CHAPTER 1

# Information Systems in Global Business Today

## Learning Objectives

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

**1-1** How are information systems transforming business, and why are they so essential for running and managing a business today?

**1-2** What is an information system? How does it work? What are its management, organization, and technology components? Why are complementary assets essential for ensuring that information systems provide genuine value for organizations?

**1-3** What academic disciplines are used to study information systems, and how does each contribute to an understanding of information systems?

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## CHAPTER CASES

Rugby Football Union Tries Big Data
The Mobile Pocket Office
Digital Transformation of Healthcare at Singapore's JurongHealth Services
Are Farms Becoming Digital Firms?

## VIDEO CASES

Business in the Cloud: Facebook and eBay Data Centers
UPS Global Operations with the DIAD
*Instructional Video:*
Tour IBM's Raleigh Data Center

## Rugby Football Union Tries Big Data

In 1871, twenty-one English clubs decided that their sport, officially called rugby union but commonly referred to simply as rugby, needed an administrative body. The clubs formed The Rugby Football Union (RFU), which today manages the English national team (England Rugby) in partnership with Premier Rugby Limited. Responsible for the promotion of rugby at all levels, the RFU organizes the Six Nations Championship, the unofficial northern hemisphere championship featuring teams from England, Scotland, Wales, Italy, Ireland, and France, and the Heineken Cup, its club-level counterpart. Owned by its member clubs, the RFU's mission is to maximize profits from international ticket sales and vending so that it can support the more than 60,000 volunteers who organize matches and seminars, help secure loans and insurance policies, fundraise, write grant proposals, provide medical advice and support, and perform the clerical duties that keep the lower-level clubs operating.

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To succeed in this complicated mission, the RFU entered into a five-year deal with IBM to capture and analyze Big Data that will be useful to both fans, and later—it is hoped—the players themselves. The system is called TryTracker. In rugby, a try, worth five points, is the highest scoring opportunity. Teams get possession of the ball through a scrum, a contest for the ball where eight players bind together and push against eight players from the other team. The outcome determines who can control the ball. To score a try, a team must break through the opposition's defenses, move into their in-goal area, and "ground" the ball. This is done in one of two ways. A player can either hold the ball in one or both hands or arms and then touch it to the ground in the in-goal area, or exert downward pressure on a ball already on the ground using one or both hands or arms or the upper front of the body (from the neck to the waistline).

The IBM TryTracker does not just track tries, however. It uses predictive analytics to track three categories of data: keys to the game, momentum, and key players. TryTracker uses over 8,000 measures of performance. Traditional rugby statistics on team and individual performance as well as live

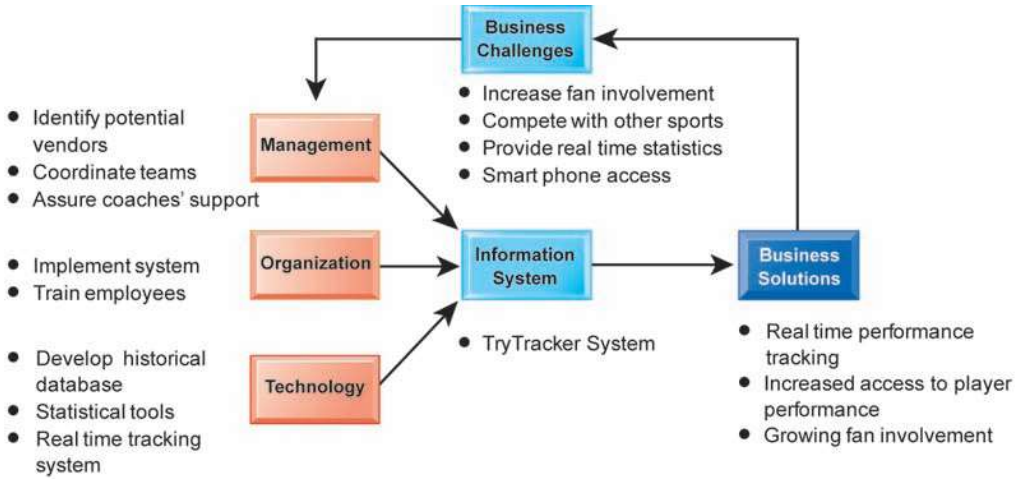
text commentary complement the TryTracker data. The keys to the game are determined ahead of a specific contest by analyzing a historical database of past matchups between a pair. For example, in 2015 England's key was to average at least 3.2 meters per carry in the forwards; attempt an offload from 10 percent of opposition tackles; and make more than 66 percent of total line-breaks in the match. Fans can use their mobile devices to keep track of how their favorite team is faring, concentrating on game elements that will increase its winning chances. Key players for each team are selected after the game by comparing a single score compiled using different criteria for each position. Goal scoring is currently excluded so as not to overvalue kickers and undervalue players who contribute to creating scoring opportunities.

Like the IBM SlamTracker used at the Grand Slam tennis tournaments, the goal of TryTracker is to provide data visualization and real-time statistics to draw in fans. To compete with more popular sports such as Premier League football, the RFU hopes that enhanced communication will increase fan engagement. In 2015, IBM TryTracker was an ever-present fixture of EnglandRugby.com's extensive match coverage. As their understanding of game mechanics and emotional investment in what their team needs to do in order to prevail grows, casual fans will become dedicated fans who return again and again. Beyond marketing strategy, the long-term potential of predictive analysis is that it may provide tactical insights to players and coaches that will improve match play and thus the overall product offered to fans.

In 2016 IBM has deployed the same predictive analytics technology to the Australian New South Wales Waratahs Rugby team with an emphasis on predicting player injuries based on their general health, and performance data on the field generated from GPS sensors that players wear.

**Sources:** IBM, "Building a Solid Foundation for Big Data Analytics," IBM Systems Thought Leadership Paper, 2016; IBM, "IBM Predictive Analytics Reduces Player Injury and Optimises Team Performance for NSW Waratahs Rugby Team," IBM.com, accessed November 14, 2016; IBM, "3 Ways Big Data and Analytics Will Change Sports," by Preetam Kumar, IBM Analytics, ibmbigdatahub.com, December 17, 2015; Simon Creasey, "Rugby Football Union Uses IBM Predictive Analytics For Six Nations," ComputerWeekly.com, 2016; "About Us," rfu.com, accessed December, 14, 2015; "TryTracker: Rugby Data Analysis," *Telegraph*, November 19, 2015; Oliver Pickup, "How Does TryTracker Work," *Telegraph*, November 19, 2015; Simon Creasey, "Rugby Football Union Uses IBM Predictive Analytics for Six Nations," *ComputerWeek*, September 2015; "IBM Rugby Insight Summer 2015," MSN.com/sports, September 3, 2015; "Live England vs. Scotland with IBM TryTracker," www.englandrugby.com, March 15, 2015; "IBM TryTracker Confirms Performance," www.englandrugby.com/ibmtrytracker/, November 29, 2014; IBM UK, "IBM TryTracker Rugby Insight: QBE Internationals 2014 England vs. Australia," *IBM Rugby Insight,* November 27, 2014; Oliver Pickup, "IBM TryTracker: How Does It Work?" *Telegraph*, October 31, 2013.

The challenges facing the RFU demonstrate why information systems are so essential today. The RFU is classified as a "Friendly Society," somewhere between a true company and a charity. It receives both government support and corporate sponsorship money. But it must maximize revenues from ticket sales, hospitality and catering, television rights, and its travel company in order to support both grassroots and elite rugby in England.




The chapter-opening diagram calls attention to important points raised by this case and this chapter. The RFU entered into a strategic partnership with IBM to educate and engage fans. Using the data collected by sports data company Opta and the analytics developed by IBM, it may also be able to improve coaching and game performance as an additional way of cultivating customers. IBM is also helping the RFU to develop a customer relationship management (CRM) system integrated with its Web site.

Here are some questions to think about: What role does technology play in the RFU's success as the administrative head of rugby union in England? Assess the contributions which these systems make to the future of RFU.

## 1-1 How are information systems transforming global business, and why are they so essential for running and managing a business today?

It's not business as usual in the global economy anymore. Information systems and technologies are transforming the global business environment. In 2015, global firms and governments spent about €3.4 trillion on information systems hardware, software, and telecommunications equipment. In addition, they spent another €544 billion on business and management consulting and services—much of which involves redesigning firms' business operations to take advantage of these new technologies (Gartner, 2016; IDC 2016; Shumsky, 2016). In fact, most of the business value of IT investment derives from these organizational, management, and cultural changes inside firms (Saunders and Brynjolfsson, 2016). It is not simply the technology that is changing. Figure 1.1 shows that between 2005 and 2015, global investment in information technology

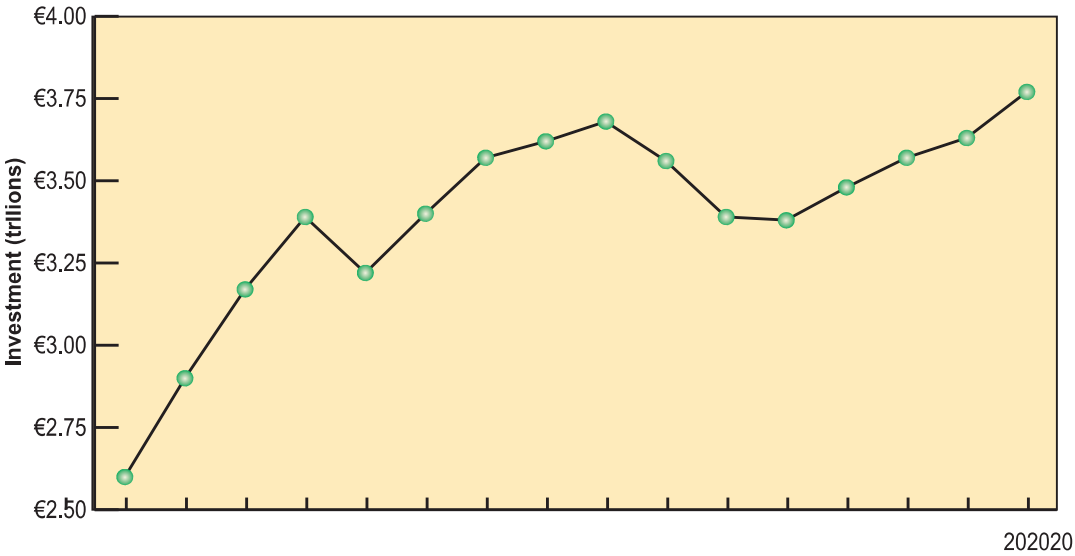
consisting of hardware, software, and communications equipment grew from €2.43 trillion to €3.18 trillion and is expected to expand to €3.55 trillion by 2020. While America and Europe account for an estimated 70 percent of this investment, 30 percent is occurring in Asia Pacific, Latin America, the Middle East and North Africa, and Eastern Europe. (Accelerance, 2016; IDC, 2016).

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 large-scale spending around you every day by observing how people conduct business. Changes in technology and new, innovative business models have transformed social life and business practices. Some 2.8 billion people worldwide have smartphones (50 percent of the world's population), and an estimated 1.26 billion use their smartphones for Internet access. More than 1 billion people use tablet computers, about 15 percent of the global population. In developing and emerging countries, phones and tablets are the primary means of access to the Internet (Pew Research, 2016; eMarketer, 2015). An estimated 2.34 billion people now use social networks, with Facebook accounting for 1.7 billion people alone. Messaging services like WhatsApp, Facebook Messenger, and Twitter collectively have over 2 billion monthly users. Smartphones,

**FIGURE 1.1 INFORMATION TECHNOLOGY CAPITAL INVESTMENT**




Global investment in information technology has expanded by 30 percent in the period 2005 to 2015. IT investment now accounts for an estimated 20 percent of all capital investment.

Source: World Economic Outlook, International Monetary Fund, October 2016; industry sources; author estimates.

social networking, texting, e-mailing, and webinars have all become essential tools of business because that's where your customers, suppliers, and colleagues can be found (eMarketer, 2016a).

By June 2015, more than 150 million businesses worldwide had dot-com Internet sites registered (Curtis, 2015). In 2016 1.62 billion Internet users will purchase online, generating $1.9 billion in sales. Half of these sales will be from mobile devices. While still only 8 percent of total retail global sales, online commerce is growing at 6 percent annually, three times the growth of traditional offline retail (eMarketer, 2016a). In 2015, FedEx moved about 11.5 million packages daily in 220 countries and territories around the world, mostly overnight, and the United Parcel Service (UPS) moved more than 18 million packages daily. Businesses are using information technology 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.

In comparison with the 2.7 billion people who read a print newspaper, online newspapers are read by one billion people, growing at 10 percent annually, far faster than print newspapers (WPT, 2016; Conaghan, 2015). An estimated 1.7 billion people watch videos and feature films online, 100 million post to a blog everyday, and 250 million read a blog, creating an explosion of new writers and new forms of customer feedback that did not exist five years ago. Social networking site Facebook attracted more than 1.7 billion monthly visitors worldwide. Nearly all of the *Fortune* 2000 global firms now have Facebook pages, Twitter accounts, and Tumblr sites.

Global e-commerce and Internet advertising continue to expand. Google's online ad revenues surpassed €80 billion in 2016, and Internet advertising continues to grow at more than 20 percent a year, reaching more than €194 billion in revenues in 2016 (eMarketer, 2016c). That's about one-third of all advertising in the world.

These changes in information technology and systems, consumer behavior, and commerce have spurred the annual growth of digital information to over 5 exabytes every few days, roughly equivalent to all the libraries in existence (Pappas, 2016). A recent study concluded that the value of information flowing between countries has grown 45 times since 2005, and the value of this information now exceeds the value of goods and finance exchanged (McKenzie, 2016).

## What's New in Management Information Systems

Plenty. In fact, there's a whole new world of doing business using new technologies for managing and organizing. What makes the MIS field the most exciting area of study in schools of business is the continuous change in technology, management, and business processes. Five changes are of paramount importance.

**IT Innovations.** A continuing stream of information technology innovations is transforming the traditional business world. Examples include the emergence of cloud computing, the growth of a mobile digital business platform based on smartphones and tablet computers, big data, business analytics, and the use of social networks by managers to achieve business objectives. Most of these

changes have occurred in the past few years. These innovations are enabling entrepreneurs and innovative traditional firms to create new products and services, develop new business models, and transform the day-to-day conduct of business. In the process, some old businesses, even industries, are being destroyed while new businesses are springing up.

**New Business Models.** For instance, the emergence of online video services like Netflix for streaming, Apple iTunes, Amazon, and many others for downloading video has forever changed how premium video is distributed and even created. Netflix in 2016 attracted more than 75 million subscribers worldwide to what it calls the "Internet TV" revolution. Netflix has moved into premium TV show production with 30 original shows such as *House of Cards* and *Orange Is the New Black*, challenging cable and broadcast producers of TV shows, and potentially disrupting cable network dominance of TV show production. Apple's iTunes now accounts for 67 percent of movie and TV show downloads and has struck deals with major Hollywood studios for recent movies and TV shows. A growing trickle of viewers are unplugging from cable and using only the Internet for entertainment.

**E-commerce Expanding.** E-commerce generated about $600 billion in revenues in 2016 and is estimated to grow to nearly $900 billion by 2020. E-commerce is changing how firms design, produce, and deliver their products and services. E-commerce has reinvented itself again, disrupting the traditional marketing and advertising industry and putting major media and content firms in jeopardy. Facebook and other social networking sites such as YouTube, Twitter, and Tumblr along with Netflix, Apple Beats music service, and many other media firms exemplify the new face of e-commerce in the twenty-first century. They sell services. When we think of e-commerce, we tend to think of selling physical products. While this iconic vision of e-commerce is still very powerful and the fastest-growing form of retail in the United States, growing up alongside is a whole new value stream based on selling services, not goods. It's a services model of e-commerce. Growth in social commerce is spurred by powerful growth of the mobile platform: 80 percent of Facebook's users access the service from mobile phones and tablets. Information systems and technologies are the foundation of this new services-based e-commerce. Mobile e-commerce hit $130 billion in 2016 and is growing at more than 30 percent a year.

**Management Changes.** The management of business firms has changed: With new mobile smartphones, high-speed wireless Wi-Fi networks, and tablets, remote salespeople on the road are only seconds away from their managers' questions and oversight. Business is going mobile, along with consumers. Managers on the move are in direct, continuous contact with their employees. The growth of enterprise-wide information systems with extraordinarily rich data means that managers no longer operate in a fog of confusion but instead have online, nearly instant access to the really important information they need for accurate and timely decisions. In addition to their public uses on the web, wikis and blogs are becoming important corporate tools for communication, collaboration, and information sharing.

**Changes in Firms and Organizations.** Compared to industrial organizations of the previous century, new fast-growing twenty-first-century business firms put less emphasis on hierarchy and structure and more emphasis on employees

## INTERACTIVE SESSION: MANAGEMENT

### The Mobile Pocket Office

Can you run your company out of your pocket? Perhaps not entirely, but there are many business functions today that can be performed using an iPhone, iPad, or Android 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, increasingly, a gateway into corporate systems. New software applications for document sharing, collaboration, sales, order processing, inventory management, and production monitoring make these devices even more versatile business tools. Mobile pocket offices that fit into a purse or coat pocket are helping to run companies large and small.

Sonic Automotive is one of the largest automotive retailers in the United States with more than 100 dealerships in 14 states. Every year Sonic sells 250,000 new and used cars from approximately 25 different automotive brands, and it also sells auto parts and maintenance, warranty, collision, and vehicle financing services. Sonic Automotive managers and employees do much of their work on the iPhone and iPad.

Sonic developed several custom iPhone and iPad applications to speed up sales and service. Virtual Lot, a dealer inventory app, lets sales associates quickly search for vehicles held in inventory by all Sonic dealerships. They have immediate access to vehicle information, pricing, trade-in values, interest rates, special promotions, financing, and what competitors are charging for identical vehicles. The associates can quickly find the best selection for each customer and often offer far more choices than the competition. Dealers are not limited to selling only their own inventory.

A mobile app called the Sonic Inventory Management System (SIMS) has speeded up and simplified trade-in appraisals and pricing. Sonic staff use their iPhones or iPads to take photos of a car, input the vehicle identification number (VIN) and mileage, and note any issues. The data are transmitted to corporate headquarters, which can quickly appraise the car. A Service Pad app simplifies the steps in repair and warranty work. In the past, customers with cars requiring repairs had to go inside the dealership and sit at a desk with a Sonic staff member who wrote up the repair order by hand. Now the Sonic staff members go outside to the customer's vehicle and enter the repair order on an iPad on the spot.

SKF is a global engineering company headquartered in Gothenburg, Sweden, with 140 manufacturing sites in 32 countries and 48,500 employees worldwide. SKF produces bearings, seals, lubrication systems, and services used in more than 40 industries, including mining, transportation, and manufacturing. SKF has developed more than 30 custom iPhone and iPad applications for streamlining workflows and accessing critical corporate data from anywhere in the world.

For example, a virtual reality app uses the iPhone or iPad camera to identify a factory machine and produce a 3-D overlay of the SKF parts it contains. A sensor-driven app called Shaft Align is used by SKF service teams and customers in the field. Shaft Align connects via wireless Bluetooth sensors to a piece of machinery such as a motor-driven fan to ensure that the drive shaft is running in proper alignment. If not, the app generates step-by-step instructions and a 3-D rendering to show how to manually align the motor. Then it checks the work and produces a report.

A mobile app called MOST enables factory operators to monitor some SKF factory production lines. MOST links to the back-end systems running the machinery and provides operators with key pieces of data. Operators using this mobile app are able to use secure instant messaging to communicate with managers and each other, update maintenance logs, and track products in real time as they move through the factory line.

SKF's Shelf mobile app allows sales engineers and customers to access on demand more than 5,000 pieces of product literature, catalogs, product specifications, and interactive marketing materials. Sales teams can use Shelf to create custom "shelves" to organize, annotate, and share materials with customers right from their iPhones or iPads. The iPhone, iPad, and Shelf app save company sales engineers as much as 25 minutes per day on processes and paperwork, freeing them up to spend more time in the field supporting customers. This increase in productivity is equivalent to putting 200 more sales engineers in the field.

SKF auditors perform about 60 audits per year, and each audit used to take more than a month to complete. With the SKF Data Collect app, auditors

are able to use their iPads to collect data and present customers with detailed reports instantly.

SKF Seals offers specifications and information about SKF's machined and injection-molded seals and plastic parts, while the Seal Select app helps users select seals and accessories using several different input parameters to find the right solution for their needs.

*Sources:* "Sonic Automotive: Driving Growth with iPhone and iPad" and "Driving Innovation in the Factory and in the Field with iOS," iPhone in Business, www.apple.com, accessed March 31, 2016; www.skf.com, accessed March 31, 2016; www.sonicautomotive.com, accessed March 31, 2016; and "Why the Mobile Pocket Office Is Good For Business," ITBusinesEdge.com, accessed March 6, 2015.

## CASE STUDY QUESTIONS

1. What kinds of applications are described here? What business functions do they support? How do they improve operational efficiency and decision making?
2. Identify the problems that businesses in this case study solved by using mobile digital devices.
3. What kinds of businesses are most likely to benefit from equipping their employees with mobile digital devices such as iPhones and iPads?
4. One company deploying iPhones has said, "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.

taking on multiple roles and tasks and collaborating with others on a team. They put greater emphasis on competency and skills rather than position in the hierarchy. They emphasize higher speed and more accurate decision making based on data and analysis. They are more aware of changes in technology, consumer attitudes, and culture. They use social media to enter into conversations with consumers and demonstrate a greater willingness to listen to consumers, in part because they have no choice. They show better understanding of the importance of information technology in creating and managing business firms and other organizations. To the extent organizations and business firms demonstrate these characteristics, they are twenty-first-century digital firms.

iPhone and iPad Applications for Business

1. Salesforce1
2. Cisco WebEx Meetings
3. SAP Business One
4. iWork
5. Evernote
6. Adobe Acrobat Reader
7. Oracle Business Intelligence Mobile
8. Dropbox

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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. A stunning multitouch display, full Internet browsing, and capabilities for messaging, video and audio transmission, and document management make each an all-purpose platform for mobile computing.

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.

## 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 worldwide phenomenon energized by expansion of trade among nations and the emergence of the first global economy.

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 United States 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 significant percentage of the global economy depends on imports and exports. In 2015, about 57 percent of the worlds €74 trillion GDP resulted from imports and exports (World Bank, 2016). Many *Fortune* 1000 global firms derive more than half their revenues from foreign operations. Tech companies are particularly dependent on offshore revenue: 85 percent of Intel's revenues in 2015 came from overseas sales of its microprocessors, while Apple earned 60 percent of its revenue outside of the United States. Eighty percent of the toys sold in the United States are manufactured in China, while all iPhones and about 90 percent of the PCs assembled in China use American-made Qualcomm, Intel or AMD chips.

It's not just goods that move across borders; jobs do too, some of them high-level jobs that pay well and require a college degree. In the past decade, the United States lost 5 million manufacturing jobs to offshore, low-wage producers. But manufacturing is now a very small part of U.S. employment (less than 12 percent of the labor force and declining). Manufacturing jobs in the last decade have been replaced by service and retail jobs even as the value of manufactured goods made in the U.S. has soared by 20 percent in the same period, largely due to highly automated factories and enterprise information systems (Casselman, 2016). In a normal year in the United States, about 300,000 service jobs move offshore to lower-wage countries. On the plus side, the global labor force expanded from 3.2 billion to 3.4 billion during the 2010 – 2015 period, an expansion of 200 million new jobs. The U.S. economy creates more than 3.5 million new jobs in a normal, non-recessionary year. Although only 1.1 million private sector jobs were created due to slow recovery in 2011, by 2015 the U.S. economy was adding more than 2 million new jobs annually for the third straight year. Employment in information systems and the other service occupations is expanding, and wages in the tech sector are rising at 5 percent annually. Outsourcing may have accelerated the development of new systems worldwide as new systems could be developed and maintained in low-wage countries. In

part this explains why the job market for MIS and computer science graduates is growing rapidly in the United States as well as Europe, the Middle East, and Asia Pacific.

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. Throughout this book, you will find 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 City, South Dakota, or Antwerp, Belgium, is now instant and virtually free. Customers can now 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, Netflix, Alibaba, 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. 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 GE (see the Chapter 12 ending case), 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.

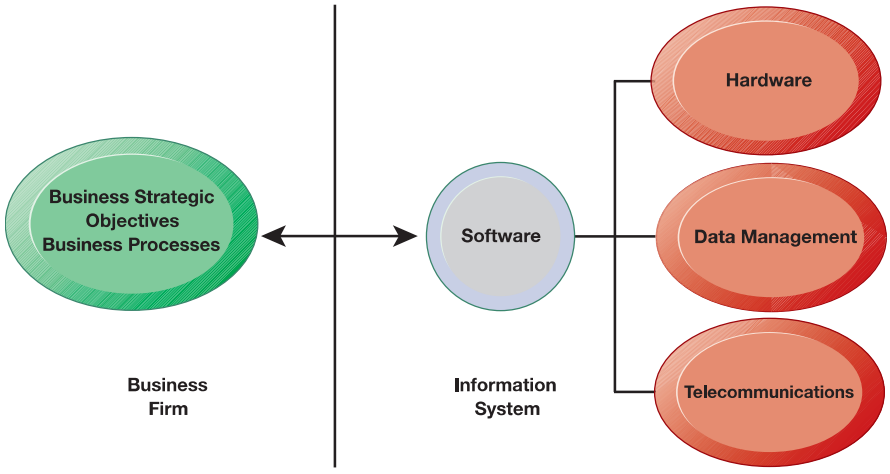
## Strategic Business Objectives of Information Systems

What makes information systems so essential today? Why are businesses investing so much in information systems and technologies? In the United States, more than 57 million managers and 120 million workers in the information and knowledge sectors in the labor force rely on information systems to conduct business. Information systems are essential for conducting day-to-day business in most 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, Volkswagen, Siemens, and GE 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

**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.

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 state of the art business practices and supportive management to achieve world-class operational efficiency. In fiscal year 2016, Walmart achieved $499 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 $600 per square foot, compared with its closest competitor, Target, at $425 a square foot and other large general merchandise retail firms producing less than $200 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 innovations, including 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 hotel group which operates hotels in Asia, Europe, and the Americas, exemplifies the use of information systems and technologies to achieve customer intimacy. These hotels use computers to keep track of guests' preferences.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.

Large national retailers in Europe, the U.S., and Asia exemplify the use of information systems to enable supplier and customer intimacy. Every time a dress shirt is bought at a store the record of the sale appears immediately on computers of suppliers like TAL Apparel Ltd. in Hong Kong, a contract manufacturer that produces one in eight dress shirts sold in the United States and Europe. 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 directly to retail stores, completely bypassing retailers' warehouses (European Commission, 2014).

## 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. 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, Privi Organics Ltd., a leading Indian company that manufactures, supplies, and exports aroma chemical products worldwide, uses the Oracle Human Capital Management system for real-time insight into individual employee information—including performance rating and compensation history. The system helps managers make faster human resource decisions, such as promotions or transfers, by integrating all employee records across the organization. Managers are able to quickly review employee performance ratings for the previous three years and drill down into more details.

## 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 the Mandarin Group 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. Today, most national banks in the world have 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.

Most nations have statutes and regulations that create a legal duty for companies and their employees to retain records, including digital records. For instance, the European Council REACH law and the U.S. Toxic Substances Control Act (1976) regulate the exposure of workers to more than 75,000 toxic chemicals and require firms to retain records on employee exposure for 30 years (European Commission, 2007). Financial regulatory agencies such as the U.S. Securities and Exchange Commission (SEC), Financial Conduct Authority (FAC UK), Financial Services Agency (FSA Japan), and the China Securities Regulatory Commission (CSRC People's Republic of China) require certified public accounting firms that audit public companies to retain audit working papers and records, including all e-mails, for five years or longer. Many other pieces

of national and regional legislation in health care, financial services, education, and privacy protection impose significant information retention and reporting requirements on global businesses. Firms turn to information systems and technologies to provide the capability to respond to these record management requirements.

## 1-2 What is an information system? How does it work? What are its management, organization, and technology components? Why are complementary assets essential for ensuring that information systems provide genuine value for organizations?

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 understood by looking at them from both a technology and a business perspective.

### What Is an Information System?

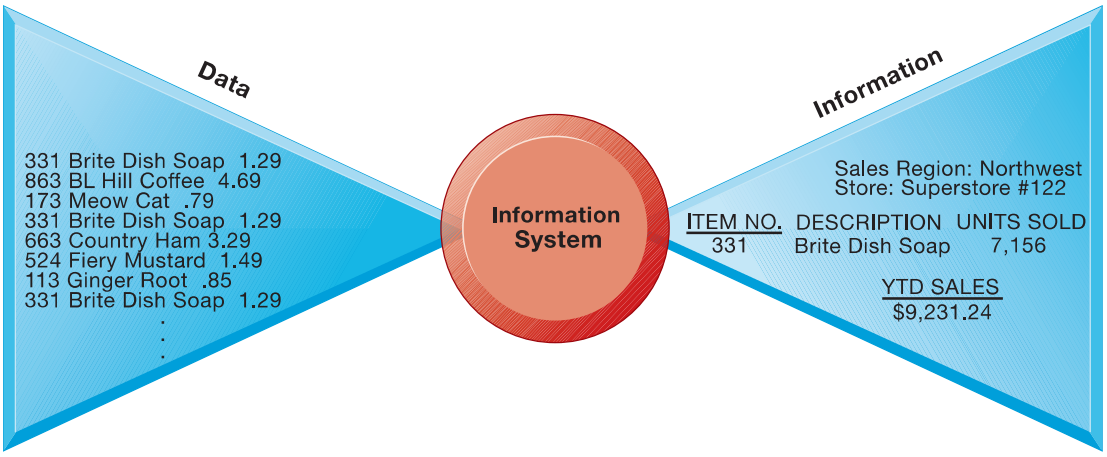
An **information system** can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization. In addition to supporting decision making, coordination, and control, information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

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

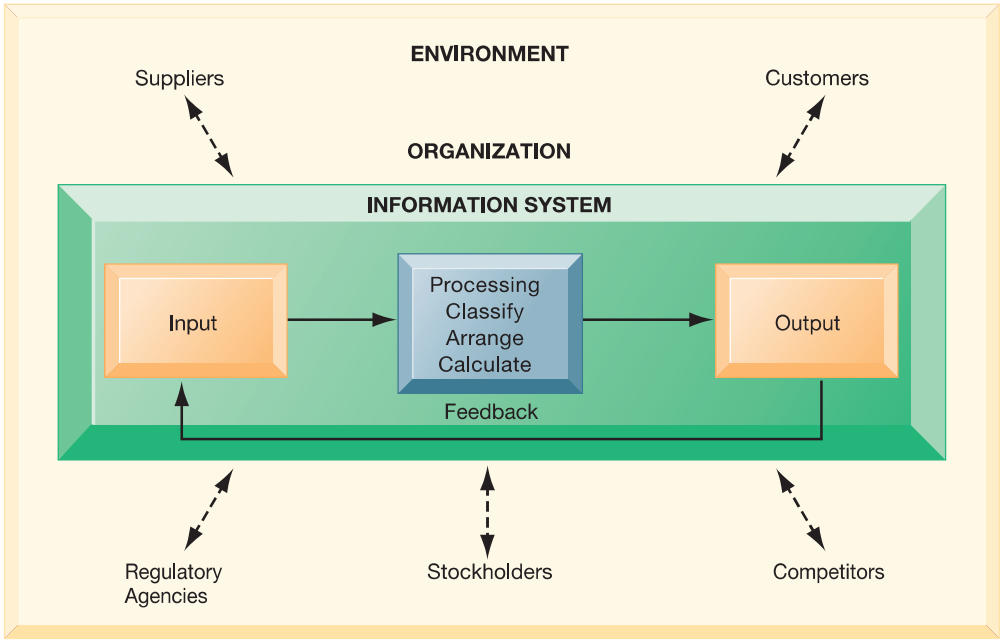
**FIGURE 1.3** DATA AND INFORMATION




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.

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.

**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.

In a professional sports team's system for selling tickets, 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. Another input would be the ticket price, which would fluctuate based on computer analysis of how much could optimally be charged for a ticket for a particular game. 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 or at a particular price, 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. Computers and related software programs are the technical foundation, the tools and materials, of modern information systems. Computers provide the equipment for storing and processing information. Computer programs, or software, are sets of operating instructions that direct and control computer processing. Knowing how computers and computer programs work is important in designing solutions to organizational problems, but computers are only part of an information system.

A house is an appropriate analogy. Houses are built with hammers, nails, and wood, but these 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 the solutions.

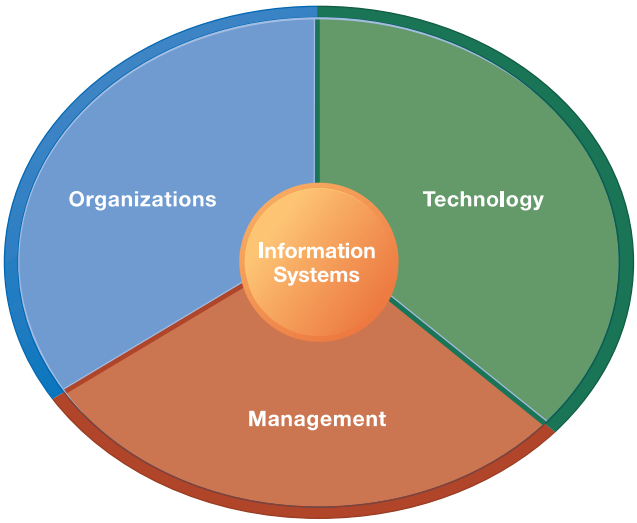
## Dimensions of Information Systems

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 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.

**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.

## 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.

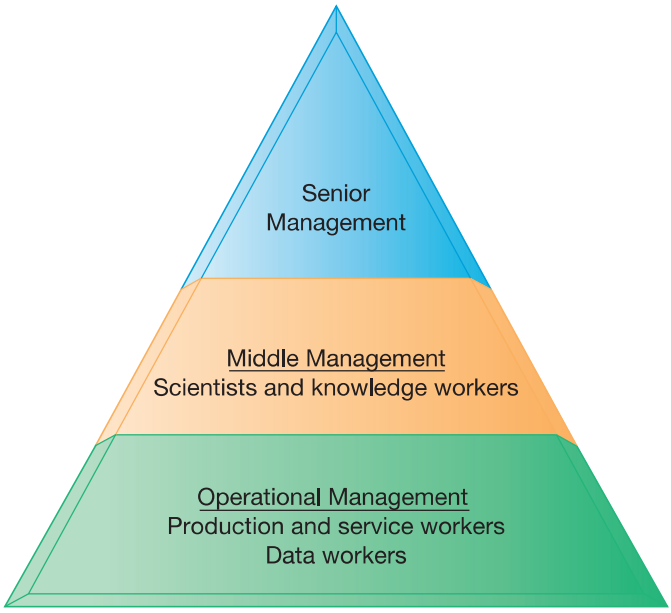
Organizations have a structure that is composed of different levels and specialties. Their structures reveal a clear-cut division of labor. Authority and responsibility in a business firm are organized as a hierarchy, or a pyramid structure. The upper levels of the hierarchy consist of managerial, professional, 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, finance and accounting, and human resources (see Table 1.1). 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.* Most organizations' business processes include formal rules that have been developed over a long time for accomplishing tasks. These

**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.

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 coworkers or customers, that are not formally documented. Information systems automate many business processes. For instance, how a customer receives credit or how a customer is billed is often determined by an information system that incorporates a set of formal business processes.

Each organization has a unique **culture**, or fundamental set of assumptions, values, and ways of doing things, that has been accepted by most of its members. 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, that the reason 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 first priority is customer service, which is

**TABLE 1.1 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 |

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 networks in more than 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.

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.

For instance, UPS operates the largest global package delivery system in the world. 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.

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 website.

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, desktop computers, wired and wireless communications networks, 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.

## INTERACTIVE SESSION: TECHNOLOGY

### Digital Transformation of Healthcare at Singapore's JurongHealth Services

Jurong Health Services, or JurongHealth, is one of Singapore's six public healthcare clusters. Healthcare clusters provide holistic and integrated care when patients move from one care setting, like a clinic, to another, like a hospital. Overall, Singapore's healthcare system comprises 8 public hospitals, 10 private hospitals, 8 national specialty centers, and an island-wide network of general medical practitioners. JurongHealth primarily manages the 700-bed Ng Teng Fong General Hospital, the 400-bed Jurong Community Hospital, and the Jurong Medical Center, all of which are located in western Singapore.

JurongHealth's goal is to provide transformative medical care for its patients through the use of innovative information technologies. Underscoring this commitment, in September 2016 JurongHealth's Ng Teng Fong General Hospital was awarded the Healthcare Information and Management Systems Society (HIMSS) Electronic Medical Record Adoption Model (EMRAM) Stage 7 Award—there are 8 stages, from 0 to 7, that measure a hospital's implementation of IT systems, and Stage 7 represents the highest level. Ng Teng Fong General thus became the first hospital in Singapore and the ASEAN region, and fifth in the Asia Pacific, to receive the award.

JurongHealth has integrated more than 50 healthcare IT systems as part of the Project OneCare initiative. The systems' implementation and integration took four years and has enabled the hospital to become paperless, scriptless, chartless, and filmless. Among the many systems implemented by the hospital are self-service kiosks to enable patients to register themselves by merely scanning their national identification cards and obtaining a queue number generated by the Enterprise Queue Management System. This unique number is used throughout the patient's visit that day for all service itineraries in the hospital. Patients refer to live screens located in the waiting areas that display a real-time queue status that shows their turn. This system has not only enabled JurongHealth to cut down on expenses but also to improve efficiency, as patients do not need different numbers for different services. It reduces waiting time and increases patient satisfaction.

Similarly, the Visitor Management System self-service kiosks enable visitors to scan their identification cards and register themselves to gain access to the hospital wards. Visitors can also register themselves and obtain an e-pass from the Visitor Registration counters that grants them access to the wards that they want to visit. The identification card or e-pass must then be scanned at the 2-in-1 Gantry when entering and leaving the ward. The 2-in-1 Gantry logs not only visitor information but also tracks staff, as they are also required to use the same gantries to visit a particular ward. Through the implementation of the Visitor Management system, the hospital can control access to the wards, and visitors or staff can be easily tracked and contacted in case of an epidemic.

Another IT system implemented is the Warehouse Management System, which eliminates the tedious process of manually counting inventory. The system uses passive radio frequency identification (RFID) technology and a two-bin shelving system to automate inventory top-up requests and improve inventory management. Once the primary compartment of the storage bin is empty, the clinical staff transfers the relevant RFID tag into a drop-box, where the reader automatically sends a request for drug replenishment, thus avoiding stock-outs.

JurongHealth has also implemented a Real-Time Location Tracking System to automatically track patients and medical equipment using Wi-Fi triangulation, low frequency exciters, and about 6,000 active RFID tags attached to patients or medical equipment. These tags continuously communicate with the low-frequency exciters to transmit data to the backend system for processing, allowing hospital staff to precisely locate patients and equipment, thus eliminating the need for tedious manual searching.

In another major move, JurongHealth made a conscious effort to ensure that the different IT systems would not be stand-alone. The hospital thus implemented an integrated Electronic Medical Record (EMR) system that combines all the functional modules of the hospital in addition to being interfaced with 140 medical devices and equipment. Using the vendor-neutral Medical Devices Middleware Integration System, data from these medical devices is directly uploaded into the EMR system, and thus no time or effort is wasted by clinical staff having to manually enter such readings, and the hospital no longer has to worry about charting errors. Being vendor-neutral also means the freedom to

adopt best-of-breed individual modules as well as a lack of reliance on a single vendor.

The EMR system has spurred other innovations such as the Electronic Patient Information Board, which enables clinic staff and nurses to view essential patient information on digital tablets, unlike most hospitals, which manually compile the information and display it at the bedside. Another example is the Inpatient Pharmacy Automation System, which receives prescriptions entered by the doctors via the EMR system and then sends machine-packed medicines to the wards using Automated Guided Vehicles that travel on pre-programmed routes and help in moving not only medication but also linen, meals, etc. At the ward, the patient's wrist tag is scanned and matched against the doctor's prescription before the medicines can be retrieved from the medical carts. Thus, only the required medication is supplied and administered to the right patient.

Another innovative use of technology is the Daily Operations Dashboard, which integrates data from different systems to show key metrics for various departments, such as emergency, outpatient clinics, inpatient wards, and surgery areas. It also analyzes, compares, and displays daily, weekly, and monthly statistics, which act as vital input for management decision making.

IT has played a key role in enabling JurongHealth to achieve its mission of providing world-class medical care at an affordable cost. As a result, JurongHealth has developed a reputation as a leading technology-driven healthcare provider as well as a role model not only in Singapore but also the entire region. This is also evident from its many accolades, which include awards for IT-driven transformation—the Project of the Year 2015–16 award by SPMI, the Singapore branch of the global professional accreditation body Project Management International—and for overall organizational transformation—"Best Companies to Work for in Asia 2014" by HR Asia.

*Sources:* P. Bhunia, "The JurongHealth IT Journey—Integrating IT from the Ground-Up into a New Digital Hospital," opengovasia.com, November 13, 2016, accessed December 21, 2016; JurongHealth, "Integrated Healthcare IT Systems at Ng Teng Fong General Hospital and Jurong Community Hospital win the Project of the Year Award at the SPMI Symposium 2016," www.jmc.com.sg, accessed December 21, 2016; JurongHealth, "Our Milestones," www.juronghealth.com.sg, October 2016, accessed December 21, 2016.

## CASE STUDY QUESTIONS

1. What technologies are used by JurongHealth? What purpose do they serve?
2. Search the web for RFID. Suggest an example of using RFID for locating and tracking people.
3. What information systems are implemented by JurongHealth? Describe the input, processing, and output of any one such system.
4. Why are information systems important for JurongHealth?

*Case contributed by Neerja Sethi and Vijay Sethi, Nanyang Technological University*

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

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.



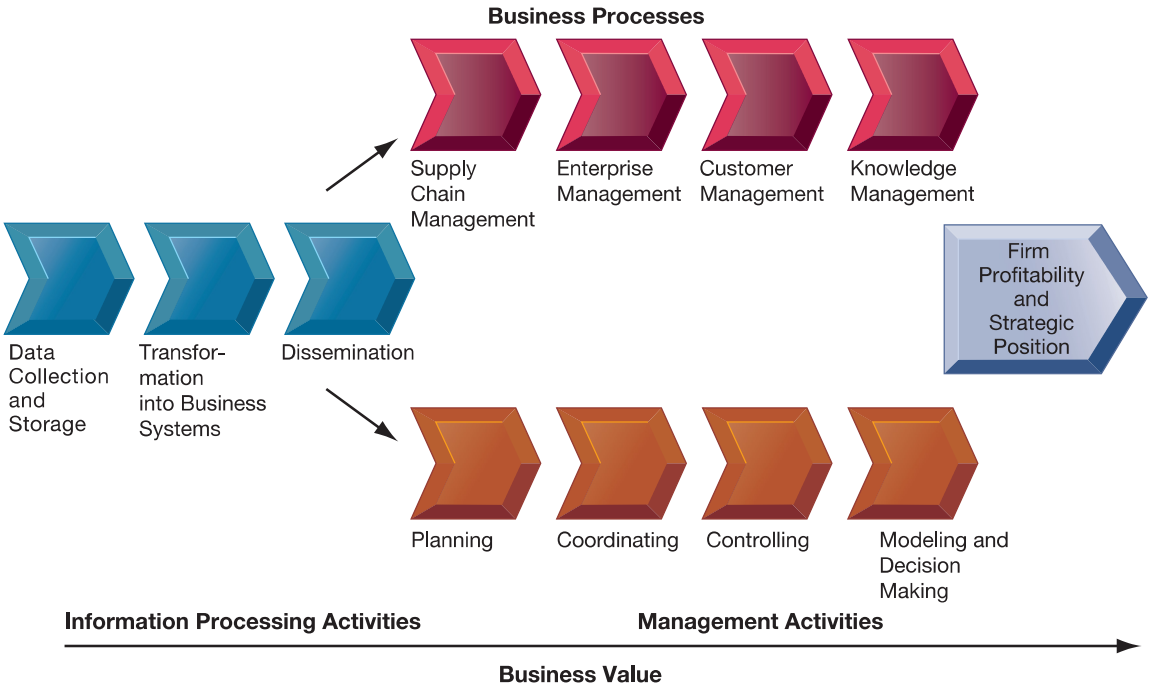
information that helps managers make better decisions or that improves the execution of business processes. For example, the information system for analyzing supermarket checkout data illustrated in Figure 1.3 can increase firm profitability by helping managers make better decisions as to which products 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 processes, and higher firm profitability. Although there are other reasons why systems are built, their primary purpose is to contribute to corporate value.

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 Rugby Football Union's systems solved the business problem presented by the need to generate revenue in a highly competitive industry. These systems created a solution that takes advantage of opportunities that new digital technology and the Internet provided. They opened up new channels for selling tickets and interacting with customers, optimized ticket pricing, and used new tools to analyze player performance. These systems were essential in improving the rugby teams' overall business performance. The diagram also illustrates

**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.

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

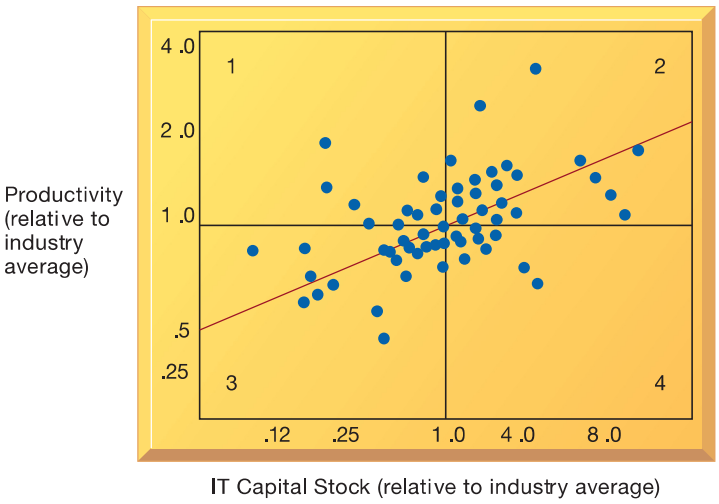
## Complementary Assets: Organizational Capital and the Right Business Model

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.

**Complementary assets** are those assets required to derive value from a primary investment (Teece, 1998). For instance, to realize value from automobiles requires substantial complementary investments in highways, roads, gasoline

**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).

stations, repair facilities, and a legal regulatory structure to set standards and control drivers.

Research 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, 2005; Brynjolfsson and Hitt, 2000; Laudon, 1974). These investments in organization and management are also known as **organizational and management capital**.

Table 1.2 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.

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

**TABLE 1.2 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 |

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.

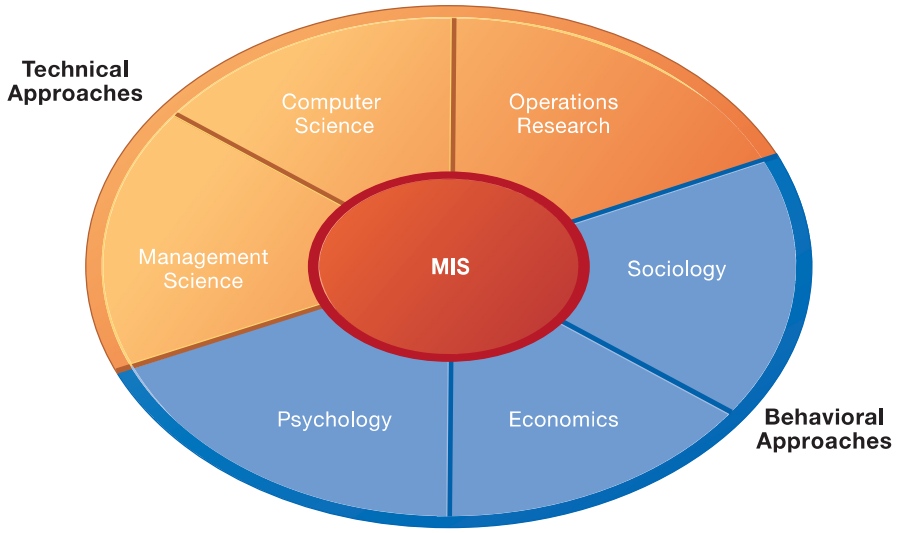
## 1-3 What academic disciplines are used to study information systems, and how does each contribute to an understanding of information systems?

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.

### 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.

**FIGURE 1.9 CONTEMPORARY APPROACHES TO INFORMATION SYSTEMS**




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

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.

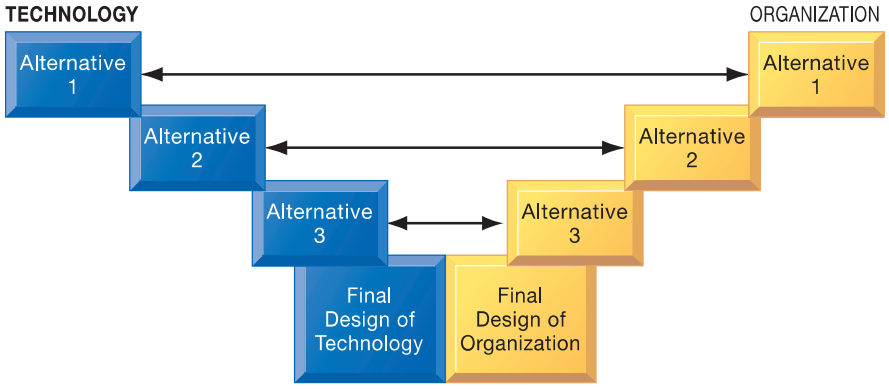
Our experience as academics and practitioners leads us to believe that no single approach effectively captures the reality of information systems. The successes and failures of information systems are rarely all technical or all behavioral. Our best advice to students is to understand the perspectives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

# Review Summary

**1-1** *How are information systems transforming business, and why are they essential for running and managing a business today?*

E-mail, online conferencing, smartphones, and tablet computers 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, big data, and cloud computing.

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.

**1-2** *What is an information system? How does it work? What are its management, organization, and technology components? Why are complementary assets essential for ensuring that information systems provide genuine value for organizations?*

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.

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, and 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.

**1-3** *What academic disciplines are used to study information systems, and how does each contribute to an understanding of information systems?*

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, 47*
*Business model, 42*
*Business processes, 40*
*Complementary assets, 54*
*Computer hardware, 49*
*Computer literacy, 46*
*Computer software, 49*
*Culture, 48*
*Data, 44*
*Data management technology, 49*
*Data workers, 47*
*Digital firm, 40*
*Extranets, 50*
*Feedback, 46*
*Information, 44*
*Information system, 44*
*Information systems literacy, 46*
*Information technology (IT), 44*
*Information technology (IT) infrastructure, 50*
*Input, 45*
*Internet, 49*
*Intranets, 50*
*Knowledge workers, 47*
*Management information systems (MIS), 46*
*Middle management, 47*
*Network, 49*
*Networking and telecommunications technology, 49*
*Operational management, 47*
*Organizational and management capital, 55*
*Output, 46*
*Processing, 45*
*Production or service workers, 47*
*Senior management, 47*
*Sociotechnical view, 58*
*World Wide Web, 50*

## MyLab MIS

To complete the problems marked with the MyLab MIS, go to the EOC Discussion Questions in MyLab MIS.

## Review Questions

**1-1** How are information systems transforming business, and why are they so essential for running and managing a business today?

- 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.
- List and briefly describe the six strategic business objectives of information systems.

**1-2** What is an information system? How does it work? What are its management, organization, and technology components? Why are complementary assets essential for ensuring that information systems provide genuine value for organizations?

- 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.
- Describe the flow of information through the business information value chain..
- Describe the complementary social, managerial, and organizational assets required to optimize returns from information technology investments.

**1-3** What academic disciplines are used to study information systems, and how does each contribute to an understanding of information systems?

- 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

**1-4** MyLabMIS What does it mean to describe the world as "flat"?

**1-5** MyLabMIS If you were setting up the website for a competitive rugby team, what management, organization, and technology issues might you encounter?

**1-6** MyLabMIS What do you think were some of the key managerial and organizational decisions that helped make JurongHealth Services' IT efforts so successful?

## Hands-On MIS Projects

The projects in this section give you hands-on experience in analyzing financial reporting and inventory management problems, using data management software to improve management decision making about increasing sales, and using Internet software for researching job requirements. Visit MyLab MIS's Multimedia Library to access this chapter's Hands-On MIS Projects.

### Management Decision Problems

**1-7** Warbenton Snack Foods is a manufacturer of potato crisps and savoury snacks in the U.K. Warbenton's financial department uses spreadsheets and manual processes for much of its data gathering and reporting. Warbenton's financial analyst would spend the entire final week of every month collecting spreadsheets from the heads of various departments. 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 then wait for the department to resubmit 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.

**1-8** Rabatt operates deep-discount stores offering housewares, cleaning supplies, clothing, health and beauty aids, and packaged food throughout Germany, with most items selling for 1 euro. Its business model calls for keeping costs as low as possible. 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

**1-9** In this project, you will start out with raw transactional sales data and use Microsoft Access database software to develop queries and reports that help managers make better decisions about product pricing, sales promotions, and inventory replenishment. In MyLab MIS, you can find a Store and Regional Sales Database developed in Microsoft Access. The database contains raw data on weekly store sales of computer equipment in various sales regions. The database includes fields for store identification number, sales region, item number, item description, unit price, units sold, and the weekly sales period when the sales were made. Use Access to develop some reports and queries to make this information more useful for running the business. Sales and production managers want answers to the following questions:

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

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

### Improving Decision Making: Using the Internet to Locate Jobs Requiring Information Systems Knowledge

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

**1-10** Visit a job-posting website such as Monster.com. Spend some time at the site 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.

## Collaboration and Teamwork Project

### Selecting Team Collaboration Tools

**1-11** Form a team with three or four classmates and review the capabilities of Google Drive and Google Sites for your team collaboration work. Compare the capabilities of these two tools for storing team documents, project announcements, source materials, work assignments, illustrations, electronic presentations, and web pages of interest. Learn how each works with Google Docs. Explain why Google Drive or Google Sites is more appropriate for your team. If possible, use Google Docs to brainstorm and develop a presentation of your findings for the class. Organize and store your presentation using the Google tool you have selected.

## Are Farms Becoming Digital Firms?

**CASE STUDY**

Ohio farmer Mark Bryant raises corn, soybeans, and soft red winter wheat on 12,000 acres. But you'll hardly ever see him on a tractor because that isn't how farms work anymore. Bryant spends most of his time monitoring dashboards full of data gathered from the 20 or so iPhones and five iPads he has supplied to employees who report on his acreage in real time. Using software from a Google-funded startup called Granular, Bryant analyzes the data along with data gathered from aircraft, self-driving tractors, and

other forms of automated and remote sensors for yield, moisture, and soil quality.

Tractors themselves have been morphed into pieces of intelligent equipment, and are now much smarter. Many tractors and combines today are guided by Global Positioning System (GPS) satellite-based navigation systems. The GPS computer receives signals from earth-orbiting satellites to track each piece of equipment's location and where it has gone. The system helps steer the equipment so farmers are able to monitor progress on iPads and other tablet computers in their tractor cabs.

The world's largest producer of autonomous four-wheeled vehicles isn't Tesla or Google, it's John Deere. The cab of one of Deere's self-driving tractors is now so full of screens and tablets that it looks like the cockpit of a jet airplane. John Deere and its competitors aren't just turning out tractors, combines, and trucks that can drive themselves, they are also turning out wirelessly connected sensors that map every field as well as planting and spraying machines that can use computerized instructions to apply seed and nutrients to a field.

Deere & Co. has embedded information technology in all of its farming equipment, creating an ecosystem for controlling sprayers, balers, and planters. Deere products include AutoTrac GPS-controlled assisted-steering systems, which allow equipment operators to take their hands off the wheel; JDLink, which enables machinery to automatically upload data about fields to a remote computer center and farmers to download planting or fertilizing instructions; and John Deere Machine Sync, which uses GPS data to create maps based on aerial or satellite photos to improve planting, seeding, spraying, and nutrient application.

Deere now ranks among the leading companies offering tools for farmers to practice what is known as precision agriculture. Managing fields with this level of computerized precision means farmers need to use fewer loads of fertilizer, potentially saving an individual farmer tens of thousands of dollars. Some also see precision agriculture as the solution to feeding the world's exploding population. By 2050, the world's population is predicted to be 9.2 billion people, 34 percent higher than today. More people will have the means to purchase food that requires more land, water, and other resources to produce. To keep up with rising populations and income growth, global food production must increase by 70 percent and precision agriculture could make this possible. Farmers using fertilizer, water, and energy to run equipment more precisely are less wasteful, and this also promotes the health of the planet.

Other large agricultural companies like Monsanto and Dupont are big precision agriculture players, providing data analysis and planting recommendations to farmers who use their seeds, fertilizers, and herbicides. Because adjustments in planting depth or the distance between crop rows can make a big difference in crop yields, these companies want their computers to analyze the data generated during computerized planting work to show farmers how to further increase their crop output.

The farmer provides data on his or her farm's field boundaries, historic crop yields, and soil conditions to these companies or another agricultural data analysis company, which analyzes the data along with other data it has collected about seed performance and soil types in different areas. The company doing the data analysis then sends a computer file with recommendations back to the farmer, who uploads the data into computerized planting equipment. The farmer's planting equipment follows the recommendations as it plants fields. For example, the recommendations might tell an Iowa corn farmer to lower the number of seeds planted per acre or to plant more seeds per acre in specified portions of the field capable of growing more corn. The farmer might also receive advice on the exact type of seed to plant in different areas. The data analysis company monitors weather and other factors to advise farmers how to manage crops as they grow.

A software application developed by Monsanto called FieldScripts takes into account variables such as the amount of sunlight and shade and variations in soil nitrogen and phosphorous content down to an area as small as a 10-meter-by-10-meter grid. Monsanto analyzes the data in conjunction with the genetic properties of its seeds, combines all this information with climate predictions, and delivers precise planting instructions or "scripts" to iPads connected to planting equipment in the field. Tools such as FieldScripts would allow farmers to pinpoint areas that need more or less fertilizer, saving them the cost of spreading fertilizer everywhere while boosting their yields in areas that have performed more poorly and reducing the amount of excess fertilizer that enters the water table—good for the environment.

Prescriptive planting could help raise the average corn harvest to more than 200 bushels an acre from the current 160 bushels, some experts say. On a larger scale, according to Monsanto, the world's largest seed company, data-driven planting advice

to farmers could increase worldwide crop production by about $20 billion a year. So far, output from prescriptive planting systems has not achieved those spectacular levels.

Is there a downside to all of this? For small farmers, the answer may be yes. The costs of investing in the new technology and vendor service fees for some of these tools such as FieldScripts can amount to more than what many small farmers can earn in extra yield from their farms. According to Sara Olson of Lux Research Inc., the problem with precision agriculture is the diminishing returns that come along with costly technologies on smaller farms. That means that only the really big farms are likely to benefit.

Monsanto estimates that FieldScripts will improve yields by five to 10 bushels per acre. With corn at about $4 per bushel, that's an increase of $20 to $40 per acre. A small farm of about 500 acres could get anywhere from $10,000 to $20,000 in extra revenue. Monsanto charges around $10 per acre for the service, so the farm will wind up paying about $5,000—in addition to paying tens of thousands of dollars to either retrofit its existing planting equipment or buy more modern tractors that include the electronics gear that syncs the "scripts" provided by the Monsanto online service with the planter's onboard navigation systems. Monsanto also charges an extra $15 per acre for its local climate prediction service. A small farm will most likely lose money or break even for the first two years of using a service like FieldScripts, according to Olson.

For a large farm of about 5,000 acres, FieldScripts could increase revenues by between $100,000 and $200,000. With Monsanto's service costing about $50,000, that farm's total profits will run between $50,000 to $150,000, more than sufficient to offset the cost of updating farm machinery. Whether a farm is big or small, the impact of FieldScripts would be minimal in good years because yields would be high regardless. The technology is likely to have a bigger impact in years when conditions aren't so propitious. A spokesperson for Monsanto stated that the outcome of its prescriptive planting system is less about the size of the farm and more about the farmer's technology know-how. According to Michael Cox, codirector of investment research at securities firm Piper Jaffray Cos., revenue from FieldScripts and other technology-driven products and services could account for 20 percent of Monsanto's projected growth in per-share earnings by 2018.

Although some farmers have embraced prescriptive planting, others are critical. Many farmers are suspicious about what Monsanto and DuPont might do with the data collected about them. Others worry about seed prices rising too much because the big companies that developed prescriptive planting technology are the same ones that sell seeds. (There has been a surge in seed prices during the past 15 years as the biggest companies increased their market share. Monsanto and DuPont now sell about 70 percent of all corn seed in the United States.) Farmers also fear that rivals could use the data to their own advantage. For instance, if nearby farmers saw crop-yield information, they might rush to rent farmland, pushing land and other costs higher. Other farmers worry that Wall Street traders could use the data to make bets on futures contracts. If such bets push futures-contract prices lower early in the growing season, it might squeeze the profits farmers might lock in for their crops by selling futures.

There are not yet any publicly known examples where a farmer's prescriptive-planting information has been misused. Monsanto and DuPont officials say the companies have no plans to sell data gathered from farmers. Monsanto has stated that it supports industrywide standards for managing information collected from fields and that it wouldn't access the data without permission from farmers. Deere & Co., which has been working with DuPont and Dow Chemical Co. to formulate specialized seed-planting recommendations based on data from its tractors, combines, and other machinery, says it obtains consent from customers before sharing any of their data.

Some farmers have discussed aggregating planting data on their own so they could decide what information to sell and at what price. Others are working with smaller technology companies that are trying to keep agricultural giants from dominating the prescriptive-planting business. Startups such as Farmobile LLC, Granular Inc., and Grower Information Services Cooperative are developing information systems that will enable farmers to capture data streaming from their own tractors and combines, store the data in their own remote data centers, and market the data to seed, pesticide, and equipment companies or futures traders if they so choose. Such platforms could help farmers wring larger profits from precision farming and give them more control over the information generated on their fields.

*Sources:* "Precision Agriculture," www.research.ibm.com, accessed April 4, 2016; Matthew J. Grassi, "Agrible Launches Nutrient Forecasting, Spray Smart Features," PrecisionAg, March 9, 2016; www.monsanto.com, accessed April 4, 2016; Jacob Bunge, "On the Farm: Startups Put Data in Farmers' Hands," *Wall Street Journal,*

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## CASE STUDY QUESTIONS

**1-12** List and describe the technologies used in this case study.

**1-13** In what sense are U.S. farms now digital firms? Explain your answer.

**1-14** How is information technology changing the way farmers run their business?

**1-15** How do the systems described in this case improve farming operations?

**1-16** How do precision agriculture systems support decision making? Identify three different decisions that can be supported.

**1-17** How helpful is precision agriculture to individual farmers and the agricultural industry? Explain your answer.

## MyLab MIS

Go to the Assignments section of MyLab MIS to complete these writing exercises.

**1-18** What are the strategic objectives that firms try to achieve by investing in information systems and technologies? For each strategic objective, give an example of how a firm could use information systems to achieve the objective.

**1-19** Describe the complementary assets that firms need in order to optimize returns from their information system investments. For each type of complementary asset, give an example of a specific asset a firm should have.

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