Part I introduces the major themes and the problem-solving approaches that are used throughout the book. While surveying the role of information systems in today’s businesses, this part raises several major questions: What is an information system? Why are information systems so essential in businesses today? How can information systems help businesses become more competitive? What do I need to know about information systems to succeed in my business career?
STUDENT LEARNING OBJECTIVES

After completing this chapter, you will be able to answer the following questions:

1. How are information systems transforming business, and what is their relationship to globalization?
2. Why are information systems so essential for running and managing a business today?
3. What exactly is an information system? How does it work? What are its people, organization, and technology components?
4. How will a four-step method for business problem solving help you solve information system-related problems?
5. How will information systems affect business careers, and what information systems skills and knowledge are essential?
THE NEW YANKEE STADIUM LOOKS TO THE FUTURE

Although baseball is a sport, it’s also big business, requiring revenue from tickets to games, television broadcasts, and other sources to pay for teams. Salaries for top players have ballooned, as have ticket prices. Many fans now watch games on television rather than attending them in person or choose other forms of entertainment, such as electronic games. One way to keep stadiums full of fans, and to keep fans at home happy as well, is to enrich the fan experience by offering more video and services based on technology. When the New York Yankees built a new Yankee Stadium, they did just that.

The new Yankee Stadium, which opened on April 2, 2009, isn’t just another ballpark: It’s the stadium of the future. It is the most wired, connected, and video-enabled stadium in all of baseball. Although the new stadium is similar in design to the original Yankee Stadium, built in 1923, the interior has more space and amenities, including more intensive use of video and computer technology. Baseball fans love video. According to Ron Ricci, co-chairman of Cisco Systems’ sports and entertainment divi-
tion, “It’s what fans want to see, to see more angles and do it on their terms.” Cisco Systems supplied the computer and networking technology for the new stadium.

Throughout the stadium, including the Great Hall, the Yankees Museum, and in-stadium restaurants and concession areas, 1,100 flat-panel high-definition TV monitors display live game coverage, up-to-date sports scores, archival and highlight video, promotional messages, news, weather, and traffic updates. There is also a huge monitor in center field that is 100 feet wide and 59 feet high. At the conclusion of games, the monitors provide up-to-the-moment traffic information and directions to the nearest stadium exits.

The monitors are designed to surround fans visually from the moment they enter the stadium, especially when they stray from a direct view of the ball field. The pervasiveness of this technology ensures that while fans are buying a hamburger or a soda, they will never miss a play. The Yankees team controls all the monitors centrally and is able to offer different content on each one. Monitors are located at concession stands, around restaurants and bars, in restrooms, and inside 59 luxury and party suites. If a Yankee player wants to review a game to see how he played, monitors in the team’s video room will display what he did from any angle. Each Yankee also has a computer at his locker.

The luxury suites have special touch-screen phones for well-heeled fans to use when ordering food and merchandise. At the stadium business center, Cisco interactive videoconferencing technology will link to a library in the Bronx and to other New York City locations, such as hospitals. Players and executives will be able to videoconference and talk to fans before or after the games. Eventually, data and video from the Stadium will be delivered to fans’ home televisions and mobile devices. And inside the stadium, fans in each seat will be able to use their mobile phones to order from the concessions or view instant replays.

The Yankees also have their own Web site, Yankees.com, where fans can watch in-market Yankees games live online, check game scores, find out more about their favorite players, purchase tickets to games, and shop for caps, baseball cards and memorabilia. The site also features fantasy baseball games, where fans compete with each other by managing “fantasy teams” based on real players’ statistics.


The challenges facing the New York Yankees and other baseball teams show why information systems are so essential today. Major league baseball is a business as well as a sport, and teams such as the Yankees need to take in revenue from games in order to stay in business. Ticket prices have risen, stadium attendance is dwindling for some teams, and the sport must also compete with other forms of entertainment, including electronic games and the Internet.

The chapter-opening diagram calls attention to important points raised by this case and this chapter. To increase stadium attendance and revenue, the New York Yankees chose to modernize Yankee Stadium and rely on information technology to provide new interactive services to fans inside and outside the Stadium. These services include high-definition television monitors displaying live game coverage, up-to-date sports scores, video, promotional messages, news, weather, and traffic information; touch screens for ordering food and merchandise; interactive videoconferencing technology for connecting to fans and the community; and, eventually, data and video broadcast to fans’ home television sets and mobile handhelds. The Yankees’ Web site provides a new channel for interacting with fans, selling tickets to games, and selling other team-related products.

It is also important to note that these technologies changed the way the Yankees run their business. Yankee Stadium’s systems for delivering game coverage, information, and interactive services changed the flow of work for ticketing, seating, crowd management, and ordering food and other items from concessions. These changes had to be carefully planned to make sure they enhanced service, efficiency, and profitability.
1.1 The Role of Information Systems in Business Today

It’s not business as usual in America any more, or the rest of the global economy. In 2009, American businesses will invest nearly $1 trillion in information systems hardware, software, and telecommunications equipment—more than half of all capital investment in the United States. In addition, they will spend another $275 billion on business and management consulting and services—much of which involves redesigning firms’ business operations to take advantage of these new technologies. More than half of all business investment in the United States each year involves information systems and technologies.

HOW INFORMATION SYSTEMS ARE TRANSFORMING BUSINESS

You can see the results of this massive spending around you every day by observing how people conduct business. More wireless cell phone accounts were opened in 2008 than telephone landlines installed. Cell phones, BlackBerrys, wireless handhelds, e-mail, and online conferencing over the Internet have all become essential tools of business. In 2008, more than 75 million businesses had dot-com Internet sites registered. Approximately 199 million Americans are online, 14 million purchase something every day on the Internet, 40 million research a product, and 100 million use a search engine. What this means is that if you and your business aren’t connected to the Internet and wireless networks, chances are you are not being as effective as you could be (Pew Internet and American Life, 2009).

Despite the economic downturn in 2008, FedEx moved over 200 million packages in the United States, mostly overnight, and United Parcel Service (UPS) moved more than 600 million packages, as businesses sought to sense and respond to rapidly changing customer demand, reduce inventories to the lowest possible levels, and achieve higher levels of operational efficiency. Supply chains have become more fast paced, with companies of all sizes depending on the delivery of just-in-time inventory to help them compete. Companies today manage their inventories in near real time in order to reduce their overhead costs and get to market faster. If you are not a part of this new supply chain management economy, chances are your business is not as efficient as it could be.

As newspaper readership continues to decline, 106 million people read at least some of their news online, 70 million read actual newspapers online, and 88 million use a social net-
working site like Facebook or MySpace. Sixty million bank online, and 55 million now read blogs, creating an explosion of new writers, readers, and new forms of customer feedback that did not exist before. Adding to this mix of new social media, about 8 million people use Twitter, the online and cellular text messaging service, including many Fortune 1000 firms communicating with their customers. This means your customers are empowered and able to talk to each other about your business products and services. Do you have a solid online customer relationship program in place? Do you know what your customers are saying about your firm? Is your marketing department listening?

E-commerce and Internet advertising are growing in 2009 despite an economic recession at a time when traditional advertising and commerce are shrinking. Google’s online ad revenues surpassed $22 billion in 2008. E-commerce revenues expanded over 5 percent in 2008, and showed no decline in 2009 (while traditional retail fell 5 percent). Is your advertising department reaching this new Web-based customer?

New federal security and accounting laws require many businesses to keep e-mail messages for five years. Coupled with existing occupational and health laws requiring firms to store employee chemical exposure data for up to 60 years, these laws are spurring the growth of digital information now estimated to be 5 exabytes, equivalent to 37,000 Libraries of Congress. Does your compliance department meet the minimal requirements for storing financial, health, and occupational information? If they don’t, your entire business may be at risk.

Briefly, it’s a new world of doing business, one that will greatly affect your future business career. Along with the changes in business come changes in jobs and careers. No matter whether you are a finance, accounting, management, marketing, operations management, or information systems major, how you work, where you work, and how well you are compensated will all be affected by business information systems. The purpose of this book is to help you understand and benefit from these new business realities and opportunities.

WHAT’S NEW IN MANAGEMENT INFORMATION SYSTEMS?

Lots! What makes management information systems the most exciting topic in business is the continual change in technology, management use of the technology, and the impact on business success. New businesses and industries appear, old ones decline, and successful firms are those that learn how to use the new technologies. Table 1.1 summarizes the major new themes in business uses of information systems. These themes will appear throughout the book in all the chapters, so it might be a good idea to take some time now and discuss these with your professor and other students.

In the technology area there are three interrelated changes: (1) the emerging mobile digital platform, (2) the growth of online software as a service, and (3) the growth in “cloud computing” where more and more business software runs over the Internet.

IPhones, BlackBerrys, and tiny Web-surfing netbooks are not just gadgets or entertainment outlets. They represent new emerging computing platforms based on an array of new hardware and software technologies. More and more business computing is moving from PCs and desktop machines to these mobile devices. Managers are increasingly using these devices to coordinate work, communicate with employees, and provide information for decision making. We call these developments the “emerging mobile platform.”

Managers routinely use so-called “Web 2.0” technologies like social networking, collaboration tools, and wikis in order to make better, faster decisions. As management behavior changes, how work gets organized, coordinated, and measured also changes. By connecting employees working on teams and projects, the social network is where works gets done, where plans are executed, and where managers manage. Collaboration spaces are where employees meet one another, even when they are separated by continents and time zones.

The strength of cloud computing, and the growth of the mobile digital platform, mean that organizations can rely more on telework, remote work, and distributed decision making. This same platform means firms can outsource more work, and rely on markets (rather than employees) to build value. It also means that firms can collaborate with suppliers and customers to create new products, or make existing products more efficiently.
<table>
<thead>
<tr>
<th>Change</th>
<th>Business Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TECHNOLOGY</strong></td>
<td></td>
</tr>
<tr>
<td>Cloud computing platform emerges as a major business area of innovation</td>
<td>A flexible collection of computers on the Internet begins to perform tasks traditionally performed on corporate computers.</td>
</tr>
<tr>
<td>Growth in software as a service (SaaS)</td>
<td>Major business applications are now delivered online as an Internet service rather than as boxed software or custom systems.</td>
</tr>
<tr>
<td>A mobile digital platform emerges to compete with the PC as a business system</td>
<td>Apple opens its iPhone software to developers, and then opens an Applications Store on iTunes where business users can download thousands of applications to support collaboration, location-based services, and communication with colleagues. Small portable lightweight, low-cost, net-centric subnotebook computers become a major segment of the laptop marketplace.</td>
</tr>
<tr>
<td><strong>PEOPLE</strong></td>
<td></td>
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<tr>
<td>Managers adopt online collaboration and social networking software to improve coordination, collaboration, and knowledge sharing</td>
<td>Google Apps, Google Sites, Microsoft’s Windows SharePoint Services, and IBM’s Lotus Connections are used by over 100 million business professionals worldwide to support blogs, project management, online meetings, personal profiles, social bookmarks, and online communities.</td>
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<tr>
<td>Business intelligence applications accelerate</td>
<td>More powerful data analytics and interactive dashboards provide real-time performance information to managers to enhance management control and decision making.</td>
</tr>
<tr>
<td>Virtual meetings proliferate</td>
<td>Managers adopt telepresence video conferencing and Web conferencing technologies to reduce travel time, and cost, while improving collaboration and decision making.</td>
</tr>
<tr>
<td><strong>ORGANIZATIONS</strong></td>
<td></td>
</tr>
<tr>
<td>Web 2.0 applications are widely adopted by firms</td>
<td>Web-based services enable employees to interact as online communities using blogs, Wikis, e-mail, and instant messaging services. Facebook and MySpace create new opportunities for business to collaborate with customers and vendors.</td>
</tr>
<tr>
<td>Telework gains momentum in the workplace</td>
<td>The Internet, wireless laptops, iPhones, and BlackBerrys make it possible for growing numbers of people to work away from the traditional office. Fifty-five percent of U.S. businesses have some form of remote work program.</td>
</tr>
<tr>
<td>Co-creation of business value</td>
<td>Sources of business value shift from products to solutions and experiences and from internal sources to networks of suppliers and collaboration with customers. Supply chains and product development become more global and collaborative; customer interactions help firms define new products and services.</td>
</tr>
</tbody>
</table>

You can see some of these trends at work in the Interactive Session on Organizations. Millions of managers rely heavily on the mobile digital platform to coordinate suppliers and shipments, satisfy customers, and manage their employees. A business day without these mobile devices or Internet access would be unthinkable. As you read this case, note how the emerging mobile platform greatly enhances the accuracy, speed, and richness of decision making.
Can you run your company out of your pocket? Perhaps not entirely, but there are many functions today that can be performed using an iPhone, BlackBerry, or other mobile handheld device. The smartphone has been called the “Swiss Army knife of the digital age.” A flick of the finger turns it into a Web browser, a telephone, a camera, a music or video player, an e-mail and messaging machine, and for some, a gateway into corporate systems. New software applications for social networking and sales force management (CRM) make these devices even more versatile business tools.

The BlackBerry has been the favored mobile handheld for business because it was optimized for e-mail and messaging, with strong security and tools for accessing internal corporate systems. Now that’s changing. Companies large and small are starting to deploy Apple’s iPhone to conduct more of their work. For some, these handhelds have become necessities.

Doylestown Hospital, a community medical center near Philadelphia, has a mobile workforce of 360 independent physicians treating thousands of patients. The physicians use the iPhone 3G to stay connected around the clock to hospital staff, colleagues, and patient information. Doylestown doctors use iPhone features such as e-mail, calendar, and contacts from Microsoft Exchange ActiveSync. The iPhone allows them to receive time-sensitive e-mail alerts from the hospital. Voice communication is important as well, and the iPhone allows the doctors to be on call wherever they are.

Doylestown Hospital customized the iPhone to provide doctors with secure mobile access from any location in the world to the hospital’s MEDITECH electronic medical records system. MEDITECH delivers information on vital signs, medications, lab results, allergies, nurses’ notes, therapy results, and even patient diets to the iPhone screen. “Every radiographic image a patient has had, every dictated report from a specialist is available on the iPhone,” notes Dr. Scott Levy, Doylestown Hospital’s Vice President and Chief Medical Officer. Doylestown doctors also use the iPhone at the patient’s bedside to access medical reference applications such as Epocrates Essentials to help them interpret lab results and obtain medication information.

Doylestown’s information systems department was able to establish the same high level of security for authenticating users of the system and tracking user activity as it maintains with all the hospital’s Web-based medical records applications. Information is stored securely on the hospital’s own server computer.

D.W. Morgan, headquartered in Pleasanton, California, serves as a supply chain consultant and transportation and logistics service provider to companies such as AT&T, Apple Computer, Johnson & Johnson, Lockheed Martin, and Chevron. It has operations in more than 85 countries on four continents, moving critical inventory to factories that use a just-in-time (JIT) strategy. In JIT, retailers and manufacturers maintain almost no excess on-hand inventory, relying upon suppliers to deliver raw materials, components, or products shortly before they are needed.

In this type of production environment, it’s absolutely critical to know the exact moment when delivery trucks will arrive. In the past, it took many phone calls and a great deal of manual effort to provide customers with such precise up-to-the-minute information. The company was able to develop a ChainLinq Mobile application for its 30 drivers that updates shipment information, collects signatures, and provides global positioning system (GPS) locations on each individual box it delivers.

As Morgan’s drivers make their shipments, they use ChainLinq to record pickups and status updates. When they reach their destination, they collect a signature on the iPhone screen. Data collected at each point along the way, including a date-stamp and time-stamped GPS location pinpointed on a Google map, are uploaded to the company’s servers. The servers make the data available to customers on the company’s Web site. Morgan’s competitors take about 20 minutes to half a day to provide proof of delivery; Morgan can do it immediately.

Aedas Sport is one of the world’s foremost designers of multipurpose sports, entertainment, and exhibition facilities. Every employee is equipped with an iPhone. Designers and architects, who work in an almost continuous stream of communication, use their iPhone cameras to take pictures of designs, models, and construction sites. They send the photos along with e-mail, text messages, and documents around the office. And of course they use the iPhone for telephone calls. Productivity has jumped as much as 400 percent.

The iPhone has made it possible for Aedas Sport to build a large archive of visual assets without planning or extra effort. The firm sends a book with all the iPhone photos of its projects to every prospective client to demonstrate the talent and creativity of the firm.

CASE STUDY QUESTIONS

1. What kinds of applications are described here? What business functions do they support? How do they improve operational efficiency and decision making?

2. Identify the problems that businesses in this case study solved by using mobile digital devices.

3. What kinds of businesses are most likely to benefit from equipping their employees with mobile digital devices such as iPhones and BlackBerrys?

4. D.W. Morgan’s CEO has stated, “The iPhone is not a game changer, it’s an industry changer. It changes the way that you can interact with your customers (and) with your suppliers.” Discuss the implications of this statement.

MIS IN ACTION

Explore the Web sites for the Apple iPhone 3G, the BlackBerry, and the Palm Pre, then answer the following questions:

1. List and describe the capabilities of each of these devices and give examples of how they could be used by businesses.

2. List and describe three downloadable business applications for each device and describe their business benefits.

GLOBALIZATION CHALLENGES AND OPPORTUNITIES: A FLATTENED WORLD

In 1492, Columbus reaffirmed what astronomers were long saying: the world was round and the seas could be safely sailed. As it turned out, the world was populated by peoples and languages living in near total isolation from one another, with great disparities in economic and scientific development. The world trade that ensued after Columbus’s voyages has brought these peoples and cultures closer. The “industrial revolution” was really a worldwide phenomenon energized by expansion of trade among nations.

By 2005, journalist Thomas Friedman wrote an influential book declaring the world was now “flat,” by which he meant that the Internet and global communications had greatly reduced the economic and cultural advantages of developed countries. U.S. and European countries were in a fight for their economic lives, competing for jobs, markets, resources, and even ideas with highly educated, motivated populations in low-wage areas in the less developed world (Friedman, 2007). This “globalization” presents you and your business with both challenges and opportunities.

A growing percentage of the economy of the United States and other advanced industrial countries in Europe and Asia depends on imports and exports. In 2009, more than 33 percent of the U.S. economy resulted from foreign trade, both imports and exports. In Europe and
Asia, the number exceeds 50 percent. Many Fortune 500 U.S. firms derive half their revenues from foreign operations. For instance, more than half of Intel’s revenues in 2008 came from overseas sales of its microprocessors. Toys for chips: 80 percent of the toys sold in the United States are manufactured in China, while about 90 percent of the PCs manufactured in China use American-made Intel or Advanced Micro Design (AMD) chips.

It’s not just goods that move across borders. So too do jobs, some of them high-level jobs that pay well and require a college degree. In the past decade, the United States lost several million manufacturing jobs to offshore, low-wage producers. But manufacturing is now a very small part of U.S. employment (less than 12 percent). In a normal year, about 300,000 service jobs move offshore to lower-wage countries, many of them in less-skilled information system occupations, but also including “tradable service” jobs in architecture, financial services, customer call centers, consulting, engineering, and even radiology.

On the plus side, the U.S. economy creates over 3.5 million new jobs a year, and employment in information systems, and the other service occupations listed previously, has expanded in sheer numbers, wages, productivity, and quality of work. Outsourcing has actually accelerated the development of new systems in the United States and worldwide. In the midst of a recession in 2009, jobs in information systems are among the most in demand.

The challenge for you as a business student is to develop high-level skills through education and on-the-job experience that cannot be outsourced. The challenge for your business is to avoid markets for goods and services that can be produced offshore much less expensively. The opportunities are equally immense. You can learn how to profit from the lower costs available in world markets and the chance to serve a marketplace with billions of customers. You have the opportunity to develop higher-level and more profitable products and services. You will find throughout this book examples of companies and individuals who either failed or succeeded in using information systems to adapt to this new global environment.

What globalization have to do with management information systems? That’s simple: everything. The emergence of the Internet into a full-blown international communications system has drastically reduced the costs of operating and transacting on a global scale. Communication between a factory floor in Shanghai and a distribution center in Sioux Falls, South Dakota, is now instant and virtually free. Customers now can shop in a worldwide marketplace, obtaining price and quality information reliably 24 hours a day. Firms producing goods and services on a global scale achieve extraordinary cost reductions by finding low-cost suppliers and managing production facilities in other countries. Internet service firms, such as Google and eBay, are able to replicate their business models and services in multiple countries without having to redesign their expensive fixed-cost information systems infrastructure. Over half of eBay’s revenues in 2009 originated outside the United States. Briefly, information systems enable globalization.

**BUSINESS DRIVERS OF INFORMATION SYSTEMS**

What makes information systems so essential today? Why are businesses investing so much in information systems and technologies? They do so to achieve six important business objectives: operational excellence; new products, services, and business models; customer and supplier intimacy; improved decision making; competitive advantage; and survival.

**Operational Excellence**

Businesses continuously seek to improve the efficiency of their operations in order to achieve higher profitability. Information systems and technologies are some of the most important tools available to managers for achieving higher levels of efficiency and productivity in business operations, especially when coupled with changes in business practices and management behavior.

Wal-Mart, the largest retailer on Earth, exemplifies the power of information systems coupled with brilliant business practices and supportive management to achieve world-class operational efficiency. In 2008, Wal-Mart achieved more than $400 billion in sales—nearly one-tenth of retail sales in the United States—in large part because of its Retail Link system,
which digitally links its suppliers to every one of Wal-Mart’s 7,873 stores worldwide. As soon as a customer purchases an item, the supplier monitoring the item knows to ship a replacement to the shelf. Wal-Mart is the most efficient retail store in the industry, achieving sales of more than $28 per square foot, compared to its closest competitor, Target, at $23 a square foot, with other retail firms producing less than $12 a square foot.

**New Products, Services, and Business Models**

Information systems and technologies are a major enabling tool for firms to create new products and services, as well as entirely new business models. A **business model** describes how a company produces, delivers, and sells a product or service to create wealth. Today’s music industry is vastly different from the industry in 2000. Apple Inc. transformed an old business model of music distribution based on vinyl records, tapes, and CDs into an online, legal distribution model based on its own iPod technology platform. Apple has prospered from a continuing stream of innovations, including the original iPod, the iPod nano, the iTunes music service, the iPod video player, and the iPhone.

**Customer and Supplier Intimacy**

When a business really knows its customers and serves them well, the way they want to be served, the customers generally respond by returning and purchasing more. This raises revenues and profits. Likewise with suppliers: the more a business engages its suppliers, the better the suppliers can provide vital inputs. This lowers costs. How to really know your customers, or suppliers, is a central problem for businesses with millions of offline and online customers.

The Mandarin Oriental in Manhattan and other high-end hotels exemplify the use of information systems and technologies to achieve customer intimacy. These hotels use computers to keep track of guests’ preferences, such as their preferred room temperature, check-in time, frequently dialed telephone numbers, and television programs, and store these data in a giant data repository. Individual rooms in the hotels are networked to a central network server computer so that they can be remotely monitored or controlled. When a customer arrives at one of these hotels, the system automatically changes the room conditions, such as dimming the lights, setting the room temperature, or selecting appropriate music, based on the customer’s digital profile. The hotels also analyze their customer data to identify their best customers and to develop individualized marketing campaigns based on customers’ preferences.

JCPenney exemplifies the benefits of information systems-enabled supplier intimacy. Every time a dress shirt is bought at a JCPenney store in the United States, the record of the sale appears immediately on computers in Hong Kong at TAL Apparel Ltd., a giant...
contract manufacturer that produces one in eight dress shirts sold in the United States. TAL runs the numbers through a computer model it developed and decides how many replacement shirts to make, and in what styles, colors, and sizes. TAL then sends the shirts to each JCPenney store, completely bypassing the retailer’s warehouses. In other words, JCPenney’s surplus shirt inventory is near zero, as is the cost of storing it.

**Improved Decision Making**

Many business managers operate in an information fog bank, never really having the right information at the right time to make an informed decision. Instead, managers rely on forecasts, best guesses, and luck. The result is over- or underproduction of goods and services, misallocation of resources, and poor response times. These poor outcomes raise costs and lose customers. In the past 10 years, information systems and technologies have made it possible for managers to use real-time data from the marketplace when making decisions.

For instance, Verizon Corporation, one of the largest regional Bell operating companies in the United States, uses a Web-based digital dashboard to provide managers with precise real-time information on customer complaints, network performance for each locality served, and line outages or storm-damaged lines. Using this information, managers can immediately allocate repair resources to affected areas, inform consumers of repair efforts, and restore service fast.

**Competitive Advantage**

When firms achieve one or more of these business objectives—operational excellence; new products, services, and business models; customer/supplier intimacy; and improved decision making—chances are they have already achieved a competitive advantage. Doing things better than your competitors, charging less for superior products, and responding to customers and suppliers in real time all add up to higher sales and higher profits that your competitors cannot match.

Perhaps no other company exemplifies all of these attributes leading to competitive advantage more than Toyota Motor Company. Toyota has become the world’s largest automaker because of its high level of efficiency and quality. Competitors struggle to keep up. Toyota’s legendary Toyota Production System (TPS) focuses on organizing work to eliminate waste, making continuous improvements, and optimizing customer value. Information systems help Toyota implement the TPS and produce vehicles based on what customers have actually ordered.

**Survival**

Business firms also invest in information systems and technologies because they are necessities of doing business. Sometimes these necessities are driven by industry-level changes. For instance, after Citibank introduced the first automated teller machines (ATMs) in the New York region in 1977 to attract customers through higher service levels, its competitors rushed to provide ATMs to their customers to keep up with Citibank. Today, virtually all banks in the United States have regional ATMs and link to national and international ATM networks, such as CIRRUS. Providing ATM services to retail banking customers is simply a requirement of being in and surviving in the retail banking business.

Many federal and state statutes and regulations create a legal duty for companies and their employees to retain records, including digital records. For instance, the Toxic Substances Control Act (1976), which regulates the exposure of U.S. workers to more than 75,000 toxic chemicals, requires firms to retain records on employee exposure for 30 years. The Sarbanes-Oxley Act (2002), which was intended to improve the accountability of public firms and their auditors, requires public companies to retain audit working papers and records, including all e-mails, for five years. Firms turn to information systems and technologies to provide the capability to respond to these information retention and reporting requirements.
1.2 Perspectives on Information Systems and Information Technology

So far we’ve used information systems and technologies informally without defining the terms. Information technology (IT) consists of all the hardware and software that a firm needs to use in order to achieve its business objectives. This includes not only computer machines, disk drives, and mobile handheld devices but also software, such as the Windows or Linux operating systems, the Microsoft Office desktop productivity suite, and the many thousands of computer programs that can be found in a typical large firm. “Information systems” are more complex and can be best be understood by looking at them from both a technology and a business perspective.

WHAT IS AN INFORMATION SYSTEM?

An information system (IS) can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making, coordinating, and control in an organization. In addition, information systems may also help managers and workers analyze problems, visualize complex subjects, and create new products.

Information systems contain information about significant people, places, and things within the organization or in the environment surrounding it. By information we mean data that have been shaped into a form that is meaningful and useful to human beings. Data, in contrast, are streams of raw facts representing events occurring in organizations or the physical environment before they have been organized and arranged into a form that people can understand and use.

A brief example contrasting information and data may prove useful. Supermarket checkout counters scan millions of pieces of data, such as bar codes, that describe the product. Such pieces of data can be totaled and analyzed to provide meaningful information, such as the total number of bottles of dish detergent sold at a particular store, which brands of dish detergent were selling the most rapidly at that store or sales territory, or the total amount spent on that brand of dish detergent at that store or sales region (see Figure 1-1).

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**Figure 1-1**
Data and Information
Raw data from a supermarket checkout counter can be processed and organized to produce meaningful information, such as the total unit sales of dish detergent or the total sales revenue from dish detergent for a specific store or sales territory.
Three activities in an information system produce the information that organizations need to make decisions, control operations, analyze problems, and create new products or services. These activities are input, processing, and output (see Figure 1-2). Input captures or collects raw data from within the organization or from its external environment. Processing converts this raw input into a meaningful form. Output transfers the processed information to the people who will use it or to the activities for which it will be used. Information systems also require feedback, which is output that is returned to appropriate members of the organization to help them evaluate or correct the input stage.

In the Yankees’ system for selling tickets through its Web site, the raw input consists of order data for tickets, such as the purchaser’s name, address, credit card number, number of tickets ordered, and the date of the game for which the ticket is being purchased. Computers store these data and process them to calculate order totals, to track ticket purchases, and to send requests for payment to credit card companies. The output consists of tickets to print, receipts for orders, and reports on online ticket orders. The system provides meaningful information, such as the number of tickets sold for a particular game, the total number of tickets sold each year, and frequent customers.

Although computer-based information systems use computer technology to process raw data into meaningful information, there is a sharp distinction between a computer and a computer program and an information system. Electronic computers and related software programs are the technical foundation, the tools and materials, of modern information systems. Computers provide the equipment for storing and processing information. Computer programs, or software, are sets of operating instructions that direct and control computer processing. Knowing how computers and computer programs work is important in designing solutions to organizational problems, but computers are only part of an information system.

A house is an appropriate analogy. Houses are built with hammers, nails, and wood, but these alone do not make a house. The architecture, design, setting, landscaping, and all of the decisions that lead to the creation of these features are part of the house and are crucial for solving the problem of putting a roof over one’s head. Computers and programs are the
hammer, nails, and lumber of computer-based information systems, but alone they cannot produce the information a particular organization needs. To understand information systems, you must understand the problems they are designed to solve, their architectural and design elements, and the organizational processes that lead to these solutions.

**IT ISN’T SIMPLY TECHNOLOGY: THE ROLE OF PEOPLE AND ORGANIZATIONS**

To fully understand information systems, you will need to be aware of the broader organization, people, and information technology dimensions of systems (see Figure 1-3) and their power to provide solutions to challenges and problems in the business environment. We refer to this broader understanding of information systems, which encompasses an understanding of the people and organizational dimensions of systems as well as the technical dimensions of systems, as **information systems literacy**. Information systems literacy includes a behavioral as well as a technical approach to studying information systems. **Computer literacy**, in contrast, focuses primarily on knowledge of information technology.

The field of **management information systems (MIS)** tries to achieve this broader information systems literacy. MIS deals with behavioral issues as well as technical issues surrounding the development, use, and impact of information systems used by managers and employees in the firm.

**DIMENSIONS OF INFORMATION SYSTEMS**

Let’s examine each of the dimensions of information systems—organizations, people, and information technology.

**Organizations**

Information systems are an integral part of organizations. And although we tend to think about information technology changing organizations and business firms, it is, in fact, a two-way street: The history and culture of business firms also affects how the technology is used and how it should be used. In order to understand how a specific business firm uses information systems, you need to know something about the structure, history, and culture of the company.

Organizations have a structure that is composed of different levels and specialties. Their structures reveal a clear-cut division of labor. A business firm is organized as a hierarchy, or a pyramid structure, of rising authority and responsibility. The upper levels of the hierarchy
consist of managerial, professional, and technical employees, whereas the lower levels consist of operational personnel. Experts are employed and trained for different business functions, such as sales and marketing, manufacturing and production, finance and accounting, and human resources. Information systems are built by the firm in order to serve these different specialties and different levels of the firm. Chapter 2 provides more detail on these business functions and organizational levels and the ways in which they are supported by information systems.

An organization accomplishes and coordinates work through this structured hierarchy and through its business processes, which are logically related tasks and behaviors for accomplishing work. Developing a new product, fulfilling an order, and hiring a new employee are examples of business processes.

Most organizations’ business processes include formal rules that have been developed over a long time for accomplishing tasks. These rules guide employees in a variety of procedures, from writing an invoice to responding to customer complaints. Some of these business processes have been written down, but others are informal work practices, such as a requirement to return telephone calls from co-workers or customers, that are not formally documented. Information systems automate many business processes. For instance, how a customer receives credit or how a customer is billed is often determined by an information system that incorporates a set of formal business processes.

Each organization has a unique culture, or fundamental set of assumptions, values, and ways of doing things, that has been accepted by most of its members. Parts of an organization’s culture can always be found embedded in its information systems. For instance, the United Parcel Service’s concern with placing service to the customer first is an aspect of its organizational culture that can be found in the company’s package tracking systems.

Different levels and specialties in an organization create different interests and points of view. These views often conflict. Conflict is the basis for organizational politics. Information systems come out of this cauldron of differing perspectives, conflicts, compromises, and agreements that are a natural part of all organizations.

People
A business is only as good as the people who work there and run it. Likewise with information systems—they are useless without skilled people to build and maintain them, and without people who can understand how to use the information in a system to achieve business objectives.

For instance, a call center that provides help to customers using an advanced customer relationship management system (described in later chapters) is useless if employees are not adequately trained to deal with customers, find solutions to their problems, and leave the customer feeling that the company cares for them. Likewise, employee attitudes about their jobs, employers, or technology can have a powerful effect on their abilities to use information systems productively.

Business firms require many different kinds of skills and people, including managers as well as rank-and-file employees. The job of managers is to make sense out of the many situations faced by organizations, make decisions, and formulate action plans to solve organizational problems. Managers perceive business challenges in the environment, they set the organizational strategy for responding to those challenges, and they allocate the human and financial resources to coordinate the work and achieve success. Throughout, they must exercise responsible leadership.

But managers must do more than manage what already exists. They must also create new products and services and even re-create the organization from time to time. A substantial part of management responsibility is creative work driven by new knowledge and information. Information technology can play a powerful role in helping managers develop novel solutions to a broad range of problems.

As you will learn throughout this text, technology is relatively inexpensive today, but people are very expensive. Because people are the only ones capable of business prob-
Problem solving and converting information technology into useful business solutions, we spend considerable effort in this text looking at the people dimension of information systems.

**Technology**

Information technology is one of many tools managers use to cope with change and complexity. **Computer hardware** is the physical equipment used for input, processing, and output activities in an information system. It consists of the following: computers of various sizes and shapes; various input, output, and storage devices; and telecommunications devices that link computers together.

**Computer software** consists of the detailed, preprogrammed instructions that control and coordinate the computer hardware components in an information system. Chapter 4 describes the contemporary software and hardware platforms used by firms today in greater detail.

**Data management technology** consists of the software governing the organization of data on physical storage media. More detail on data organization and access methods can be found in Chapter 5.

**Networking and telecommunications technology**, consisting of both physical devices and software, links the various pieces of hardware and transfers data from one physical location to another. Computers and communications equipment can be connected in networks for sharing voice, data, images, sound, and video. A **network** links two or more computers to share data or resources, such as a printer.

The world’s largest and most widely used network is the **Internet**. The Internet is a global “network of networks” that uses universal standards (described in Chapter 6) to connect millions of different networks in nearly 200 countries around the world.

The Internet has created a new “universal” technology platform on which to build new products, services, strategies, and business models. This same technology platform has internal uses, providing the connectivity to link different systems and networks within the firm. Internal corporate networks based on Internet technology are called **intranets**. Private intranets extended to authorized users outside the organization are called **extranets**, and firms use such networks to coordinate their activities with other firms for making purchases, collaborating on design, and performing other interorganizational work. For most business firms today, using Internet technology is a business necessity and a competitive advantage.

The **World Wide Web** is a service provided by the Internet that uses universally accepted standards for storing, retrieving, formatting, and displaying information in a page format on the Internet. Web pages contain text, graphics, animations, sound, and video and are linked to other Web pages. By clicking on highlighted words or buttons on a Web page, you can link to related pages to find additional information and links to other locations on the Web. The Web can serve as the foundation for new kinds of information systems such as UPS’s Web-based package tracking system or the Yankees’ online system for ordering tickets and playing “fantasy” baseball described in the chapter-opening case.

All of these technologies, along with the people required to run and manage them, represent resources that can be shared throughout the organization and constitute the firm’s **information technology (IT) infrastructure**. The IT infrastructure provides the foundation, or **platform**, on which the firm can build its specific information systems. Each organization must carefully design and manage its information technology infrastructure so that it has the set of technology services it needs for the work it wants to accomplish with information systems. Chapters 4 through 7 of this text examine each major technology component of information technology infrastructure and show how they all work together to create the technology platform for the organization.

The Interactive Session on Technology describes some of the typical technologies used in computer-based information systems today. UPS invests heavily in information systems technology to make its business more efficient and customer oriented. It uses an array of information technologies including bar code scanning systems, wireless networks, large
INTERACTIVE SESSION: TECHNOLOGY

United Parcel Service (UPS) started out in 1907 in a closet-sized basement office. Jim Casey and Claude Ryan—two teenagers from Seattle with two bicycles and one phone—promised the “best service and lowest rates.” UPS has used this formula successfully for more than a century to become the world’s largest ground and air package-distribution company. It is a global enterprise with more than 415,000 employees, 99,000 vehicles, and the world’s eighth largest airline.

Today, UPS delivers more than 15 million parcels and documents each day in the United States and more than 200 other countries and territories. The firm has been able to maintain leadership in small-package delivery services despite stiff competition from FedEx and Airborne Express by investing heavily in advanced information technology. UPS spends more than $1 billion each year to maintain a high level of customer service while keeping costs low and streamlining its overall operations.

It all starts with the scannable bar-coded label attached to a package, which contains detailed information about the sender, the destination, and when the package should arrive. Customers can download and print their own labels using special software provided by UPS or by accessing the UPS Web site. Before the package is even picked up, information from the “smart” label is transmitted to one of UPS’s computer centers in Mahwah, New Jersey, or Alpharetta, Georgia, and sent to the distribution center nearest its final destination. Dispatchers at this center download the label data and use special software to create the most efficient delivery route for each driver that considers traffic, weather conditions, and the location of each stop. UPS estimates its delivery trucks save 28 million miles and burn 3 million fewer gallons of fuel each year.

The first thing a UPS driver picks up each day is a handheld computer called a Delivery Information Acquisition Device (DIAD), which can access one of the wireless networks cell phones rely on. As soon as the driver logs on, his or her day’s route is downloaded onto the handheld. The DIAD also automatically captures customers’ signatures along with pickup and delivery information. Package tracking information is then transmitted to UPS’s computer network for storage and processing. From there, the information can be accessed worldwide to provide proof of delivery to customers or to respond to customer queries. It usually takes less than 60 seconds from the time a driver presses “complete” on the DIAD for the new information to be available on the Web.

Through its automated package tracking system, UPS can monitor and even re-route packages throughout the delivery process. At various points along the route from sender to receiver, bar code devices scan shipping information on the package label and feed data about the progress of the package into the central computer. Customer service representatives are able to check the status of any package from desktop computers linked to the central computers and respond immediately to inquiries from customers. UPS customers can also access this information from the company’s Web site using their own computers or wireless devices.

Anyone with a package to ship can access the UPS Web site to track packages, check delivery routes, calculate shipping rates, determine time in transit, print labels, and schedule a pickup. The data collected at the UPS Web site are transmitted to the UPS central computer and then back to the customer after processing. UPS also provides tools that enable customers, such as Cisco Systems, to embed UPS functions, such as tracking and cost calculations, into their own Web sites so that they can track shipments without visiting the UPS site.

In June 2009, UPS launched a new Web-based Post-Sales Order Management System (OMS) that manages global service orders and inventory for critical parts fulfillment. The system enables high-tech electronics, aerospace, medical equipment, and other companies anywhere in the world that ship critical parts to quickly assess their critical parts inventory, determine the most optimal routing strategy to meet customer needs, place orders online, and track parts from the warehouse to the end user. An automated e-mail or fax feature keeps customers informed of each shipping milestone and can provide notification of any changes to flight schedules for commercial airlines carrying their parts. Once orders are complete, companies can print documents such as labels and bills of lading in multiple languages.

UPS is now leveraging its decades of expertise managing its own global delivery network to manage logistics and supply chain activities for other companies. It created a UPS Supply Chain Solutions division that provides a complete bundle of standardized services to subscribing companies at a fraction of what it would cost to build their own systems and infrastructure. These services include supply chain design and management, freight forwarding, customs brokerage, mail services, multimodal transportation, and financial services, in addition to logistics services.
Servalite, an East Moline, Illinois manufacturer of fasteners, sells 40,000 different products to hardware stores and larger home improvement stores. The company had used multiple warehouses to provide two-day delivery nationwide. UPS created a new logistics plan for the company that helped it reduce freight time in transit and consolidate inventory. Thanks to these improvements, Servalite has been able to keep its two-day delivery guarantee while lowering warehousing and inventory costs.


CASE STUDY QUESTIONS

1. What are the inputs, processing, and outputs of UPS’s package tracking system?
2. What technologies are used by UPS? How are these technologies related to UPS’s business model and business objectives?
3. What problems do UPS’s information systems solve? What would happen if these systems were not available?

MIS IN ACTION

Explore the UPS Web site (www.ups.com) and answer the following questions:

1. What kind of information and services does the Web site provide for individuals, small businesses, and large businesses? List these services.
2. Go to the Business Solutions portion of the UPS Web site. Browse the UPS Business Solutions by category (such as shipment delivery returns or international trade) and write a description of all the services UPS provides for one of these categories. Explain how a business would benefit from these services.
3. Explain how the Web site helps UPS achieve some or all of the strategic business objectives we described earlier in this chapter. What would be the impact on UPS’s business if this Web site were not available?

Using a handheld computer called a Delivery Information Acquisition Device (DIAD), UPS drivers automatically capture customers’ signatures along with pickup, delivery, and time card information. UPS information systems use these data to track packages while they are being transported.
mainframe computers, handheld computers, the Internet, and many different pieces of software for tracking packages, calculating fees, maintaining customer accounts, and managing logistics. As you read this case, try to identify the problem this company was facing, what alternative solutions were available to management, and how well the chosen solution worked.

Let’s identify the organization, people, and technology elements in the UPS package tracking system we have just described. The organization element anchors the package tracking system in UPS’s sales and production functions (the main product of UPS is a service—package delivery). It specifies the required procedures for identifying packages with both sender and recipient information, taking inventory, tracking the packages en route, and providing package status reports for UPS customers and customer service representatives.

The system must also provide information to satisfy the needs of managers and workers. UPS drivers need to be trained in both package pickup and delivery procedures and in how to use the package tracking system so that they can work efficiently and effectively. UPS customers may need some training to use UPS in-house package tracking software or the UPS Web site.

UPS’s management is responsible for monitoring service levels and costs and for promoting the company’s strategy of combining low cost and superior service. Management decided to use automation to increase the ease of sending a package using UPS and of checking its delivery status, thereby reducing delivery costs and increasing sales revenues.

The technology supporting this system consists of handheld computers, bar code scanners, wired and wireless communications networks, desktop computers, UPS’s central computer, storage technology for the package delivery data, UPS in-house package tracking software, and software to access the World Wide Web. The result is an information system solution to the business challenge of providing a high level of service with low prices in the face of mounting competition.

1.3 Understanding Information Systems: A Business Problem-Solving Approach

Our approach to understanding information systems is to consider information systems and technologies as solutions to a variety of business challenges and problems. We refer to this as a “problem-solving approach.” Businesses face many challenges and problems, and information systems are one major way of solving these problems. All of the cases in this book illustrate how a company used information systems to solve a specific problem.

The problem-solving approach has direct relevance to your future career. Your future employers will hire you because you are able to solve business problems and achieve business objectives. Your knowledge of how information systems contribute to problem solving will be very helpful to both you and your employers.

THE PROBLEM-SOLVING APPROACH

At first glance, problem solving in daily life seems to be perfectly straightforward: A machine breaks down, parts and oil spill all over the floor, and, obviously, somebody has to do something about it. So, of course, you find a tool around the shop and start repairing the machine. After a cleanup and proper inspection of other parts, you start the machine, and production resumes.

No doubt some problems in business are this straightforward. But few problems are this simple in the real world of business. In real-world business firms, a number of major factors are simultaneously involved in problems. These major factors can usefully be grouped into three categories: organization, technology, and people. In other words, a whole set of problems is usually involved.
A MODEL OF THE PROBLEM-SOLVING PROCESS

There is a simple model of problem solving that you can use to help you understand and solve business problems using information systems. You can think of business problem-solving as a four-step process (see Figure 1-4). Most problem solvers work through this model on their way to finding a solution. Let’s take a brief look at each step.

Problem Identification

The first step in the problem-solving process is to understand what kind of problem exists. Contrary to popular beliefs, problems are not like basketballs on a court simply waiting to be picked up by some “objective” problem solver. Before problems can be solved, there must be agreement in a business that a problem exists, about what the problem is, about what its causes are, and about what can be done about the problem given the limited resources of the organization. Problems have to be properly defined by people in an organization before they can be solved.

For instance, what at first glance what might seem like a problem with employees not adequately responding to customers in a timely and accurate manner might in reality be a result of a older, out-of-date information system for keeping track of customers. Or it might be a combination of both poor employee incentives for treating customers well and an outdated system. Once you understand this critical fact, you can start to solve problems creatively. Finding answers to these questions will require fact gathering, interviews with people involved in the problem, and analysis of documents.

In this text, we emphasize three different and typical dimensions of business problems: organizations, technology, and people (see Table 1.2). Typical organizational problems include poor business processes (usually inherited from the past), unsupportive culture, political in-fighting, and changes in the organization’s surrounding environment. Typical technology problems include insufficient or aging hardware, outdated software, inadequate database capacity, insufficient telecommunications capacity, and the incompatibility of old systems with new technology. Typical people problems include employee training, difficulties of evaluating performance, legal and regulatory compliance, ergonomics, poor or indecisive management, and employee support and participation. When you begin to
analyze a business problem, you will find these dimensions are helpful guides to understanding the kind of problem with which you are working.

**Solution Design**
The second step is to design solutions to the problem(s) you have identified. As it turns out, there are usually a great many “solutions” to any given problem, and the choice of solution often reflects the differing perspectives of people in an organization. You should try to consider as many different solutions as possible so that you can understand the range of possible solutions. Some solutions emphasize technology; others focus on change in the organization and people aspects of the problem. As you will find throughout the text, most successful solutions result from an integrated approach in which new technologies are accompanied by changes in organization and people.

**Solution Evaluation and Choice**
Choosing the “best” solution for your business firm is the next step in the process. Some of the factors to consider when trying to find the “best” single solution are the cost of the solution, the feasibility of the solution for your business given existing resources and skills, and the length of time required to build and implement the solution. Also very important at this point are the attitudes and support of your employees and managers. A solution that does not have the support of all the major interests in the business can quickly turn into a disaster.

**Implementation**
The best solution is one that can be implemented. Implementation of an information system solution involves building the solution and introducing it into the organization. This includes purchasing or building the software and hardware—the technology part of the equation. The software must be tested in a realistic business setting; then employees need to be trained, and documentation about how to use the new system needs to be written.
You will definitely need to think about change management. Change management refers to the many techniques used to bring about successful change in a business. Nearly all information systems require changes in the firm’s business processes and, therefore, changes in what hundreds or even thousands of employees do every day. You will have to design new, more efficient business processes, and then figure out how to encourage employees to adapt to these new ways of doing business. This may require meeting sessions to introduce the change to groups of employees, new training modules to bring employees quickly up to speed on the new information systems and processes, and finally some kind of rewards or incentives to encourage people to enthusiastically support the changes.

Implementation also includes the measurement of outcomes. After a solution has been implemented, it must be evaluated to determine how well it is working and whether any additional changes are required to meet the original objectives. This information is fed back to the problem solvers. In this way, the identification of the problem can change over time, solutions can be changed, and new choices made, all based on experience.

**Problem Solving: A Process, Not an Event**

It is often assumed that once a problem is “solved,” it goes away and can be forgotten about. And it is easy to fall into the trap of thinking about problem solving as an event that is “over” at some point, like a relay race or a baseball game. Often in the real world this does not happen. Sometimes the chosen solution does not work, and new solutions are required.

For instance, the U.S. National Aeronautics and Space Administration (NASA) spent more than $1 billion to fix a problem with shedding foam on the space shuttle. Experience proved the initial solution did not work. More often, the chosen solution partially works but needs a lot of continuous changes to truly “fit” the situation. Initial solutions are often rough approximations at first of what ultimately “works.” Sometimes, the nature of the problem changes in a way that makes the initial solution ineffective. For instance, hackers create new variations on computer viruses that require continually evolving antivirus programs to hold in check. For all these reasons, problem solving is a continuous process rather than a single event.

**THE ROLE OF CRITICAL THINKING IN PROBLEM SOLVING**

It is amazingly easy to accept someone else’s definition of a problem or to adopt the opinions of some authoritative group that has “objectively” analyzed the problem and offers quick solutions. You should try to resist this tendency to accept existing definitions of any problem. Through the natural flow of decision making, it is essential that you try to maintain some distance from any specific solution until you are sure you have properly identified the problem, developed understanding, and analyzed alternatives. Otherwise, you may leap off in the wrong direction, solve the wrong problem, and waste resources. You will have to engage in some critical-thinking exercises.

**Critical thinking** can be briefly defined as the sustained suspension of judgment with an awareness of multiple perspectives and alternatives. It involves at least four elements:

- Maintaining doubt and suspending judgment
- Being aware of different perspectives
- Testing alternatives and letting experience guide
- Being aware of organizational and personal limitations

Simply following a rote pattern of decision making, or a model, does not guarantee a correct solution. The best protection against incorrect results is to engage in critical thinking throughout the problem-solving process.

First, maintain doubt and suspend judgment. Perhaps the most frequent error in problem solving is to arrive prematurely at a judgment about the nature of the problem. By doubting all solutions at first and refusing to rush to a judgment, you create the necessary mental
conditions to take a fresh, creative look at problems, and you keep open the chance to make a creative contribution.

Second, recognize that all interesting business problems have many dimensions and that the same problem can be viewed from different perspectives. In this text, we have emphasized the usefulness of three perspectives on business problems: technology, organizations, and people. Within each of these very broad perspectives are many subperspectives, or views. The technology perspective, for instance, includes a consideration of all the components in the firm’s IT infrastructure and the way they work together. The organization perspective includes a consideration of a firm’s business processes, structure, culture, and politics. The people perspective includes consideration of the firm’s management, as well as employees as individuals and their interrelationships in workgroups.

You will have to decide for yourself which major perspectives are useful for viewing a given problem. The ultimate criterion here is usefulness: Does adopting a certain perspective tell you something more about the problem that is useful for solving the problem? If not, reject that perspective as being not meaningful in this situation and look for other perspectives.

The third element of critical thinking involves testing alternatives, or modeling solutions to problems, letting experience be the guide. Not all contingencies can be known in advance, and much can be learned through experience. Therefore, experiment, gather data, and reassess the problem periodically.

THE CONNECTION BETWEEN BUSINESS OBJECTIVES, PROBLEMS, AND SOLUTIONS

Now let’s make the connection between business information systems and the problem-solving approach. At the beginning of this chapter we talked about the six reasons business firms invest in information systems and technologies. We identified six business objectives of information systems: operational excellence; new products, services, and business models; customer/supplier intimacy; improved decision making; strategic advantage; and survival. When firms cannot achieve these objectives, they become “challenges” or “problems” that receive attention. Managers and employees who are aware of these challenges often turn to information systems as one of the solutions, or the entire solution.

Review the diagram at the beginning of this chapter. The diagram shows how the Yankees’ systems solved the business problem presented by declining interest in baseball games and competition from television and other media. These systems provide a solution that takes advantage of new interactive digital technology and opportunities created by the Internet. They opened up new channels for selling tickets and interacting with customers that improved business performance. The diagram also illustrates how people, technology, and organizational elements work together to create the systems.

Each chapter of this text begins with a diagram similar to this one to help you analyze the chapter-opening case. You can use this diagram as a starting point for analyzing any information system or information system problem you encounter.

1.4 Information Systems and Your Career

Looking out to 2016, the U.S. economy will create 15.6 million new jobs and 30 million existing jobs will open up as their occupants retire. More than 95 percent of the new jobs will be created in the service sector. The vast majority of these new jobs and replacement jobs will require a college degree to perform (Statistical Abstract, 2008; U.S. Bureau of Labor Statistics, 2009).
What this means is that U.S. business firms are looking for candidates who have a broad range of problem-solving skills—the ability to read, write, and present ideas—as well as the technical skills required for specific tasks. Regardless of your business school major, or your future occupation, information systems and technologies will play a major and expanding role in your day-to-day work and your career. Your career opportunities, and your compensation, will in part depend on your ability to help business firms use information systems to achieve their objectives.

HOW INFORMATION SYSTEMS WILL AFFECT BUSINESS CAREERS

In the following sections, we describe how specific occupations will be affected by information systems and what skills you should be building in order to benefit from this emerging labor market. Let’s look at the career opportunities for business school majors.

Accounting

There are about 1.8 million accountants in the U.S. labor force today, and the field is expected to expand by 18 percent by the year 2016, adding 300,000 new jobs, and a similar number of jobs to replace retirees. This above-average growth in accounting is in part driven by new accounting laws for public companies, greater scrutiny of public and private firms by government tax auditors, and a growing demand for management and operational advice.

Accountants can be broadly classified as public accountants, management accountants, government accountants, and internal auditors. Accountants provide a broad range of services to business firms including preparing, analyzing, and verifying financial documents; budget analysis; financial planning; information technology consulting; and limited legal services. A new specialty called “forensic accounting” investigates white-collar crimes, such as securities fraud and embezzlement, bankruptcies and contract disputes, and other possibly criminal financial transactions.

Accountants rely heavily on information systems to summarize transactions, create financial records, organize data, and perform financial analysis. As a result of new public laws, accountants are beginning to perform more technical duties, such as implementing, controlling, and auditing systems and networks, and developing technology plans and budgets.

What kinds of information system skills are really important for accounting majors given these changes in the accounting profession? Here is a short list:

- Knowledge of current and likely future changes in information technology, including hardware, software, and telecommunications, which will be used by public and private firms, government agencies, and financial advisors as they perform auditing and accounting functions. Accounting professionals also require knowledge of accounting and financial applications and design factors to ensure firms are able to maintain accounting records and perform auditing functions. An understanding of system and network security issues to protect the integrity of accounting systems is also essential.
- Because so many transactions are occurring over the Internet, accountants need to understand online transaction and reporting systems, and how systems are used to achieve management accounting functions in an online, wireless, and mobile business environment.

Finance

If you include financial analysts, stock analysts, insurance underwriters, and related financial service occupations, there are currently 2 million managers in finance. Financial managers develop financial reports, direct investment activities, and implement cash management strategies. There are about 1.1 million financial managers in the U.S. labor force and this occupation is expected to grow by about 20 percent by 2016, adding over 200,000 new jobs and replacing about 100,000 additional jobs.
Financial managers play important roles in planning, organizing, and implementing information system strategies for their firms. Financial managers work directly with a firm’s board of directors and senior management to ensure investments in information systems help achieve corporate goals and achieve high returns. The relationship between information systems and the practice of modern financial management and services is so strong that many advise finance majors to also co-major in information systems (and vice versa).

What kinds of information system skills should finance majors develop? Following is a brief list:

- An understanding of likely future changes in information technology, including hardware, software, and telecommunications, that will be used by financial managers and financial service firms. This includes an understanding of financial applications and design factors to ensure firms are able to manage their investments, cash, and risks along with new mobile and wireless applications to manage financial reporting. As new trading systems emerge, financial service firms and managers will need to understand how these systems work and how they will change their firm’s business.
- Knowledge of the new role played by enterprise-wide financial reporting systems on a global and national scale. As more and more transactions move online, finance majors need to understand online transaction reporting systems and management of online system investments.

Marketing

No field has undergone more technology-driven change in the past five years than marketing and advertising. The explosion in e-commerce activity described earlier means that eyeballs are moving rapidly to the Internet. As a result, Internet advertising is the fastest growing form of advertising, reaching $24 billion in 2009. Product branding and customer communication are moving online at a fast pace.

There are about 900,000 marketing, public relations, sales, and advertising managers in the U.S. labor force. This field is growing faster than average, and is expected to add more than 162,000 jobs by 2016 and replace an additional 100,000 employees who are retiring. There is a much larger group of 2.6 million nonmanagerial employees in marketing-related occupations (art, design, entertainment, sports, and media) and more than 15.9 million employees in sales. These occupations together are expected to create an additional 3.3 million jobs by 2016.

Here are some of the general information systems skills on which marketing majors should focus:

- An ability to understand Internet and marketing database systems, and how they impact traditional marketing activities, such as brand development, production promotion, and sales. This would include an understanding of design factors to ensure firms are able to market their products, develop reports on product performance, retrieve feedback from customers, and manage product development.
- An understanding of how enterprise wide-systems for product management, sales force management, and customer relationship management are used to develop products that consumers want, to manage the customer relationship, and to manage an increasingly mobile sales force.

Operations Management in Services and Manufacturing

The growing size and complexity of modern industrial production and the emergence of huge global service companies have created a growing demand for employees who can coordinate and optimize the resources required to produce goods and services. Operations management as a discipline is directly relevant to three occupational categories: industrial production managers, administrative service managers, and operations analysts.
Production managers, administrative service managers, and operations analysts will be employing information systems and technologies every day to accomplish their jobs, with extensive use of database and analytical software. Here are the general information systems skills on which operations management majors should focus:

- Knowledge of the changing hardware and software platforms that will be used in operations management. This would include an understanding of the role that databases, modeling tools, and business analytical software play in production and services management.
- An in-depth understanding of how enterprise-wide information systems for production management, supplier management, sales force management, and customer relationship management are used to achieve efficient operations and meet other firm objectives.

Management

Management is the largest single group in the U.S. business labor force with more than 15 million members, not including an additional 627,000 management consultants. Overall, the management corps in the United States is expected to expand faster than other occupational groups, adding about 3 million new jobs by 2016, with about 2 million openings in this period to replace retirements. There are more than 20 different types of managers tracked by the Bureau of Labor Statistics, all the way from chief executive officer, to human resource managers, production managers, project managers, lodging managers, medical managers, and community service managers.

The job of management has been transformed by information systems. Arguably, it would be impossible to manage business firms today, even very small firms, without the extensive use of information systems. Nearly all U.S. managers use information systems and technologies every day to accomplish their jobs, from desktop productivity tools to applications coordinating the entire enterprise. Here are the general information systems skills on which management majors should focus:

- Knowledge of new hardware and software that can make management more efficient and effective, enhance leadership and coordination capabilities, and improve the achievement of corporate business objectives in the broadest sense. This would include an understanding of the role that databases play in managing information resources of the firm, and the role of new communication and collaboration technologies, such as wikis, blogs, and wireless mobile computing.
• An in-depth understanding of how enterprise-wide information systems for production management, supplier management, sales force management, and customer relationship management are used to achieve efficient operations and help managers make better decisions for improving firm performance.

Information Systems
The information systems field is arguably one of the most fast-changing and dynamic of all the business professions because information technologies are among the most important tools for achieving business firms’ key objectives. The explosive growth of business information systems has generated a growing demand for information systems employees and managers who work with other business professionals to design and develop new hardware and software systems to serve the needs of business. Of the top 20 fastest growing occupations through 2016, five are information systems occupations.

There are about 467,000 information system managers in the United States, with an estimated growth rate of 36 percent through 2016, expanding the number of new jobs by more than 168,000 new positions, with an additional 80,000 new hires required for replacements. As businesses and government agencies increasingly rely on the Internet for communication and computing resources, system and network security management positions are growing very rapidly. The fastest growing U.S. occupational group is network systems and data communications analysts, with a projected growth rate of 50 percent.

Outsourcing and Offshoring
The Internet has created new opportunities for outsourcing many information systems jobs, along with many other service sector and manufacturing jobs. There are two kinds of outsourcing: outsourcing to domestic U.S. firms and offshore outsourcing to low-wage countries, such as India and eastern European countries. Even this distinction blurs as domestic service providers, such as IBM, develop global outsourcing centers in India.

The impact of domestic outsourcing on the overall demand for information technology employment through 2016 is most likely quite small. Service provider firms, such as Hewlett-Packard and Accenture, add domestic IT employees as they expand their domestic IT services, while domestic companies’ information systems departments lose some employees or do not hire new employees.

Offshore outsourcing to low-wage countries has been controversial because U.S. workers fear it will reduce demand for U.S. information systems employment. However, this fear is overblown given the huge demand for new information system hires in the United States through 2016. In fact, reducing the cost of providing information technology services to U.S. corporations by offshoring labor-intensive and lower-level jobs may increase the demand for U.S.-based information system workers as firms find the price of investing in information technology falls relative to other investments while its power to increase revenues and profits grows.

The most common and successful offshore outsourcing projects involve production programming and system maintenance programming work, along with call center work related to customer relationship management systems. However, the additional management costs incurred in outsourcing projects is leading to a counter movement of jobs back to the United States. Moreover, although technical IS jobs can be outsourced easily, all those management and organizational tasks required in systems development—including business process design, customer interface, and supply chain management—often remain in the United States. The net result is that offshore outsourcing will increase demand in the United States for managerial IS positions.

Given all these factors in the IT labor market, on what kinds of skills should information system majors focus? Following is a list of general skills we believe will optimize employment opportunities:

• An in-depth knowledge of how new and emerging hardware and software can be used by business firms to make them more efficient and effective, enhance customer and supplier intimacy, improve decision making, achieve competitive advantage, and ensure firm sur-
vival. This includes an in-depth understanding of databases, database design, implementation, and management.

- An ability to take a leadership role in the design and implementation of new information systems, work with other business professionals to ensure systems meet business objectives, and work with software packages providing new system solutions.

**INFORMATION SYSTEMS AND YOUR CAREER: WRAP-UP**

Looking back at the information system skills required for specific majors, there are some common themes that affect all business majors. Following is a list of these common requirements for information system skills and knowledge:

- All business students, regardless of major, should understand how information systems and technologies can help firms achieve business objectives such as achieving operational efficiency, developing new products and services, and maintaining customer intimacy.
- Perhaps the most dominant theme that pervades this review of necessary job skills is the central role of databases in a modern firm. Each of the careers we have just described relies heavily in practice on databases.
- With the pervasive growth in databases comes inevitably an exponential growth in digital information and a resulting challenge to managers trying to understand all this information. Regardless of major, business students need to develop skills in analysis of information and helping firms understand and make sense out of their environments.
- All business majors need to be able to work with specialists and system designers who build and implement information systems. This is necessary to ensure that the systems that are built actually service business purposes and provide the information and understanding required by managers and employees.
- Each of the business majors will be impacted by changes in the ethical, social, and legal environment of business. Business school students need to understand how information systems can be used to meet business requirements for reporting to government regulators and the public and how information systems impact the ethical issues in their fields.

**HOW THIS BOOK PREPARES YOU FOR THE FUTURE**

This book is explicitly designed to prepare you for your future business career. It provides you with the necessary knowledge and foundation concepts for understanding the role of information systems in business organizations. You will be able to use this knowledge to identify opportunities for increasing the effectiveness of your business. You will learn how to use information systems to improve operations, create new products and services, improve decision making, increase customer intimacy, and promote competitive advantage.

Equally important, this book develops your ability to use information systems to solve problems that you will encounter on the job. You will learn how to analyze and define a business problem and how to design an appropriate information system solution. You will deepen your critical-thinking and problem-solving skills. The following features of the text and the accompanying learning package reinforce this problem-solving and career orientation.

**A Framework for Describing and Analyzing Information Systems**

The text provides you with a framework for analyzing and solving problems by examining the people, organizational, and technology components of information systems. This framework is used repeatedly throughout the text to help you understand information systems in business and analyze information systems problems.

**A Four-Step Model for Problem Solving**

The text provides you with a four-step method for solving business problems, which we introduced in this chapter. You will learn how to identify a business problem, design alternative solutions, choose the correct solution, and implement the solution. You will be asked to
use this problem-solving method to solve the case studies in each chapter. Chapter 11 will show you how to use this approach to design and build new information systems.

**Hands-On MIS Projects for Stimulating Critical Thinking and Problem Solving**
Each chapter concludes with a series of hands-on MIS projects to sharpen your critical-thinking and problem-solving skills. These projects include two Management Decision Problems, hands-on application software problems, and projects for building Internet skills. For each of these projects, we identify both the business skills and the software skills required for the solution.

**Career Resources**
To make sure you know how the text is directly useful in your future business career, we’ve added a full set of Career Resources to help you with career development and job hunting.

**Digital Portfolio** MyMISLab includes a template for preparing a structured digital portfolio to demonstrate the business knowledge, application software skills, Internet skills, and analytical skills you have acquired in this course. You can include this portfolio in your resume or job applications. Your professors can also use the portfolio to assess the skills you have learned.

**Career Resources** A Career Resources section in MyMISLab shows you how to integrate what you have learned in this course in your resume, cover letter, and job interview to improve your chances for success in the job market.

### 1.5 Hands-On MIS Projects

The projects in this section give you hands-on experience in analyzing financial reporting and inventory management problems, using data management software to improve management decision making about increasing sales, and using Internet software for researching job requirements.

**MANAGEMENT DECISION PROBLEMS**

1. Snyders of Hanover, which sells about 80 million bags of pretzels, snack chips, and organic snack items each year, had its financial department use spreadsheets and manual processes for much of its data gathering and reporting. Hanover’s financial analyst would spend the entire final week of every month collecting spreadsheets from the heads of more than 50 departments worldwide. She would then consolidate and re-enter all the data into another spreadsheet, which would serve as the company’s monthly profit-and-loss statement. If a department needed to update its data after submitting the spreadsheet to the main office, the analyst had to return the original spreadsheet, then wait for the department to re-submit its data before finally submitting the updated data in the consolidated document. Assess the impact of this situation on business performance and management decision making.

2. Dollar General Corporation operates deep-discount stores offering housewares, cleaning supplies, clothing, health and beauty aids, and packaged food, with most items selling for $1. Its business model calls for keeping costs as low as possible. Although the company uses information systems (such as a point-of-sale system to track sales at the register), it deploys them very sparingly to keep expenditures to the minimum. The company has no automated method for keeping track of inventory at each store. Managers know approximately how many cases of a particular product the store is supposed to receive when a delivery truck arrives, but the stores lack technology for scanning the cases or verifying the item count inside the cases. Merchandise losses from theft or other mishaps have been rising and now represent over 3 percent of total sales. What decisions have to be made before investing in an information system solution?
IMPROVING DECISION MAKING: USING DATABASES TO ANALYZE SALES TRENDS

Software skills: Database querying and reporting
Business skills: Sales trend analysis

You can find out how information systems improve management decision making in this exercise. Rather than guessing or relying on estimates and experience, managers today rely on information stored in databases. In this project, you will start out with raw transactional sales data and use Microsoft Access database software to develop queries and reports that help managers make better decisions about product pricing, sales promotions, and inventory replenishment. A part of the database is shown in the following figure.

In MyMISLab, you can find a Store and Regional Sales Database developed in Microsoft Access. The database contains raw data on weekly store sales of computer equipment in various sales regions. You will use Access to manage the data and turn them into useful business information.

The database includes fields for store identification number, sales region, item number, item description, unit price, units sold, and the weekly sales period when the sales were made.

Develop some reports and queries to make this information more useful for running the business. Sales and production managers want answers to the following questions:

- Which products should be restocked?
- Which stores and sales regions would benefit from a promotional campaign and additional marketing?
- When (what time of year) should products be offered at full price, and when should discounts be used?

You can easily modify the database table to find and report your answers. Print your reports and results of queries.

IMPROVING DECISION MAKING: USING THE INTERNET TO LOCATE JOBS REQUIRING INFORMATION SYSTEMS KNOWLEDGE

Software skills: Internet-based software
Business skills: Job searching

Visit job-posting Web sites such as Monster.com or hotjobs.com. Spend some time at the sites examining jobs for accounting, finance, sales, marketing, and human resources. Find two or three descriptions of jobs that require some information systems knowledge. What information systems knowledge do these jobs require? What do you need to do to prepare for these jobs? Write a one- to two-page report summarizing your findings.
Review Summary

1 How are information systems transforming business, and what is their relationship to globalization? E-mail, online conferencing, and cell phones have become essential tools for conducting business. Information systems are the foundation of fast-paced supply chains. The Internet allows businesses to buy, sell, advertise, and solicit customer feedback online. The Internet has stimulated globalization by dramatically reducing the costs of producing, buying, and selling goods on a global scale.

2 Why are information systems so essential for running and managing a business today? Information systems are a foundation for conducting business today. In many industries, survival and even existence is difficult without extensive use of information technology. Businesses use information systems to achieve six major objectives: operational excellence; new products, services, and business models; customer/supplier intimacy; improved decision making; competitive advantage; and day-to-day survival.

3 What exactly is an information system? How does it work? What are its people, organization, and technology components? From a technical perspective, an information system collects, stores, and disseminates information from an organization’s environment and internal operations to support organizational functions and decision making, communication, coordination, control, analysis, and visualization. Information systems transform raw data into useful information through three basic activities: input, processing, and output. From a business perspective, an information system provides a solution to a problem or challenge facing a firm and represents a combination of people, organization, and technology elements.

   The people dimension of information systems involves issues such as training, job attitudes, and management behavior. The technology dimension consists of computer hardware, software, data management technology, and networking/telecommunications technology, including the Internet. The organization dimension of information systems involves issues such as the organization’s hierarchy, functional specialties, business processes, culture, and political interest groups.

4 How will a four-step method for business problem solving help you solve information system-related problems? Problem identification involves understanding what kind of problem is being presented, and identifying people, organizational, and technology factors. Solution design involves designing several alternative solutions to the problem that has been identified. Evaluation and choice entails selecting the best solution, taking into account its cost and the available resources and skills in the business. Implementation of an
information system solution entails purchasing or building hardware and software, testing the software, providing employees with training and documentation, managing change as the system is introduced into the organization, and measuring the outcome. Problem solving requires critical thinking in which one suspends judgment to consider multiple perspectives and alternatives.

5. **How will information systems affect business careers, and what information system skills and knowledge are essential?** Business careers in accounting, finance, marketing, operations management, management and human resources, and information systems all will need an understanding of how information systems help firms achieve major business objectives; an appreciation of the central role of databases; skills in information analysis and business intelligence; sensitivity to the ethical, social, and legal issues raised by systems; and the ability to work with technology specialists and other business professionals in designing and building systems.

### Key Terms

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### Review Questions

1. **How are information systems transforming business, and what is their relationship to globalization?**
   - Describe how information systems have changed the way businesses operate and their products and services.
   - Describe the challenges and opportunities of globalization in a “flattened” world.

2. **Why are information systems so essential for running and managing a business today?**
   - List and describe the six reasons why information systems are so important for business today.

3. **What exactly is an information system? How does it work? What are its people, organization, and technology components?**
   - List and describe the organizational, people, and technology dimensions of information systems.
   - Define an information system and describe the activities it performs.
   - Distinguish between data and information and between information systems literacy and computer literacy.
   - Explain how the Internet and the World Wide Web are related to the other technology components of information systems.
4. How will a four-step method for business problem solving help you solve information system-related problems?
   • List and describe each of the four steps for solving business problems.
   • Give some examples of people, organizational, and technology problems found in businesses.
   • Describe the relationship of critical thinking to problem solving.
   • Describe the role of information systems in business problem solving.

5. How will information systems affect business careers, and what information system skills and knowledge are essential?
   • Describe the role of information systems in careers in accounting, finance, marketing, management, and operations management, and explain how careers in information systems have been affected by new technologies and outsourcing.
   • List and describe the information system skills and knowledge that are essential for all business careers.

Discussion Questions

1. What are the implications of globalization when you have to look for a job? What can you do to prepare yourself for competing in a globalized business environment? How would knowledge of information systems help you compete?

2. If you were setting up the Web site for another Major League Baseball team, what people, organization, and technology issues might you encounter?

Collaborating and Teamwork

Creating a Web Site for Team Collaboration

Form a team with three or four classmates. Then use the tools at Google Sites to create a Web site for your team. You will need to create a Google account for the site and specify the collaborators (your team members) who are allowed to access the site and make contributions. Specify your professor as the viewer of the site so that person can evaluate your work. Assign a name to the site. Select a theme for the site and make any changes you wish to colors and fonts. Add features for project announcements and a repository for team documents, source materials, illustrations, electronic presentations, and Web pages of interest. You can add other features if you wish. Use Google to create a calendar for your team. After you complete this exercise, you can use this Web site and calendar for your other team projects.

Video Cases

Video Cases and Instructional Videos illustrating some of the concepts in this chapter are available. Contact your instructor to access these videos.
BUSINESS PROBLEM-SOLVING CASE

What’s the Buzz on Smart Grids?

The existing electricity infrastructure in the United States is outdated and inefficient. Energy companies provide power to consumers, but the grid provides no information about how the consumers are using that energy, making it difficult to develop more efficient approaches to distribution. Also, the current electricity grid offers few ways to handle power provided by alternative energy sources, which are critical components of most efforts to go “green”. Enter the smart grid.

A smart grid delivers electricity from suppliers to consumers using digital technology to save energy, reduce cost, and increase reliability and transparency. The smart grid enables information to flow back and forth between electric power providers and consumers to allow both consumers and energy companies to make more intelligent decisions regarding energy consumption and production. Information from smart grids would show utilities when to raise prices when demand is high and lower them when demand lessens. Smart grids would also help consumers program high-use electrical appliances like heating and air conditioning systems to reduce consumption during times of peak usage. If implemented nationwide, proponents believe, smart grids would lead to a 5 to 15 percent decrease in energy consumption.

Managing the information flowing in these smart grids requires technology: networks and switches for power management, sensor and monitoring devices to track energy usage and distribution trends, systems to provide energy suppliers and consumers with usage data, communications systems to relay data along the entire energy supply system, and systems linked to programmable appliances to run them when energy is least costly.

If consumers had in-home displays showing how much energy they are consuming at any moment and the price of that energy, they are more likely to curb their consumption to cut costs. Home thermostats and appliances could adjust on their own automatically, depending on the cost of power, and even obtain that power from nontraditional sources, such as a neighbor’s rooftop solar panel. Instead of power flowing from a small number of power plants, the smart grid will make it possible to have a distributed energy system. Electricity will flow from homes and businesses into the grid, and they will use power from local and faraway sources. Besides increasing energy efficiency, converting to smart grids along with other related energy initiatives could create up to 370,000 jobs.

That’s why pioneering smart grid projects such as SmartGridCity in Boulder, Colorado, are attracting attention. SmartGridCity represents a collaboration by Xcel Energy Inc. and residents of Boulder to test the viability of smart grids on a smaller scale. Participants can check their power consumption levels and costs online, and will soon be able to program home appliances over the Web. Customers access this information and set goals and guidelines for their home’s energy usage through a Web portal.

SmartGridCity is also attempting to turn homes into “miniature power plants” using solar-powered battery packs that “TiVo electricity”, or stash it away to use at a later time. This serves as backup power for homes using the packs, but Xcel can also tap into that power during times of peak energy consumption to lessen the overall energy load. Xcel will be able to remotely adjust thermostats and water heaters and will have much better information about the power consumption of their consumers.

Bud Peterson, chancellor of the University of Colorado at Boulder, and his wife Val have worked with Xcel to turn their home into the prototype residence for the SmartGridCity project. Their house was supplied with a six-kilowatt photovoltaic system on two roofs, four thermostats controlled via the Web, a plug-in hybrid electric vehicle (PHEV) Ford Escape, and other high-tech, smart grid-compatible features. Xcel employees are able to monitor periods of high power consumption and how much energy the Escape is using on the road.

A digital dashboard in the Peterson’s house displays power usage information in dozens of different ways—live household consumption and production, stored backup power, carbon emission reductions translated into gallons of gasoline, and acres of trees saved each year. The dashboard also allows the Petasons to program their home thermostats to adjust the temperature by room, time of day, and season. Since the project began in the spring of 2008, the Petasons have been able to reduce their electricity use by one-third.

Xcel is not alone. Hundreds of technology companies and almost every major electric utility company see smart grids as the wave of the future. Heightening interest is $4.5 billion in federal economic recovery money for smart grid technology. Duke Energy spent $35 million on smart grid initiatives even before the economic stimulus plan was announced. It installed 80,000 smart meters as part of a
pilot project in Charlotte, North Carolina, to provide business and residential customers with up-to-the-minute information on their energy use, as well as data on how much their appliances cost to operate. This helps them save money by curbing usage during peak times when rates are high or by replacing inefficient appliances. Duke now plans to spend $1 billion on sensors, intelligent meters, and other upgrades for a smart grid serving 700,000 customers in Cincinnati.

Florida Power and Light is budgeting $200 million for smart meters covering one million homes and businesses in the Miami area over the next two years. Center Point Energy, which services 2.2 million customers in the metropolitan Houston area, is planning to spend $1 billion over the next five years on a smart grid. Although residential customers will be charged an extra $3.24 per month, the company says this amount will be more than offset by energy savings.

Google has developed a free Web service called PowerMeter for tracking energy use in houses or businesses as power is consumed. It expects other companies to build the devices that will supply data to PowerMeter.

Wireless phone companies are also salivating over the opportunity to provide wireless communication links with the two-way meters being installed as part of the fledgling smart grids being developed in California, Texas, and sites like Boulder. AT&T, T-Mobile, Sprint Nextel, and Verizon Wireless are competing to team with utilities in providing a wireless communication link between their networks and smart meters. Users will be able to wirelessly receive alerts about outages, manage their service remotely, and sign up for a variety of rate plans.

There are a number of challenges facing the efforts to implement smart grids. Changing the infrastructure of our electricity grids is a daunting task. Two-way meters that allow information to flow both to and from homes need to be installed at any home or building that uses electric power—in other words, essentially everywhere. Some SmartGridCity participants reported that the dashboard they used to manage their appliances was too confusing and high-tech. Even Val Peterson admitted that at first, managing the information about her power usage supplied through the Xcel Web portal was an intimidating process.

The smart grid won’t be cheap, with estimated costs running as high as $75 billion. Meters run $250 to $500 each when they are accompanied by new utility billing systems. Who is going to pay the bill? Is the average consumer willing to pay the upfront costs for a smart grid system and then respond appropriately to price signals? Will consumers get the promised payback if they buy into smart grid technology? Might “smart meters” be too intrusive? Would a highly computerized grid increase the risk of cyberattacks?

Jack Oliphant, a retiree living north of Houston in Spring, Texas, believes that the $444 he will pay Center Point for a smart meter won’t justify the expense. “There’s no mystery about how you save energy,” he says. “You turn down the air conditioner and shut off some lights. I don’t need an expensive meter to do that.” Others have pointed out other less-expensive methods of energy consumption. Marcel Hawiger, an attorney for The Utility Reform Network, a San Francisco consumer advocacy group, favors expanding existing air conditioner-cycling programs, where utilities are able to control air conditioners so they take turns coming on and off, thereby reducing demands on the electric system. He believes air conditioner controllers, which control temperature settings and compressors to reduce overall energy costs, provide much of the benefit of smart meters at a fraction of their cost.

Consumer advocates have vowed to fight smart grids if they boost rates for customers who are unable or unwilling to use Web portals and allow energy companies to control aspects of their appliances. Advocates also argue that smart grids represent an Orwellian intrusion of people’s right to use their appliances as they see fit without disclosing facts about their usage to others. A proposal by officials in California to require all new homes to have remotely adjustable thermostats was soundly defeated after critics worried about the privacy implications.

Energy companies stand to lose money as individuals conserve more electricity, creating a disincentive for them to cooperate with conservation efforts like smart grids. And, last but not least, in the short term, smart grid technologies will be expensive to implement. Patience will be critical as energy companies and local communities work to set up new technologies and pricing plans.


Case Study Questions

1. How do smart grids differ from the current electricity infrastructure in the United States?

2. What people, organization, and technology issues should be considered when developing a smart grid?

3. What challenge to the development of smart grids do you think is most likely to hamper their development?

4. What other areas of our infrastructure could benefit from “smart” technologies? Describe one example not listed in the case.

5. Would you like your home and your community to be part of a smart grid? Why or why not? Explain.