian country with a population of 138 million people, is challenged with a burgeoning growth in their birthrate. The country, with a population of less than half that of the United States and a geographical area slightly less than the state of Iowa, had a birthrate in 2003 of approximately 30 births per 1,000 population, over twice that of the United States and up 20 percent from just three years earlier. Birth registration in Bangladesh is seen as a fundamental right for all children and is part of a mandate from the country's government. Since this mandate, established in 1971 following the declaration of Bangladesh independence from West Pakistan, birth registration has been carried out with all data registered manually. Because of this approach, a simple query such as asking about the total number of girls registered took a long time to answer. All birth register books had to be manually searched, and separate tally sheets had to be prepared. Further, the process was subject to serious delays, and often during the process of transferring data between registers, numerous errors, duplications, and inconsistencies arose. Through the financial assistance of

UNICEF, Bangladesh, the electronic birth registration information system (BRIS) was developed.

A number of significant challenges faced the development of the system. First, the widespread poverty in Bangladesh has led to corruption in both public and private sectors as individuals rely on bribes to maintain their livelihoods. Systems like BRIS are viewed as a threat to corrupt activities: They remove duplicated activities and they increase access to information. Thus, any system rollout beyond the pilot phase and location might be resisted. Further, a severe lack of IT skills within the Bangladesh public sector exists. This problem is exacerbated because many appointments are made on the basis of seniority or political involvement, and as a result, many IT professionals are not qualified to design or maintain information systems. Finally, the system budget was severely constrained due to limited funds.

The key to success was the development team's sensitivity to these issues combined with their creative approach to system development. First, they realized that by employing a young and creative staff of developers, they could reduce initial costs while maximizing innovative thinking. Second, they focused their initial efforts on changing the existing structures and processes. The team knew that more significant gains in efficiency and effectiveness can often come not only from relying on high technology, but from improving the structures and processes of the manual system. This approach ensured that the automated system would be free from redundant or inefficient processes. Finally, the team realized the value of starting small but anticipating the bigger picture. As such, the project started with a small pilot, but was designed with an eye toward future integration with other possibly yet undeveloped systems.

To date, the project has been labeled a huge success. Originally rolled out in a local area network format, the system has been fully operational for more than a year, and a plan to move to a Web-based system that will potentially draw in a much broader range of agencies and shared data is under way. Since its deployment, both birth registration and immunization rates have increased. As for the budget constraints—the direct costs of system development were less than US$20,000, and operational costs are around US$200 per month [2, 4].

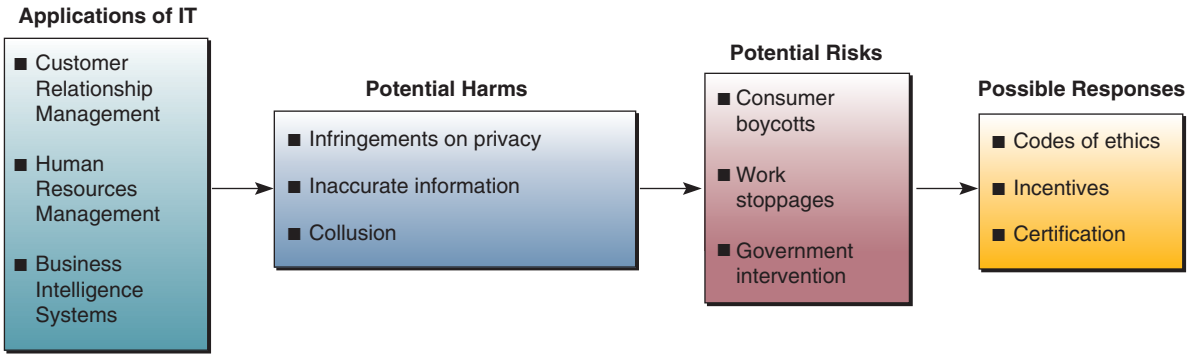
Challenges and Ethics of IT

As a prospective manager, business professional, or knowledge worker, you will be challenged by the **ethical responsibilities** generated by the use of information technology. For example, what uses of information technology might be considered improper, irresponsible, or harmful to other individuals or to society? What is the proper business use of the Internet and an organization's IT resources? What does it take to be a **responsible end user** of information technology? How can you protect yourself from computer crime and other risks of information technology? These are some of the questions that outline the ethical dimensions of information systems that we will discuss and illustrate with Real World Cases throughout this text. Figure 1.14 outlines some of the ethical risks that may arise in the use of several major applications of information technology. The following example illustrates some of the security challenges associated with conducting business over the Internet.

Citibank: Problems with e-Mail Scams

Citigroup Inc. (www.citigroup.com), one of the world's largest and most profitable financial services companies, has been in existence since 1812 and has some 200 million customer accounts in more than 100 countries. It would seem that such a large and prosperous organization would be protected from Internet scams as securely as a bank vault. Unfortunately, they are the first to point out that no one is immune to these activities.

FIGURE 1.14 Examples of some of the ethical challenges that must be faced by business managers who implement major applications of information technology.



In November 2003, Citibank customers worldwide were being targeted by scam artists trying to get their confidential bank card numbers. The hoax was perpetrated via e-mail that included a link directing the recipients to a Citibank website, where they were greeted with a pop-up box asking them for their full debit card numbers, their personal identification numbers (PINs), and their card expiration dates. However, the website was a fake site operated by someone trying to gain access to the information. It was eventually determined that the spoofed site was hosted by a Web-hosting company in Moscow.

Citibank network security officials were immediately alerted and posted a message to their customers on their website explaining the nature of the fraudulent e-mail and what customers should do if they received it, or worse, if they had responded to it.

The good news is that little actual damage or loss affected Citibank customers as a result of this potentially devastating fraud. Despite this, customer confidence decreased, and Citibank incurred a significant cost in both money and time to secure their site, to notify their customers of the hoax, and to investigate any potential losses. The business potential of the Internet also brings with it the challenge of securing customer information and valuable corporate resources. This challenge grows each day, and all IT professionals must work toward improving the security and integrity of the Internet [5, 11].

Challenges of IT Careers

Both information technology and the myriad of information systems it supports have created interesting, challenging, and lucrative career opportunities for millions of men and women all over the globe. At this point in your life you may still be uncertain about the career path you wish to follow, so learning more about information technology may help you decide if you want to pursue an IT-related career. In recent years, economic downturns have affected all job sectors, including IT. Further, rising labor costs in North America, Canada, and Europe have resulted in a large-scale movement to outsource basic software programming functions to India, the Middle East, and to Asia-Pacific countries. Despite this move, employment opportunities in the information systems field are strong, with more new and exciting jobs emerging each day as organizations continue to expand their use of information technology. In addition, these new jobs pose constant human resource management challenges to all organizations because shortages of qualified information systems personnel frequently occur. The constantly changing job requirements in information systems due to the dynamic

FIGURE 1.15
Careers in IS are as diverse and exciting as the technologies used in them. IS professionals have career opportunities in every business environment and activity throughout the world.

Systems Analyst	System Consultant	Business Applications Consultant
Chief Information Officer	Computer Operator	Computer Serviceperson
Network Administrator	Data Dictionary Specialist	Network Manager
Database Administrator	Database Analyst	Documentation Specialist
IS Auditor	End-User Computer Manager	Equipment Manufacturer Representative
PC Sales Representative	Programmer	Program Librarian
Project Manager	Records Manager	Hardware Sales Representative
Scheduling and Control Person	Security Officer	Office Automation Specialist
Senior Project Leader	Service Sales Representative	Software Sales Representative
Technical Analyst	Software Quality Evaluator	Technical Writer
Telecommunications Specialist	Training & Standards Manager	User Interface Specialist

developments in business and information technologies will ensure that the long-term job outlook in IT remains both positive and exciting.

One major recruiter of IT professionals is the IT industry itself. Thousands of companies develop, manufacture, market, and service computer hardware, software, data, and network products and services, or provide e-business and commerce applications and services, end user training, or business systems consulting. However, the biggest need for qualified people comes from the millions of businesses, government agencies, and other organizations that use information technology. They need many types of IS professionals such as systems analysts, software developers, and network managers to help them plan, develop, implement, and manage today's Internet-based and Web-enabled business/IT applications. Figure 1.15 lists just a few of the myriad of career roles available to the modern IT professional.

Computer systems analysts, database administrators, and other managerial-level IS positions are expected to be among the fastest growing occupations through 2012. Employment of IS professionals is expected to grow over 36 percent (much greater than average) for all occupations as organizations continue to adopt and integrate increasingly sophisticated technologies. Job increases will be driven by very rapid growth in computer system design and related services, which is projected to be one of the fastest-growing industries in the U.S. economy. In addition, many job openings will arise annually from the need to replace workers who move into managerial positions or other occupations or who leave the labor force.

Despite the recent economic downturn among information technology firms, IS professionals still enjoy favorable job prospects. The demand for networking to facilitate the sharing of information, the expansion of client/server environments, and the need for specialists to use their knowledge and skills in a problem-solving capacity will be major factors in the rising demand for computer systems analysts, database administrators, and other IS professionals. Moreover, falling prices of computer hardware and software should continue to induce more businesses to expand their computerized operations and to integrate new technologies into them. To maintain a competitive edge and operate more efficiently, firms will keep demanding professionals who are knowledgeable about the latest technologies and are able to apply them to meet the needs of businesses.

Increasingly, more sophisticated and complex technology is being implemented across all organizations, which should fuel the demand for these computer occupations. The demand grows for system analysts to help firms maximize their efficiency with available technology. Expansion of electronic commerce—doing business on the Internet—and the continuing need to build and maintain databases that store critical information on customers, inventory, and projects are fueling demand for database administrators familiar with the latest technology. Also, the increasing importance being placed on "cybersecurity"—the protection of electronic information—will result in a need for workers skilled in information security. Let's take a look at IT career challenges at a leading Web company.

Amazon.com: IT Career Challenges

John Vlastelca is the technical recruiting manager of Amazon.com Inc. in Seattle. He says: "We have a huge demand for software developers and systems analysts who have experience building systems that support relationships with customers online—people who bring together a retailing background and some IT background. We hire smart folks, and they are working their butts off. There is a heavy dose of informality. People aren't title-centric; the best idea wins and the career path is often a vertical crossover to management or content areas.

"The one thing that drives us is an obsession with the customer. What helps us make our selection decision is the question, 'Is this a technical person who views technology as a means to an end, where the end is the customer? Or does this person define him or herself as just a Java programmer?'

"But the bar is incredibly high here. It is really hard for my team to find the combination of skills—the software engineer who really understands the customer and the business. So half don't make it because they are not strong enough technically. Other reasons have to do with soft skills—being open to ideas, just raw smarts, and not being passionate enough. The problem space we operate in is unexplored territory" [7].

The IS Function

Successful management of information systems and technologies presents major challenges to business managers and professionals. Thus, the information systems function represents:

- A major functional area of business equally as important to business success as the functions of accounting, finance, operations management, marketing, and human resources management.
- An important contributor to operational efficiency, employee productivity and morale, and customer service and satisfaction.
- A major source of information and support needed to promote effective decision making by managers and business professionals.
- A vital ingredient in developing competitive products and services that give an organization a strategic advantage in the global marketplace.
- A dynamic, rewarding, and challenging career opportunity for millions of men and women.
- A key component of the resources, infrastructure, and capabilities of today's networked business enterprises.

SECTION II

Foundation Concepts: The Components of Information Systems

System Concepts: A Foundation

System concepts underlie all business processes as well as our understanding of information systems and technologies. That's why we need to discuss how generic system concepts apply to business firms and the components and activities of information systems. Understanding system concepts will help you understand many other concepts in the technology, applications, development, and management of information systems that we will cover in this text. For example, system concepts help us understand:

- **Technology.** That computer networks are systems of information processing components that use a variety of hardware, software, data management, and telecommunications network technologies.
- **Applications.** That electronic business and commerce applications involve interconnected business information systems.
- **Development.** That developing ways to use information technology in business includes designing the basic components of information systems.
- **Management.** That managing information technology emphasizes the quality, strategic business value, and security of an organization's information systems.

Read the Real World Case about how information systems can be used to support business. We can learn a lot from this case about the use of information technology to empower and support business professionals today. See Figure 1.16.

What Is a System?

We've used the term *system* well over a hundred times already and will use it thousands more before we're done. It seems reasonable that we focus our attention on exactly what a **system** is. As we discussed at the beginning of the chapter, a system is defined as *a set of interrelated components, with a clearly defined boundary, working together to achieve a common set of objectives by accepting inputs and producing outputs in an organized transformation process.* Many examples of systems can be found in the physical and biological sciences, in modern technology, and in human society. Thus, we can talk of the physical system of the sun and its planets, the biological system of the human body, the technological system of an oil refinery, and the socioeconomic system of a business organization.

Systems have three basic functions:

- **Input** involves capturing and assembling elements that enter the system to be processed. For example, raw materials, energy, data, and human effort must be secured and organized for processing.
- **Processing** involves transformation processes that convert input into output. Examples are a manufacturing process, the human breathing process, or mathematical calculations.
- **Output** involves transferring elements that have been produced by a transformation process to their ultimate destination. For example, finished products, human services, and management information must be transmitted to their human users.

Example. A manufacturing system accepts raw materials as input and produces finished goods as output. An information system is a system that accepts resources (data) as input and processes them into products (information) as output. A business organization is a system where human and economic resources are transformed by various business processes into goods and services.

REAL WORLD CASE 2

Lufthansa: Taking Mobile Computing to the Skies While Keeping the Mobile Workforce Connected

How do you keep 3,500 highly mobile airline pilots trained on the latest technology and procedures, plugged into the corporate infrastructure, and informed about schedules, weather events, and other facts that affect their jobs throughout the world? What's more, how do you accomplish this while controlling costs?

In 2001, Lufthansa launched the "Lufthansa Mobile Initiative," which aimed to provide all pilots with notebook computers. Lufthansa knew that the benefits of mobile computers would translate into major gains for the company as a whole.

The Lufthansa Mobile Initiative is yielding significant productivity and efficiency improvements, while keeping costs manageable.

The successes being realized today were not without significant challenges. Lufthansa had strict parameters that notebook PCs needed to meet before the pilots' union would sign off on the plan. Chief among the requirements were: The notebooks had to have enough performance capability to run key software applications used by the pilots, the notebooks had to weigh less than 2 kilograms (about 4.4 pounds), their screens had to be at least 12 inches diagonally as well as be bright and easy to read due to lighting conditions in the cockpit, and battery life had to be at least five hours for long airplane trips.

For the early tests of the project in 1998, Lufthansa decided to purchase mobile systems based on the low-voltage Mobile Intel® Pentium® III Processor–M operating at 600MHz, with 128MB of RAM and a 20GB hard drive.

FIGURE 1.16

Modern businesses implement sales readiness systems that provide their global sales forces with Web-based access to sales and marketing materials.

Source: Steve Chenn/Corbis.

Today, Lufthansa pilots enjoy state-of-the-art notebook PCs weighing less than 3.5 pounds with several times the power and performance of the early Pentium III platforms.4

So far, the payoff from mobile computing at Lufthansa has been significant. Giving notebooks to pilots provided the company with several key tangible and intangible benefits:

- Pilots are more productive because they can access updated data electronically.
- They are more productive because they can work in a variety of locations including airplanes, airports, hotels, and other remote locations.
- Pilots appreciate the convenience of not having to carry heavy manuals and documentation to multiple locations.
- Pilots can take their required training on their laptops during downtime in any airport.

Now that all of Lufthansa's pilots have laptops, Lufthansa no longer conducts classroom training. "Such training used to mean preparing training centers, arranging a time when pilots could attend the sessions, and actually getting the pilots to the training location," recalls Rolf Mueller, project manager for the Lufthansa Mobile Initiative. "Now pilots use their notebooks for computer-based training whether they are learning about new aircraft or things like specific hydraulic systems." Lufthansa also plans to phase out the desktop computers that it had previously deployed in airports, thereby streamlining its infrastructure and cutting even more costs.

Helping Lufthansa even further is the fact that the total cost of ownership for notebooks has decreased significantly over the last several years. Capital costs are lower. End user operations and technical support costs are decreasing due to improved manageability and stability. "We've been quite happy with Windows XP," said a Lufthansa representative. "Not only is it stable, but it's flexible and gives us an environment that is easy to update and keep current. Overall, the total cost of ownership is quite low because of our system of browser-based components and a sophisticated update network."

Mobile computing is catching on throughout the Lufthansa Group. Rolf Mueller says that in addition to Lufthansa Cargo, he has been talking to Lufthansa CityLine, the company's short-haul passenger line that serves Europe. "We're really leading the way in using mobile computers. Lufthansa CityLine will end up with 800 of its own notebooks for flight captains."

And the Mobile Initiative at Lufthansa extends beyond the company's crew. Lufthansa understands fully the needs of mobile workers, including its own customers. Since late 2004, the announcement "We have reached surfing altitude" has become as familiar to Lufthansa travelers as safety

demonstrations, packs of peanuts, and stowing the tray in the upright and locked position.

Using the Connexion system by Boeing, Lufthansa can deliver broadband Internet to the aircraft and, ultimately, to their passengers.

Lufthansa, through Boeing, is selling the service directly to passengers and offers either flat-rate pricing, at $19.95 for flights of between three and six hours or $29.95 for flights of six hours or more, or metered pricing, at $9.95 for 30 minutes and 20 cents per subsequent minute.

The backbone of the system is a network of transponders leased across eight commercial satellites that provides coverage of most major air routes in the Northern Hemisphere. Each transponder can support a high-speed data channel, and Boeing allocates one to be used for passenger Internet access, says Stan Deal, vice president of Connexion.

There are plans for a second stream to carry live television, such as 24-hour news, sports and financial channels, and a channel for airline use, such as sending real-time telemetry, maintenance information, and intracompany communications. Additional Internet data channels also can be added to keep up with demand.

Four earth stations, in Japan, Russia, Switzerland, and the United States, provide the gateway link between the aircraft and a terrestrial network provided by Internap Network Services that carries traffic to the Internet.

The connection to the satellite from the aircraft is accomplished using an antenna designed by Mitsubishi Electric. The system is mounted in the top of the cabin above the roof. The long, thin antenna is curved like a parabolic satellite dish, and motors constantly adjust its position so that it remains pointing at the satellite during the flight, Deal says.

Whether the service is a success might not be a question of technology or price. Aircraft cabins are one of the few places a busy traveler can get away from phones, e-mail, and instant messages, so some might resent the intrusion of the Internet in the air.

Boeing's market research found up to 6 percent of people surveyed would change their flight plans, within a certain set of limits, to get aboard an aircraft that has the system, says Michael Carson, sales director at Connexion.

As it moves forward, Lufthansa can point to a litany of benefits when describing its mobile computer program. "Most of all, pilots work when they can," says Rolf Mueller. "Whether they are on their way to the airport, waiting during a layover, or away from work." Equally important, Lufthansa passengers can be more productive.

Lufthansa regards their mobile computing initiative as extremely successful based on their high return on investment (ROI). By deploying mobile PCs to all their pilots, they have realized significant productivity benefits while effectively managing costs.

Source: Adapted from Intel Corporation, "Lufthansa Mobile Computing Case Study, 2002." © Intel Corporation, 2002 and Martyn Williams. "Broadband Internet Takes to the Skies," *Network World*, May 17, 2004. © Network World, Inc., 2004.

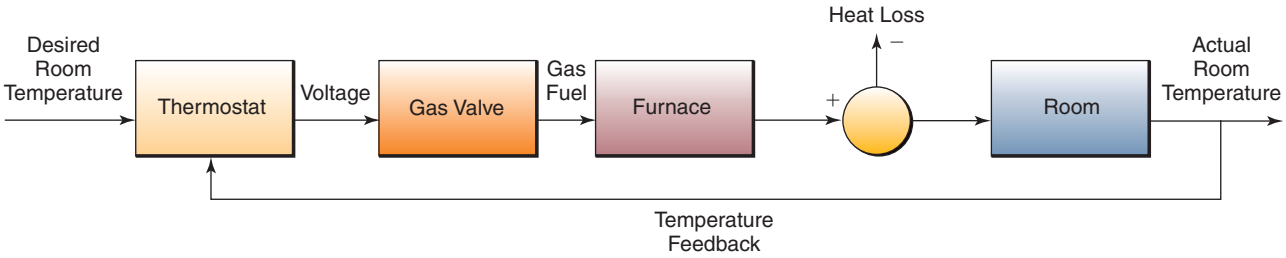
CASE STUDY QUESTIONS

1. Are many of Lufthansa's challenges identified in the case similar to those being experienced by other businesses in today's global economy? Explain and provide some examples.
2. What other tangible and intangible benefits, beyond those identified by Lufthansa, might a mobile workforce enjoy as a result of deploying mobile technologies? Explain.
3. Lufthansa was clearly taking a big risk with their decision to deploy notebook computers to their pilots. What steps did they take to manage that risk, and what others might be needed in today's business environment? Provide some examples.

REAL WORLD ACTIVITIES

1. The Connexion system by Boeing is rapidly becoming the standard for high-speed Internet access on commercial airliners. Go to the Connexion website at www.connexionbyboeing.com, and check out some of the features of the new system.
2. European air carriers have embraced having Internet access on their aircraft far faster than U.S. carriers. Break into small groups with your classmates, and discuss the reasons why a lack of interest still exists in the United States. Find out how many of your friends would prefer an airline with onboard Internet access. Would you pay more for this service? Why or why not?

FIGURE 1.17 A common cybernetic system is a home temperature control system. The thermostat accepts the desired room temperature as input and sends voltage to open the gas valve which fires the furnace. The resulting hot air goes into the room, and the thermometer in the thermostat provides feedback to shut the system down when the desired temperature is reached.



Feedback and Control

The system concept becomes even more useful by including two additional elements: feedback and control. A system with feedback and control functions is sometimes called a *cybernetic* system, that is, a self-monitoring, self-regulating system.

- **Feedback** is data about the performance of a system. For example, data about sales performance is feedback to a sales manager. Data about the speed, altitude, attitude, and direction of an aircraft is feedback to the aircraft's pilot or autopilot.
- **Control** involves monitoring and evaluating feedback to determine whether a system is moving toward the achievement of its goal. The control function then makes the necessary adjustments to a system's input and processing components to ensure that it produces proper output. For example, a sales manager exercises control when reassigning salespersons to new sales territories after evaluating feedback about their sales performance. An airline pilot, or the aircraft's autopilot, makes minute adjustments after evaluating the feedback from the instruments to ensure the plane is exactly where the pilot wants it to be.

Example. Figure 1.17 illustrates a familiar example of a self-monitoring, self-regulating, thermostat-controlled heating system found in many homes; it automatically monitors and regulates itself to maintain a desired temperature. Another example is the human body, which can be regarded as a cybernetic system that automatically monitors and adjusts many of its functions, such as temperature, heartbeat, and breathing. A business also has many control activities. For example, computers may monitor and control manufacturing processes, accounting procedures help control financial systems, data entry displays provide control of data entry activities, and sales quotas and sales bonuses attempt to control sales performance.

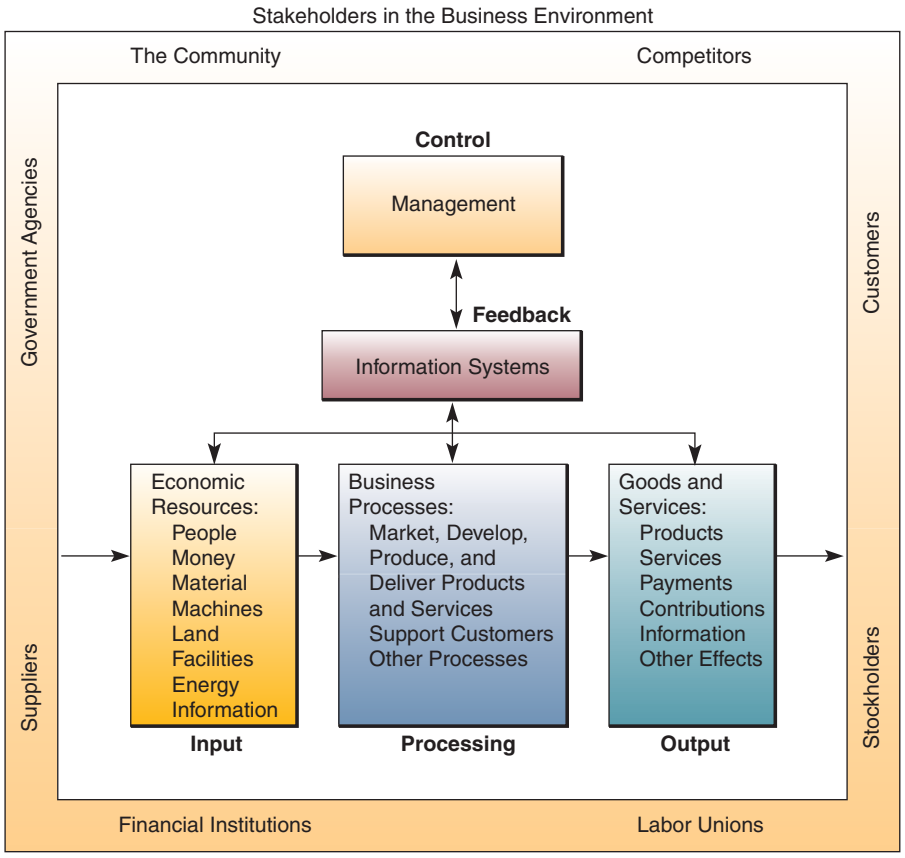
Other System Characteristics

Figure 1.18 uses a business organization to illustrate the fundamental components of a system, as well as several other system characteristics. Note that a system does not exist in a vacuum; rather, it exists and functions in an *environment* containing other systems. If a system is one of the components of a larger system, it is a *subsystem*, and the larger system is its environment.

Several systems may share the same environment. Some of these systems may be connected to one another by means of a shared boundary, or *interface*. Figure 1.18 also illustrates the concept of an *open system*, that is, a system that interacts with other systems in its environment. In this diagram, the system exchanges inputs and outputs with its environment. Thus, we could say that it is connected to its environment by input and output interfaces. Finally, a system that has the ability to change itself or its environment in order to survive is an *adaptive system*.

Example. Organizations such as businesses and government agencies are good examples of the systems in society, which is their environment. Society contains a multitude of such systems, including individuals and their social, political, and economic institutions.

FIGURE 1.18
A business is an example of an organizational system where economic resources (input) are transformed by various business processes (processing) into goods and services (output). Information systems provide information (feedback) on the operations of the system to management for the direction and maintenance of the system (control) as it exchanges inputs and outputs with its environment.



Organizations themselves consist of many subsystems, such as departments, divisions, process teams, and other workgroups. Organizations are examples of open systems because they interface and interact with other systems in their environment. Finally, organizations are examples of adaptive systems, since they can modify themselves to meet the demands of a changing environment.

If we apply our understanding of general system concepts to information systems, it should be easy to see the parallels.

Information systems are made up of interrelated components:

- People, hardware, software, peripherals, and networks.

They have clearly defined boundaries:

- Functions, modules, type of application, department, or end user group.

All the interrelated components work together to achieve a common goal by accepting inputs and producing outputs in an organized transformation process:

- Using raw materials, hiring new people, manufacturing products for sale, and disseminating information to others.

Information systems make extensive use of feedback and control to improve their effectiveness:

- Error messages, dialog boxes, passwords, and user rights management.

Many information systems are designed to change in relation to their environments and are adaptive:

- Intelligent software agents, expert systems, and highly specialized decision support systems.

Information systems are systems just like any other system. Their value to the modern organization, however, is unlike any other system ever created.

Components of an Information System

We have said that an information system is a system that accepts data resources as input and processes them into information products as output. How does an information system accomplish this? What system components and activities are involved?

Figure 1.19 illustrates an **information system model** that expresses a fundamental conceptual framework for the major components and activities of information systems. An information system depends on the resources of people (end users and IS specialists), hardware (machines and media), software (programs and procedures), data (data and knowledge bases), and networks (communications media and network support) to perform input, processing, output, storage, and control activities that convert data resources into information products.

This information system model highlights the relationships among the components and activities of information systems. It provides a framework that emphasizes four major concepts that can be applied to all types of information systems:

- People, hardware, software, data, and networks are the five basic resources of information systems.
- People resources include end users and IS specialists, hardware resources consist of machines and media, software resources include both programs and procedures, data resources can include data and knowledge bases, and network resources include communications media and networks.
- Data resources are transformed by information processing activities into a variety of information products for end users.
- Information processing consists of the system activities of input, processing, output, storage, and control.

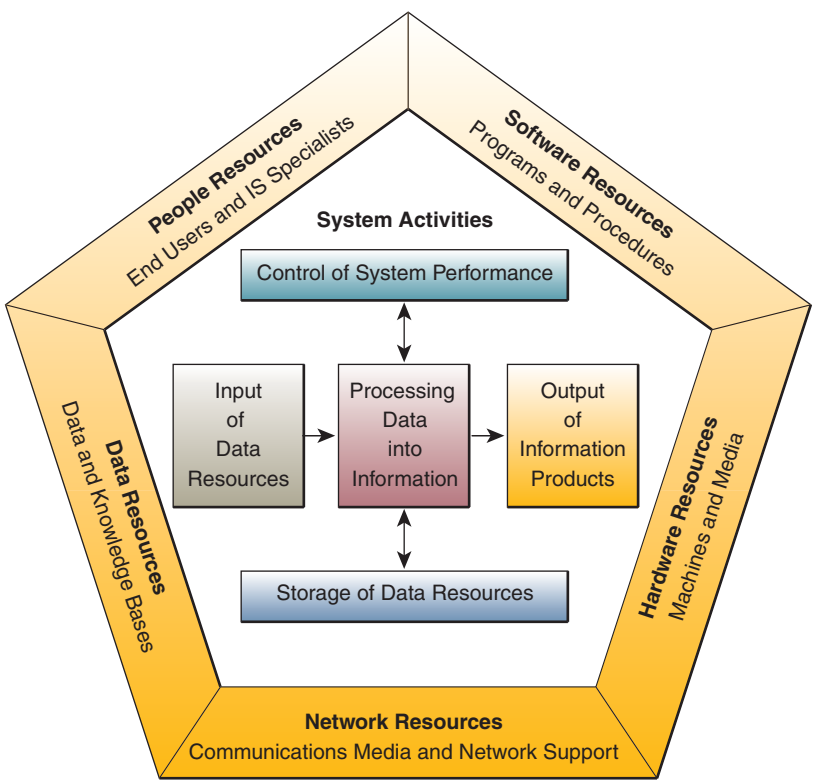


FIGURE 1.19
The components of an information system. All information systems use people, hardware, software, data, and network resources to perform input, processing, output, storage, and control activities that transform data resources into information products.

Information System Resources

Our basic IS model shows that an information system consists of five major resources: people, hardware, software, data, and networks. Let's briefly discuss several basic concepts and examples of the roles these resources play as the fundamental components of information systems. You should be able to recognize these five components at work in any type of information system you encounter in the real world. Figure 1.20 outlines several examples of typical information system resources and products.

People Resources

People are the essential ingredient for the successful operation of all information systems. These **people resources** include end users and IS specialists.

- **End users** (also called users or clients) are people who use an information system or the information it produces. They can be customers, salespersons, engineers, clerks, accountants, or managers and are found at all levels of an organization. In fact, most of us are information system end users. And most end users in business are **knowledge workers,** that is, people who spend most of their time communicating and collaborating in teams and workgroups and creating, using, and distributing information.
- **IS specialists** are people who develop and operate information systems. They include systems analysts, software developers, system operators, and other managerial, technical, and clerical IS personnel. Briefly, systems analysts design information systems based on the information requirements of end users, software developers create computer programs based on the specifications of systems analysts, and system operators help to monitor and operate large computer systems and networks.

Hardware Resources

The concept of **hardware resources** includes all physical devices and materials used in information processing. Specifically, it includes not only **machines,** such as computers and other equipment, but also all data **media,** that is, tangible objects on which data are recorded, from sheets of paper to magnetic or optical disks. Examples of hardware in computer-based information systems are:

- **Computer systems,** which consist of central processing units containing microprocessors, and a variety of interconnected peripheral devices such as printers, scanners, monitors, and so on. Examples are hand-held, laptop, tablet, or desktop microcomputer systems, midrange computer systems, and large mainframe computer systems.

FIGURE 1.20
Examples of information system resources and products.

Information Systems Resources and Products
People Resources Specialists—systems analysts, software developers, system operators. End Users—anyone else who uses information systems.
Hardware Resources Machines—computers, video monitors, magnetic disk drives, printers, optical scanners. Media—floppy disks, magnetic tape, optical disks, plastic cards, paper forms.
Software Resources Programs—operating system programs, spreadsheet programs, word processing programs, payroll programs. Procedures—data entry procedures, error correction procedures, paycheck distribution procedures.
Data Resources Product descriptions, customer records, employee files, inventory databases.
Network Resources Communications media, communications processors, network access and control software.
Information Products Management reports and business documents using text and graphics displays, audio responses, and paper forms.

- **Computer peripherals,** which are devices such as a keyboard, electronic mouse, trackball, or stylus for input of data and commands, a video screen or printer for output of information, and magnetic or optical disk drives for storage of data resources.

Software Resources

The concept of **software resources** includes all sets of information processing instructions. This generic concept of software includes not only the sets of operating instructions called **programs,** which direct and control computer hardware, but also the sets of information processing instructions called **procedures** that people need.

It is important to understand that even information systems that don't use computers have a software resource component. This is true even for the information systems of ancient times, or for the manual and machine-supported information systems still used in the world today. They all require software resources in the form of information processing instructions and procedures in order to properly capture, process, and disseminate information to their users.

The following are examples of software resources:

- **System software,** such as an operating system program, which controls and supports the operations of a computer system. Microsoft Windows® and Unix are but two examples of popular computer operating systems.
- **Application software,** which are programs that direct processing for a particular use of computers by end users. Examples are a sales analysis program, a payroll program, and a word processing program.
- **Procedures,** which are operating instructions for the people who will use an information system. Examples are instructions for filling out a paper form or using a software package.

Data Resources

Data are more than the raw material of information systems. The concept of **data resources** has been broadened by managers and information systems professionals. They realize that data constitute valuable organizational resources. Thus, you should view data the same as any organizational resource that must be managed effectively to benefit all stakeholders in an organization.

The concept of data as an organizational resource has resulted in a variety of changes in the modern organization. Data that were previously captured as a result of a common transaction are now stored, processed, and analyzed using sophisticated software applications that can reveal complex relationships about sales, customers, competitors, and markets. In today's wired world, the data to create a simple list of an organization's customers are protected with the same energy as the cash in a bank vault. Data are the lifeblood of today's organizations, and the effective and efficient management of data is considered an integral part of organizational strategy.

Data can take many forms, including traditional alphanumeric data, composed of numbers, letters, and other characters that describe business transactions and other events and entities. Text data, consisting of sentences and paragraphs used in written communications; image data, such as graphic shapes and figures, and photographic and video images; and audio data, the human voice and other sounds, are also important forms of data.

The data resources of information systems are typically organized, stored, and accessed by a variety of data resource management technologies into:

- Databases that hold processed and organized data.
- Knowledge bases that hold knowledge in a variety of forms such as facts, rules, and case examples about successful business practices.

For example, data about sales transactions may be accumulated, processed, and stored in a Web-enabled sales database that can be accessed for sales analysis reports by managers and marketing professionals. Knowledge bases are used by knowledge management systems and expert systems to share knowledge or to give expert advice on specific subjects. We will explore these concepts further in later chapters.

Data versus Information. The word **data** is the plural of *datum*, though data commonly represents both singular and plural forms. Data are raw facts or observations, typically about physical phenomena or business transactions. For example, a spacecraft launch or the sale of an automobile would generate a lot of data describing those events. More specifically, data are objective measurements of the *attributes* (the characteristics) of *entities* (such as people, places, things, and events).

Example. Business transactions such as buying a car or an airline ticket can produce a lot of data. Just think of the hundreds of facts needed to describe the characteristics of the car you want and its financing, or the details for even the simplest airline reservation.

People often use the terms *data* and *information* interchangeably. However, it is better to view data as raw material resources that are processed into finished information products. Then we can define **information** as data that have been converted into a meaningful and useful context for specific end users. Thus, data are usually subjected to a value-added process (*data processing* or *information processing*) where (1) their form is aggregated, manipulated, and organized; (2) their content is analyzed and evaluated; and (3) they are placed in a proper context for a human user.

The issue of context is really at the heart of understanding the difference between information and data. Data can be thought of as context-independent: A list of numbers or names, by itself, does not provide any understanding of the context in which it was recorded. In fact, the same list could be recorded in a variety of contexts. In contrast, for data to become information, both the context of the data and the perspective of the person accessing the data become essential. The same data may be considered valuable information to one person and completely irrelevant to the next. Just think of data as potentially valuable to all and the value of information as being valuable relative to its user.

Example. Names, quantities, and dollar amounts recorded on sales forms represent data about sales transactions. However, a sales manager may not regard these as information. Only after such facts are properly organized and manipulated can meaningful sales information be furnished, specifying, for example, the amount of sales by product type, sales territory, or salesperson.

Network Resources

Telecommunications technologies and networks like the Internet, intranets, and extranets are essential to the successful electronic business and commerce operations of all types of organizations and their computer-based information systems. Telecommunications networks consist of computers, communications processors, and other devices interconnected by communications media and controlled by communications software. The concept of **network resources** emphasizes that communications technologies and networks are a fundamental resource component of all information systems. Network resources include:

- **Communications media.** Examples include twisted-pair wire, coaxial and fiber-optic cables, and microwave, cellular, and satellite wireless technologies.
- **Network infrastructure.** This generic category emphasizes that many hardware, software, and data technologies are needed to support the operation and use of a communications network. Examples include communications processors such as modems and internetwork processors, and communications control software such as network operating systems and Internet browser packages.

Information System Activities

Regardless of the type of information system, the same basic **information system activities** occur. Let's take a closer look now at each of the basic **information processing** (or data processing) activities. You should be able to recognize input, processing, output, storage, and control activities taking place in any information system you are studying. Figure 1.21 lists business examples that illustrate each of these information system activities.

FIGURE 1.21
Business examples of the basic activities of information systems.

Information System Activities
• **Input.** Optical scanning of bar-coded tags on merchandise.
• **Processing.** Calculating employee pay, taxes, and other payroll deductions.
• **Output.** Producing reports and displays about sales performance.
• **Storage.** Maintaining records on customers, employees, and products.
• **Control.** Generating audible signals to indicate proper entry of sales data.

Input of Data Resources

Data about business transactions and other events must be captured and prepared for processing by the **input** activity. Input typically takes the form of *data entry* activities such as recording and editing. End users typically enter data directly into a computer system or record data about transactions on some type of physical medium such as a paper form. This usually includes a variety of editing activities to ensure that they have recorded the data correctly. Once entered, data may be transferred onto a machine-readable medium such as a magnetic disk until needed for processing.

For example, data about sales transactions may be recorded on source documents such as paper order forms. (A **source document** is the original formal record of a transaction.) Alternatively, salespersons might capture sales data using computer keyboards or optical scanning devices; they are visually prompted to enter data correctly by video displays. This provides them with a more convenient and efficient **user interface,** that is, methods of end user input and output with a computer system. Methods such as optical scanning and displays of menus, prompts, and fill-in-the-blanks formats make it easier for end users to enter data correctly into an information system.

Processing of Data into Information

Data are typically subjected to **processing** activities such as calculating, comparing, sorting, classifying, and summarizing. These activities organize, analyze, and manipulate data, thus converting them into information for end users. The quality of any data stored in an information system must also be maintained by a continual process of correcting and updating activities.

Example. Data received about a purchase can be (1) *added* to a running total of sales results, (2) *compared* to a standard to determine eligibility for a sales discount, (3) *sorted* in numerical order based on product identification numbers, (4) *classified* into product categories (such as food and nonfood items), (5) *summarized* to provide a sales manager with information about various product categories, and, finally, (6) used to *update* sales records.

Output of Information Products

Information in various forms is transmitted to end users and made available to them in the **output** activity. The goal of information systems is the production of appropriate **information products** for end users. Common information products include messages, reports, forms, and graphic images, which may be provided by video displays, audio responses, paper products, and multimedia. We routinely use the information provided by these products as we work in organizations and live in society. For example, a sales manager may view a video display to check on the performance of a salesperson, accept a computer-produced voice message by telephone, and receive a printout of monthly sales results.

Storage of Data Resources

Storage is a basic system component of information systems. Storage is the information system activity in which data are retained in an organized manner for later use. For example, just as written text material is organized into words, sentences, paragraphs, and documents, stored data are commonly organized into a variety of data elements and databases. This facilitates their later use in processing or retrieval as output when needed by users of a system. Such data elements and databases are discussed further in Chapter 5, Data Resource Management.

Control of System Performance

An important information system activity is the **control** of system performance. An information system should produce feedback about its input, processing, output, and storage activities. This feedback must be monitored and evaluated to determine if the system is meeting established performance standards. Then appropriate system activities must be adjusted so that proper information products are produced for end users.

For example, a manager may discover that subtotals of sales amounts in a sales report do not add up to total sales. This might mean that data entry or processing procedures need to be corrected. Then changes would have to be made to ensure that all sales transactions would be properly captured and processed by a sales information system.

Recognizing Information Systems

As a business professional, you should be able to recognize the fundamental components of information systems you encounter in the real world. This means that you should be able to identify:

- The people, hardware, software, data, and network resources they use.
- The types of information products they produce.
- The way they perform input, processing, output, storage, and control activities.

This kind of understanding will help you be a better user, developer, and manager of information systems. And that, as we have pointed out in this chapter, is important to your future success as a manager, entrepreneur, or professional in business.

Summary

- **IS Framework for Business Professionals.** The IS knowledge that a business manager or professional needs to know is illustrated in Figure 1.2 and covered in this chapter and text. This includes (1) *foundation concepts:* fundamental behavioral, technical, business, and managerial concepts like system components and functions, or competitive strategies; (2) *information technologies:* concepts, developments, or management issues regarding hardware, software, data management, networks, and other technologies; (3) *business applications:* major uses of IT for business processes, operations, decision making, and strategic/competitive advantage; (4) *development processes:* how end users and IS specialists develop and implement business/IT solutions to problems and opportunities arising in business; and (5) *management challenges:* how to effectively and ethically manage the IS function and IT resources to achieve top performance and business value in support of the business strategies of the enterprise.
- **Business Roles of Information Systems.** Information systems perform three vital roles in business firms. Business applications of IS support an organization's business processes and operations, business decision making, and strategic competitive advantage. Major application categories of information systems include operations support systems, such as transaction processing systems, process control systems, and enterprise collaboration systems, and management support systems, such as management information systems, decision support systems, and executive information systems. Other major categories are expert systems, knowledge management systems, strategic information systems, and functional business systems. However, in the real world, most application categories are combined into cross-functional information systems that provide information and support for decision making and also perform operational information processing activities. Refer to Figures 1.7, 1.9, and 1.11 for summaries of the major application categories of information systems.
- **System Concepts.** A system is a group of interrelated components, with a clearly defined boundary, working toward the attainment of a common goal by accepting inputs and producing outputs in an organized transformation process. Feedback is data about the performance of a system. Control is the component that monitors and evaluates feedback and makes any necessary adjustments to the input and processing components to ensure that proper output is produced.
- **Information System Model.** An information system uses the resources of people, hardware, software, data, and networks to perform input, processing, output, storage, and control activities that convert data resources into information products. Data are first collected and converted to a form that is suitable for processing (input). Then the data are manipulated and converted into information (processing), stored for future use (storage), or communicated to their ultimate user (output) according to correct processing procedures (control).
- **IS Resources and Products.** Hardware resources include machines and media used in information processing. Software resources include computerized instructions (programs) and instructions for people (procedures). People resources include information

systems specialists and users. Data resources include alphanumeric, text, image, video, audio, and other forms of data. Network resources include communications media and network support. Information products produced by an information system can take a variety of forms, including paper reports, visual displays, multimedia documents, electronic messages, graphics images, and audio responses.

Key Terms and Concepts

These are the key terms and concepts of this chapter. The page number of their first explanation is in parentheses.

1. Computer-based information system (••)
2. Control (••)
3. Data (••)
4. Data or information processing (••)
5. Data resources (••)
6. Developing successful information system solutions (••)
7. E-business (••)
8. E-business applications (••)
9. Electronic commerce (••)
10. Enterprise collaboration systems (••)
11. Extranet (••)
12. Feedback (••)
13. Hardware resources (••)
    - *a.* Machines (••)
    - *b.* Media (••)
14. Information (••)
    - *a.* Information products (••)
15. Information system (••)
16. Information system activities (••)
    - *a.* Input (••)
    - *b.* Processing (••)
    - *c.* Output (••)
    - *d.* Storage (••)
    - *e.* Control (••)
17. Information system model (••)
18. Information technology (••)
19. Intranet (••)
20. Knowledge workers (••)
21. Network resources (••)
22. People resources (••)
    - *a.* IS specialists (••)
    - *b.* End users (••)
23. Roles of IS in business (••)
    - *a.* Support of business processes and operations (••)
    - *b.* Support of business decision making (••)
    - *c.* Support of strategies for competitive advantage (••)
24. Software resources (••)
    - *a.* Programs (••)
    - *b.* Procedures (••)
25. System (••)
26. Types of information systems (••)
    - *a.* Cross-functional informational systems (••)
    - *b.* Management support systems (••)
    - *c.* Operations support systems (••)
    - *d.* Functional business systems (••)

Match one of the previous key terms and concepts with one of the following brief examples or definitions. Look for the best fit for answers that seem to fit more than one key term or concept. Defend your choices.

____ 1. People who spend most of their workday creating, using, and distributing information.

____ 2. Computer hardware and software, networks, data management, and other technologies.

____ 3. Information systems support an organization's business processes, operations, decision making, and strategies for competitive advantage.

____ 4. Using IT to reengineer business processes to support e-business operations.

____ 5. Using Web-based decision support systems to support sales managers.

____ 6. Using information technology for electronic commerce to gain a strategic advantage over competitors.

____ 7. A system that uses people, hardware, software, and network resources to collect, transform, and disseminate information within an organization.

____ 8. An information system that uses computers and their hardware and software.

____ 9. Anyone who uses an information system or the information it produces.

____ 10. Applications using the Internet, corporate intranets, and interorganizational extranets for electronic business operations, e-commerce, and enterprise collaboration.

____ 11. The buying, selling, marketing, and servicing of products over the Internet and other networks.

____ 12. Groupware tools to support collaboration among networked teams.

____ 13. A group of interrelated components with a clearly defined boundary working together toward the attainment of a common goal.

____ 14. Data about a system's performance.

____ 15. Making adjustments to a system's components so that it operates properly.

____ 16. Facts or observations.

____ 17. Data that have been placed into a meaningful context for an end user.

____ 18. Converting data into information is a type of this kind of activity.

____ 19. An information system uses people, hardware, software, network, and data resources to perform input, processing, output, storage, and control activities that transform data resources into information products.

____ 20. Machines and media.

____ 21. Computers, disk drives, video monitors, and printers are examples.

____ 22. Magnetic disks, optical disks, and paper forms are examples.

____ 23. Programs and procedures.

____ 24. A set of instructions for a computer.

____ 25. A set of instructions for people.

____ 26. End users and information systems professionals.

____ 27. Using the keyboard of a computer to enter data.

____ 28. Computing loan payments.

____ 29. Printing a letter you wrote using a computer.

____ 30. Saving a copy of the letter on a magnetic disk.

____ 31. Having a sales receipt as proof of a purchase.

____ 32. Information systems can be classified into operations, management, and other categories.

____ 33. Includes transaction processing, process control, and end user collaboration systems.

____ 34. Includes management information, decision support, and executive information systems.

____ 35. Information systems that perform transaction processing and provide information to managers across the boundaries of functional business areas.

____ 36. Internet-like networks and websites inside a company.

____ 37. Interorganizational Internet-like networks among trading partners.

____ 38. Using the Internet, intranets, and extranets to empower internal business operations, electronic commerce, and enterprise collaboration.

____ 39. Information systems that focus on operational and managerial applications in support of basic business functions such as accounting or marketing.

____ 40. This suggests that data should be viewed the same as any organizational resource that must be managed effectively to benefit all stakeholders in an organization.

____ 41. This is a major challenge for business managers and professionals today in solving business problems.

____ 42. Examples include messages, reports, forms, and graphic images, which may be provided by video displays, audio responses, paper products, and multimedia.

____ 43. These include communications media and network infrastructure.

____ 44. People who develop and operate information systems.

1. How can information technology support a company's business processes and decision making, and give it a competitive advantage? Give examples to illustrate your answer.
2. How does the use of the Internet, intranets, and extranets by companies today support their business processes and activities?
3. Refer to the Real World Case on Continental Airlines in the chapter. Can you think of other ways beyond CallMiner that technology could be used to improve customer service? Explain your position and provide specific examples.
4. Why do big companies still fail in their use of information technology? What should they be doing differently?
5. How can a manager demonstrate that he or she is a responsible end user of information systems? Give several examples.
6. Refer to the Real World Case on Lufthansa in the chapter. What challenges in pilot morale, performance, and management might arise with the use of mobile computing devices in the field and in the cockpit? What preventive actions or solutions to these potential problem areas could you suggest?
7. What are some of the toughest management challenges in developing IT solutions to solve business problems and meet new business opportunities?
8. Why are there so many conceptual classifications of information systems? Why are they typically integrated in the information systems found in the real world?
9. In what major ways have information systems in business changed during the last 40 years? What is one major change you think will happen in the next 10 years? Refer to Figure 1.4 to help you answer.
10. Refer to the real world example of Hershey Foods in the chapter. Are the failure and success described due to managerial or technological challenges? Explain.

Analysis Exercises

Complete the following exercises as individual or group projects that apply chapter concepts to real world business situations.

1. **Using PowerWeb Resources**
   Visit the McGraw-Hill PowerWeb (Figure 1.22) website for Management Information Systems, which is available for users of this text at http://www.dushkin.com/powerweb/.

   As you will see, PowerWeb is a great online resource for self-study resources on MIS topics covered in this text, Web research tips and links, MIS periodicals, and current news on information technology topics. For example, click on the *Current News* link and search for and read a few current news articles on an MIS topic you are interested in, such as cybercrime or e-commerce.

   a. Prepare a one- or two-page summary describing the *Current News* articles you found most interesting and relevant as a business professional.
   b. End your paper with a few sentences describing one thing you have learned from your reading that might help you in your future career.

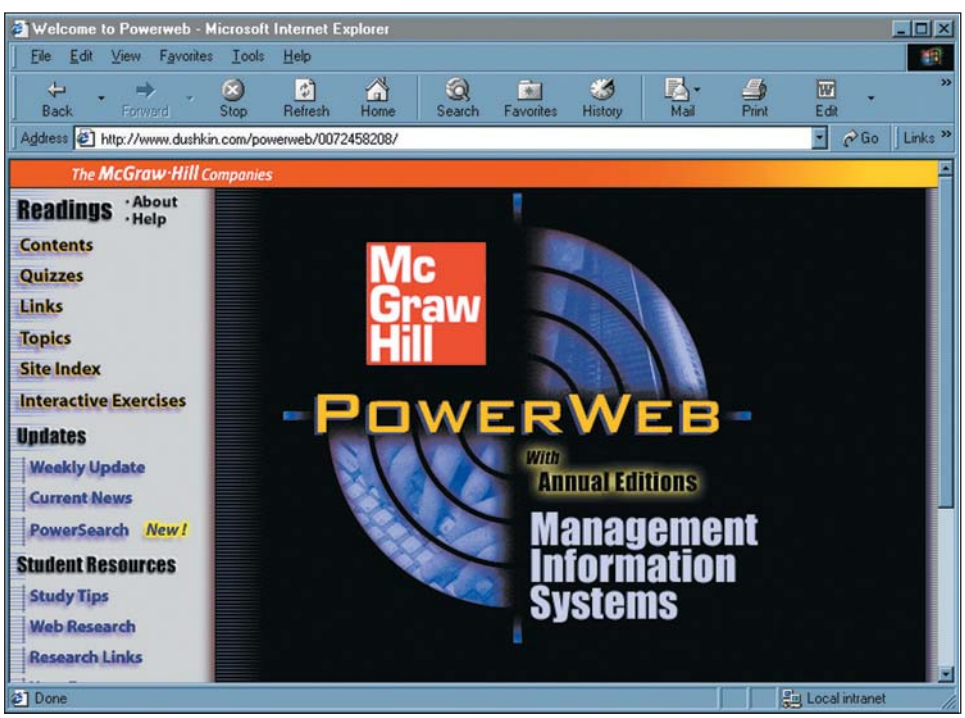
2. **Career Research**
   Select a job title that you would like to pursue as a summer intern or new graduate. Use your favorite job search websites or access the McGraw-Hill PowerWeb website for links to several job listing search engines. Use these resources to look up four different job postings for your desired job title.

   a. Select several job listings most relevant to your desired job title. List the degrees, training, experience, and/or certifications these job postings shared in common.
   b. Outline your plan for obtaining any requirements that you do not *currently* have.
   c. Which website did you find most useful? Describe the attributes you found most important in making this determination.

3. **Skydive Chicago: Recognizing IS Components**
   Skydive Chicago (www.SkydiveChicago.com) is one of the United States' premier skydiving resorts. In 2002, Skydive Chicago welcomed over 100 new skydivers who made well over 1,000 training jumps through its advanced training program. To support this enterprise, Skydive Chicago founder Roger Nelson, 1982 Olympic Skydiving Team captain and six-time world record holder, developed an innovative training program far exceeding the specifications set forth by the United States Parachute Association (USPA) (www.uspa.org).

   Each student in Skydive Chicago's training program makes a series of progressive training jumps under the direct supervision of a USPA-rated jumpmaster. The training program gears each jump in the series toward teaching one or two new skills. Nelson's training

FIGURE 1.22
The McGraw-Hill PowerWeb home page for management information systems.



Source: McGraw-Hill Higher Education.

innovations included mounting a video camera to the helmet of each jumpmaster. After each training jump, the jumpmaster debriefs the student using the tape for illustration. Jumpmasters also copy well-executed student skydives to the facility's tape library. Using this video library, students can stop by the dropzone's training room and watch video clips to prepare for their next jump in the training series. By videotaping each student jump, the training program gains numerous benefits:

- Students learn more quickly.
- Jumpmasters can identify and correct even subtle bad habits.
- Students require less jumpmaster time to brief and debrief.
- The dropzone's chief trainer can frequently assess current training techniques' effectiveness.
- Jumpmasters can easily replace the video library's dated clips with new clips reflecting any training program changes.
- Whenever new safety issues arise, the dropzone's Safety & Training Advisor can provide the USPA with video documentation supporting recommendations to modify the organization's Basic Safety Requirements.

Aside from the initial capital expense for video cameras, helmets, and TV/VCRs, this process adds no appreciable variable costs. However, both dropzone and student significantly benefit. By increased training efficiency, the dropzone can train more students per instructor. The students can also see and more easily recall their skydives. Lastly, skydivers often enjoy sharing their training triumphs and "bloopers" with their friends long after they've earned their skydiving license.

a. What are the inputs, processes, outputs, and storage devices associated with this information system?
b. Briefly describe each "process" associated with this information system.
c. How might Skydive Chicago combine Internet technologies and student video to their advantage?
d. What other products or services might Skydive Chicago provide using Internet technologies?

4. Office Products Corporation: Recognizing IS Components

Office Products Corporation receives more than 10,000 customer orders a month, drawing on a combined inventory of over 1,000 office products stocked at the company's warehouse. About 60 PCs are installed at Office Products's headquarters and connect in a local area network to several IBM Netfinity servers. Orders are received by phone or mail and entered into the system by customer representatives at network computers, or they are entered directly by customers who have shopped at the electronic commerce website developed by Office Products. Formatted screens help users follow data entry procedures. Netfinity servers store these orders on magnetic disks.

As the order is entered, a server checks the availability of the parts, allocates the stock, and updates customer and part databases stored on its magnetic disks. It then sends the order pick list to the warehouse printer, where warehouse personnel use the printout to fill the order. The company president has a networked PC workstation in her office and so do the controller, sales manager, inventory manager, and other executives. They use simple database management inquiry commands to get responses and reports concerning sales orders, customers, and inventory, and to review product demand and service trends.

Make an outline that identifies the information system components in Office Products's order processing system.

a. Identify the people, hardware, software, data, and network resources and the information products of this information system.
b. Identify the input, processing, output, storage, and control activities that occurred.

5. Western Chemical Corporation: Recognizing the Types and Roles of Information Systems

Western Chemical uses the Internet and an electronic commerce website to connect to its customers and suppliers, and to capture data and share information about sales orders and purchases. Sales and order data are processed immediately, and inventory and other databases are updated. Videoconferencing and electronic mail services are also provided. Data generated by a chemical refinery process are captured by sensors and processed by a computer that also suggests answers to a complex refinery problem posed by an engineer. Managers and business professionals access reports on a periodic, exception, and demand basis, and use computers to interactively assess the possible results of alternative decisions. Finally, top management can access text summaries and graphics displays that identify key elements of organizational performance and compare them to industry and competitor performance.

Western Chemical Corporation has started forming business alliances and using intranets, extranets, and the Internet to build a global electronic commerce website to offer their customers worldwide products and services. Western Chemical is in the midst of making fundamental changes to their computer-based systems to increase the efficiency of their e-business operations and their managers' ability to react quickly to changing business conditions.

a. Make an outline that identifies how information systems support (1) business operations, (2) business decision making, (3) strategic advantage, (4) an e-business enterprise, and (5) electronic commerce at Western Chemical.
b. Western Chemical has many different types of information systems. Identify as many as you can in the preceding scenario. Explain the reasons for your choices.

REAL WORLD CASE 3

Aviall Inc.: From Failure to Success with Information Technology

When Joe Lacik arrived at Aviall in January 2000 as Chief Information Officer (CIO), the supplier of airplane parts and components had lost control of its inventory.

An installation of Lawson Software to keep track of the availability and prices of the 360,000 parts it buys and then supplies to airplane operators and owners had gotten "ugly," he says. The company couldn't count on the price-tracking software to work with its warehouse management and inventory control software from Catalyst International, or its purchasing-forecasting software from Xelus.

The result? The wrong parts got to the wrong customers. And sometimes, not even that—it got so bad that in some instances Aviall sent empty boxes to its customers, Lacik says.

The company's sales fell 8 percent, from $404.2 million in 1998 to $371.9 million in 1999. So when Lacik and new Chief Executive Paul Fulchino arrived in the first month of 2000, the charge was simple: Clean up the mess.

"Aviall didn't have a middleware vision," says Mike Justice, who handled the account for Lawson. Translation: Aviall hadn't figured out what it needed to get all of its new software products to work together.

Yes, the wounds were self-inflicted. Aviall's own technology staff had picked the software and installed it.

Aviall had committed to spending as much as $40 million on overhauling its hardware, software, and facilities. But the overhaul was double-edged. At the same time that Lacik had to come up with a "middleware vision," the company's headquarters and operations were moving to Dallas-Fort Worth International Airport. A new 200,000-square-foot warehouse would replace a 132,000-square-foot facility in Farmers Branch, five miles away.

This was supposed to be a crowning moment. Besides improving operations and lowering cost, the new building would sport "an impressive facade," according to Senior VP of Operations Charles Kienzle. That would be good for marketing. But it could backfire if the company's systems didn't work right.

Lacik's answer? Find a way to get the Lawson, Xelus, and Catalyst software to exchange data. And while tackling that task, make sure the data also could be swapped with other key applications brought in to help it fill boxes: its new customer service software from Siebel Systems and its Web commerce software from BroadVision.

Broadly, Lacik had three choices: one, to fix the problem in-house, with existing staff. Not an option, really, because once the fix was done, he'd have to let folks go.

Two, to use an outside consultant. But then it was only a matter of time before some "very polished, highly paid individuals put their arm around my shoulder and say, 'we didn't realize this application has a real flaw.'" The invariable solution: "It's OK, it'll only cost you another $1 million and I'll fix it for you."

Three, to hire another software supplier. In this case, Aviall could get a small infantry to address the problem, and, watching over its shoulder, gain competency in-house to maintain the fix for the long term. This was Lacik's choice.

Plus, in Lacik's view, a supplier of software designed to fix a specific problem is hooked. If the software doesn't work as advertised, it's got to be fixed or it's not saleable elsewhere.

The difference between hiring a consultant and hiring a coding company is the difference between eggs and ham. With eggs, the chicken is involved. With ham, the pig is committed. "I wanted pigs; I didn't want chickens," Lacik says.

The "pigs" came from New Era of Networks, an Englewood, Colorado, company whose products attempt to overcome "language barriers" afflicting software used by large corporations.

New Era, acquired subsequently by database pioneer Sybase of Dublin, California, created software "adapters" that would let the different pieces of software swap data.

Simply put, when two pieces of software call the same piece of data, an adapter figures out what has to be done. The adapter transfers that piece of data between the two programs, making sure it ends up in the right place. Then each program that receives it can process the data further.

With this approach, the various applications don't even have to know the others exist. "The edges don't have to be aware of each other," says Bob Breton, senior director of product strategy at Sybase. "All the transformations and decisions take place in the middle."

Simple in concept, but a hard sell nonetheless. It was a hard sell to Aviall's finance department because the adapters in place would wind up costing an extra $1 million. It also was a hard sell inside Aviall's information technology department. "Hot-shot developers don't like middleware," Lacik says. "That's like saying to Picasso that there's a paint-by-number [answer] ready to go."

Lacik freed his own developers to work on custom code that would actually improve functions in the distribution facility. But even asking a software supplier to troubleshoot problems is not as easy as it sounds.

One of the most important connections would be between the Lawson software and the Siebel software, enabling a sales representative to assure a customer that an order could be fulfilled. The Siebel customer-service software would have to draw information on the prices and availability of parts from Lawson.

Figuring out how to do that took two years—and Lawson even brought in e-business consultants from accounting firm Grant Thornton to hammer out the connections with Siebel.

Lacik, too, pushed Sybase hard to deliver on its promise that it could make the Lawson and Siebel programs talk to each other. But when the moment of truth arrived, nothing much happened. "When we plugged into the Siebel adapter, there wasn't much rockin' and rollin' going on," says Lacik.

Eventually, the adapter got fixed. And Lacik would find that "the technology is the easy part" when installing something like Siebel's customer relationship management (CRM) application.

First, he now says, you have to change the sales force. Or at least how it conducts business. "The vast majority of CRM projects fail; and the reason is you have to change the behavior of the sales force," he says.

In this case, Aviall's sales force needed to get used to having their actions measured, Lacik contends. For the first time, the number of sales calls a month, the types of customers called on, and the reasons why, all would be tracked. Aviall's number of inside sales and customer service representatives dropped, by about five heads, in the adjustment.

But technically hard parts were still to come. When it came to mimicking the system that its 250 inside sales, branch, and customer-service people used to manage orders, it was not an overnight proposition.

"We didn't want to re-create the order-entry process," says Lacik. In this case, the technology staff "didn't even know the right questions to ask" in order to create a new computer-based system.

It has taken about 20 "yeah, but" sessions with salespeople, so far, to figure out what's needed. And it has taken nearly three years, because issues as simple as whether a customer has sufficient credit to make a purchase have to be handled deftly. In the past, whether a customer had enough credit to complete the sale wasn't figured out until after all the other details of the transaction were finalized. Now, the customer is first kicked over to the credit department (which also uses Siebel) for review and assistance.

But the resuscitation of Aviall's sales didn't depend solely on the launch of the order management system. With adapters in place, salespeople working the Siebel system could immediately check prices and availability of parts by querying the Lawson system. And the combination of Xelus and Catalyst made sure that the right parts got to the right customers at the right time. No empty boxes.

New radio guns help speed up the order-picking inside the warehouse. And as customers visit the distribution facility, the largest in the aviation parts business, it is making the "very strong visual impression" that Kienzle hoped for.

Sales grew at not just double-digit rates, but almost doubled—to $222 million in the September 2003 quarter, up from $127.8 million the previous year. The big impetus: a $3 billion, 10-year contract to sell and distribute spare parts for a widely used engine made by Rolls-Royce PLC, signed after the building was completed. It was the biggest deal in Aviall history.

When you fly into the dark, such results aren't guaranteed. You get "arrows in the back, sometimes," says Justice. "Sometimes, it pays big dividends."

CASE STUDY QUESTIONS

1. Why do you think that Aviall failed in their implementation of an enterprise resource planning system? What could they have done differently?
2. How has information technology brought new business success to Aviall? How did IT change Aviall's business model?
3. How could other companies use Aviall's approach to the use of IT to improve their business success? Give several examples.

REAL WORLD ACTIVITIES

1. Go to Aviall's website at www.aviall.com and look through some of the case studies of business solutions that Aviall provides to its customers. See if you can find evidence of successes directly related to the new system.
2. Sometimes, big failures can become big successes when working with innovative applications of technology. Break into small groups with your classmates and discuss your thoughts as to why it seems a failure has to happen first. Is it because we don't hear about the successes unless they come from a failure? How can we learn from the failures in applying innovative technologies so that more successes can be realized?