Principles of Information Systems 10E

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Principles of Information Systems, Tenth Edition
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CHAPTER

1

An Introduction to Information Systems

PRINCIPLES	LEARNING OBJECTIVES
▪ The value of information is directly linked to how it helps decision makers achieve the organization's goals.	▪ Discuss why it is important to study and understand information systems. ▪ Distinguish data from information and describe the characteristics used to evaluate the quality of data.
▪ Computers and information systems help make it possible for organizations to improve the way they conduct business.	▪ Name the components of an information system and describe several system characteristics.
▪ Knowing the potential impact of information systems and having the ability to put this knowledge to work can result in a successful personal career and in organizations that reach their goals.	▪ List the components of a computer-based information system. ▪ Identify the basic types of business information systems and discuss who uses them, how they are used, and what kinds of benefits they deliver.
▪ System users, business managers, and information systems professionals must work together to build a successful information system.	▪ Identify the major steps of the systems development process and state the goal of each.
▪ Information systems must be applied thoughtfully and carefully so that society, businesses, and industries can reap their enormous benefits.	▪ Describe some of the threats that information systems and the Internet can pose to security and privacy. ▪ Discuss the expanding role and benefits of information systems in business and industry.

Information Systems in the Global Economy
Braskem S.A., Brazil

The Power of Information in the Petrochemical Industry

You've probably heard that "information is power." In fact, the power of information depends on how it serves a specific need at a certain time. For example, when you are deciding which automobile to buy, the fact that the Yankees won the 2009 World Series is of no value to you. Information is most powerful when it enables strategic decision making. It must be delivered to the right person at the right time with as little effort as possible. For businesses, correctly managing strategic information can mean the difference between success and failure. Consequently, today's businesses invest a large percentage of their budgets in systems designed to deliver the right information to the right people at the right time. Such is the case for Braskem S.A.

Braskem S.A. is the largest petrochemical company in Latin America, with annual revenue of $13 billion (US) and 5,500 employees. Braskem was created in 2002 out of the merger of six Brazilian companies. Its 13 chemical plants produce basic raw materials such as ethylene, propylene, and chlorine, which are used in the production of thermoplastic resins. Braskem then sells the resins to manufacturers of plastic products. Toothbrushes, baby bottles, backpacks, automotive parts, and computer parts are all made from thermoplastic resins produced by Braskem, ExxonMobile, Dow Chemical, and other petrochemical companies.

Recently, Braskem invested heavily in an information systems (IS) development effort to provide all of its 4,000 office and production staff access to information from one central source using one system. In planning and developing the new system, Braskem IS managers needed to consider many factors. The system would handle science and research information as well as production, business, and financial information. Such enterprise-wide systems are often referred to as enterprise resource planning systems (ERPs). Braskem wanted the system to be implemented within a year—a tall order for an ERP. Braskem executives also wanted the system to help the company's employees make it one of the world's top 10 petrochemical companies.

Although this may seem a lot to ask of an IS, information systems do directly influence the implementation of smart business processes. An IS can either hamper people from proper business practices or it can help them establish best practices across an organization. "Best practices" refers to insightful business practices that are proven to provide a competitive advantage. Braskem wanted its new information systems to help establish best practices and streamline its essential business processes. Braskem's chief information officer (CIO), Stefan Lanna Lepecki, investigated what type of information systems the top global petrochemical companies were using. He soon discovered that 9 of the top 10 companies used information systems developed by SAP.

SAP is a multinational software development and consulting corporation with headquarters in Waldorf, Germany. Having worked with major petrochemical companies, SAP system engineers were well acquainted with the business and with systems that guide best business practices. After gaining the approval of the steering committee, top executives, and even the workers in the plant, Braskem hired SAP to build the new system. Rather than viewing the project as a technology initiative, Braskem embraced it as a business process transformation. Systems engineers, business managers, and hourly employees would all be involved.

Braskem's CIO kept customization requests to a minimum to implement a system that, for the most part, used the same standard SAP software that other petrochemical companies used. The system required Braskem to get a new technology infrastructure including new hardware, databases, telecommunications equipment, and software. It was

implemented within one year. In the final stages of development, Braskem instituted a rigorous training regimen for the 4,000 employees who would be working with the system. Using simulations, each employee was required to advance through eight skill levels before being allowed to use the real system. Although training required 63,930 people hours, it ensured that employees used the best practices and procedures that the system supported. The result was an improvement of business processes across the enterprise.

Braskem no longer suffers the frustration of working with different systems at different sites. Today, information flows freely among Braskem's plants and offices, with executives, managers, and employees accessing up-to-the-minute information from any Braskem location. They can also access the system from mobile devices when they travel. The company has reduced its maintenance, repair, and operations costs. The improved efficiency of its systems also allows Braskem to reduce the amount of inventory it keeps on hand because inventory now ships when it rolls off the production line. In general, business tasks require fewer people and take less time with the new system. The system also complies with government regulations such as the Sarbanes-Oxley Act designed to keep business practices transparent. The new IS puts Braskem in an ideal position to gain market share and reach its goals.

As you read this chapter, consider the following:

- How might the information system used at Braskem depend on the various components of a computer-based information system: hardware, software, databases, telecommunications, people, and procedures?
- How do computer-based information systems like Braskem's help businesses implement best practices?

Why Learn About Information Systems?

Information systems are used in almost every imaginable profession. Entrepreneurs and small business owners use information systems to reach customers around the world. Sales representatives use information systems to advertise products, communicate with customers, and analyze sales trends. Managers use them to make multimillion-dollar decisions, such as whether to build a manufacturing plant or research a cancer drug. Financial advisors use information systems to advise their clients to help them save for retirement or their children's education. From a small music store to huge multinational companies, businesses of all sizes could not survive without information systems to perform accounting, marketing, management, finance and similar operations. Regardless of your college major or chosen career, information systems are indispensable tools to help you achieve your career goals. Learning about information systems can help you land your first job, earn promotions, and advance your career.

This chapter presents an overview of information systems, with each section getting full treatment in subsequent chapters. We start by exploring the basics of information systems.

information system (IS)
A set of interrelated components that collect, manipulate, store, and disseminate data and information and provide a feedback mechanism to meet an objective.

People and organizations use information every day. The components that are used are often called an information system. An **information system** (IS) is a set of interrelated components that collect, manipulate, store, and disseminate data and information and provide a feedback mechanism to meet an objective.[1] It is the feedback mechanism that helps organizations achieve their goals, such as increasing profits or improving customer service.[2] Businesses can use information systems to increase revenues and reduce costs. This book emphasizes the benefits of an information system, including speed, accuracy, increased revenues, and reduced costs.

We interact with information systems every day, both personally and professionally. We use automated teller machines at banks, access information over the Internet, select information from kiosks with touch screens, and scan the barcodes on our purchases at self-checkout lanes. Major *Fortune 500* companies can spend more than $1 billion per year on information systems. Knowing the potential of information systems and putting this

knowledge to work can help individuals enjoy a successful career and help organizations reach their goals.

Information systems are everywhere. An air traveler checks in for a flight using a kiosk, which sends the check-in information to a network to verify the traveler's reservation and flight information. The kiosk's system processes the information and prints a boarding pass, speeding airport check-in times.

(Source: © Tim Boyle/Getty Images)

Today we live in an information economy.[3] Information itself has value, and commerce often involves the exchange of information rather than tangible goods. Systems based on computers are increasingly being used to create, store, and transfer information. Using information systems, investors make multimillion-dollar decisions, financial institutions transfer billions of dollars around the world electronically, and manufacturers order supplies and distribute goods faster than ever before. Computers and information systems will continue to change businesses and the way we live. To prepare for these innovations, you need to be familiar with fundamental information concepts.

INFORMATION CONCEPTS

Information is a central concept of this book. The term is used in the title of the book, in this section, and in almost every chapter. To be an effective manager in any area of business, you need to understand that information is one of an organization's most valuable resources. This term, however, is often confused with *data*.

Data, Information, and Knowledge

Data consists of raw facts, such as an employee number, total hours worked in a week, inventory part numbers, or sales orders. As shown in Table 1.1, several types of data can represent these facts. When facts are arranged in a meaningful manner, they become information. **Information** is a collection of facts organized and processed so that they have additional value beyond the value of the individual facts. For example, sales managers might find that knowing the total monthly sales suits their purpose more (i.e., is more valuable) than knowing the number of sales for each sales representative. Providing information to customers can also help companies increase revenues and profits. FedEx, a worldwide leader in shipping packages and products around the world, believes that information about a package can be as important as the package itself for many of its customers.[4] Information generated by FedEx and other organizations is being placed on the Internet more now than ever. In another example, many universities place course information and content on the Internet. Using the Open Course Ware program, Massachusetts Institute of Technology (MIT) places class notes and contents on the Internet for many of its courses.[5]

data
Raw facts, such as an employee number, total hours worked in a week, inventory part numbers, or sales orders.

information
A collection of facts organized and processed so that they have additional value beyond the value of the individual facts.

Data represents real-world things. Hospitals and healthcare organizations, for example, maintain patient medical data, which represents actual patients with specific health situations. In many cases, hospitals and healthcare organizations are converting data to electronic form. Some have developed electronic records management (ERM) systems to store, organize, and control important data. However, data—raw facts—has little value beyond its existence. The U.S. federal stimulus plan could invest as much as $2 billion into helping healthcare organizations develop a medical records program to store and use the vast amount of medical

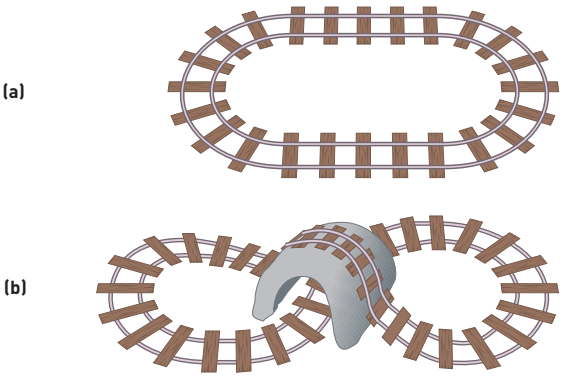
data that is generated each year.[6] Medical records systems can be used to generate critical health-related information, which in turn can save money and lives.

Table 1.1
Types of Data

Data	Represented by
Alphanumeric data	Numbers, letters, and other characters
Image data	Graphic images and pictures
Audio data	Sound, noise, or tones
Video data	Moving images or pictures

Here is another example of the difference between data and information. Consider data as pieces of railroad track in a model railroad kit. Each piece of track has limited inherent value as a single object. However, if you define a relationship among the pieces of the track, they gain value. By arranging the pieces in a certain way, a railroad layout begins to emerge (see Figure 1.1a). Data and information work the same way. Rules and relationships can be set up to organize data into useful, valuable information.

Figure 1.1
Defining and Organizing Relationships Among Data Creates Information



The type of information created depends on the relationships defined among existing data. For example, you could rearrange the pieces of track to form different layouts. Adding new or different data means you can redefine relationships and create new information. For instance, adding new pieces to the track can greatly increase the value—in this case, variety and fun—of the final product. You can now create a more elaborate railroad layout (see Figure 1.1b). Likewise, a sales manager could add specific product data to sales data to create monthly sales information organized by product line. The manager could use this information to determine which product lines are the most popular and profitable.

process
A set of logically related tasks performed to achieve a defined outcome.

knowledge
The awareness and understanding of a set of information and ways that information can be made useful to support a specific task or reach a decision.

Turning data into information is a **process**, or a set of logically related tasks performed to achieve a defined outcome. The process of defining relationships among data to create useful information requires knowledge. **Knowledge** is the awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision. Having knowledge means understanding relationships in information. Part of the knowledge you need to build a railroad layout, for instance, is the understanding of how much space you have for the layout, how many trains will run on the track, and how fast they will travel. Selecting or rejecting facts according to their relevancy to particular tasks is based on the knowledge used in the process of converting data into information. Therefore, you can also think of information as data made more useful through the application of knowledge. *Knowledge workers* (*KWs*) are people who create, use, and disseminate knowledge and are usually professionals in science, engineering, business, and other areas.[7] A *knowledge management system* (*KMS*) is an organized collection of people, procedures, software, databases, and devices used to create, store, and use the organization's knowledge and experience.[8] Research has shown that the success of a KMS is linked to how easy it is to use and how satisfied users are with it.[9]

In some cases, people organize or process data mentally or manually. In other cases, they use a computer. Where the data comes from or how it is processed is less important than whether the data is transformed into results that are useful and valuable. This transformation process is shown in Figure 1.2.

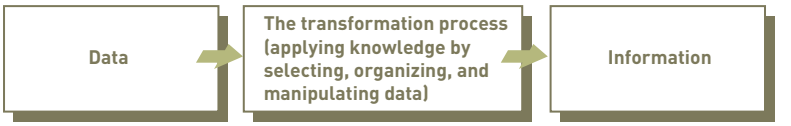


Figure 1.2

The Process of Transforming Data into Information

The Characteristics of Valuable Information

To be valuable to managers and decision makers, information should have the characteristics described in Table 1.2. These characteristics make the information more valuable to an organization. Many shipping companies, for example, can determine the exact location of inventory items and packages in their systems, and this information makes them responsive to their customers. In contrast, if an organization's information is not accurate or complete, people can make poor decisions, costing thousands or even millions of dollars. If an inaccurate forecast of future demand indicates that sales will be very high when the opposite is true, an organization can invest millions of dollars in a new plant that is not needed. Furthermore, if information is not relevant, not delivered to decision makers in a timely fashion, or too complex to understand, it can be of little value to the organization.

Table 1.2

Characteristics of Valuable Information

Characteristics	Definitions
Accessible	Information should be easily accessible by authorized users so they can obtain it in the right format and at the right time to meet their needs.
Accurate	Accurate information is error free. In some cases, inaccurate information is generated because inaccurate data is fed into the transformation process. (This is commonly called garbage in, garbage out [GIGO].)
Complete	Complete information contains all the important facts. For example, an investment report that does not include all important costs is not complete.
Economical	Information should also be relatively economical to produce. Decision makers must always balance the value of information with the cost of producing it.
Flexible	Flexible information can be used for a variety of purposes. For example, information on how much inventory is on hand for a particular part can be used by a sales representative in closing a sale, by a production manager to determine whether more inventory is needed, and by a financial executive to determine the total value the company has invested in inventory.
Relevant	Relevant information is important to the decision maker. Information showing that lumber prices might drop might not be relevant to a computer chip manufacturer.
Reliable	Reliable information can be trusted by users. In many cases, the reliability of the information depends on the reliability of the data-collection method. In other instances, reliability depends on the source of the information. A rumor from an unknown source that oil prices might go up might not be reliable.
Secure	Information should be secure from access by unauthorized users.
Simple	Information should be simple, not overly complex. Sophisticated and detailed information might not be needed. In fact, too much information can cause information overload, whereby a decision maker has too much information and is unable to determine what is really important.
Timely	Timely information is delivered when it is needed. Knowing last week's weather conditions will not help when trying to decide what coat to wear today.
Verifiable	Information should be verifiable. This means that you can check it to make sure it is correct, perhaps by checking many sources for the same information.

Depending on the type of data you need, some of these attributes are more important than others. For example, with market-intelligence data, some inaccuracy and incompleteness is acceptable, but timeliness is essential. Getco, a Chicago-based stock-trading company, requires the most timely market information possible so it can place profitable trades.[10] Getco uses an approach called high-frequency trading that requires powerful and very fast computers to make its trades. On some days, Getco can account for 10 to 20 percent of the total trading volume for some stocks. Likewise, some healthcare organizations have developed a real-time system for their intensive care units (ICUs) that can detect and prevent deadly infections, saving lives every year and millions of dollars in additional healthcare costs. Similarly, market intelligence might alert you that competitors are about to make a major price cut. The exact details and timing of the price cut might not be as important as being warned far enough in advance to plan how to react. On the other hand, accuracy, verifiability, and completeness are critical for data used in accounting to manage company assets such as cash, inventory, and equipment.

The Value of Information

The value of information is directly linked to how it helps decision makers achieve their organization's goals. Valuable information can help people in their organizations perform tasks more efficiently and effectively. Consider a market forecast that predicts a high demand for a new product. If you use this information to develop the new product and your company makes an additional profit of $10,000, the value of this information to the company is $10,000 minus the cost of the information. Valuable information can also help managers decide whether to invest in additional information systems and technology. A new computerized ordering system might cost $30,000 but generate an additional $50,000 in sales. The *value added* by the new system is the additional revenue from the increased sales of $20,000. Most corporations have cost reduction as a primary goal. Using information systems, some manufacturing companies have slashed inventory costs by millions of dollars. Other companies have increased inventory levels to increase profits. Walmart, for example, uses information about certain regions of the country and specific situations to increase needed inventory levels of certain products and improve overall profitability. In other cases, the value of information can be realized in cost savings. Shermag, a Canadian furniture manufacturing company, was able to use a sophisticated computer system to achieve the company's cost reduction goal.[11] The company was able to reduce total costs by more than 20 percent by using optimization software to reduce material and manufacturing costs.

SYSTEM CONCEPTS

system
A set of elements or components that interact to accomplish goals.

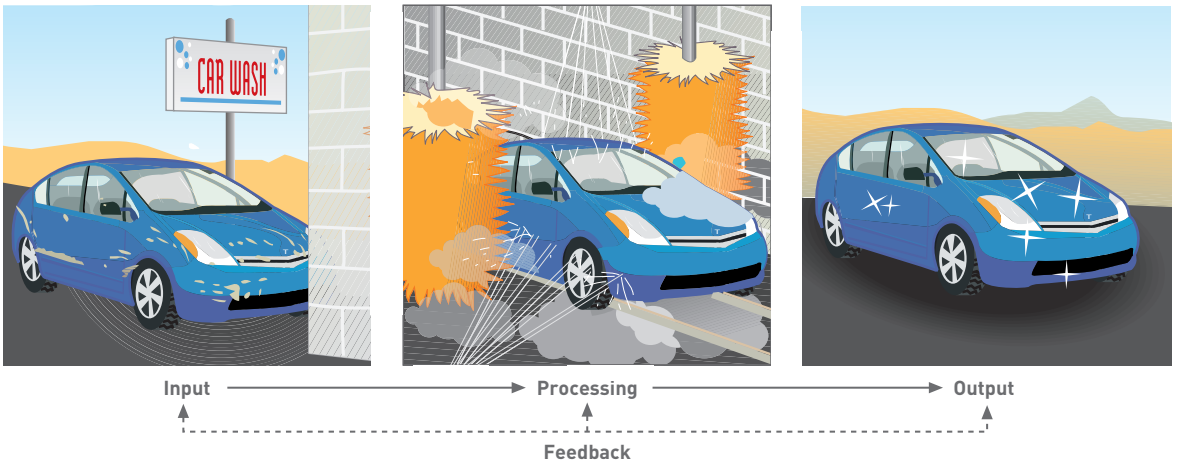
Like information, another central concept of this book is that of a system. A **system** is a set of elements or components that interact to accomplish goals. The elements themselves and the relationships among them determine how the system works. Systems have inputs, processing mechanisms, outputs, and feedback (see Figure 1.3). For example, consider an automatic car wash. Tangible *inputs* for the process are a dirty car, water, and various cleaning ingredients. Time, energy, skill, and knowledge also serve as inputs to the system because they are needed to operate it. Skill is the ability to successfully operate the liquid sprayer, foaming brush, and air dryer devices. Knowledge is used to define the steps in the car wash operation and the order in which the steps are executed.

The *processing mechanisms* consist of first selecting which cleaning option you want (wash only, wash with wax, wash with wax and hand dry, etc.) and communicating that to the operator of the car wash. A *feedback mechanism* is your assessment of how clean the car is. Liquid sprayers shoot clear water, liquid soap, or car wax depending on where your car is in the process and which options you selected. The *output* is a clean car. As in all systems, independent elements or components (the liquid sprayer, foaming brush, and air dryer) interact to create a clean car.

Figure 1.3

Components of a System

A system's four components consist of input, processing, output, and feedback.



System Performance and Standards

System performance can be measured in various ways. **Efficiency** is a measure of what is produced divided by what is consumed. It can range from 0 to 100 percent. For example, the efficiency of a motor is the energy produced (in terms of work done) divided by the energy consumed (in terms of electricity or fuel). Some motors have an efficiency of 50 percent or less because of the energy lost to friction and heat generation.

efficiency
A measure of what is produced divided by what is consumed.

Efficiency is a relative term used to compare systems. For example, a hybrid gasoline engine for an automobile or truck can be more efficient than a traditional gasoline engine because, for the equivalent amount of fuel consumed, the hybrid engine travels more miles and gets better gas mileage. Many organizations can reduce their energy usage by investing in more energy-efficient computer systems.[12]

Effectiveness is a measure of the extent to which a system achieves its goals. It can be computed by dividing the goals actually achieved by the total of the stated goals. For example, a company might want to achieve a net profit of $100 million for the year using a new information system. Actual profits, however, might only be $85 million for the year. In this case, the effectiveness is 85 percent (85/100 = 85%). Of course, companies measure effectiveness using different measures. According to the chief information officer (CIO) of Wipro, a large consulting and outsourcing company, "An important metric for us is when our people … deliver an improved bottom line. When there's a reduction in people traveling for collaborating on projects, that's an important measure of effectiveness."[13]

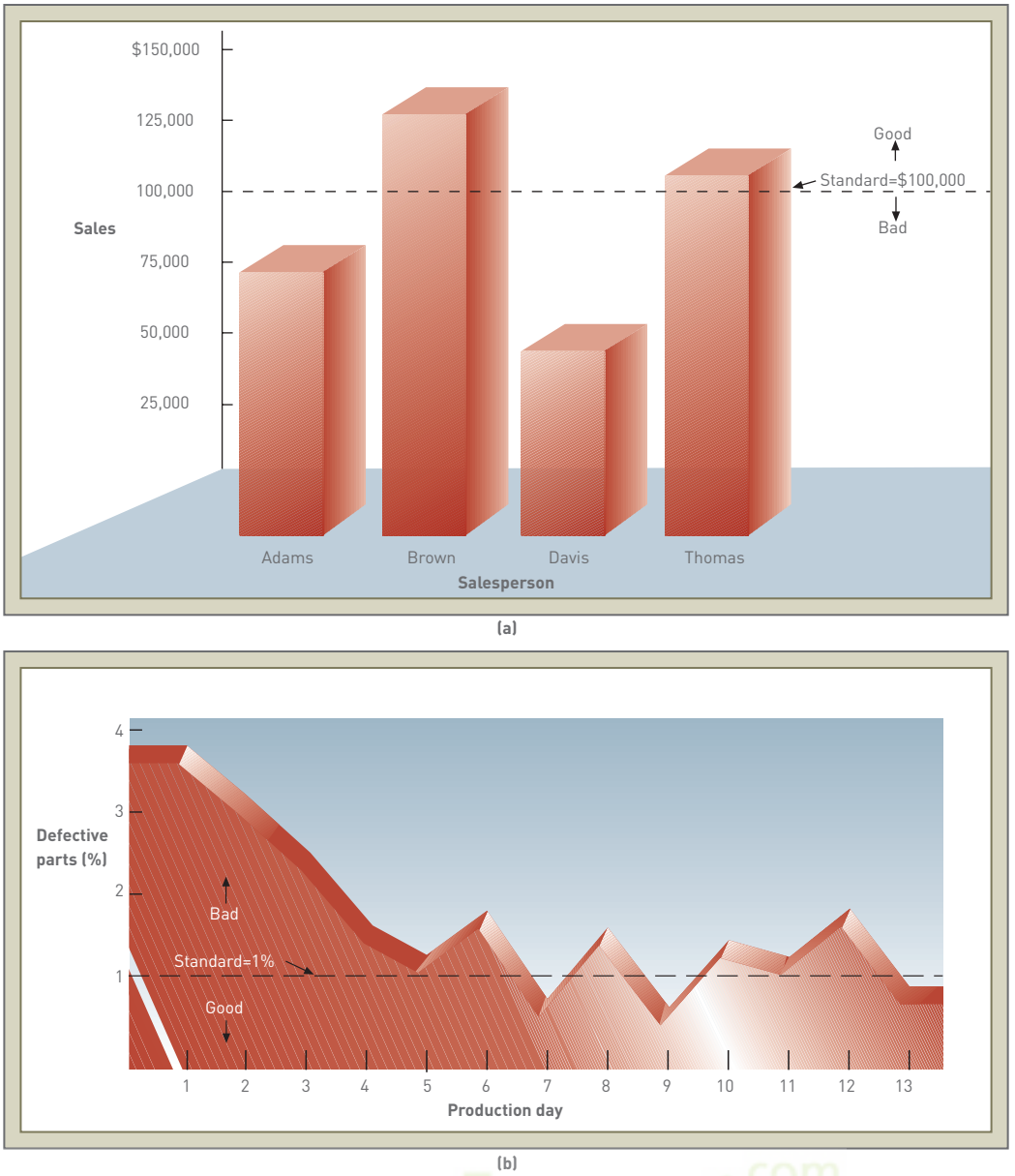
effectiveness
A measure of the extent to which a system achieves its goals; it can be computed by dividing the goals actually achieved by the total of the stated goals.

Evaluating system performance also calls for using performance standards. A **system performance standard** is a specific objective of the system. For example, a system performance standard for a marketing campaign might be to have each sales representative sell $100,000 of a certain type of product each year (see Figure 1.4a). A system performance standard for a manufacturing process might be to provide no more than 1 percent defective parts (see Figure 1.4b). After standards are established, system performance is measured and compared with the standard. Variances from the standard are determinants of system performance.

system performance standard
A specific objective of the system.

Figure 1.4

System Performance Standards



WHAT IS AN INFORMATION SYSTEM?

As mentioned previously, an information system (IS) is a set of interrelated elements or components that collect (input), manipulate (process), store, and disseminate (output) data and information and provide a corrective reaction (feedback mechanism) to meet an objective (see Figure 1.5). The feedback mechanism is the component that helps organizations achieve their goals, such as increasing profits or improving customer service.

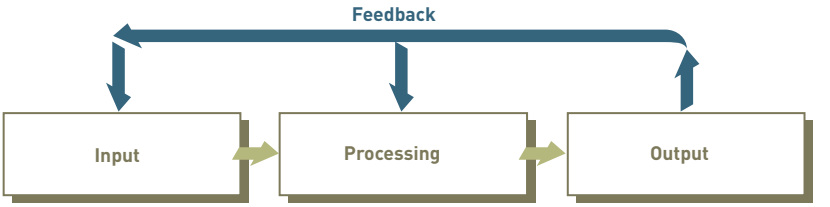


Figure 1.5

The Components of an Information System

Feedback is critical to the successful operation of a system.

Input, Processing, Output, Feedback

Input

In information systems, **input** is the activity of gathering and capturing raw data. In producing paychecks, for example, the number of hours every employee works must be collected before paychecks can be calculated or printed. In a university grading system, instructors must submit student grades before a summary of grades can be compiled and sent to students.

input
The activity of gathering and capturing raw data.

Processing

In information systems, **processing** means converting or transforming data into useful outputs. Processing can involve making calculations, comparing data and taking alternative actions, and storing data for future use. Processing data into useful information is critical in business settings.

Processing can be done manually or with computer assistance. In a payroll application, the number of hours each employee worked must be converted into net, or take-home, pay. Other inputs often include employee ID number and department. The processing can first involve multiplying the number of hours worked by the employee's hourly pay rate to get gross pay. If weekly hours worked exceed 40, overtime pay might also be included. Then deductions—for example, federal and state taxes or contributions to insurance or savings plans—are subtracted from gross pay to get net pay.

After these calculations and comparisons are performed, the results are typically stored. *Storage* involves keeping data and information available for future use, including output, discussed next.

processing
Converting or transforming data into useful outputs.

Output

In information systems, **output** involves producing useful information, usually in the form of documents and reports. Outputs can include paychecks for employees, reports for managers, and information supplied to stockholders, banks, government agencies, and other groups. In some cases, output from one system can become input for another. For example, output from a system that processes sales orders can be used as input to a customer billing system.

output
Production of useful information, usually in the form of documents and reports.

Feedback

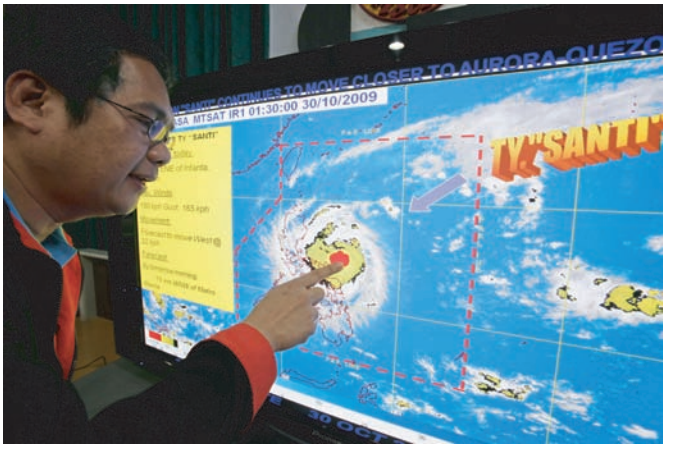
In information systems, **feedback** is information from the system that is used to make changes to input or processing activities. For example, errors or problems might make it necessary to correct input data or change a process. Consider a payroll example. Perhaps the number of hours an employee worked was entered as 400 instead of 40. Fortunately, most information systems check to make sure that data falls within certain ranges. For number of hours worked, the range might be from 0 to 100 because it is unlikely that an employee would work more than 100 hours in a week. The information system would determine that 400 hours is out of range and provide feedback. The feedback is used to check and correct the input on the number of hours worked to 40. If undetected, this error would result in a very high net pay!

Feedback is also important for managers and decision makers. For example, a furniture maker could use a computerized feedback system to link its suppliers and plants. The output from an information system might indicate that inventory levels for mahogany and oak are getting low—a potential problem. A manager could use this feedback to decide to order more wood. These new inventory orders then become input to the system. In addition to this reactive approach, a computer system can also be proactive—predicting future events to avoid

feedback
Output that is used to make changes to input or processing activities.

forecasting
Predicting future events to avoid problems.

problems. This concept, often called **forecasting**, can be used to estimate future sales and order more inventory before a shortage occurs. According to the CIO of Coty Fragrance, which produces Jennifer Lopez and Vera Wang brands, "If we can't meet demand, it annoys the retailers, the consumers lose interest, and we lose sales."[14] Forecasting is also used to predict the strength and landfall sites of hurricanes, future stock market values, and who will win a political election. Disappointed with existing weather forecasting systems, Robert Baron developed a more sophisticated forecasting approach that used radar data along with other meteorological data to forecast storms and weather. Today, his weather forecasting software generates about $25 million in annual revenues. [15]



Information systems are everywhere. An air traveler checks in for a flight using a kiosk, which sends the check-in information to a network to verify the traveler's reservation and flight information. The kiosk's system processes the information and prints a boarding pass, speeding airport check-in times.

(Source: © Tim Boyle/Getty Images)

Manual and Computerized Information Systems

As discussed earlier, an information system can be manual or computerized. For example, some investment analysts manually draw charts and trend lines to assist them in making investment decisions. Tracking data on stock prices (input) over the last few months or years, these analysts develop patterns on graph paper (processing) that help them determine what stock prices are likely to do in the next few days or weeks (output). Some investors have made millions of dollars using manual stock analysis information systems. Of course, today many excellent computerized information systems follow stock indexes and markets and suggest when large blocks of stocks should be purchased or sold (called "program trading") to take advantage of market discrepancies.

Computer-Based Information Systems

computer-based information system (CBIS)
A single set of hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information.

A **computer-based information system** (**CBIS**) is a single set of hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information. Lloyd's Insurance in London used a CBIS to reduce paper transactions and convert to an electronic insurance system. The CBIS allows Lloyd's to insure people and property more efficiently and effectively. Lloyd's often insures the unusual, including actress Betty Grable's legs, Rolling Stone Keith Richards's hands, and a possible appearance of the Lock Ness Monster (Nessie) in Scotland, which would result in a large payment for the person first seeing the monster.

technology infrastructure
All the hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information.

The components of a CBIS are illustrated in Figure 1.6. "Information technology (IT)" refers to hardware, software, databases, and telecommunications. Telecommunications also includes networks and the Internet. A business's **technology infrastructure** includes all the hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information. The technology infrastructure is a set of shared IS resources that form the foundation of each computer-based information system.

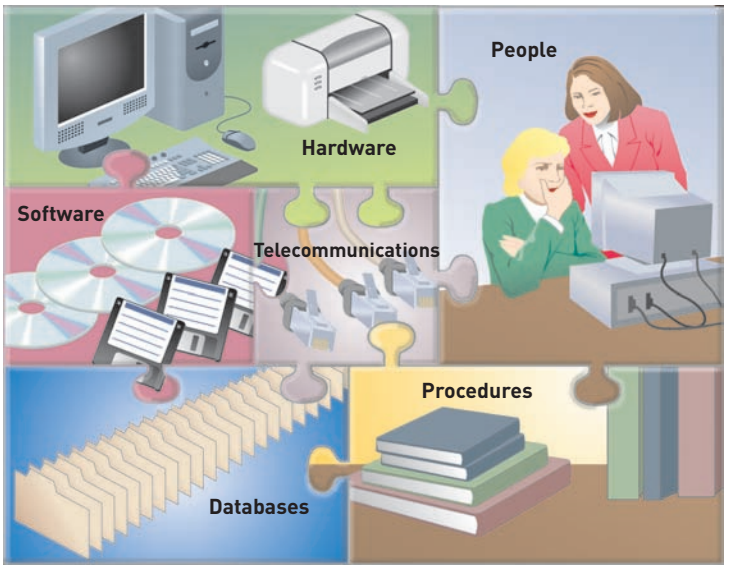


Figure 1.6

The Components of a Computer-Based Information System.

Hardware

Hardware consists of the physical components of a computer that perform the input, processing, storage, and output activities of the computer. Input devices include keyboards, mice, and other pointing devices; automatic scanning devices; and equipment that can read magnetic ink characters. Processing devices include computer chips that contain the central processing unit and main memory. Advances in chip design allow faster speeds, less power consumption, and larger storage capacity. New, specialized computer chips will be able to monitor power consumption for companies and homeowners.[16] SanDisk and other companies make small, portable chips that are used to conveniently store programs, data files, and more.[17] The publisher of this book, for example, used this type of chip storage device to send promotional material for this book to professors and instructors.

hardware
The physical components of a computer that perform the input, processing, storage, and output activities of the computer.

Processor speed is also important. Today's more advanced processor chips have the same power as 1990s-era supercomputers that occupied a room measuring 10 feet by 40 feet. Today, a large IBM computer used by U.S. Livermore National Laboratories to analyze nuclear explosions is one of the fastest computers in the world at up to 300 teraflops—300 trillion operations per second.[18] The super-fast computer, called Blue Gene, costs about $40 million.[19] It received the *National Medal of Technology and Innovation* award from President Barack Obama. Small, inexpensive computers and handheld devices are also becoming popular. Inexpensive netbooks are small, inexpensive laptop computers that can cost less than $500 and be used primarily to connect to the Internet.[20] In addition, the iPhone by Apple Computer can perform many functions that can be done on a desktop or laptop computer.[21] The One Laptop Per Child computer costs less than $200.[22] The Classmate PC by Intel will cost about $300 and include some educational software. Both computers are intended for regions of the world that can't afford traditional personal computers. The country of Peru, for example, has purchased about 350,000 laptops loaded with about 100 books for children, who also teach their parents how to use the inexpensive computers.[23] According to the founder of One Laptop Per Child, "If that doesn't give you goose bumps, I don't know what will."

The many types of output devices include printers and computer screens. Some touch-sensitive computer screens, for example, can be used to execute functions or complete programs, such as connecting to the Internet or running a new computer game or word-processing program.[24] Many special-purpose hardware devices have also been developed. Computerized event data recorders (EDRs) are now being placed into vehicles. Like an airplane's black box, EDRs record vehicle speed, possible engine problems, driver performance, and more. The technology is being used to document and monitor vehicle operation, determine the cause of accidents, and investigate whether truck drivers are taking required breaks. In one case, an EDR was used to help convict a driver of vehicular homicide. In another case,

an EDR in a police officer's car showed that the officer may have run a stop light and accelerated to more than 70 miles per hour on a road with a speed limit of 35 miles per hour, which may have caused an accident that killed two teenagers.[25]

The One Laptop Per Child computer costs less than $200, and is designed for regions of the world that can't afford traditional personal computers.

(Source: Courtesy of AFP/Getty Images.)

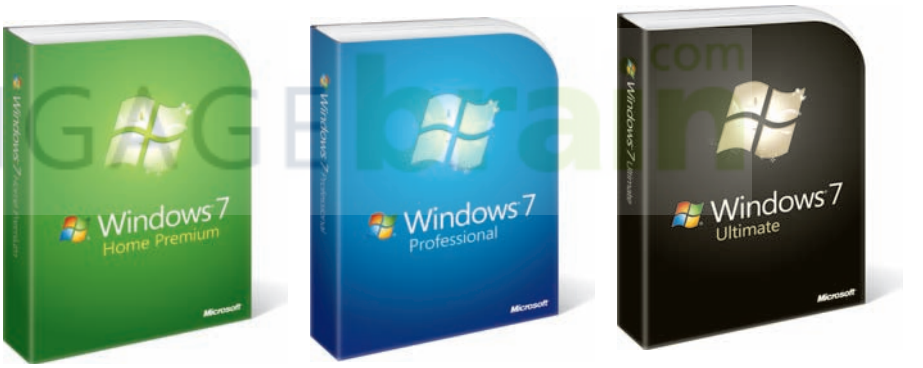
Software

software
The computer programs that govern the operation of the computer.

Software consists of the computer programs that govern the operation of the computer. These programs allow a computer to process payroll, send bills to customers, and provide managers with information to increase profits, reduce costs, and provide better customer service. Fab Lab software, for example, controls tools such as cutters, milling machines, and other devices.[26] One Fab Lab system, which costs about $20,000, has been used to make radio frequency tags to track animals in Norway, engine parts to allow tractors to run on processed castor beans in India, and many other fabrication applications. SalesForce (*www.salesforce.com*) sells software to help companies manage their salesforce and help improve customer satisfaction.[27]

The two types of software are system software, such as Microsoft Windows Vista and Windows 7, which controls basic computer operations, including start-up and printing, and applications software, such as Microsoft Office 2010, which allows you to accomplish specific tasks, including word processing or tabulating numbers.[28] Software is needed for computers of all sizes, from small handheld computers to large supercomputers. The Android operating system by Google and Microsoft's Mobile 6.5, for example, are operating systems for cell phones and small portable devices.[29] Although most software can be installed from CDs, many of today's software packages can be downloaded through the Internet.

Sophisticated application software, such as Adobe Creative Suite 4, can be used to design, develop, print, and place professional-quality advertising, brochures, posters, prints, and videos on the Internet.[30] Nvidia's GeForce 3D is software that can display images on a computer screen that appear three-dimensional (3D) when viewed using special glasses.[31]



Windows 7 is systems software that controls basic computer operations, including start-up and printing.

(Source: Courtesy of Microsoft Corporation.)

Databases

database
An organized collection of facts and information.

A **database** is an organized collection of facts and information, typically consisting of two or more related data files. An organization's database can contain facts and information on customers, employees, inventory, competitors' sales, online purchases, and much more. A database manager for a large bank, for example, has developed a patented security process that generates a random numeric code from a customer's bank card that can be verified by a computer system through a customer database.[32] Once the bank card and customer have been verified, the customer can make financial transactions.

Most managers and executives consider a database to be one of the most valuable parts of a computer-based information system. Data can be stored in large data centers, within computers of all sizes, on the Internet, and in smart cell phones and small computing devices.[33] The New York Stock Exchange (NYSE) and other exchanges are using database systems to get better business information and intelligence to help them run successful and profitable operations.[34] The huge increase in database storage requirements, however, often requires more storage devices, more space to house the additional storage devices, and additional electricity to operate them.[35] Most organizations using database systems have seen storage requirements increase more than 10 percent every year. An important issue for any organization is how to keep a vast database secure and safe from the prying eyes of outside individuals and groups.[36]

Telecommunications, Networks, and the Internet

telecommunications
The electronic transmission of signals for communications; enables organizations to carry out their processes and tasks through effective computer networks.

Telecommunications is the electronic transmission of signals for communications, which enables organizations to carry out their processes and tasks through effective computer networks. Telecommunications can take place through wired, wireless, and satellite transmissions.[37] The Associated Press was one of the first users of telecommunications in the 1920s, sending news over 103,000 miles of wire in the United States and over almost 10,000 miles of cable across the ocean. Today, telecommunications is used by organizations of all sizes and individuals around the world. With telecommunications, people can work at home or while traveling. This approach to work, often called "telecommuting," allows someone living in England to send work to the United States, China, or any location with telecommunications capabilities.

networks
Computers and equipment that are connected in a building, around the country, or around the world to enable electronic communications.

Networks connect computers and equipment in a building, around the country, or around the world to enable electronic communication. Wireless transmission allows aircraft drones, such as Boeing's Scan Eagle, to fly using a remote control system to monitor commercial buildings or enemy positions.[38] The drones are smaller and less-expensive versions of the Predator and Global Hawk drones that the U.S. military used in the Afghanistan and Iraq conflicts. According to a Navy Rear Admiral, "There are all sorts of levels of stealthiness. Operators have been deploying it in an undetectable fashion; at a certain low altitude, you can't hear it or see it."

Internet
The world's largest computer network, consisting of thousands of interconnected networks, all freely exchanging information.

The **Internet** is the world's largest computer network, consisting of thousands of interconnected networks, all freely exchanging information. Research firms, colleges, universities, high schools, hospitals, and businesses are just a few examples of organizations using the Internet. Beth Israel Deaconess Medical Center, for example, allows doctors to use its Internet site to provide better patient care and reduce costs.[39] The doctors pay a monthly service fee to use the hospital's Internet site. Increasingly, businesses and people are using the Internet to run and deliver important applications, such as accessing vast databases, performing sophisticated business analyses, and getting a variety of reports. This concept, called *cloud computing*, allows people to get the information they need from the Internet (the cloud) instead of from desktop or corporate computers.[40] According to the CIO of Avon Products, "Today, wherever you are, you can connect to all the information you need." Some applications are available to everyone (public cloud computing), while other applications are only available to corporate employees and managers (private cloud computing).[41]

Doctors use cloud computing and other types of Web sites to provide better patient care and reduce costs.

(Source: © B Busco/Getty Images.)

People use the Internet to research information, buy and sell products and services, make travel arrangements, conduct banking, download music and videos, read books, and listen to radio programs, among other activities.[42] Even some airline companies are offering Internet access on their flights.[43] Bank of America allows people to check their bank balances and pay their bills on the Internet using Apple's iPhone and other handheld devices.[44] Internet sites like MySpace (*www.myspace.com*) and Facebook (*www.facebook.com*) have become popular places to connect with friends and colleagues. People can also send short messages of up to 140 characters using Twitter (*www.twitter.com*) over the Internet.[45] Some people, however, fear that this increased usage can lead to problems, including criminals hacking into the Internet and gaining access to sensitive personal information.

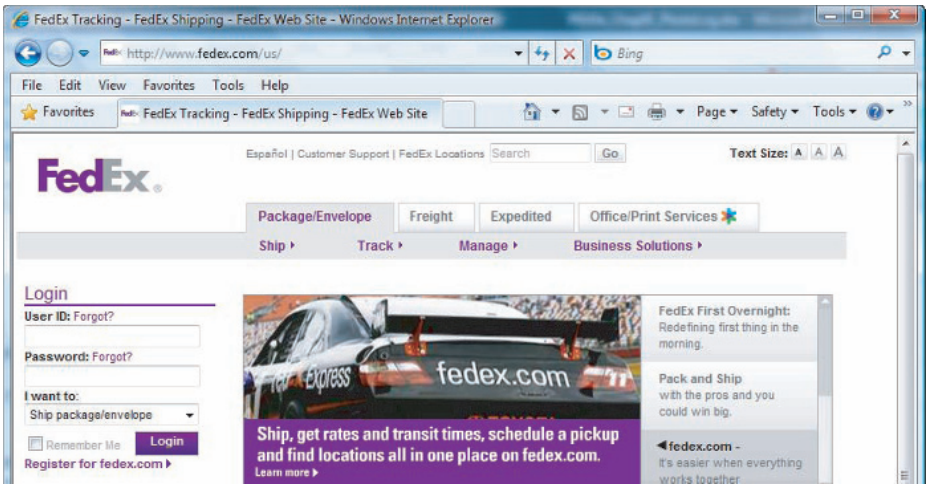
Large computers, personal computers, and today's cell phones, such as Apple's iPhone, can access the Internet.[46] This not only speeds communications, but also allows people to conduct business electronically. Internet users can create Web logs ("blogs") to store and share their thoughts and ideas with others around the world. Using podcasting, you can download audio programs or music from the Internet to play on computers or music players. One of the authors of this book uses podcasts to obtain information on information systems and technology.

The World Wide Web (WWW), or the Web, is a network of links on the Internet to documents containing text, graphics, video, and sound. Information about the documents and access to them are controlled and provided by tens of thousands of special computers called Web servers. The Web is one of many services available over the Internet and provides access to millions of documents. New Internet technologies and increased Internet communications and collaboration are collectively called Web 2.0.[47]

intranet
An internal network based on Web technologies that allows people within an organization to exchange information and work on projects.

extranet
A network based on Web technologies that allows selected outsiders, such as business partners and customers, to access authorized resources of a company's intranet.

The technology used to create the Internet is also being applied within companies and organizations to create **intranets**, which allow people in an organization to exchange information and work on projects. ING DIRECT Canada (*www.ingdirect.ca/en*), for example, used its intranet to get ideas from its employees. According to one corporate executive, "Many of the ideas we've been able to implement are from front-line staff who talk to our customers every day and know what they want."[48] Companies often use intranets to connect their employees around the globe. An **extranet** is a network based on Web technologies that allows selected outsiders, such as business partners and customers, to access authorized resources of a company's intranet. Many people use extranets every day without realizing it—to track shipped goods, order products from their suppliers, or access customer assistance from other companies. Penske Truck Leasing, for example, uses an extranet (*www.MyFleetAtPenske.com*) for Penske leasing companies and its customers.[49] The extranet site allows customers to schedule maintenance, find Penske fuel stops, receive emergency roadside assistance, participate in driver training programs, and more. If you log on to the FedEx site (*www.fedex.com*) to check the status of a package, for example, you are using an extranet.

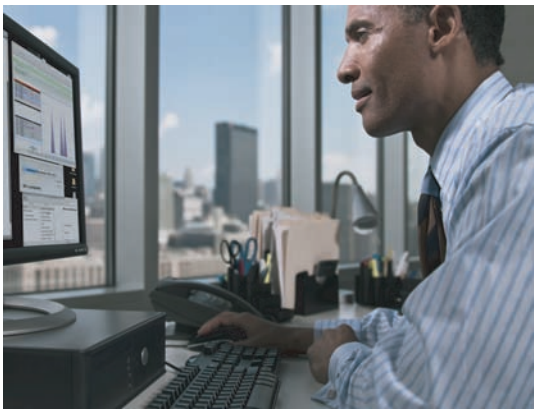


When you log on to the FedEx site (*www.fedex.com*) to check the status of a package, you are using an extranet.

(Source: *www.fedex.com*.)

People

People are the most important element in most computer-based information systems. They make the difference between success and failure for most organizations. Information systems personnel include all the people who manage, run, program, and maintain the system, including the CIO, who manages the IS department.[50] Users are people who work with information systems to get results. Users include financial executives, marketing representatives, manufacturing operators, and many others. Certain computer users are also IS personnel.



The chief information officer (CIO) manages the Information Systems department, which includes all the people who manage, run, program, and maintain a computer-based information system.

(Source: © Ryan McVay/Getty Images.)

Procedures

Procedures include the strategies, policies, methods, and rules for using the CBIS, including the operation, maintenance, and security of the computer. For example, some procedures describe when each program should be run. Others describe who can access facts in the database or what to do if a disaster, such as a fire, earthquake, or hurricane, renders the CBIS unusable. Good procedures can help companies take advantage of new opportunities and avoid potential disasters. Poorly developed and inadequately implemented procedures, however, can cause people to waste their time on useless rules or result in inadequate responses to disasters, such as hurricanes or tornadoes.

procedures
The strategies, policies, methods, and rules for using a CBIS.

Now that we have looked at computer-based information systems in general, we will briefly examine the most common types used in business today. These IS types are covered in greater detail in Part 3.

BUSINESS INFORMATION SYSTEMS

The most common types of information systems used in business organizations are those designed for electronic and mobile commerce, transaction processing, management information, and decision support. In addition, some organizations employ special-purpose systems, such as virtual reality, that not every organization uses. Although these systems are discussed in separate sections in this chapter and explained in greater detail later, they are often integrated in one product and delivered by the same software package. See Figure 1.7. For example, some business information systems process transactions, deliver information, and support decisions. Figure 1.8 shows a simple overview of the development of important business information systems discussed in this section.

Figure 1.7

Business information systems

Business information systems are often integrated in one product and can be delivered by the same software package.

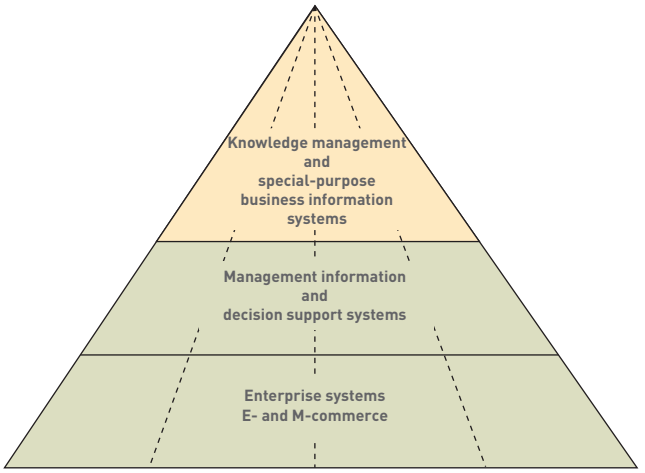
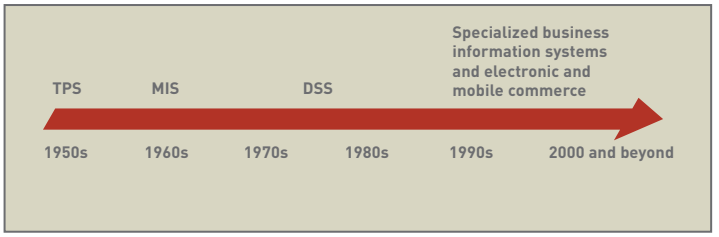


Figure 1.8

The Development of Important Business Information Systems



INFORMATION SYSTEMS @ WORK

Hilton Hospitality in the Palm of Your Hand

With the economy faltering and fewer people traveling, businesses in the travel industry are struggling to stay afloat. Competition to win travelers is intense, and companies are turning to information systems to gain a competitive advantage. Hilton Worldwide, parent of Hilton hotels, Embassy Suites, and Doubletree hotels, has recognized a golden opportunity in iPhone apps.

While fewer people are traveling worldwide, people who do travel rely on their smartphones for information and services. Of the more than 100,000 applications, or apps, available for the iPhone, 5 percent are related to travel, making travel apps the fifth largest category in the iPhone Apps store. Hilton Worldwide recognized that travelers often need to book a room at the last minute. Hilton developed a system that uses an iPhone mobile commerce or m-commerce app to connect to its reservation system, where users can book rooms.

When you use the Hilton Worldwide iPhone app, it accesses the GPS in the iPhone to automatically find Hilton hotels near your current location. Select a specific Hilton hotel from the list provided to access its reservation system. Fill out the form including your choice of bed type, pillow type, and other personal preferences, and provide your credit card number to complete the transaction. Not only can you make reservations, but you can also use it to check in within 48 hours in advance of arrival. You can even use the app to order room service so that dinner is waiting in your room upon arrival.

While Hilton chose the iPhone platform for its m-commerce investment, other hotel companies are focusing on other platforms such as the Blackberry, Palm, and Android. Intercontinental, which owns Holiday Inn Express and others, and Marriott International are both investing in making their Web sites accessible from all mobile Web browsers. Once that is completed, they may move onto develop their own iPhone apps. Marriott's Web site is visited by 500,000 mobile users each month.

One of the most popular iPhone travel apps is the Negotiator from Priceline.com. This app incorporates Priceline's well-known marketing campaign featuring William Shatner in a fun interface that negotiates the best deal on a nearby hotel room. The app is especially useful for travelers needing a room at a moment's notice. It takes advantage of a hotel's willingness to drop prices to fill rooms that would otherwise remain vacant.

Many businesses inside and outside the travel industry are increasing revenues by expanding their presence to mobile devices. Providing m-commerce applications to customers anywhere anytime through mobile devices increases customer satisfaction and loyalty with better service and availability. Deciding which mobile platform to pursue can be difficult, since platforms and software are not always compatible. However, companies such as Apple, RIM, Google, and Palm are eager to have software developers choose their platforms and are providing development tools that minimize the barriers to entry.

Discussion Questions

1. Would you find an app such as Hilton's or Priceline's useful? Why or why not?
2. How does Hilton's iPhone app allow it to gain a competitive advantage over others in the industry?

Critical Thinking Questions

1. Are you comfortable carrying out financial transactions over a smartphone? If not, what are your concerns? If so, why do you feel it is safe?
2. Should businesses be moving their IS investment from e-commerce (computers) to m-commerce (smartphones)? Will m-commerce eventually make e-commerce obsolete? Why or why not?

SOURCES: DeLollis, Barbara, "Hilton Hotel Guests Get Handy New Apps," Top Tech News Web site, November 10, 2009, *www.toptechnews.com/news/Hilton-Guests-Get-Handy-New-Apps/story.xhtml?story_id=023002AKGXRN*; iTunes Store, accessed November 12, 2009, through iTunes software; O'Neill, Sean, "iPhone: Priceline's new app is best for last-minute hotel bids," *Newsweek*, Budget Travel Web page, October 28, 2009, *http://current.newsweek.com/budgettravel/2009/10/iphone_pricelines_new_app_make.html*.

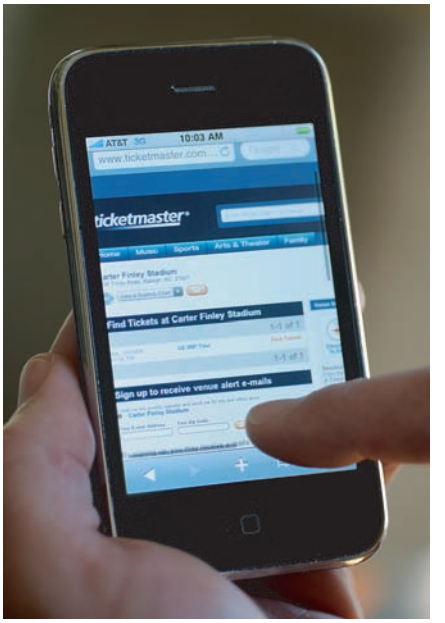
Electronic and Mobile Commerce

e-commerce
Any business transaction executed electronically between companies (business-to-business, or B2B), companies and consumers (business-to-consumer, or B2C), consumers and other consumers (consumer-to-consumer, or C2C), business and the public sector, and consumers and the public sector.

mobile commerce (m-commerce)
The use of mobile, wireless devices to place orders and conduct business.

E-commerce involves any business transaction executed electronically between companies (business-to-business, or B2B), companies and consumers (business-to-consumer, or B2C), consumers and other consumers (consumer-to-consumer, or C2C), business and the public sector, and consumers and the public sector.[51] Some of the stimulus funds in 2009, for example, were aimed at increasing electronic record keeping and electronic commerce for healthcare facilities.[52] E-commerce offers opportunities for businesses of all sizes to market and sell at a low cost worldwide, allowing them to enter the global market. **Mobile commerce** (**m-commerce**) is the use of mobile, wireless devices to place orders and conduct business. M-commerce relies on wireless communications that managers and corporations use to place orders and conduct business with handheld computers, portable phones, laptop computers connected to a network, and other mobile devices. Today, mobile commerce has exploded in popularity with advances in smartphones, including Apple's iPhone.[53] Customers are using their cell phones to purchase concert tickets from companies such as Ticketmaster Entertainment (*www.ticketmaster.com*) and Tickets (*www.tickets.com*).[54] In South Korea, cell phones are used 70 percent of the time to pay for digital content, such as digital music.

E-commerce offers many advantages for streamlining work activities. Figure 1.9 provides a brief example of how e-commerce can simplify the process of purchasing new office furniture from an office supply company. In the manual system, a corporate office worker must get approval for a purchase that exceeds a certain amount. That request goes to the purchasing department, which generates a formal purchase order to procure the goods from the approved vendor. Business-to-business e-commerce automates the entire process. Employees go directly to the supplier's Web site, find the item in a catalog, and order what they need at a price set by their company. If management approval is required, the manager is notified automatically. As the use of e-commerce systems grows, companies are phasing out their traditional systems. The resulting growth of e-commerce is creating many new business opportunities.



With mobile commerce (m-commerce), people can use cell phones to pay for goods and services anywhere, anytime.

(Source: Courtesy of Davie Hinshaw/MCT/Landov.)

E-commerce can enhance a company's stock prices and market value. Today, several e-commerce firms have teamed up with more traditional brick-and-mortar businesses to draw from each other's strengths. For example, e-commerce customers can order products on a Web site and pick them up at a nearby store.

In addition to e-commerce, business information systems use telecommunications and the Internet to perform many related tasks. Electronic procurement (e-procurement), for example, involves using information systems and the Internet to acquire parts and supplies. **Electronic business** (**e-business**) goes beyond e-commerce and e-procurement by using information systems and the Internet to perform all business-related tasks and functions, such as accounting, finance, marketing, manufacturing, and human resource activities. E-business also includes working with customers, suppliers, strategic partners, and stakeholders. Compared to traditional business strategy, e-business strategy is flexible and adaptable. See Figure 1.10.

electronic business (e-business)
Using information systems and the Internet to perform all business-related tasks and functions.

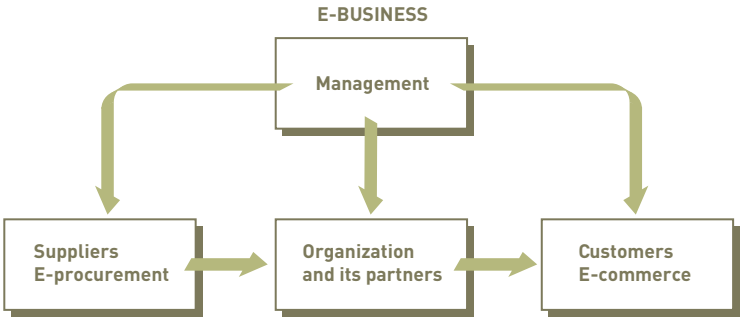
Figure 1.9

E-Commerce Greatly Simplifies Purchasing

Figure 1.10

Electronic Business

E-business goes beyond e-commerce to include using information systems and the Internet to perform all business-related tasks and functions, such as accounting, finance, marketing, manufacturing, and human resources activities.



Enterprise Systems: Transaction Processing Systems and Enterprise Resource Planning

Enterprise systems that process daily transactions have evolved over the years and offer important solutions for businesses of all sizes. Traditional transaction processing systems are still being used, but increasingly, companies are turning to enterprise resource planning systems. These systems are discussed next.

Transaction Processing Systems

Since the 1950s, computers have been used to perform common business applications. Many of these early systems were designed to reduce costs by automating routine, labor-intensive business transactions. A **transaction** is any business-related exchange such as payments to employees, sales to customers, or payments to suppliers. Processing business transactions was the first computer application developed for most organizations. A **transaction processing system** (TPS) is an organized collection of people, procedures, software, databases, and devices used to perform and record business transactions. If you understand a transaction processing system, you understand basic business operations and functions.

transaction
Any business-related exchange, such as payments to employees, sales to customers, and payments to suppliers.

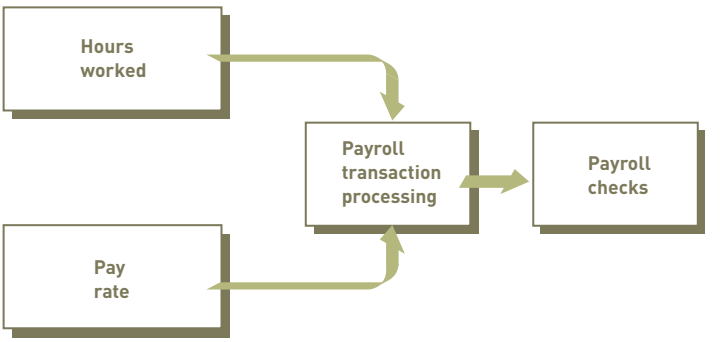
transaction processing system (TPS)
An organized collection of people, procedures, software, databases, and devices used to perform and record business transactions.

One of the first business systems to be computerized was the payroll system (see Figure 1.11). The primary inputs for a payroll TPS are the number of employee hours worked during the week and the pay rate. The primary output consists of paychecks. Early payroll systems produced employee paychecks and related reports required by state and federal agencies, such as the Internal Revenue Service. Other routine applications include sales ordering, customer billing and customer relationship management, and inventory control.

Figure 1.11

A Payroll Transaction Processing System

In a payroll TPS, the inputs (numbers of employee hours worked and pay rates) go through a transformation process to produce outputs (paychecks).



Enterprise systems help organizations perform and integrate important tasks, such as paying employees and suppliers, controlling inventory, sending invoices, and ordering supplies. In the past, companies accomplished these tasks using traditional transaction processing systems. Today, more companies use enterprise resource planning systems for these tasks.

Enterprise Resource Planning

enterprise resource planning (ERP) system
A set of integrated programs capable of managing a company's vital business operations for an entire multisite, global organization.

An **enterprise resource planning (ERP) system** is a set of integrated programs that manages the vital business operations for an entire multisite, global organization.[55] Pick n Pay, a South African (SA) food retailer, used ERP to reduce costs and the prices paid by customers. According to the chief executive officer, "We are happy to play our part in ensuring that SA's economy continues to perform well, particularly given the pressures being felt globally."[56]

An ERP system can replace many applications with one unified set of programs, making the system easier to use and more effective. Today, using ERP systems and getting timely reports from them can be done using cell phones and mobile devices.[57]

Although the scope of an ERP system might vary from company to company, most ERP systems provide integrated software to support manufacturing and finance. Many ERP systems also have a purchasing subsystem that orders the needed items. In addition to these core business processes, some ERP systems can support functions such as customer service, human resources, sales, and distribution. The primary benefits of implementing an ERP system include easing adoption of improved work processes and increasing access to timely data for decision making.

Information and Decision Support Systems

The benefits provided by an effective TPS or ERP, including reduced processing costs and reductions in needed personnel, are substantial and justify their associated costs in computing equipment, computer programs, and specialized personnel and supplies. Companies soon realize that they can use the data stored in these systems to help managers make better decisions, whether in human resource management, marketing, or administration. Satisfying the needs of managers and decision makers continues to be a major factor in developing information systems.

Management Information Systems

management information system (MIS)
An organized collection of people, procedures, software, databases, and devices that provides routine information to managers and decision makers.

A **management information system (MIS)** is an organized collection of people, procedures, software, databases, and devices that provides routine information to managers and decision makers. An MIS focuses on operational efficiency. Manufacturing, marketing, production, finance, and other functional areas are supported by MISs and are linked through a common database. MISs typically provide standard reports generated with data and information from the TPS or ERP (see Figure 1.12). Dell Computer, for example, used manufacturing MIS

software to develop a variety of reports on its manufacturing processes and costs.[58] Dell was able to double its product variety, while saving about $1 million annually in manufacturing costs as a result. Today, many hospitals and healthcare facilities are using electronic records to streamline MIS reports, reduce recordkeeping costs, and save lives by avoiding medical errors in diagnoses, treatments, and adverse drug interactions.[59]

SAP AG, a German software company, is one of the leading suppliers of ERP software. The company employs more than 50,000 people in more than 120 countries.

(Source: *www.sap.com*.)

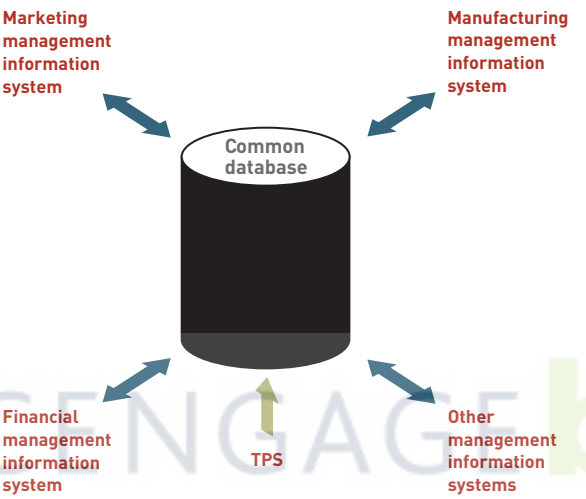


Figure 1.12

Management Information System

Functional management information systems draw data from the organization's transaction processing system.

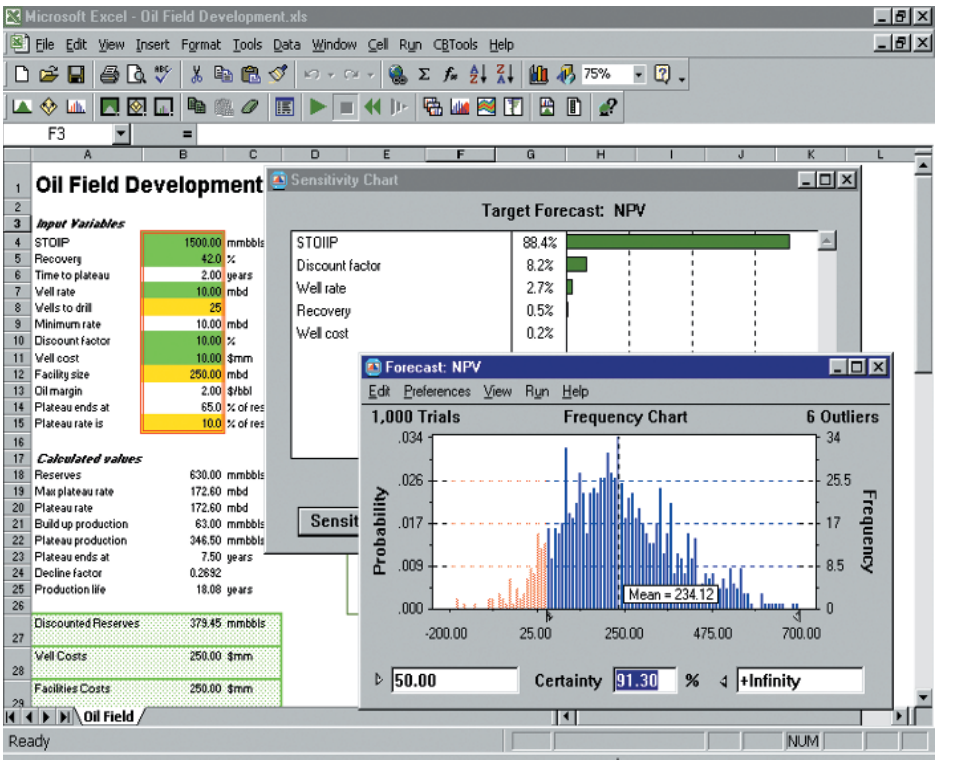
MISs were first developed in the 1960s and typically use information systems to produce managerial reports. In many cases, these early reports were produced periodically—daily, weekly, monthly, or yearly. Because of their value to managers, MISs have proliferated throughout the management ranks.

Decision Support Systems

By the 1980s, dramatic improvements in technology resulted in information systems that were less expensive but more powerful than earlier systems. People quickly recognized that

decision support system (DSS)
An organized collection of people, procedures, software, databases, and devices used to support problem-specific decision making.

computer systems could support additional decision-making activities. A **decision support system (DSS)** is an organized collection of people, procedures, software, databases, and devices that support problem-specific decision making. The focus of a DSS is on making effective decisions. Whereas an MIS helps an organization "do things right," a DSS helps a manager "do the right thing."[60]



Endeca provides Discovery for Design, decision support software that helps businesspeople assess risk and analyze performance. The data shown here is for electronic component development.

(Source: Courtesy of Endeca Technologies, Inc.)

A DSS goes beyond a traditional MIS by providing immediate assistance in solving problems. Many of these problems are unique and complex, and key information is often difficult to obtain. For instance, an auto manufacturer might try to determine the best location to build a new manufacturing facility. Traditional MISs are seldom used to solve these types of problems; a DSS can help by suggesting alternatives and assisting in final decision making. A DSS recognizes that different managerial styles and decision types require different systems. For example, two production managers in the same position trying to solve the same problem might require different information and support. The overall emphasis is to support, rather than replace, managerial decision making. The chief executive officer of Serena, a California software company, gets decision support by using his cell phone to get rapid feedback on the corporate financial performance of each of his key executives.[61] Other executives might prefer a DSS that provides marketing and sales information on their desktop computers.

A DSS can include a collection of models used to support a decision maker or user (model base), a collection of facts and information to assist in decision making (database), and systems and procedures (user interface or dialogue manager) that help decision makers and other users interact with the DSS (see Figure 1.13). Software called the database management system (DBMS) is often used to manage the database, and software called the model management system (MMS) is used to manage the model base. Not all DSSs have all of these components.

In addition to DSSs for managers, other systems use the same approach to support groups and executives. A *group support system* includes the DSS elements just described as well as software, called groupware, to help groups make effective decisions. Kraft, for example, uses iPhones and other mobile devices to help managers and workers stay connected and work together on important projects.[62] An *executive support system*, also called an executive information system, helps top-level managers, including a firm's president, vice presidents, and

members of the board of directors, make better decisions. Healthland and Performance Management Institute, a healthcare company, has developed an executive information system to help small community and rural hospital executives make better decisions about delivering quality health care to patients and increasing the efficient delivery of healthcare services for hospitals.[63] The American Recovery and Reinvestment Act provides funds for qualifying healthcare companies that invest in better information and decision support systems. An executive support system can assist with strategic planning, top-level organizing and staffing, strategic control, and crisis management.

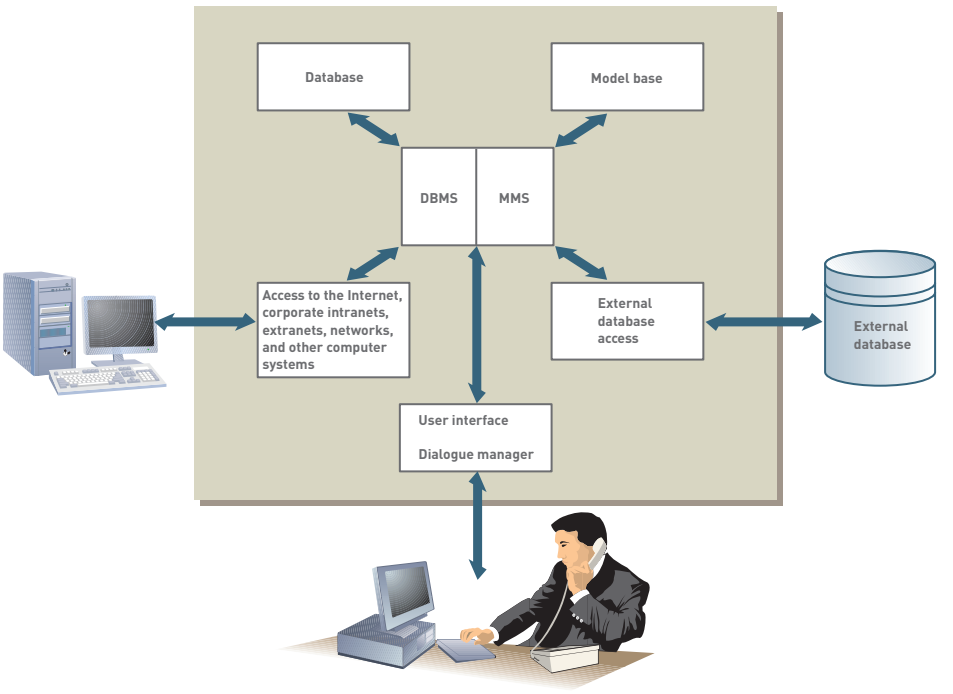


Figure 1.13
Essential DSS Elements

Specialized Business Information Systems: Knowledge Management, Artificial Intelligence, Expert Systems, and Virtual Reality

In addition to TPSs, MISs, and DSSs, organizations often rely on specialized systems. Many use knowledge management systems (KMSs), an organized collection of people, procedures, software, databases, and devices, to create, store, share, and use the organization's knowledge and experience.[64] A shipping company, for example, can use a KMS to streamline its transportation and logistics business. Advent, a San Francisco company that develops investment software for hedge funds, used a KMS to help its employees locate and use critical knowledge to help its customers.[65]

In addition to knowledge management, companies use other types of specialized systems. Experimental systems in cars can help prevent accidents. These new systems allow cars to communicate with each other using radio chips installed in their trunks. When two or more cars move too close together, the specialized systems sound alarms and brake in some cases. Some specialized systems are based on the notion of **artificial intelligence** (**AI**), in which the computer system takes on the characteristics of human intelligence. The field of artificial intelligence includes several subfields (see Figure 1.14). Some people predict that in the future we will have nanobots, small molecular-sized robots, traveling throughout our bodies and in our bloodstream, monitoring our health.[66] Other nanobots will be embedded in products and services.[67]

artificial intelligence (AI)
A field in which the computer system takes on the characteristics of human intelligence.

A Nissan Motor Company car swerves back into its lane on its own shortly after it ran off the track during a test of the Lane Departure Prevention feature, which also sounds a warning when the car veers out of its lane.

(Source: © AP Photo/Katsumi Kasahara.)

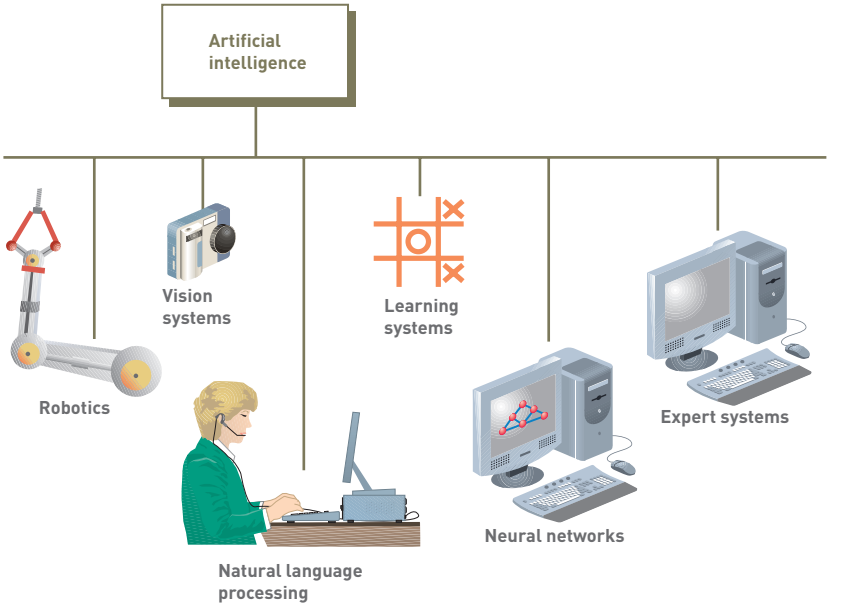


Figure 1.14

The Major Elements of Artificial Intelligence

Artificial Intelligence

Robotics is an area of artificial intelligence in which machines take over complex, dangerous, routine, or boring tasks, such as welding car frames or assembling computer systems and components. Honda Motor has spent millions of dollars on advanced robotics that allows a person to give orders to a computer using only his or her thoughts. The new system uses a special helmet that can measure and transmit brain activity to a computer. [68] A robot used by a Staples distribution center in the Denver area is able to locate items in a 100,000 square foot warehouse and pack them into containers to be shipped to other Staples stores.[69] Vision systems allow robots and other devices to "see," store, and process visual images. Natural language processing involves computers understanding and acting on verbal or written commands in English, Spanish, or other human languages. Learning systems allow computers to learn from past mistakes or experiences, such as playing games or making business decisions. Neural networks is a branch of artificial intelligence that allows computers to recognize and act on patterns or trends.[70] Some successful stock, options, and futures traders use neural networks to spot trends and improve the profitability of their investments.

Honda Motor is developing an advanced robotics system that allows a person to give orders to a computer using only his or her thoughts.

(Source: © Associated Press.)

Expert Systems

Expert systems give the computer the ability to make suggestions and function like an expert in a particular field, helping enhance the performance of the novice user. The unique value of expert systems is that they allow organizations to capture and use the wisdom of experts and specialists.[71] Therefore, years of experience and specific skills are not completely lost when a human expert dies, retires, or leaves for another job. The U.S. Army uses the Knowledge and Information Fusion Exchange (KnIFE) expert system to help soldiers in the field make better military decisions based on successful decisions made in previous military engagements. The collection of data, rules, procedures, and relationships that must be followed to achieve value or the proper outcome is contained in the expert system's **knowledge base**.

expert system
A system that gives a computer the ability to make suggestions and function like an expert in a particular field.

knowledge base
The collection of data, rules, procedures, and relationships that must be followed to achieve value or the proper outcome.

Virtual Reality And Multimedia

Virtual reality and multimedia are specialized systems that are valuable for many businesses and nonprofit organizations. Many imitate or act like real environments. These unique systems are discussed in this section.

Virtual reality is the simulation of a real or imagined environment that can be experienced visually in three dimensions.[72] One healthcare company, for example, is experimenting with a virtual reality game designed to help treat cancer in young adults and children. Developed by HopeLab (*www.hopelab.org*), the virtual reality game called Re-Mission shows young adults and children how to combat cancer.

virtual reality
The simulation of a real or imagined environment that can be experienced visually in three dimensions.

Originally, virtual reality referred to immersive virtual reality, which means the user becomes fully immersed in an artificial, computer-generated 3D world. The virtual world is presented in full scale and relates properly to the human size. Virtual reality can also refer to applications that are not fully immersive, such as mouse-controlled navigation through a 3D environment on a graphics monitor, stereo viewing from the monitor via stereo glasses, stereo projection systems, and others. Boeing, for example, used virtual reality and computer simulation to help design and build its Dreamliner 787.[73] The company used 3D models from Dassault Systems to design and manufacture the new aircraft. Retail stores are using virtual reality to help advertise high-end products on the Internet.

A variety of input devices, such as head-mounted displays (see Figure 1.15), data gloves, joysticks, and handheld wands, allow the user to navigate through a virtual environment and to interact with virtual objects. Directional sound, tactile and force feedback devices, voice recognition, and other technologies enrich the immersive experience. Because several people can share and interact in the same environment, virtual reality can be a powerful medium for communication, entertainment, and learning.

Multimedia is a natural extension of virtual reality. It can include photos and images, the manipulation of sound, and special 3D effects. Once used primarily in movies, 3D technology can be used by companies to design products, such as motorcycles, jet engines, bridges, and more.[74] Autodesk, for example, makes exciting 3D software that companies can use to design large skyscrapers and other buildings.[75] The software can also be used by Hollywood animators to develop action and animated movies.

The Cave Automatic Virtual Environment (CAVE) is a virtual reality room that allows users to completely immerse themselves in a virtual car interior while operating a workstation in a factory.

(Source: © Sipa via AP Images.)

Figure 1.15

A Head-Mounted Display

The head-mounted display (HMD) was the first device to provide the wearer with an immersive experience. A typical HMD houses two miniature display screens and an optical system that channels the images from the screens to the eyes, thereby presenting a stereo view of a virtual world. A motion tracker continuously measures the position and orientation of the user's head and allows the image-generating computer to adjust the scene representation to the current view. As a result, the viewer can look around and walk through the surrounding virtual environment.

(Source: Courtesy of 5DT, Inc. *www.5dt.com.*)

It is difficult to predict where information systems and technology will be in 10 to 20 years. It seems, however, that we are just beginning to discover the full range of their usefulness. Some forensics experts are now experimenting with computer software that can draw images of crime suspects based only on their DNA collected at the crime scene.[76] Some lawmakers, however, are concerned about privacy invasion and the use of DNA to target or identify possible crime suspects. Technology has been improving and expanding rapidly; dramatic growth and change are expected for years to come. Without question, having knowledge of the effective use of information systems will be critical for managers both now and in the long term. Now, let's examine how information systems are created.

SYSTEMS DEVELOPMENT

systems development
The activity of creating or modifying business systems.

Systems development is the activity of creating or modifying information systems. Systems development projects can range from small to very large and are conducted in fields as diverse as stock analysis and video game development. Individuals from around the world are using the steps of systems development to create unique applications for the iPhone.[77] Apple has special tools for iPhone application developers, including GPS capabilities and audio streaming, to make it easier for people to craft unique applications. Apple is also allowing these systems developers to charge users in a variety of ways, including fixed prices and subscription fees. Recall that individuals and companies are developing "cloud computing" applications

that can be run from the Internet.[78] These applications have additional systems development challenges, such as making sure that the data and programs on the Internet are safe and secure from hackers and corporate spies.

People inside a company can develop systems, or companies can use outsourcing, hiring an outside company to perform some or all of a systems development project. Outsourcing allows a company to focus on what it does best and delegate other functions to companies with expertise in systems development. The drug company Pfizer, for example, used outsourcing to allow about 4,000 of its busy employees to outsource some of their jobs functions to other individuals or companies around the globe, allowing them to concentrate on key tasks.[79] Any outsourcing decision should depend on the company and the project being considered for outsourcing.

Some systems development efforts fail to meet their cost or schedule goals. The state of Florida, for example, had problems with its $15 billion Medicaid program, making it difficult or impossible for some beneficiaries to gain access to the system or receive payments. According to a February statement made by one frustrated state senator, "I'm not looking for zero errors, but you're saying it's going to be into the summer before we can expect our constituents to be able to get through on the call lines?" [80] Systems development failures can be a result of poor planning and scheduling, insufficient management of risk, poor requirements determination, and lack of user involvement. One strategy for improving the results of a systems development project is to divide it into several steps, each with a well-defined goal and set of tasks to accomplish (see Figure 1.16). These steps are summarized next.

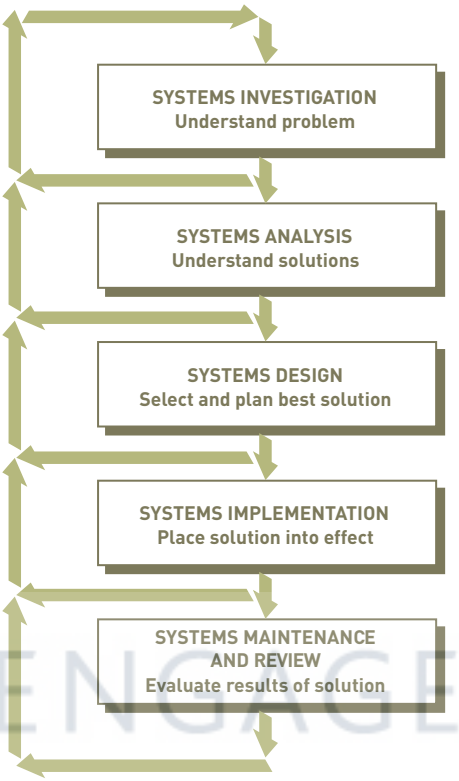


Figure 1.16
An Overview of Systems Development

Systems Investigation and Analysis

The first two steps of systems development are systems investigation and analysis. The goal of the systems investigation is to gain a clear understanding of the problem to be solved or opportunity to be addressed. After an organization understands the problem, the next question is, "Is the problem worth solving?" Given that organizations have limited resources—people and money—this question deserves careful consideration. If the decision is to continue with the solution, the next step, systems analysis, defines the problems and opportunities of

the existing system. During systems investigation and analysis, as well as design maintenance and review, discussed next, the project must have the complete support of top-level managers and must focus on developing systems that achieve business goals.

Systems Design, Implementation, and Maintenance and Review

Systems design determines how the new system should be developed to meet the business needs defined during systems analysis. For some companies, this involves environmental design that attempts to reduce impact on the environment while still making a profit. Gazelle, for example, used systems design to develop the software and systems needed to recycle computer and electronic systems for a profit. According to the company founder, "What we're doing here is buying dollars for 80 cents."[81] Systems implementation involves creating or acquiring the various system components (hardware, software, databases, etc.) defined in the design step, assembling them, and putting the new system into operation. For many organizations, this includes purchasing software, hardware, databases, and other IS components. The purpose of systems maintenance and review is to check and modify the system so that it continues to meet changing business needs. Companies often hire outside companies to do their design, implementation, maintenance, and review functions.

INFORMATION SYSTEMS IN SOCIETY, BUSINESS, AND INDUSTRY

Information systems have been developed to meet the needs of all types of organizations and people. The speed and widespread use of information systems, however, opens users to a variety of threats from unethical people.[82] Computer criminals and terrorists, for example, have used the Internet to steal millions of dollars or promote terrorism and violence. Some studies report that 50 to 75 percent of corporate security attacks come from people inside the company.[83] Computer-related attacks can come from individuals, groups, companies, and even countries.[84]

Security, Privacy, and Ethical Issues in Information Systems and the Internet

Although information systems can provide enormous benefits, they do have drawbacks. Some drawbacks are minor, such as receiving unwanted e-mail.[85] Others problems can be more severe, where people's personal data, including Social Security and credit card numbers, can be lost or stolen, resulting in credit card fraud and ruined credit. In the United States, the Privacy Rights Clearinghouse estimates that since early 2005, about 150 million computer records have been stolen or exposed to fraud. This type of data loss can cost companies hundreds of dollars per lost record. Some companies have spent millions of dollars to investigate and counteract stolen computer records.

Computer-related mistakes and waste are also a concern. In Japan, a financial services firm had trading losses of $335 million due to a typing mistake in entering a trade. Another computer mistake stranded hundreds of airline flights. Unwanted e-mail, called "spam," can also be a huge waste of people's time. Many individuals and organizations are trying to find better ways to block spam.

Who Is Interested in Your Social Network Updates?

More than two-thirds of the world's online population use social networks such as Facebook, MySpace, and Twitter to stay in touch with friends. It is likely that you are one of them. In 2008, social networks became more popular than e-mail, with 66.8 percent of Internet users accessing member communities. Most members of social networks use a posting feature that allows them to share their day-to-day thoughts and activities with their circle of friends. Facebook calls these postings "updates," while Twitter calls them "tweets." Most users do not realize the value of their comments, updates, or tweets to people outside their circle.

Businesses are flocking to social networks to harvest consumer sentiment for use in guiding product development. They are also watching social networks to confront negative publicity. The broad scale use of social networks and the careful analysis of billions of messages have made it possible to collect public sentiment and build customer relations in a manner never done before. But sifting through the babble to discover comments of interest is challenging.

A number of information system companies have sprung up to provide products designed to monitor social media. Companies such as Alterian, Radian6, Attensity, Visible Technologies, Conversion, and Nielsen Online provide social media monitoring systems for businesses and organizations. As a young technology, there is no standard approach to social media monitoring. Similar to a search engine, the systems typically traverse the continuous streams of comments in social networks looking for key terms related to specified products. AI techniques that automate the interpretation of user comments make it possible to quickly identify comments of particular interest. Ultimately, they generate analytic and performance reports for the human expert to evaluate. Systems that monitor social media enable useful information to be drawn from billions of seemingly mundane and unrelated messages.

Monitoring social media can focus on brand reputation management, public relations, or even market research. Companies such as Comcast, a major communications company, hire full-time social media experts who interact with customers online to address problems and complaints. For example, if you complain about Comcast service on Twitter, you might be contacted by a Comcast employee offering to help you.

The social network service owners are well aware of the value of the information that flows over their networks. Most of them intend to build their business through the comments and attention of their members. Whether through targeted ads or selling access to user data, social networks can become very lucrative businesses. Why else would Twitter, a service with apparently no business model, be worth over a billion dollars? Twitter's goal is to grow to one billion members and provide interested parties with the pulse of the planet.

How do users feel about their "personal" comments being harvested to make billions for Internet companies? With social network growth rates in 2009 ranging from 228 percent for Facebook to 1,382 percent for Twitter, users are either unaware or unconcerned. Regardless of what users think, it is likely that businesses will increasingly analyze the continuous flow of data over social networks to generate insights they can use.

Discussion Questions

1. Do you think it is ethical for social networks to sell access to user information to businesses for market research and other uses? Why or why not?
2. What service does the monitoring of social media ultimately provide for consumers?

Critical Thinking Questions

1. What competitive advantage does the monitoring of social media provide to companies that invest in it?
2. Why is the monitoring of social media considered a CBIS?

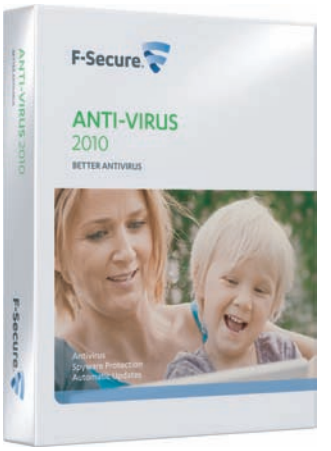
SOURCES: Ostrow, Adam, "Social Networking More Popular than Email," *Mashable*, March 9, 2009, *http://mashable.com/2009/03/09/social-networking-more-popular-than-email*; Zabin, Jeff, "Finding Out What They're Saying About You Is Worth Every Penny," *E-Commerce Times*, November 12, 2009, *www.ecommercetimes.com/rsstory/68624.html*; Bensen, Connie, "Do you know what people are saying about you?" *Reuters UK*, September 14, 2009, *http://blogs.reuters.com/great-debate-uk/2009/09/14/do-you-know-what-people-are-saying-about-you*; Schonfeld, Erick, "Twitter's Internal Strategy Laid Bare: To Be "The Pulse of the Planet," *TechCrunch*, July 16, 2009, *www.techcrunch.com/2009/07/16/twitters-internal-strategy-laid-bare-to-be-the-pulse-of-the-planet*; Reisner, Rebecca, "Comcast's Twitter Man," *Business Week*, January 13, 2009, *www.businessweek.com/managing/content/jan2009/ca20090113_373506.htm*; McCarthy, Carolina, "Nielsen: Twitter's growing really, really, really, really fast," CNET, March 2009, *http://news.cnet.com/8301-13577_3-10200161-36.html*; Nielsen Staff, "Social Networking's New Global Footprint," *NielsenWire*, March 9, 2009, *http://blog.nielsen.com/nielsenwire/global/social-networking-new-global-footprint/*.

The Privacy Rights Clearinghouse estimates that since 2005, about 150 million computer records have been stolen or exposed to fraud.

(Source: *www.privacyrights.org*.)

Ethical issues concern what is generally considered right or wrong. Some IS professionals believe that computers may create new opportunities for unethical behavior. For example, a faculty member of a medical school falsified computerized research results to get a promotion—and a higher salary.[86] In another case, a company was charged with using a human resource information system to time employee layoffs and firings to avoid paying pensions. More and more, the Internet is associated with unethical behavior. Unethical investors have placed false rumors or incorrect information about a company on the Internet and tried to influence its stock price to make money.

Individual privacy is also an important social issue. People can inadvertently disclose personal information while using the Internet.[87] Once private information or photos have been placed on the Internet, it can be very difficult to remove them.[88] One large drug company agreed to pay more than $2 million in fines because it didn't prevent individual credit card and Social Security numbers from being disclosed.[89] To protect against threats to your privacy and data, you can install security and control measures. For example, many software products can detect and remove viruses and spam from computer systems. Some financial institutions use handheld identity authorization devices to prevent bank fraud.



F-Secure is a popular virus-detection program.

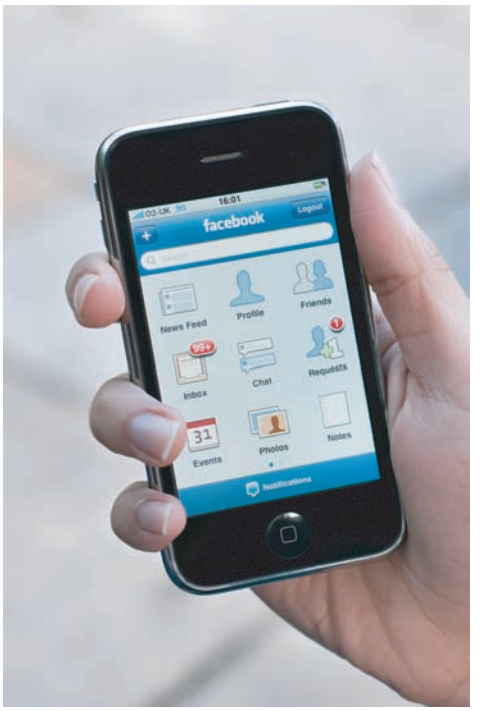
(Source: Courtesy of F-Secure Corporation.)

You can install firewalls (software and hardware that protect a computer system or network from outside attacks) to avoid viruses and prevent unauthorized people from gaining access to your computer system.[90] You can also use identification numbers and passwords. In response to possible abuses, a number of laws have been passed to protect people from invasion of their privacy, including The Privacy Act, enacted in the 1970s.

Use of information systems also raises work concerns, including job loss through increased efficiency and potential health problems from making repetitive motions. Ergonomics, the study of designing and positioning workplace equipment, can help you avoid health-related problems of using computer systems.

Computer and Information Systems Literacy

Whatever your college major or career path, understanding computers and information systems will help you cope, adapt, and prosper in this challenging environment. Some colleges are requiring a certain level of computer and information systems literacy before students are admitted or accepted into the college. While at school, you might connect with friends and other students using a social networking Internet site, such as MySpace (*www.myspace.com*) or Facebook (*www.facebook.com*).



Connect with friends and other students using a social networking Internet site, such as MySpace (*www.myspace.com*) or Facebook (*www.facebook.com*).

(Source: © Alex Segre/Alamy.)

A knowledge of information systems will help you make a significant contribution on the job. It will also help you advance in your chosen career or field. Managers are expected to identify opportunities to implement information systems to improve their business. They are also expected to lead IS projects in their areas of expertise. To meet these personal and organizational goals, you must acquire both computer literacy and information systems literacy. **Computer literacy** is the knowledge of computer systems and equipment and the ways they function. It includes the knowledge of equipment and devices (hardware), programs and instructions (software), databases, and telecommunications.

computer literacy
Knowledge of computer systems and equipment and the ways they function; it includes the knowledge of equipment and devices (hardware), programs and instructions (software), databases, and telecommunications.

Information systems literacy goes beyond knowing the fundamentals of computer systems and equipment. **Information systems literacy** is the knowledge of how data and information are used by individuals, groups, and organizations. It includes knowledge of computer technology and the broader range of information systems. Most important, however, it encompasses *how* and *why* this technology is applied in business. Knowing about various types of hardware and software is an example of computer literacy. Knowing how to use hardware and software to increase profits, cut costs, improve productivity, and increase customer satisfaction is an example of information systems literacy.

information systems literacy
Knowledge of how data and information are used by individuals, groups, and organizations.

Information Systems in the Functional Areas of Business

Information systems are used in all functional areas and operating divisions of business. In finance and accounting, information systems forecast revenues and business activity, determine the best sources and uses of funds, manage cash and other financial resources, analyze investments, and perform audits to make sure that the organization is financially sound and that all financial reports and documents are accurate. Sales and marketing use information systems to develop new goods and services (product analysis), select the best location for production and distribution facilities (place or site analysis), determine the best advertising and sales approaches (promotion analysis), and set product prices to get the highest total revenues (price analysis). In manufacturing, information systems process customer orders, develop production schedules, control inventory levels, and monitor product quality. In addition, information systems help to design products (computer-assisted design, or CAD), manufacture items (computer-assisted manufacturing, or CAM), and integrate machines or pieces of equipment (computer-integrated manufacturing, or CIM). Human resource management uses information systems to screen applicants, administer performance tests to employees, monitor employee productivity, and more. Legal information systems analyze product liability and warranties and help to develop important legal documents and reports.

One way that sales and marketing departments use information systems is for place or site analysis.

(Source: © Jeff Greenberg/Alamy.)

Information Systems in Industry

In addition to being used in every department in a company, information systems are used in almost every industry or field in business. The airline industry develops Internet auction sites to offer discount fares and increase revenue. Investment firms use information systems to analyze stocks, bonds, options, the futures market, and other financial instruments and provide improved services to their customers. Banks use information systems to help make sound loans and good investments as well as to provide online check payment for account holders. The transportation industry uses information systems to schedule trucks and trains to deliver goods and services at the lowest cost. Publishing companies use information systems to analyze markets and to develop and publish newspapers, magazines, and books. Healthcare organizations use information systems to diagnose illnesses, plan medical treatment, track patient records, and bill patients. Health maintenance organizations (HMOs) use Web technology to access patients' insurance eligibility and other information stored in databases to cut patient costs. Retail companies are using the Web to take orders and provide customer service support. Retail companies also use information systems to help market products and services, manage inventory levels, control the supply chain, and forecast demand. Power management and utility companies use information systems to monitor and control power generation and usage. Professional services firms have information systems to improve the speed and quality of services they provide to customers. Management consulting firms use intranets and extranets to offer information on products, services, skill levels, and past engagements to their consultants. These industries are discussed in greater detail as we continue through the book.

GLOBAL CHALLENGES IN INFORMATION SYSTEMS

Changes in society as a result of increased international trade and cultural exchange, often called globalization, have always had a significant impact on organizations and their information systems. In his book, *The World Is Flat*, Thomas Friedman describes three eras of globalization.[91] (See Table 1.3.) According to Friedman, we have progressed from the globalization of countries (Globalization 1.0) to the globalization of multinational corporations (Globalization 2.0) and individuals (Globalization 3.0). Today, people in remote areas can use the Internet to compete with and contribute to other people, the largest corporations, and entire countries. These workers are empowered by high-speed Internet access, making the world flatter. In the Globalization 3.0 era, designing a new airplane or computer can be separated into smaller subtasks and then completed by a person or small group that can do the best job. These workers can be located in India, China, Russia, Europe, and other areas of the world. The subtasks can then be combined or reassembled into the complete design. This approach can be used to prepare tax returns, diagnose a patient's medical condition, fix a broken computer, and many other tasks.

Table 1.3
Eras of Globalization

Era	Dates	Characterized by
Globalization 1.0	Late 1400–1800	Countries with the power to explore and influence the world
Globalization 2.0	1800–2000	Multinational corporations that have plants, warehouses, and offices around the world
Globalization 3.0	2000–today	Individuals from around the world who can compete and influence other people, corporations, and countries by using the Internet and powerful technology tools

Global markets have expanded. People and companies can get products and services from around the world, instead of around the corner or across town. These opportunities, however, introduce numerous obstacles and issues, including challenges involving culture, language, and many others.

- **Cultural challenges.** Countries and regional areas have their own cultures and customs that can significantly affect individuals and organizations involved in global trade.
- **Language challenges.** Language differences can make it difficult to translate exact meanings from one language to another.
- **Time and distance challenges.** Time and distance issues can be difficult to overcome for individuals and organizations involved with global trade in remote locations. Large time differences make it difficult to talk to people on the other side of the world. With long distance, it can take days to get a product or part from one location to another.
- **Infrastructure challenges.** High-quality electricity and water might not be available in certain parts of the world. Telephone services, Internet connections, and skilled employees might be expensive or not readily available.
- **Currency challenges.** The value of various currencies can vary significantly over time, making international trade more difficult and complex.
- **Product and service challenges.** Traditional products that are physical or tangible, such as an automobile or bicycle, can be difficult to deliver to the global market. However, electronic products (e-products) and electronic services (e-services) can be delivered to customers electronically, over the phone, through networks or the Internet, or by other electronic means. Software, music, books, manuals, and advice can all be delivered globally and over the Internet.
- **Technology transfer issues.** Most governments don't allow certain military-related equipment and systems to be sold to some countries. Even so, some believe that foreign companies are stealing intellectual property, trade secrets, and copyrighted materials and counterfeiting products and services.
- **State, regional, and national laws.** Each state, region, and country has a set of laws that must be obeyed by citizens and organizations operating in the country. These laws can deal with a variety of issues, including trade secrets, patents, copyrights, protection of personal or financial data, privacy, and much more. Laws restricting how data enters or exits a country are often called transborder data-flow laws. Keeping track of these laws and incorporating them into the procedures and computer systems of multinational and transnational organizations can be very difficult and time consuming, requiring expert legal advice.
- **Trade agreements.** Countries often enter into trade agreements with each other. The North American Free Trade Agreement (NAFTA) and the Central American Free Trade Agreement (CAFTA) are examples. The European Union (EU) is another example of a group of countries with an international trade agreement.[92] The EU is a collection of mostly European countries that have joined together for peace and prosperity. Additional trade agreements include the Australia-United States Free Trade Agreement (AUSFTA), signed into law in 2005, and the Korean-United States Free Trade Agreement (KORUS-FTA), signed into law in 2007. Free trade agreements have been established between Bolivia and Mexico, Canada and Costa Rica, Canada and Israel, Chile and Korea, Mexico and Japan, the United States and Jordan, and many others.[93]

SUMMARY

Principle:

The value of information is directly linked to how it helps decision makers achieve the organization's goals.

Information systems are used in almost every imaginable career area. Regardless of your college major or chosen career, you will find that information systems are indispensable tools to help you achieve your career goals. Learning about information systems can help you get your first job, earn promotions, and advance your career.

Data consists of raw facts; information is data transformed into a meaningful form. The process of defining relationships among data requires knowledge. Knowledge is an awareness and understanding of a set of information and the way that information can support a specific task. To be valuable, information must have several characteristics: It should be accurate, complete, economical to produce, flexible, reliable, relevant, simple to understand, timely, verifiable, accessible, and secure. The value of information is directly linked to how it helps people achieve their organizations' goals.

Principle:

Computers and information systems help make it possible for organizations to improve the way they conduct business.

A system is a set of elements that interact to accomplish a goal or set of objectives. The components of a system include inputs, processing mechanisms, and outputs. A system uses feedback to monitor and control its operation to make sure that it continues to meet its goals and objectives.

System performance is measured by its efficiency and effectiveness. Efficiency is a measure of what is produced divided by what is consumed; effectiveness measures the extent to which a system achieves its goals. A systems performance standard is a specific objective.

Principle:

Knowing the potential impact of information systems and having the ability to put this knowledge to work can result in a successful personal career and organizations that reach their goals.

Information systems are sets of interrelated elements that collect (input), manipulate and store (process), and disseminate (output) data and information. Input is the activity of capturing and gathering new data, processing involves converting or transforming data into useful outputs, and output involves producing useful information. Feedback is the output that is used to make adjustments or changes to input or processing activities.

The components of a computer-based information system (CBIS) include hardware, software, databases, telecommunications and the Internet, people, and procedures. The types of CBISs that organizations use can be classified into four basic groups: (1) e-commerce and m-commerce, (2) TPS and ERP systems, (3) MIS and DSS, and (4) knowledge management and specialized business information systems. The key to understanding these types of systems begins with learning their fundamentals.

E-commerce involves any business transaction executed electronically between parties such as companies (business-to-business), companies and consumers (business-to-consumer), business and the public sector, and consumers and the public sector. The major volume of e-commerce and its fastest-growing segment is business-to-business transactions that make purchasing easier for big corporations. E-commerce also offers opportunities for small businesses to market and sell at a low cost worldwide, thus allowing them to enter the global market right from start-up. M-commerce involves anytime, anywhere computing that relies on wireless networks and systems.

The most fundamental system is the transaction processing system (TPS). A transaction is any business-related exchange. The TPS handles the large volume of business transactions that occur daily within an organization. An enterprise resource planning (ERP) system is a set of integrated programs that can manage the vital business operations for an entire multisite, global organization. A management information system (MIS) uses the information from a TPS to generate information useful for management decision making.

A decision support system (DSS) is an organized collection of people, procedures, databases, and devices that help make problem-specific decisions. A DSS differs from an MIS in the support given to users, the emphasis on decisions, the development and approach, and the system components, speed, and output.

Specialized business information systems include artificial intelligence, expert systems, multimedia, and virtual reality systems. Knowledge management systems are organized collections of people, procedures, software, databases, and devices used to create, store, share, and use the organization's knowledge and experience. Artificial intelligence (AI) includes a wide range of systems in which the computer takes on the characteristics of human intelligence. Robotics is an area of artificial intelligence in which machines perform complex, dangerous, routine, or boring tasks, such as welding car frames or assembling computer systems and components. Vision systems allow robots and other devices

to have "sight" and to store and process visual images. Natural language processing involves computers interpreting and acting on verbal or written commands in English, Spanish, or other human languages. Learning systems let computers "learn" from past mistakes or experiences, such as playing games or making business decisions, while neural networks is a branch of artificial intelligence that allows computers to recognize and act on patterns or trends. An expert system (ES) is designed to act as an expert consultant to a user who is seeking advice about a specific situation. Originally, the term "virtual reality" referred to immersive virtual reality, in which the user becomes fully immersed in an artificial, computer-generated 3D world. Virtual reality can also refer to applications that are not fully immersive, such as mouse-controlled navigation through a 3D environment on a graphics monitor, stereo viewing from the monitor via stereo glasses, and stereo projection systems. Multimedia is a natural extension of virtual reality. It can include photos and images, the manipulation of sound, and special 3D effects.

Principle:

System users, business managers, and information systems professionals must work together to build a successful information system.

Systems development involves creating or modifying existing business systems. The major steps of this process and their goals include systems investigation (gain a clear understanding of what the problem is), systems analysis (define what the system must do to solve the problem), systems design (determine exactly how the system will work to meet the business needs), systems implementation (create or acquire the various system components defined in the design step), and systems maintenance and review (maintain and then modify the system so that it continues to meet changing business needs).

Principle:

Information systems must be applied thoughtfully and carefully so that society, business, and industry around the globe can reap their enormous benefits.

Information systems play a fundamental and ever-expanding role in society, business, and industry. But their use can also raise serious security, privacy, and ethical issues. Effective information systems can have a major impact on corporate strategy and organizational success. Businesses around the globe are enjoying better safety and service, greater efficiency and effectiveness, reduced expenses, and improved decision making and control because of information systems. Individuals who can help their businesses realize these benefits will be in demand well into the future.

Computer and information systems literacy are prerequisites for numerous job opportunities, and not only in the IS field. Computer literacy is knowledge of computer systems, software, and equipment; information systems literacy is knowledge of how data and information are used by individuals, groups, and organizations. Today, information systems are used in all the functional areas of business, including accounting, finance, sales, marketing, manufacturing, human resource management, and legal information systems. Information systems are also used in every industry, such as airlines, investment firms, banks, transportation companies, publishing companies, healthcare, retail, power management, professional services, and more.

Changes in society as a result of increased international trade and cultural exchange, often called globalization, have always had a significant impact on organizations and their information systems. In his book, *The World Is Flat*, Thomas Friedman describes three eras of globalization, spanning the globalization of countries to the globalization of multinational corporations and individuals. Today, people in remote areas can use the Internet to compete with and contribute to other people, the largest corporations, and entire countries. People and companies can get products and services from around the world, instead of around the corner or across town. These opportunities, however, introduce numerous obstacles and issues, including challenges involving culture, language, and many others.

CHAPTER 1: SELF-ASSESSMENT TEST

The value of information is directly linked to how it helps decision makers achieve the organization's goals.

1. A(n) _____ is a set of interrelated components that collect, manipulate, and disseminate data and information and provide a feedback mechanism to meet an objective.

2. What consists of raw facts, such as an employee number?
   a. bytes
   b. data
   c. information
   d. knowledge

3. Knowledge workers are usually professionals in science, engineering, business, and other areas. True or False?

Computers and information systems help make it possible for organizations to improve the way they conduct business.

4. A(n) _____ is a set of elements or components that interact to accomplish a goal.
5. A measure of what is produced divided by what is consumed is known as _____.
   a. efficiency
   b. effectiveness
   c. performance
   d. productivity
6. A specific objective of a system is called a performance standard. True or False?

Knowing the potential impact of information systems and having the ability to put this knowledge to work can result in a successful personal career and organizations that reach their goals.

7. A(n) _____ consists of hardware, software, databases, telecommunications, people, and procedures.
8. Computer programs that govern the operation of a computer system are called _____.
   a. feedback
   b. feedforward
   c. software
   d. transaction processing systems
9. Payroll and order processing are examples of a computerized knowledge management system. True or False?
10. What is an organized collection of people, procedures, software, databases, and devices used to create, store, share, and use the organization's experience and knowledge?
    a. TPS (transaction processing system)
    b. MIS (management information system)
    c. DSS (decision support system)
    d. KM (knowledge management)
11. _____ is a set of integrated programs that manage vital business operations.

System users, business managers, and information systems professionals must work together to build a successful information system.

12. What defines the problems and opportunities of an existing system?
    a. systems analysis
    b. systems review
    c. systems development
    d. systems design

Information systems must be applied thoughtfully and carefully so that society, business, and industry around the globe can reap their enormous benefits.

13. _____ literacy is a knowledge of how data and information are used by individuals, groups, and organizations.

CHAPTER 1: SELF-ASSESSMENT TEST ANSWERS

(1) information system (2) b (3) True (4) system (5) a (6) True (7) computer-based information system (CBIS) (8) c (9) False (10) d (11) Enterprise resource planning (ERP) (12) a (13) Information systems

REVIEW QUESTIONS

1. What is an information system? What are some of the ways information systems are changing our lives?
2. How is data different from information? Information from knowledge?
3. Describe the various types of data.
4. What is the difference between efficiency and effectiveness?
5. What are the components of any information system?
6. What is feedback? What are possible consequences of inadequate feedback?
7. How is system performance measured?
8. What is a knowledge management system? Give an example.
9. What is a computer-based information system? What are its components?
10. Describe the characteristics of a decision support system.
11. What is the difference between an intranet and an extranet?
12. What is m-commerce? Describe how it can be used.
13. What are the most common types of computer-based information systems used in business organizations today? Give an example of each.
14. Describe three applications of virtual reality.
15. What are computer literacy and information systems literacy? Why are they important?
16. What are some of the benefits organizations seek to achieve through using information systems?
17. Identify the steps in the systems development process and state the goal of each.

DISCUSSION QUESTIONS

1. Why is the study of information systems important to you? What do you hope to learn from this course to make it worthwhile?
2. List the ways an information system can be used in a career area of interest to you.
3. What is the value of software? Give several examples of software you use at school or home.
4. Why is a database an important part of a computer-based information system?
5. What is the difference between e-commerce and m-commerce?
6. What is the difference between DSS and knowledge management?
7. Suppose that you are a teacher assigned the task of describing the learning processes of preschool children. Why would you want to build a model of their learning processes? What kinds of models would you create? Why might you create more than one type of model?
8. Describe the "ideal" automated class registration system for a college or university. Compare this "ideal" system with what is available at your college or university.
9. What computer application needs the most improvement at your college or university? Describe how systems development could be used to develop it.
10. Discuss how information systems are linked to the business objectives of an organization.
11. What are your career goals, and how can you use a computer-based information system to achieve them?

PROBLEM-SOLVING EXERCISES

1. Prepare a data disk and a backup disk for the problem-solving exercises and other computer-based assignments you will complete in this class. Create one folder for each chapter in the textbook (you should have 14 folders). As you work through the problem-solving exercises and complete other work using the computer, save your assignments for each chapter in the appropriate folder. On the label of each disk or USB flash drive, be sure to include your name, course, and section. On one disk, write "Working Copy;" on the other, write "Backup."
2. Search through several business magazines (*BusinessWeek*, *Computerworld*, *PC Week*, etc.) or use an Internet search engine to find recent articles that describe potential social or ethical issues related to the use of an information system. Use word-processing software to write a one-page report summarizing what you discovered.
3. Create a table that lists 10 or more possible career areas, annual salaries, and brief job descriptions, and rate how much you would like the career area on a scale from 1 (don't like) to 10 (like the most). Print the results. Sort the table according to annual salaries from high to low and print the resulting table. Sort the table from the most liked to least liked and print the results.
4. Do some research to obtain estimates of the rate of growth of social networking sites like MySpace and Facebook. Use the plotting capabilities of your spreadsheet or graphics software to produce a bar chart of that growth over a number of years. Share your findings with the class.

TEAM ACTIVITIES

1. Before you can do a team activity, you need a team! As a class member, you might create your own team, or your instructor might assign members to groups. After your group has been formed, meet and introduce yourselves to each other. Find out the first name, hometown, major, e-mail address, and phone number of each member. Find out one interesting fact about each member of your team as well. Brainstorm a name for your team. Put the information on each team member into a database and print enough copies for each team member and your instructor.
2. With the other members of your group, use word-processing software to write a one-page summary of what your team hopes to gain from this course and what you are willing to do to accomplish these goals. Send the report to your instructor via e-mail.

WEB EXERCISES

1. Throughout this book, you will see how the Internet provides a vast amount of information to individuals and organizations. We will stress the World Wide Web, or simply the Web, which is an important part of the Internet. Most large universities and organizations have an address on the Internet, called a Web site or home page. The address of the Web site for this publisher is *www.cengage.com*. You can gain access to the Internet through a browser, such as Microsoft Internet Explorer or Safari. Using an Internet browser, go to the Web site for this publisher. What did you find? Try to obtain information on this book. You might be asked to develop a report or send an e-mail message to your instructor about what you found.
2. Go to an Internet search engine, such as *www.google.com* or *www.bing.com*, and search for information about artificial intelligence. Write a brief report that summarizes what you found.
3. Using the Internet, search for information on the use of information systems in a company or organization that interests you. How does the organization use technology to help it accomplish its goals?

CAREER EXERCISES

1. In the Career Exercises found at the end of every chapter, you will explore how material in the chapter can help you excel in your college major or chosen career. Write a brief report on the career that appeals to you the most. Do the same for two other careers that interest you.
2. Research careers in finance, management, information systems, and two other career areas that interest you. Describe the job opportunities, job duties, and the possible starting salaries for each career area in a report.

CASE STUDIES

Case One

Effectively Managing Resources at Aéroports de Paris

Imagine a busy airport at peak capacity, and then double the amount of congestion—the result is Aéroports de Paris, a combination of two Paris airports managed by one central controlling agency. In 2008, Aéroports de Paris handled 87.1 million passengers and tons of freight flying on more than 1,500 flights per day from 460 different airlines. Congestion, flight delays, and long lines of frustrated passengers make the two Paris airports difficult environments to manage.

Each flight arriving at Aéroports de Paris requires a long list of resources, including gates, parking stands, fuel trucks, check-in counters, buses, luggage conveyor belts, a variety of ground equipment, and personnel. Orchestrating the efficient delivery of these resources is beyond the skills of any person. Recently, Aéroports de Paris turned to IBM for help.

IBM assisted Aéroports de Paris in developing a sophisticated resource allocation system that maximizes efficiencies and reduces the stress at the busy Paris airports. The new system is based on the following IBM technologies:

- IBM ILOG CP optimization software
- IBM ILOG Views
- IBM ILOG Gantt for .Net visualization products

The resulting system is named SAÏGA. SAÏGA is responsible for directing the 900 passenger flights arriving each day to one of 240 parking stands and gates. Gates are assigned based on considerations such as fuel and luggage handling, departure and arrival times, security concerns, and airline preference. Along with gates, the system allocates all of the primary ground resources. SAÏGA works in real time, managing unexpected constraints such as flight delays, or it can allocate resources in advance to manage long-term scheduling. As a decision support system, SAÏGA provides useful charts that managers review to spot patterns and problems in scheduling and resources.

The SAÏGA system took three years to develop, with the special optimization software requiring only two months. Among the benefits for Aéroports de Paris are a decline in flight delays, more appropriate and timely assignment of resources, faster turnaround time for flights, faster through time for passengers, and reduced operating costs. Airport

systems engineers use SAÏGA tools to quickly build interfaces that provide easy-to-interpret plans and schedules. Aéroports de Paris executives can use the system to study operations over time and decide if and where improvements are needed. For example, are additional flights needed between Paris and Madrid? Is more time required for passenger boarding? Using SAÏGA to maximize efficiencies will help Aéroports de Paris increase profits, while decreasing airfares and airport stress.

Discussion Questions

1. In what manner does SAÏGA act as an MIS and DSS?
2. Why is scheduling of this scale best left to information systems such as SAÏGA rather than to human managers?

Critical Thinking Questions

1. What other industries might benefit from an information system like SAÏGA?
2. Is there any danger in relying on a system like SAÏGA? If so, how might an organization minimize the risks?

SOURCES: IBM Staff, "Aéroports de Paris reduces congestion at airports," *IBM Case Studies*, accessed June 30, 2009, *www-01.ibm.com/software/success/cssdb.nsf/CS/VCHN-7TCFYU?OpenDocument&Site=wssoftware&cty=en_us*; ILOG Products Web site, accessed November 12, 2009, *www.ilog.com*; Aéroports de Paris Web site, accessed November 12, 2009, *www.aeroportsdeparis.fr*.

Case Two

Information System as an Effective Force Against H1N1 Pandemic

Information systems are valuable to businesses for tracking business activities in real-time, as they occur. They are also valuable to the medical community for tracking the spread of viruses such as the H1N1 virus, also known as the swine flu. New Jersey-based Emergency Medical Associates (EMA) operates 21 emergency rooms in hospitals across New Jersey, New York, and Pennsylvania. With information mined from its diverse locations, EMA is in an ideal position to spot an outbreak of the flu in its early stages. All it requires is an information system to provide valuable information in a timely manner.

EMA's CIO and information systems specialists applied proven business information management techniques to their medical information needs. They understood that tracking medical statistics across their 21 emergency rooms was similar to tracking sales statistics across retail outlets. They required the same business intelligence (BI) and reporting tools used by successful businesses. Business intelligence or BI systems are designed to extract, or mine, useful information out of the data collected by businesses or organizations into databases. That data may consist of detailed sales information collected at the time of a sale or patient symptom information collected at the time of an examination.

EMA began by installing a database management system from Oracle. The database was shared by all of its 21 emergency rooms over a high-speed private network. EMA then contracted with SAP to install its BusinessObjects XI tool set to function as the company's BI platform. BusinessObjects can sort and sift through data in the database to find patterns and exceptions. Combining the BusinessObjects system with other software, including Xcelsius and Crystal Reports (powerful reporting software), and Web Intelligence (providing a Web interface to the system), EMA created a system that generates insightful reports and visualizations about medical conditions on a regular schedule and on demand.

Today, EMA physicians and nurses, depending on their needs, can access 27 dashboards, which provide statistics displayed in charts and lists that are updated as information is entered into the database. They also have access to 30 daily reports from the system informing them of the current status in all of their emergency rooms and of any changes in the status quo. The system allows users to customize their view of the data to focus on the information that is most important to their work.

Using its new information system, EMA was the first to spot the outbreak of H1N1 in the Northeast. Doctors knew that about 6 percent of patients complain of flu-like symptoms on any given day. When the EMA BI system reported that 30 percent of patients were arriving with flu symptoms, the doctors warned the country that H1N1 was on the move. This alert provided medical professionals and citizens the time needed to take action.

Discussion Questions

1. What role did business intelligence software play in catching an H1N1 outbreak in the northeastern United States.?
2. How does a system such as EMA's BI system use human intelligence and machine intelligence to support decision making?

Critical Thinking Questions

1. How do the BI needs of business professionals and medical professionals differ? How are they alike?
2. How does this case study reflect the need for standardized digital medical records systems in the U.S.? How might such standards influence the country's ability to keep its population healthy?

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Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. The following questions cover this Web case.

Altitude Online: Outgrowing Systems

Discussion Questions

1. Why do you think it's a problem for Altitude Online to use different information systems in its branch locations?
2. What information do you think Jon should collect from the branch offices to plan the new centralized information system?

Critical Thinking Questions

1. With Jon's education and experience, he could design and implement a new information system for Altitude Online himself. What would be the benefits and drawbacks of doing the job himself compared to contracting with an information systems contractor?
2. While Jon is visiting the branch offices, how might he prepare them for the inevitable upheaval caused by the upcoming overhaul to the information system?

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