Chapter 1

Information Systems in Global Business Today

LEARNING OBJECTIVES

After reading 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 management, organization, and technology components?
4. What are complementary assets? Why are complementary assets essential for ensuring that information systems provide genuine value for an organization?
5. What academic disciplines are used to study information systems? How does each contribute to an understanding of information systems? What is a sociotechnical systems perspective?

Interactive Sessions:

MIS in Your Pocket

UPS Competes Globally with Information Technology

CHAPTER OUTLINE

1.1 *THE ROLE OF INFORMATION SYSTEMS IN BUSINESS TODAY*
How Information Systems Are Transforming Business
What's New in Management Information Systems?
Globalization Challenges and Opportunities: A Flattened World
The Emerging Digital Firm
Strategic Business Objectives of Information Systems

1.2 *PERSPECTIVES ON INFORMATION SYSTEMS*
What Is an Information System?
Dimensions of Information Systems
It Isn't Just Technology: A Business Perspective on Information Systems
Complementary Assets: Organizational Capital and the Right Business Model

1.3 *CONTEMPORARY APPROACHES TO INFORMATION SYSTEMS*
Technical Approach
Behavioral Approach
Approach of This Text: Sociotechnical Systems

1.4 *HANDS-ON MIS PROJECTS*
Management Decision Problems
Improving Decision Making: Using Databases to Analyze Sales Trends
Improving Decision Making: Using the Internet to Locate Jobs Requiring Information Systems Knowledge

LEARNING TRACKS MODULES
How Much Does IT Matter?
Information Systems and Your Career
The Emerging Mobile Digital Platform

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 the 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 division, "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, 1,200 flat-panel high-definition HDTV 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 101 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 player 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. Inside the stadium, fans in each seat will be able to use their mobile phones to order from the concessions or view instant replays. If they have an iPhone, an application called Venuing lets them communicate with other fans at the game, find nearby facilities, obtain reviews of concessions, play pub-style trivia games, and check for news updates.

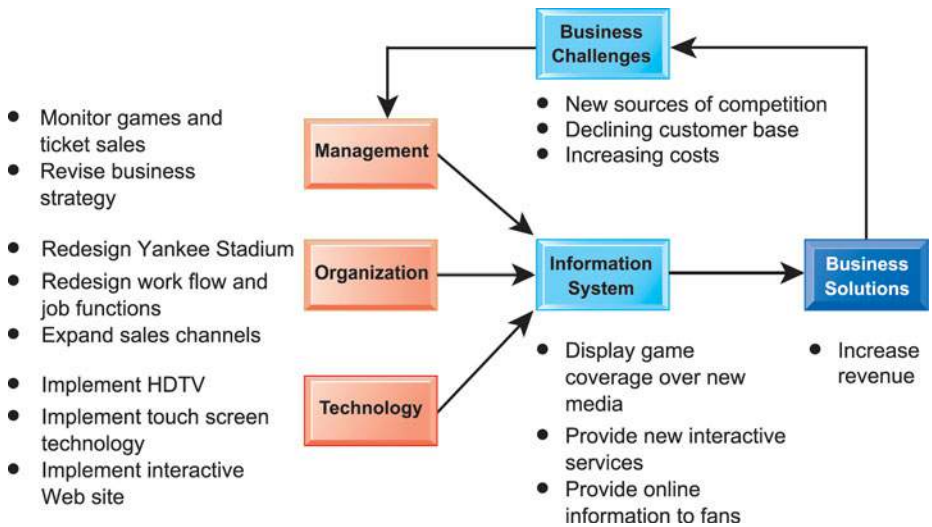
The Yankees also have their own Web site, Yankees.com, where fans can watch in-market Yankees games live online, check game scores, find out more about their favorite players, purchase tickets to games, and shop for caps, baseball cards and memorabilia. The site also features fantasy baseball games,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

Sources: www.mlb.com, accessed May 5, 2010; Rena Bhattacharyya, Courtney Munroe, and Melanie Posey, "Yankee Stadium Implements State-of-the-Art Technology from AT&T," www.forbescustom.com, April 13, 2010; "Venuing: An iPhone App Tailor-Made for Yankee Stadium Insiders," NYY Stadium Insider, March 30, 2010; Dean Meminger, "Yankees' New Stadium Is More than a Ballpark," NY1.com, April 2, 2009.

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-density 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; mobile social networking applications; 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

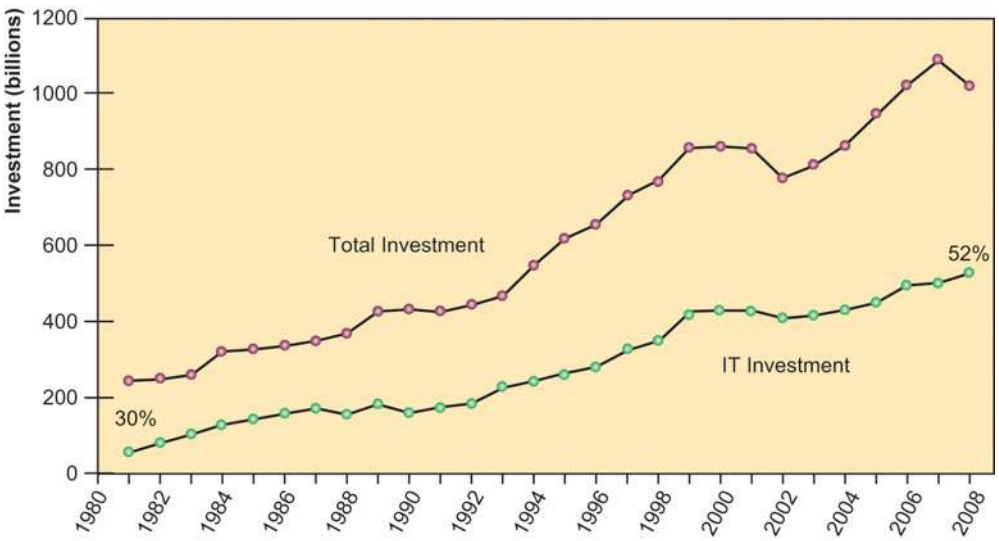
It's not business as usual in America anymore, or the rest of the global economy. In 2010, American businesses will spend over $562 billion on information systems hardware, software, and telecommunications equipment. In addition, they will spend another $800 billion on business and management consulting and services—much of which involves redesigning firms' business operations to take advantage of these new technologies. Figure 1-1 shows that between 1980 and 2009, private business investment in information technology consisting of hardware, software, and communications equipment grew from 32 percent to 52 percent of all invested capital.

As managers, most of you will work for firms that are intensively using information systems and making large investments in information technology. You will certainly want to know how to invest this money wisely. If you make wise choices, your firm can outperform competitors. If you make poor choices, you will be wasting valuable capital. This book is dedicated to helping you make wise decisions about information technology and information systems.

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 2009 than telephone land lines installed. Cell phones, BlackBerrys, iPhones, e-mail, and online conferencing over the Internet have all become essential tools of business. Eighty-nine million people in the United States access the Internet using mobile devices in 2010, nearly half the total

FIGURE 1-1 INFORMATION TECHNOLOGY CAPITAL INVESTMENT



Information technology capital investment, defined as hardware, software, and communications equipment, grew from 32 percent to 52 percent of all invested capital between 1980 and 2009.

Source: Based on data in U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*, 2009.

Internet user population (eMarketer, 2010). There are 285 million cell phone subscribers in the United States, and nearly 5 billion worldwide (Dataxis, 2010).

By June 2010, more than 99 million businesses worldwide had dot-com Internet sites registered (Verisign, 2010). Today, 162 million Americans shop online, and 133 million have purchased online. Every day about 41 million Americans go online to research a product or service.

In 2009, FedEx moved over 3.4 million packages daily in the United States, mostly overnight, and the United Parcel Service (UPS) moved over 15 million packages daily worldwide. 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 just-in-time inventory to reduce their overhead costs and get to market faster.

As newspaper readership continues to decline, more than 78 million people receive their news online. About 39 million people watch a video online everyday, 66 million read a blog, and 16 million post to blogs, creating an explosion of new writers and new forms of customer feedback that did not exist five years ago (Pew, 2010). Social networking site Facebook attracted 134 million monthly visitors in 2010 in the United States, and over 500 million worldwide. Businesses are starting to use social networking tools to connect their employees, customers, and managers worldwide. Many Fortune 500 companies now have Facebook pages.

Despite the recession, e-commerce and Internet advertising continue to expand. Google's online ad revenues surpassed $25 billion in 2009, and Internet advertising continues to grow at more than 10 percent a year, reaching more than $25 billion in revenues in 2010.

New federal security and accounting laws, requiring 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, are spurring the growth of digital information at the estimated rate of 5 exabytes annually, equivalent to 37,000 new Libraries of Congress.

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 who 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, iPads, BlackBerrys, and 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

TABLE 1-1 WHAT'S NEW IN MIS

CHANGE	BUSINESS IMPACT
TECHNOLOGY	
Cloud computing platform emerges as a major business area of innovation	A flexible collection of computers on the Internet begins to perform tasks traditionally performed on corporate computers.
Growth in software as a service (SaaS)	Major business applications are now delivered online as an Internet service rather than as boxed software or custom systems.
A mobile digital platform emerges to compete with the PC as a business system	Apple opens its iPhone software to developers, and then opens an Applications Store on iTunes where business users can download hundreds of applications to support collaboration, location-based services, and communication with colleagues. Small portable lightweight, low-cost, net-centric subnotebook computers are a major segment of the laptop marketplace. The iPad is the first successful tablet-sized computing device with tools for both entertainment and business productivity.
MANAGEMENT	
Managers adopt online collaboration and social networking software to improve coordination, collaboration, and knowledge sharing	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.
Business intelligence applications accelerate	More powerful data analytics and interactive dashboards provide real-time performance information to managers to enhance decision making.
Virtual meetings proliferate	Managers adopt telepresence video conferencing and Web conferencing technologies to reduce travel time, and cost, while improving collaboration and decision making.
ORGANIZATIONS	
Web 2.0 applications are widely adopted by firms	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.
Telework gains momentum in the workplace	The Internet, netbooks, iPads, iPhones, and BlackBerrys make it possible for growing numbers of people to work away from the traditional office; 55 percent of U.S. businesses have some form of remote work program.
Co-creation of business value	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 are more global and collaborative than in the past; customers help firms define new products and services.

work, communicate with employees, and provide information for decision making. We call these developments the "emerging mobile digital 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 allow organizations to 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.

You can see some of these trends at work in the Interactive Session on Management. 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.

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 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 world-wide phenomenon energized by expansion of trade among nations.

In 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. Friedman argued that the 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 both challenges and opportunities for business firms

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 2010, more than 33 percent of the U.S. economy resulted from foreign trade, both imports and exports. In Europe and Asia, the number exceeded 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 2010 came from overseas sales of its microprocessors. Eighty percent of the toys sold in the U.S. 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 and declining). 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.

INTERACTIVE SESSION: MANAGEMENT

MIS IN YOUR POCKET

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 salesforce 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 an application called ChainLinq Mobile for its 30 drivers that updates shipment information, collects signatures, and provides global positioning system (GPS) tracking on each 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- 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.

TCHO is a start-up that uses custom-developed machinery to create unique chocolate flavors. Owner Timothy Childs developed an iPhone app that enables him to remotely log into each chocolate-making machine, control time and temperature, turn the machines on and off, and receive alerts about when to make temperature changes. The iPhone app also enables him to remotely view several video cameras that show how the TCHO

FlavorLab is doing. TCHO employees also use the iPhone to exchange photos, e-mail, and text messages.

The Apple iPad is also emerging as a business tool for Web-based note-taking, file sharing, word processing, and number-crunching. Hundreds of business productivity applications are being developed, including tools for Web conferencing, word processing, spreadsheets, and electronic presentations. Properly configured, the iPad is able to connect to corporate networks to obtain e-mail messages, calendar events, and contacts securely over the air.

Sources: "Apple iPhone in Business Profiles, www.apple.com, accessed May 10, 2010; Steve Lohr, Cisco Cheng, "The Ipad Has Business Potential," *PC World*, April 26, 2010; and "Smartphone Rises Fast from Gadget to Necessity," *The New York Times*, June 10, 2009.

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, iPads, 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 site for the Apple iPhone, the Apple iPad, the BlackBerry, and the Motorola Droid, 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.

iPhone and iPad Applications Used in Business:

1. Salesforce.com
2. FedEx Mobile
3. iTimeSheet
4. QuickOffice Connect
5. Documents to Go
6. GoodReader
7. Evernote
8. WebEx

Whether it's attending an online meeting, checking orders, working with files and documents, or obtaining business intelligence, Apple's iPhone and iPad offer unlimited possibilities for business users. Both devices have stunning multitouch display, full Internet browsing, capabilities for messaging, video and audio transmission, and document management. These features make each an all-purpose platform for mobile computing.

On the plus side, in a normal, non-recessionary year, the U.S. economy creates over 3.5 million new jobs. Employment in information systems and the other service occupations is expanding, and wages are stable. Outsourcing has actually accelerated the development of new systems in the United States and worldwide.

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 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 does 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 Rapid 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. Half of the revenue of eBay (as well as General Motors) in 2011 will originate outside the United States. Briefly, information systems enable globalization.

THE EMERGING DIGITAL FIRM

All of the changes we have just described, coupled with equally significant organizational redesign, have created the conditions for a fully digital firm. A digital firm can be defined along several dimensions. A **digital firm** is one in which nearly all of the organization's *significant business relationships* with customers, suppliers, and employees are digitally enabled and mediated. *Core business processes* are accomplished through digital networks spanning the entire organization or linking multiple organizations.

Business processes refer to the set of logically related tasks and behaviors that organizations develop over time to produce specific business results and the unique manner in which these activities are organized and coordinated. Developing a new product, generating and fulfilling an order, creating a marketing plan, and hiring an employee are examples of business processes, and the ways organizations accomplish their business processes can be a source of competitive strength. (A detailed discussion of business processes can be found in Chapter 2.)

Key corporate assets—intellectual property, core competencies, and financial and human assets—are managed through digital means. In a digital firm, any piece of information required to support key business decisions is available at any time and anywhere in the firm.

Digital firms sense and respond to their environments far more rapidly than traditional firms, giving them more flexibility to survive in turbulent times. Digital firms offer extraordinary opportunities for more flexible global organization and management. In digital firms, both time shifting and space shifting are

the norm. *Time shifting* refers to business being conducted continuously, 24/7, rather than in narrow "work day" time bands of 9 A.M. to 5 P.M. *Space shifting* means that work takes place in a global workshop, as well as within national boundaries. Work is accomplished physically wherever in the world it is best accomplished.

Many firms, such as Cisco Systems. 3M, and IBM, are close to becoming digital firms, using the Internet to drive every aspect of their business. Most other companies are not fully digital, but they are moving toward close digital integration with suppliers, customers, and employees. Many firms, for example, are replacing traditional face-to-face meetings with "virtual" meetings using videoconferencing and Web conferencing technology. (See Chapter 2.)

STRATEGIC BUSINESS OBJECTIVES OF INFORMATION SYSTEMS

What makes information systems so essential today? Why are businesses investing so much in information systems and technologies? In the United States, more than 23 million managers and 113 million workers in the labor force rely on information systems to conduct business. Information systems are essential for conducting day-to-day business in the United States and most other advanced countries, as well as achieving strategic business objectives.

Entire sectors of the economy are nearly inconceivable without substantial investments in information systems. E-commerce firms such as Amazon, eBay, Google, and E*Trade simply would not exist. Today's service industries—finance, insurance, and real estate, as well as personal services such as travel, medicine, and education—could not operate without information systems. Similarly, retail firms such as Walmart and Sears and manufacturing firms such as General Motors and General Electric require information systems to survive and prosper. Just as offices, telephones, filing cabinets, and efficient tall buildings with elevators were once the foundations of business in the twentieth century, information technology is a foundation for business in the twenty-first century.

There is a growing interdependence between a firm's ability to use information technology and its ability to implement corporate strategies and achieve corporate goals (see Figure 1-2). What a business would like to do in five years often depends on what its systems will be able to do. Increasing market share, becoming the high-quality or low-cost producer, developing new products, and increasing employee productivity depend more and more on the kinds and quality of information systems in the organization. The more you understand about this relationship, the more valuable you will be as a manager.

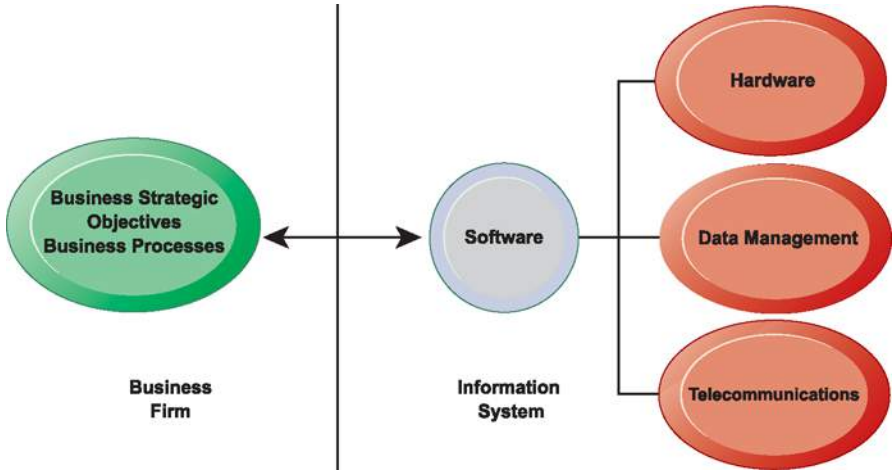
Specifically, business firms invest heavily in information systems to achieve six strategic business objectives: operational excellence; new products, services, and business models; customer and supplier intimacy; improved decision making; competitive advantage; and survival.

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.

Walmart, the largest retailer on earth, exemplifies the power of information systems coupled with brilliant business practices and supportive management

FIGURE 1-2 THE INTERDEPENDENCE BETWEEN ORGANIZATIONS AND INFORMATION SYSTEMS



In contemporary systems there is a growing interdependence between a firm's information systems and its business capabilities. Changes in strategy, rules, and business processes increasingly require changes in hardware, software, databases, and telecommunications. Often, what the organization would like to do depends on what its systems will permit it to do.

to achieve world-class operational efficiency. In fiscal year 2010, Walmart achieved $408 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 Walmart's stores. As soon as a customer purchases an item, the supplier monitoring the item knows to ship a replacement to the shelf. Walmart 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 a decade ago. 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 iPod innovations, including the iPod, the iTunes music service, the iPad, and the iPhone.

Customer and Supplier Intimacy

When a business really knows its customers, and serves them well, 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 large 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 the TAL Apparel Ltd. supplier, a 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 then decides how many replacement shirts to make, and in what styles, colors, and sizes. TAL then sends the shirts to each JCPenney store, bypassing completely the retailer's warehouses. In other words, JCPenney's 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 decade, 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 telecommunication 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. Apple Inc., Walmart, and UPS, described later in this chapter, are industry leaders because they know how to use information systems for this purpose.

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.

There are many federal and state statutes and regulations that 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 certified public accounting firms that audit public companies to retain audit working papers and records, including all e-mails, for five years. Many other pieces of federal and state legislation in health care, financial services, education, and privacy protection impose significant information retention and reporting requirements on U.S. businesses. Firms turn to information systems and technologies to provide the capability to respond to these challenges.

1.2 Perspectives on Information Systems

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, storage devices, and handheld mobile 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.

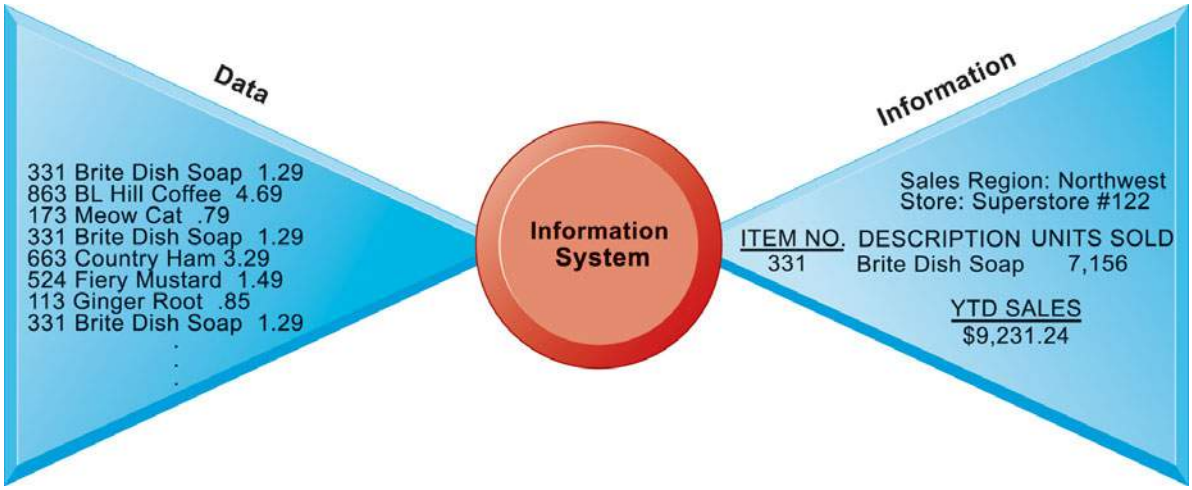
WHAT IS AN INFORMATION SYSTEM?

An **information system** can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization. In addition to supporting decision making, coordination, and control, 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 from bar codes, which describe each 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 1-3).

FIGURE 1-3 DATA AND INFORMATION



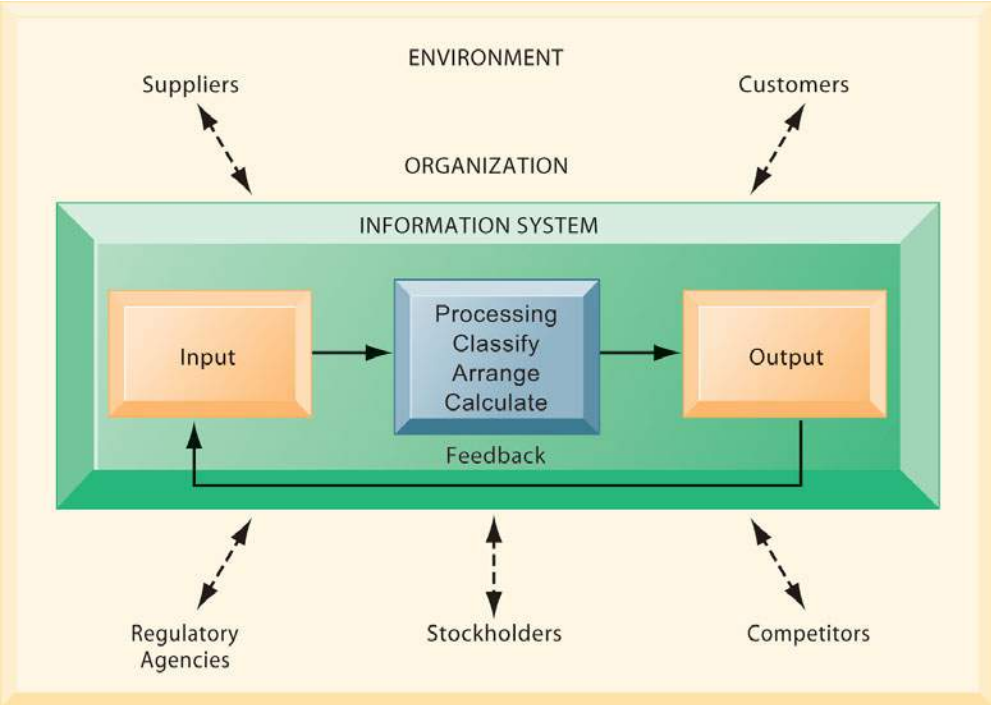
Raw data from a supermarket checkout counter can be processed and organized to produce meaningful information, such as the total unit sales of dish detergent or the total sales revenue from dish detergent for a specific store or sales territory.

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 1-4). **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 out, 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 on the one hand, and an information system on the other. 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.

FIGURE 1-4 FUNCTIONS OF AN INFORMATION SYSTEM



An information system contains information about an organization and its surrounding environment. Three basic activities—input, processing, and output—produce the information organizations need. Feedback is output returned to appropriate people or activities in the organization to evaluate and refine the input. Environmental actors, such as customers, suppliers, competitors, stockholders, and regulatory agencies, interact with the organization and its information systems.

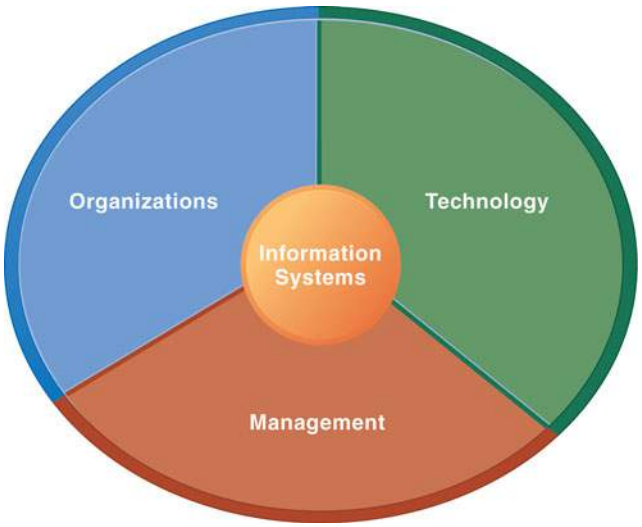
A house is an appropriate analogy. Houses are built with hammers, nails, and wood, but these do not make a house. The architecture, design, setting, landscaping, and all of the decisions that lead to the creation of these features are part of the house and are crucial for solving the problem of putting a roof over one's head. Computers and programs are the hammers, 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.

DIMENSIONS OF INFORMATION SYSTEMS

To fully understand information systems, you must understand the broader organization, management, and information technology dimensions of systems (see Figure 1-5) 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 management and organizational dimensions of systems as well as the technical dimensions of systems, as **information systems literacy**. **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

FIGURE 1-5 INFORMATION SYSTEMS ARE MORE THAN COMPUTERS



Using information systems effectively requires an understanding of the organization, management, and information technology shaping the systems. An information system creates value for the firm as an organizational and management solution to challenges posed by the environment.

as technical issues surrounding the development, use, and impact of information systems used by managers and employees in the firm.

Let's examine each of the dimensions of information systems—organizations, management, and information technology.

Organizations

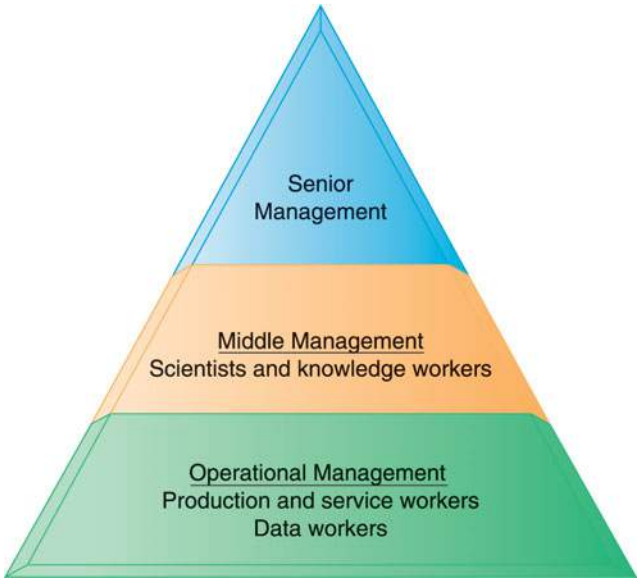
Information systems are an integral part of organizations. Indeed, for some companies, such as credit reporting firms, there would be no business without an information system. The key elements of an organization are its people, structure, business processes, politics, and culture. We introduce these components of organizations here and describe them in greater detail in Chapters 2 and 3.

Organizations have a structure that is composed of different levels and specialties. Their structures reveal a clear-cut division of labor. Authority and responsibility in a business firm are organized as a hierarchy, or a pyramid structure. The upper levels of the hierarchy consist of managerial, professional, and technical employees, whereas the lower levels consist of operational personnel.

Senior management makes long-range strategic decisions about products and services as well as ensures financial performance of the firm. **Middle management** carries out the programs and plans of senior management and **operational management** is responsible for monitoring the daily activities of the business. **Knowledge workers**, such as engineers, scientists, or architects, design products or services and create new knowledge for the firm, whereas **data workers**, such as secretaries or clerks, assist with scheduling and communications at all levels of the firm. **Production or service workers** actually produce the product and deliver the service (see Figure 1-6).

Experts are employed and trained for different business functions. The major **business functions**, or specialized tasks performed by business organizations, consist of sales and marketing, manufacturing and production,

FIGURE 1-6 LEVELS IN A FIRM



Business organizations are hierarchies consisting of three principal levels: senior management, middle management, and operational management. Information systems serve each of these levels. Scientists and knowledge workers often work with middle management.

finance and accounting, and human resources (see Table 1-2). Chapter 2 provides more detail on these business functions and the ways in which they are supported by information systems.

An organization coordinates work through its 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.

TABLE 1-2 MAJOR BUSINESS FUNCTIONS

FUNCTION	PURPOSE
Sales and marketing	Selling the organization's products and services
Manufacturing and production	Producing and delivering products and services
Finance and accounting	Managing the organization's financial assets and maintaining the organization's financial records
Human resources	Attracting, developing, and maintaining the organization's labor force; maintaining employee records

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. You can see organizational culture at work by looking around your university or college. Some bedrock assumptions of university life are that professors know more than students, the reasons students attend college is to learn, and that classes follow a regular schedule.

Parts of an organization's culture can always be found embedded in its information systems. For instance, UPS'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, which we describe later in this section.

Different levels and specialties in an organization create different interests and points of view. These views often conflict over how the company should be run and how resources and rewards should be distributed. 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. In Chapter 3, we examine these features of organizations and their role in the development of information systems in greater detail.

Management

Management's job 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. The business information systems described in this book reflect the hopes, dreams, and realities of real-world managers.

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 design and deliver new products and services and redirecting and redesigning their organizations. Chapter 12 treats management decision making in detail.

Information Technology

Information technology is one of many tools managers use to cope with change. **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 (including mobile handheld devices); 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 5 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 6.

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 7) to connect millions of different networks with more than 1.4 billion users in over 230 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 other interorganizational work. For most business firms today, using Internet technology is both 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 described in the following Interactive Session.

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 IT infrastructure so that it has the set of technology services it needs for the work it wants to accomplish with information systems. Chapters 5 through 8 of this book 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 mainframe computers, handheld computers, the Internet, and many different pieces of software for tracking packages, calculating fees, maintaining customer accounts, and managing logistics.

Let's identify the organization, management, 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.

INTERACTIVE SESSION: TECHNOLOGY

UPS COMPETES GLOBALLY WITH INFORMATION 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 100 years to become the world's largest ground and air package delivery company. It's a global enterprise with over 408,000 employees, 96,000 vehicles, and the world's ninth largest airline.

Today, UPS delivers more than 15 million packages 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 as a result of using this technology. To further increase cost savings and safety, drivers are trained to use "340 Methods" developed by industrial engineers to optimize the performance of every task from lifting and loading boxes to selecting a package from a shelf in the truck.

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 a 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 mobile phones.

Anyone with a package to ship can access the UPS Web site to check delivery routes, calculate shipping rates, determine time in transit, print labels, schedule a pickup, and track packages. 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 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.

Sources: Jennifer Levitz, "UPS Thinks Out of the Box on Driver Training," *The Wall Street Journal*, April 6, 2010; United Parcel Service, "In a Tighter Economy, a Manufacturer Fastens Down Its Logistics," *UPS Compass*, accessed May 5, 2010; Agam Shah, "UPS Invests $1 Billion in Technology to Cut Costs," *Bloomberg Businessweek*, March 25, 2010; UPS, "UPS Delivers New App for Google's Android," April 12, 2010; Chris Murphy, "In for the Long Haul," *Information Week*, January 19, 2009; United Parcel Service, " UPS Unveils Global Technology for Critical Parts Fulfillment," June 16, 2009; and www.ups.com, accessed May 5, 2010.

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 strategy?
3. What strategic business objectives do UPS's information systems address?
4. What would happen if UPS's information 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?

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 computer systems to increase the ease of sending a package using UPS and of checking its delivery status, thereby reducing delivery costs and increasing sales revenues.

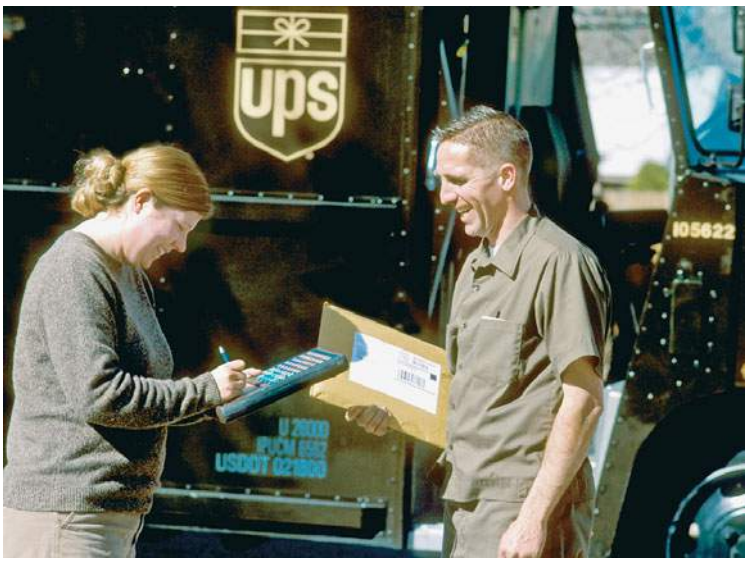
The technology supporting this system consists of handheld computers, bar code scanners, wired and wireless communications networks, desktop computers, UPS's data center, storage technology for the package delivery data, UPS in-house package tracking software, and software to access the World Wide Web. 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.

IT ISN'T JUST TECHNOLOGY: A BUSINESS PERSPECTIVE ON INFORMATION SYSTEMS

Managers and business firms invest in information technology and systems because they provide real economic value to the business. The decision to build or maintain an information system assumes that the returns on this investment will be superior to other investments in buildings, machines, or other assets. These superior returns will be expressed as increases in productivity, as increases in revenues (which will increase the firm's stock market value), or perhaps as superior long-term strategic positioning of the firm in certain markets (which produce superior revenues in the future).

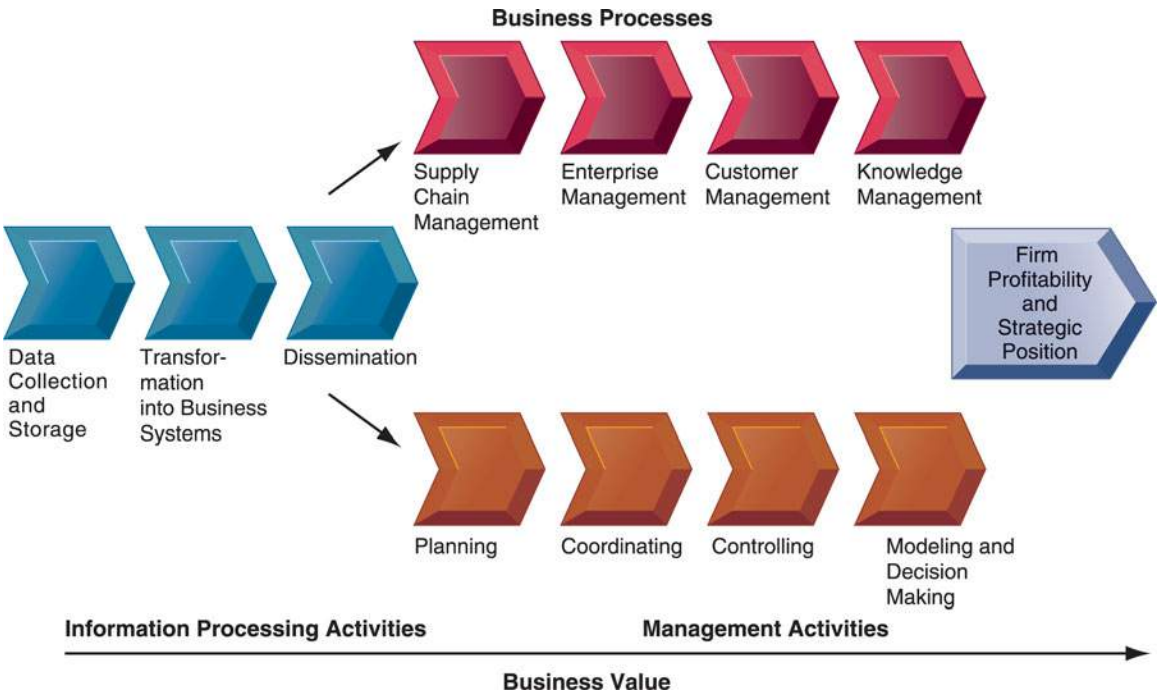
We can see that from a business perspective, an information system is an important instrument for creating value for the firm. Information systems enable the firm to increase its revenue or decrease its costs by providing information that helps managers make better decisions or that improves the execution of business processes. For example, the information system for analyzing supermarket checkout data illustrated in Figure 1-3 can increase firm profitability by helping managers make better decisions on which products to stock and promote in retail supermarkets.

Every business has an information value chain, illustrated in Figure 1-7, in which raw information is systematically acquired and then transformed through various stages that add value to that information. The value of an information system to a business, as well as the decision to invest in any new information system, is, in large part, determined by the extent to which the system will lead to better management decisions, more efficient business



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.

FIGURE 1-7 THE BUSINESS INFORMATION VALUE CHAIN



From a business perspective, information systems are part of a series of value-adding activities for acquiring, transforming, and distributing information that managers can use to improve decision making, enhance organizational performance, and, ultimately, increase firm profitability.

processes, and higher firm profitability. Although there are other reasons why systems are built, their primary purpose is to contribute to corporate value.

From a business perspective, information systems are part of a series of value-adding activities for acquiring, transforming, and distributing information that managers can use to improve decision making, enhance organizational performance, and, ultimately, increase firm profitability.

The business perspective calls attention to the organizational and managerial nature of information systems. An information system represents an organizational and management solution, based on information technology, to a challenge or problem posed by the environment. Every chapter in this book begins with a short case study that illustrates this concept. A diagram at the beginning of each chapter illustrates the relationship between a business challenge and resulting management and organizational decisions to use IT as a solution to challenges generated by the business environment. You can use this diagram as a starting point for analyzing any information system or information system problem you encounter.

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

management, technology, and organizational elements work together to create the systems.

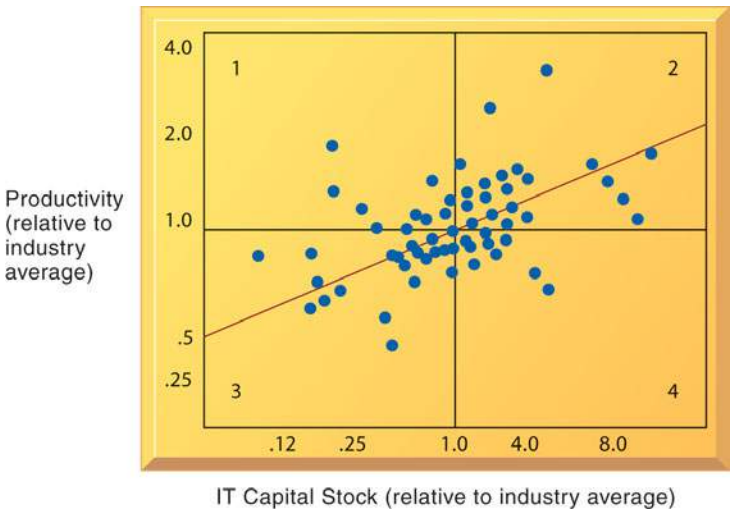
COMPLEMENTARY ASSETS: ORGANIZATIONAL CAPITAL AND THE RIGHT BUSINESS MODEL

Awareness of the organizational and managerial dimensions of information systems can help us understand why some firms achieve better results from their information systems than others. Studies of returns from information technology investments show that there is considerable variation in the returns firms receive (see Figure 1-8). Some firms invest a great deal and receive a great deal (quadrant 2); others invest an equal amount and receive few returns (quadrant 4). Still other firms invest little and receive much (quadrant 1), whereas others invest little and receive little (quadrant 3). This suggests that investing in information technology does not by itself guarantee good returns. What accounts for this variation among firms?

The answer lies in the concept of complementary assets. Information technology investments alone cannot make organizations and managers more effective unless they are accompanied by supportive values, structures, and behavior patterns in the organization and other complementary assets. Business firms need to change how they do business before they can really reap the advantages of new information technologies.

Some firms fail to adopt the right business model that suits the new technology, or seek to preserve an old business model that is doomed by new technology. For instance, recording label companies refused to change their old business model, which was based on physical music stores for distribution rather than adopt a new online distribution model. As a result, online legal

FIGURE 1-8 VARIATION IN RETURNS ON INFORMATION TECHNOLOGY INVESTMENT



Although, on average, investments in information technology produce returns far above those returned by other investments, there is considerable variation across firms.

Source: Based on Brynjolfsson and Hitt (2000).

music sales are dominated not by record companies but by a technology company called Apple Computer.

Complementary assets are those assets required to derive value from a primary investment (Teece, 1988). For instance, to realize value from automobiles requires substantial complementary investments in highways, roads, gasoline stations, repair facilities, and a legal regulatory structure to set standards and control drivers.

Research on business information technology investment indicates that firms that support their technology investments with investments in complementary assets, such as new business models, new business processes, management behavior, organizational culture, or training, receive superior returns, whereas those firms failing to make these complementary investments receive less or no returns on their information technology investments (Brynjolfsson, 2003; Brynjolfsson and Hitt, 2000; Davern and Kauffman, 2000; Laudon, 1974). These investments in organization and management are also known as **organizational and management capital**.

Table 1-3 lists the major complementary investments that firms need to make to realize value from their information technology investments. Some of this investment involves tangible assets, such as buildings, machinery, and tools. However, the value of investments in information technology depends to a large extent on complementary investments in management and organization.

Key organizational complementary investments are a supportive business culture that values efficiency and effectiveness, an appropriate business model, efficient business processes, decentralization of authority, highly distributed decision rights, and a strong information system (IS) development team.

Important managerial complementary assets are strong senior management support for change, incentive systems that monitor and reward individual innovation, an emphasis on teamwork and collaboration, training programs, and a management culture that values flexibility and knowledge.

TABLE 1-3 COMPLEMENTARY SOCIAL, MANAGERIAL, AND ORGANIZATIONAL ASSETS REQUIRED TO OPTIMIZE RETURNS FROM INFORMATION TECHNOLOGY INVESTMENTS

Organizational assets	Supportive organizational culture that values efficiency and effectiveness Appropriate business model Efficient business processes Decentralized authority Distributed decision-making rights Strong IS development team
Managerial assets	Strong senior management support for technology investment and change Incentives for management innovation Teamwork and collaborative work environments Training programs to enhance management decision skills Management culture that values flexibility and knowledge-based decision making.
Social assets	The Internet and telecommunications infrastructure IT-enriched educational programs raising labor force computer literacy Standards (both government and private sector) Laws and regulations creating fair, stable market environments Technology and service firms in adjacent markets to assist implementation

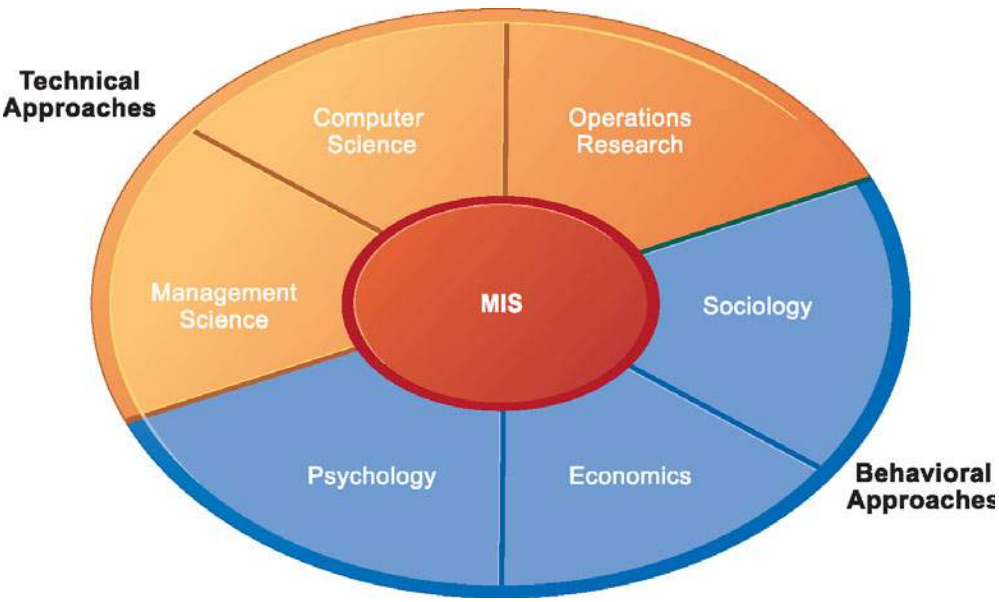
Important social investments (not made by the firm but by the society at large, other firms, governments, and other key market actors) are the Internet and the supporting Internet culture, educational systems, network and computing standards, regulations and laws, and the presence of technology and service firms.

Throughout the book we emphasize a framework of analysis that considers technology, management, and organizational assets and their interactions. Perhaps the single most important theme in the book, reflected in case studies and exercises, is that managers need to consider the broader organization and management dimensions of information systems to understand current problems as well as to derive substantial above-average returns from their information technology investments. As you will see throughout the text, firms that can address these related dimensions of the IT investment are, on average, richly rewarded.

1.3 Contemporary Approaches to Information Systems

The study of information systems is a multidisciplinary field. No single theory or perspective dominates. Figure 1-9 illustrates the major disciplines that contribute problems, issues, and solutions in the study of information systems. In general, the field can be divided into technical and behavioral approaches. Information systems are sociotechnical systems. Though they are composed of machines, devices, and "hard" physical technology, they require substantial social, organizational, and intellectual investments to make them work properly.

FIGURE 1-9 CONTEMPORARY APPROACHES TO INFORMATION SYSTEMS



The study of information systems deals with issues and insights contributed from technical and behavioral disciplines.

TECHNICAL APPROACH

The technical approach to information systems emphasizes mathematically based models to study information systems, as well as the physical technology and formal capabilities of these systems. The disciplines that contribute to the technical approach are computer science, management science, and operations research.

Computer science is concerned with establishing theories of computability, methods of computation, and methods of efficient data storage and access. Management science emphasizes the development of models for decision-making and management practices. Operations research focuses on mathematical techniques for optimizing selected parameters of organizations, such as transportation, inventory control, and transaction costs.

BEHAVIORAL APPROACH

An important part of the information systems field is concerned with behavioral issues that arise in the development and long-term maintenance of information systems. Issues such as strategic business integration, design, implementation, utilization, and management cannot be explored usefully with the models used in the technical approach. Other behavioral disciplines contribute important concepts and methods.

For instance, sociologists study information systems with an eye toward how groups and organizations shape the development of systems and also how systems affect individuals, groups, and organizations. Psychologists study information systems with an interest in how human decision makers perceive and use formal information. Economists study information systems with an interest in understanding the production of digital goods, the dynamics of digital markets, and how new information systems change the control and cost structures within the firm.

The behavioral approach does not ignore technology. Indeed, information systems technology is often the stimulus for a behavioral problem or issue. But the focus of this approach is generally not on technical solutions. Instead, it concentrates on changes in attitudes, management and organizational policy, and behavior.

APPROACH OF THIS TEXT: SOCIOTECHNICAL SYSTEMS

Throughout this book you will find a rich story with four main actors: suppliers of hardware and software (the technologists); business firms making investments and seeking to obtain value from the technology; managers and employees seeking to achieve business value (and other goals); and the contemporary legal, social, and cultural context (the firm's environment). Together these actors produce what we call *management information systems*.

The study of management information systems (MIS) arose to focus on the use of computer-based information systems in business firms and government agencies. MIS combines the work of computer science, management science, and operations research with a practical orientation toward developing system solutions to real-world problems and managing information technology resources. It is also concerned with behavioral issues surrounding the development, use, and impact of information systems, which are typically discussed in the fields of sociology, economics, and psychology.

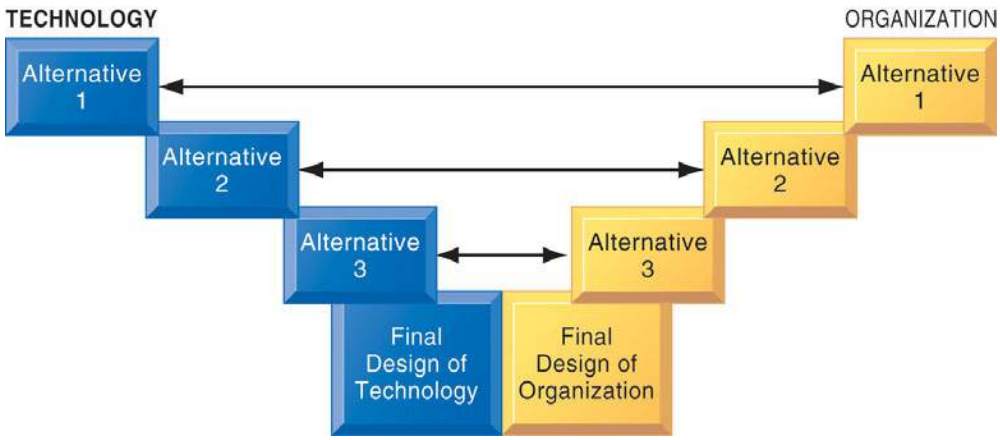
Our experience as academics and practitioners leads us to believe that no single approach effectively captures the reality of information systems. The successes and failures of information are rarely all technical or all behavioral. Our best advice to students is to understand the perspectives of many disciplines. Indeed, the challenge and excitement of the information systems field is that it requires an appreciation and tolerance of many different approaches.

The view we adopt in this book is best characterized as the **sociotechnical view** of systems. In this view, optimal organizational performance is achieved by jointly optimizing both the social and technical systems used in production.

Adopting a sociotechnical systems perspective helps to avoid a purely technological approach to information systems. For instance, the fact that information technology is rapidly declining in cost and growing in power does not necessarily or easily translate into productivity enhancement or bottom-line profits. The fact that a firm has recently installed an enterprise-wide financial reporting system does not necessarily mean that it will be used, or used effectively. Likewise, the fact that a firm has recently introduced new business procedures and processes does not necessarily mean employees will be more productive in the absence of investments in new information systems to enable those processes.

In this book, we stress the need to optimize the firm's performance as a whole. Both the technical and behavioral components need attention. This means that technology must be changed and designed in such a way as to fit organizational and individual needs. Sometimes, the technology may have to be "de-optimized" to accomplish this fit. For instance, mobile phone users adapt this technology to their personal needs, and as a result manufacturers quickly seek to adjust the technology to conform with user expectations. Organizations and individuals must also be changed through training, learning, and planned organizational change to allow the technology to operate and prosper. Figure 1-10 illustrates this process of mutual adjustment in a sociotechnical system.

FIGURE 1-10 A SOCIOTECHNICAL PERSPECTIVE ON INFORMATION SYSTEMS



In a sociotechnical perspective, the performance of a system is optimized when both the technology and the organization mutually adjust to one another until a satisfactory fit is obtained.

1.4 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 developing shipping budgets.

Management Decision Problems

1. Snyders of Hanover, which sells more than 78 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 and 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

Effective information systems transform data into meaningful information for decisions that improve business performance. In MyMISLab, you can find a Store and Regional Sales Database with raw data on weekly store sales of computer equipment in various sales regions. A sample is shown below, but MyMISLab may have a more recent version of this database for this exercise. The database includes fields for store identification number, sales region number, 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. Try to use the information in the database to support decisions on which products to restock, which stores and sales regions would benefit from additional marketing and promotional campaigns, which times of the year products


Store & Region Sales Database

ID	Store No	Sales Region	Item No	Item Description	Unit Price	Units Sold	Week Ending
1	1	South	2005	17" Monitor	$229.00	28	10/27/2010
2	1	South	2005	17" Monitor	$229.00	30	11/24/2010
3	1	South	2005	17" Monitor	$229.00	9	12/29/2010
4	1	South	3006	101 Keyboard	$19.95	30	10/27/2010
5	1	South	3006	101 Keyboard	$19.95	35	11/24/2010
6	1	South	3006	101 Keyboard	$19.95	39	12/29/2010
7	1	South	6050	PC Mouse	$8.95	28	10/27/2010
8	1	South	6050	PC Mouse	$8.95	3	11/24/2010
9	1	South	6050	PC Mouse	$8.95	38	12/29/2010
10	1	South	8500	Desktop CPU	$849.95	25	10/27/2010
11	1	South	8500	Desktop CPU	$849.95	27	11/24/2010
12	1	South	8500	Desktop CPU	$849.95	33	12/29/2010
13	2	South	2005	17" Monitor	$229.00	8	10/27/2010
14	2	South	2005	17" Monitor	$229.00	8	11/24/2010
15	2	South	2005	17" Monitor	$229.00	10	12/29/2010

Record: 1 of 96 No Filter Search

should be offered at full price, and which times of the year products should be discounted. Modify the database table, if necessary, to provide all of the information you require. 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 CareerBuilder.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.

Learning Track Modules

The following Learning Tracks provide content relevant to topics covered in this chapter:

1. How Much Does IT Matter?
2. Information Systems and Your Career
3. The Emerging Mobile Digital Platform

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 many businesses to buy, sell, advertise, and solicit customer feedback online. Organizations are trying to become more competitive and efficient by digitally enabling their core business processes and evolving into digital firms. The Internet has stimulated globalization by dramatically reducing the costs of producing, buying, and selling goods on a global scale. New information system trends include the emerging mobile digital platform, online software as a service, and cloud computing.

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 the ability to achieve strategic business goals are difficult without extensive use of information technology. Businesses today 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 management, 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 management, organization, and technology elements. The management dimension of information systems involves issues such as leadership, strategy, 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. *What are complementary assets? Why are complementary assets essential for ensuring that information systems provide genuine value for an organization?*

In order to obtain meaningful value from information systems, organizations must support their technology investments with appropriate complementary investments in organizations and management. These complementary assets include new business models and business processes, supportive organizational culture and management behavior, appropriate technology standards, regulations, and laws. New information technology investments are unlikely to produce high returns unless businesses make the appropriate managerial and organizational changes to support the technology.

5. *What academic disciplines are used to study information systems? How does each contribute to an understanding of information systems? What is a sociotechnical systems perspective?*

The study of information systems deals with issues and insights contributed from technical and behavioral disciplines. The disciplines that contribute to the technical approach focusing on formal models and capabilities of systems are computer science, management science, and operations research. The disciplines contributing to the behavioral approach focusing on the design, implementation, management, and business impact of systems are psychology, sociology, and economics. A sociotechnical view of systems considers both technical and social features of systems and solutions that represent the best fit between them.

Key Terms

Business functions, 18
Business model, 13
Business processes, 11
Complementary assets, 27
Computer hardware, 20
Computer literacy, 17
Computer software, 20
Culture, 20
Data, 15
Data management technology, 20
Data workers, 18
Digital firm, 11
Extranets, 21
Feedback, 16
Information, 15
Information system, 15
Information systems literacy, 17
Information technology (IT), 15
Information technology (IT) infrastructure, 21
Input, 16
Internet, 21
Intranets, 21
Knowledge workers, 18
Management information systems (MIS), 17
Middle management, 18
Network, 21
Networking and telecommunications technology, 20
Operational management, 18
Organizational and management capital, 27
Output, 16
Processing, 16
Production or service workers, 18
Senior management, 18
Sociotechnical view, 30
World Wide Web, 21

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.
- Identify three major new information system trends.
- Describe the characteristics of a digital firm.
- 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 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 management, organization, and technology components?

- Define an information system and describe the activities it performs.
- List and describe the organizational, management, and technology dimensions of information systems.
- 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. What are complementary assets? Why are complementary assets essential for ensuring that information systems provide genuine value for an organization?

- Define complementary assets and describe their relationship to information technology.
- Describe the complementary social, managerial, and organizational assets required to optimize returns from information technology investments.

5. What academic disciplines are used to study information systems? How does each contribute to an understanding of information systems? What is a sociotechnical systems perspective?

- List and describe each discipline that contributes to a technical approach to information systems.
- List and describe each discipline that contributes to a behavioral approach to information systems.
- Describe the sociotechnical perspective on information systems.

Discussion Questions

1. Information systems are too important to be left to computer specialists. Do you agree? Why or why not?
2. If you were setting up the Web site for another Major League Baseball team, what management, organization, and technology issues might you encounter?
3. What are some of the organizational, managerial, and social complementary assets that help make UPS's information systems so successful?

Video Cases

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

Collaboration 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 a 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.

What's the Buzz on Smart Grids?

CASE STUDY

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 costs, and increase reliability and transparency. The smart grid enables information to flow back and forth between electric power providers and individual households 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. Electricity grids are sized to meet the maximum electricity need, so a drop in peak demand would enable utilities to operate with fewer expensive power plants, thereby lowering costs and pollution.

Another advantage of smart grids is their ability to detect sources of power outages more quickly and precisely at the individual household level. With such precise information, utilities will be able to respond to service problems more rapidly and efficiently.

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. They also have the option of allowing Xcel to remotely adjust their thermostats during periods of high demand.

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 Petersons' Escape is using on the road.

A digital dashboard in the Petersons' house displays power usage information in dozens of different ways—live household consumption and production, stored backup power, and carbon emission reductions translated into gallons of gasoline and acres of trees saved each year. The dashboard also allows the Petersons 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 Petersons 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 $3.4 billion in federal economic recovery money for smart grid technology.

Duke Energy spent $35 million on smart grid initiatives, installing 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 1 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' monthly electric bills will be $3.24 higher, the company says this amount will be more than offset by energy savings. Pacific Gas & Electric, which distributes power to Northern and Central California, is in the process of installing 10 million smart meters by mid-2012.

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

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. Another challenge is creating an intuitive end-user interface. 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 and utility companies get the promised payback if they buy into smart grid technology? Might "smart meters" be too intrusive? Would consumers really want to entrust energy companies with regulating the energy usage inside their homes? 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 reducing 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. Patience will be critical as energy companies and local communities work to set up new technologies and pricing plans.

Sources: Rebecca Smith, "What Utilities Have Learned from Smart-Meter Tests," *The Wall Street Journal*, February 22, 2010; "Smart Grid: & Reasons Why IT Matters," *CIO Insight*, March 24, 2010; Yuliya Chernova, "Getting Smart About Smart Meters," *The Wall Street Journal*, May 10, 2010; Bob Evans, "IT's Dark-Side Potential Seenin SmartGridCity Project," *Information Week*, March 24, 2009; Bob Violino, "No More Grid-Lock," *Information Week*, November 16, 2009; K.C. Jones, "Smart Grids to Get Jolt from IT," *Information Week*, March 23, 2009; Rebecca Smith, "Smart Meter, Dumb Idea?" *The Wall Street Journal*, April 27, 2009; Stephanie Simon, "The More Your Know…" *The Wall Street Journal*, February 9, 2009; and Matthew Wald and Miguel Helft, "Google Taking a Step into Power Metering," *The New York Times*, February 10, 2009.

CASE STUDY QUESTIONS

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

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