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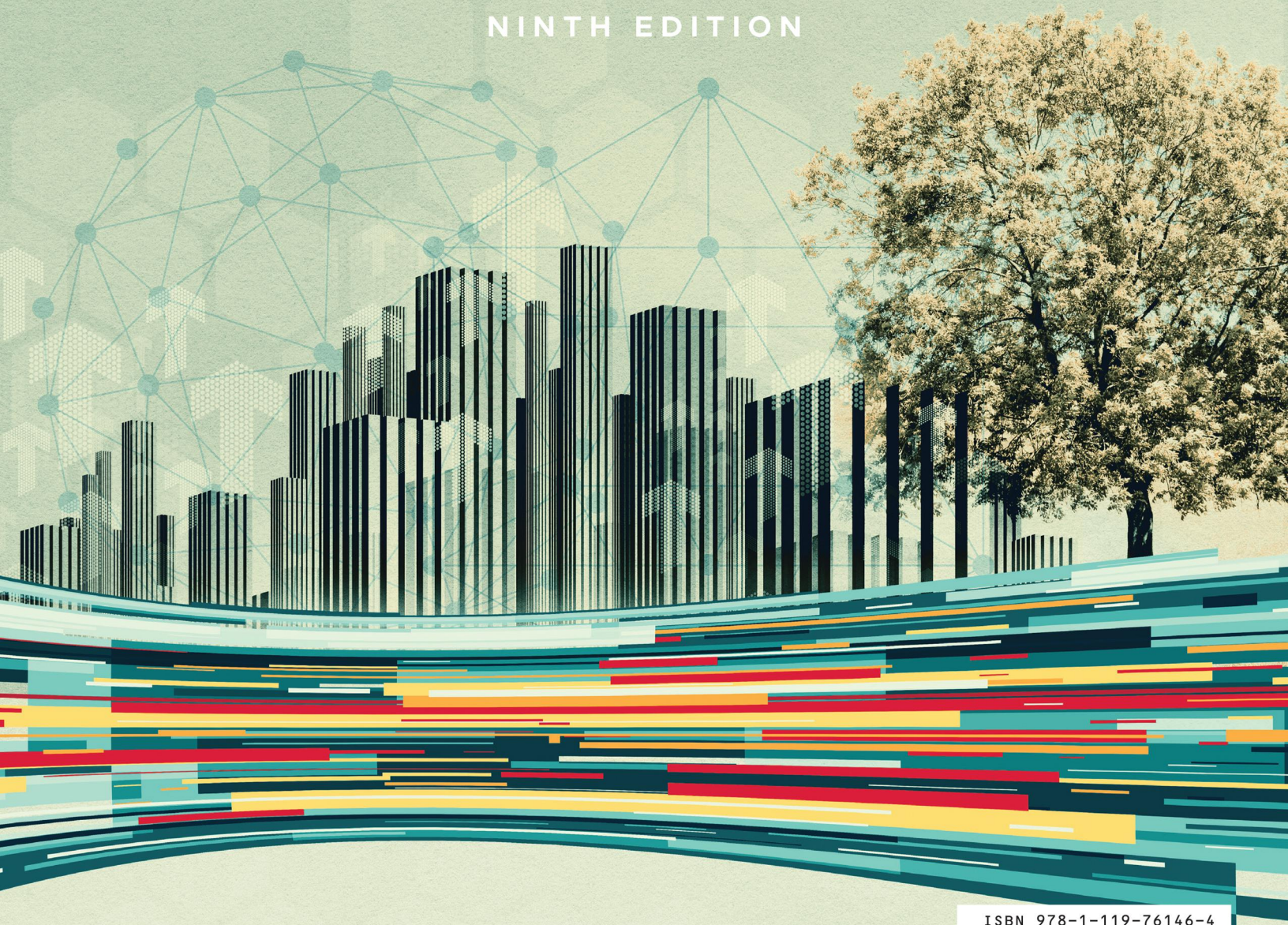
# INTRODUCTION TO INFORMATION SYSTEMS

R. KELLY RAINER | BRAD PRINCE

NINTH EDITION



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# Introduction to Information Systems

## Supporting and Transforming Business

Ninth Edition

R. KELLY RAINER JR.

BRAD PRINCE

WILEY

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The entire focus of this book is to help students become informed users of information systems and information technology. In general, informed users receive increased value from organizational information systems and technologies. We hope to help students do just that.

## What Do Information Systems Have to Do with Business?

This edition of Rainer and Prince's *Introduction to Information Systems* will answer this question for you. In every chapter, you will see how real global businesses use technology and information systems to increase their profitability, gain market share, develop and improve their customer relations, and manage their daily operations. In other words, you will learn how information systems provide the foundation for all modern organizations, whether they are public sector, private section, for-profit, or not-for-profit. We have several goals for all business majors, particularly undergraduates. First, we want to teach you how to use information technology to help you master your current or future jobs to help ensure the success of your organizations. Second, we want you to become *informed users* of information systems and information technology. Third, we want you to understand the digital transformation that your organization will likely be undergoing. The digital transformation of organizations is the acceleration of existing business processes and the development of new processes and business models. In this way, organizations can capitalize on the capabilities and opportunities of various technologies to improve performance. Examples of these technologies include Big Data, cloud computing, artificial intelligence, the Internet of Things, mobile computing, and commerce. We address each of these in our book. To accomplish these goals, we focus on not merely *learning* the concepts of information technology but rather on *applying* those concepts to perform business more effectively and efficiently. We concentrate on placing information systems in the context of business, so that you will more readily grasp the concepts we present in the text.

## Pedagogical Structure

Various pedagogical features provide a structured learning system that reinforces the concepts through features such as chapter-opening organizers, section reviews, study aids, frequent applications, and hands-on exercises and activities.

Chapter-opening organizers include the following pedagogical features:

- **Chapter Outline:** Lists the major concepts covered in each chapter.
- **Learning Objectives:** Provide an overview of the key learning goals that students should achieve after reading the chapter.
- **Opening Cases:** With the exception of Chapter 8, chapter-opening cases address a business problem faced by actual organizations and how they employ information systems and information technology to solve these issues. The cases generally consist of a description of the problem, an overview of the IS solutions implemented, and a presentation of the results of the implementation. Each case closes with discussion questions so that students can further explore the concepts presented in the case.

  Chapter 8's opening case addresses how pro-democracy protesters in Hong Kong have used a variety of technologies that make it easier and safer for them to communicate and collaborate. These technologies include mesh networks, encrypted messaging apps, a Reddit-like forum, and online anonymity measures. An important aspect of this case for students is that information systems impact societies as a whole, not just organizations.

Study aids are provided throughout each chapter. These include the following:

- IT's About Business cases provide real-world applications, with questions that relate to concepts covered in the text. Icons relate these sections to the specific functional areas in the text.
- Highlighted examples interspersed throughout the text illustrate the use (and misuse) of IT by real-world organizations, thus making the conceptual discussion more concrete.
- Tables list key points or summarize different concepts.
- End-of-section reviews (Before You Go On…) prompt students to pause and test their understanding of basic concepts before moving on to the next section.

End-of-chapter study aids provide extensive opportunity for the reader to review:

- What's in IT for Me? is a unique chapter summary section that demonstrates the relevance of topics for

different functional areas (accounting, finance, marketing, production/operations management, and human resources management).

- The chapter Summary, keyed to learning objectives listed at the beginning of the chapter, enables students to review the major concepts covered in the chapter.
- The end-of-chapter Glossary facilitates studying by listing and defining all the key terms introduced in the chapter.
- Closing cases in each chapter address a business problem faced by actual companies and how they used IS to solve these issues. The cases generally consist of a description of the problem, an overview of the IS solution implemented, and a presentation of the results of that implementation. Each case is followed by discussion questions so that students can further explore the concepts presented in the case.

Hands-on exercises and activities require the reader to do something with the concepts they have studied. These include the following:

- Apply the Concept Activities: This book's unique pedagogical structure is designed to keep students actively engaged with the course material. Reading material in each chapter subsection is supported by an "Apply the Concept" activity that is directly related to a chapter objective. These activities include links to online videos and articles and other hands-on activities that require students to immediately apply what they have learned. Each Apply the Concept has the following elements:
  - Background (places the activity in the context of relevant reading material)
  - Activity (a hands-on activity that students carry out)
  - Deliverable (various tasks for students to complete as they perform the activity)
- Discussion Questions and Problem-Solving Activities: Provide practice through active learning. These exercises are hands-on opportunities to apply the concepts discussed in the chapter.

# Key Features

We have been guided by the following goals that we believe will enhance the teaching and learning experience.

## What's in IT for Me? Theme

We emphasize the importance of information systems by calling attention in every chapter to how that chapter's topic relates to each business major. Icons guide students to relevant issues for their specific functional area—accounting (ACC), finance (FIN), marketing (MKT), production operations management (POM), human resources management (HRM), and management information systems (MIS). Chapters conclude with a detailed summary (entitled "What's in IT for Me?") of how key concepts in the chapter relate to each functional area.

## Active Learning

We recognize the need to actively involve students in problem solving, creative thinking, and capitalizing on opportunities. Therefore, we have included in every chapter a variety of hands-on exercises, activities, and mini-cases, including exercises that require students to use software application tools. Through these activities and an interactive website, we enable students to apply the concepts they learn.

## Diversified and Unique Examples from Different Industries

Extensive use of vivid examples from large corporations, small businesses, and government and not-for-profit organizations enlivens the concepts from the chapter. The examples illustrate everything from the capabilities of information systems, to their cost and justification and the innovative ways that corporations are using IS in their operations. Small businesses have been included to recognize the fact that many students will work for small- to mid-sized companies, and some will even start their own small business. In fact, some students may already be working at local businesses, and the concepts they are learning in class can be readily observed or put into practice in their jobs. Each chapter constantly highlights the integral connection between business and IS. This connection is especially evident in the chapter-opening and closing cases, the "IT's About Business" boxes, and the highlighted examples.

## Successes and Failures

Many textbooks present examples of the successful implementation of information systems, and our book is no exception. However, we go one step beyond by also providing numerous examples of IS failures, in the context of lessons that can be learned from such failures. Misuse of information systems can be very expensive.

## Global Focus

An understanding of global competition, partnerships, and trading is essential to success in a modern business environment. Therefore, we provide a broad selection of international cases and examples. We discuss the role of information systems in facilitating export and import, the management of international companies, and electronic trading around the globe.

## Innovation and Creativity

In today's rapidly changing business environment, creativity and innovation are necessary for a business to operate effectively and profitably. Throughout our book, we demonstrate how information systems facilitate these processes.

## Focus on Ethics

With corporate scandals appearing in the headlines almost daily, ethics and ethical questions have come to the forefront of businesspeople's minds. In addition to devoting an entire chapter to ethics and privacy (Chapter 3), we have included examples and cases throughout the text that focus on business ethics.

## A Guide to Icons in This Book

As you read this book, you will notice a variety of icons interspersed throughout the chapters.

**These icons highlight material relating to different functional areas.** MIS concepts are relevant to all business careers, not just careers in IT. The functional area icons help students of different majors quickly pick out concepts and examples of particular relevance to them. Below is a quick reference of these icons:

ACCT **For the Accounting Major** highlights content relevant to the functional area of accounting.

FIN **For the Finance Major** highlights content relevant to the functional area of finance.

MKT **For the Marketing Major** highlights content relevant to the functional area of marketing.

POM **For the Production/Operations Management Major** highlights content relevant to the functional area of production/operations management.

HRM **For the Human Resources Major** highlights content relevant to the functional area of human resources.

MIS **For the MIS Major** highlights content relevant to the functional area of MIS.

# What's New in Rainer *Introduction to Information Systems*, 9e

The new edition includes all new or updated chapter opening cases, chapter closing cases, and IT's About Business.

# Highlights of Rainer 9e (or New Material)

## Digital Transformation of Organizations

More than likely, students will go to work for companies that are undergoing digital transformation. We emphasize digital transformation and the information technologies that drive such transformations (see Chapter 1's opening case, IT's About Business 1.1, IT's About Business 1.2, IT's About Business 1.3, and Chapter 1's closing case). The technologies that drive digital transformation include Big Data (see Chapter 5), broadband Internet access (see Chapter 6), wireless and mobile computing (see Chapter 8), the Internet of Things (see Chapter 8), social computing (see Chapter 9), business analytics (see Chapter 12), agile systems development methods (see Chapter 13), cloud computing (see Technology Guide 3), and artificial intelligence (see Chapter 14).

## Artificial Intelligence

In our all-new Chapter 14, we address the critically important topic of artificial intelligence.

- We first carefully define AI in terms of the tasks that humans perform, rather than how humans think. We then compare the capabilities of natural intelligence and artificial intelligence.
- We differentiate between weak AI and strong AI.
- We define supervised machine learning, semi-supervised machine learning, reinforcement learning, unsupervised machine learning, and deep learning.
- We address bias in machine-learning systems.
- We define neural networks and how they function.
- We discuss various applications of AI, including computer vision, natural language processing, robotics, speech recognition, and intelligent agents.
- We provide a thorough discussion of AI applications in the functional areas, including accounting, finance, marketing, production/operations management, human resource management, and MIS.

## Business Analytics

In Chapter 12, we expanded our discussion of the difference between analytics and statistics, added real-world scenarios that allow students to apply the business analytics process (Figure 12.3), and added a discussion of Google Analytics.

## Social Computing

In Chapter 9, we added a section called "Problems with Social Computing." We address three serious issues with social media platforms. First, they allow almost anyone to publish any content. Second, the platforms employ psychological measures to keep visitors on their sites longer. Third, third-party entities employ various means to spread their messages. Our discussion includes bots, cyborgs, trolls, troll farms, fake news, and deepfakes, as well as the infinite scroll and randomly scheduled rewards.

## E-Business and E-Commerce

In Chapter 7, we provide an expanded discussion of blockchain technology. We provide examples of the use of blockchains, including cryptocurrencies such as Bitcoin, the energy grid, digital content creators (e.g., music and journalism), and along supply chains.

## Telecommunications and Networking

In Chapter 6, we provide an expanded discussion of the evolution of the Web, from Web 1.0 to Web 5.0.

## Hardware

- In Technology Guide 1, we added a new section addressing augmented reality (AR), virtual reality (VR), and mixed reality (MR). We provide numerous real-world examples of AR, VR, and MR.
- We added a brief discussion of why Moore's Law is slowing down.
- We also added brief discussions of graphics processing units and quantum computing.

## Cloud Computing

- In Technology Guide 3, we added a new section comparing the "Big Three" cloud computing vendors: Amazon Web Services, Microsoft Azure, and the Google Cloud Platform.
- We also added a discussion of multi–cloud computing environments.

# Online Resources

This text also facilitates the teaching of an introductory IS course by providing extensive support materials for instructors and students. Go to **www.wiley.com** to access the Student and Instructor websites.

# Instructor's Manual

The Instructor's Manual includes a chapter overview, teaching tips and strategies, answers to all end-of-chapter questions, supplemental mini-cases with essay questions and answers, and experiential exercises that relate to particular topics.

# Test Bank

The Test Bank is a comprehensive resource for test questions. It contains multiple-choice, true/false, short answer, and essay questions for each chapter. The multiple-choice and true/false questions are labeled according to difficulty: easy, medium, or hard.

# Computerized Test Bank

Wiley provides complimentary software to generate print exams or to import test bank questions into standard LMS formats. The assessment items available in this software are a subset of those in the WileyPLUS question banks. See the assignment banks in WileyPLUS for the complete catalog of assessment items related to your adopted text.

# PowerPoint Presentations

The PowerPoint presentations consist of a series of slides for each chapter of the text, are designed around the text content, and incorporate key points from the text and all text illustrations as appropriate.

# Weekly Updates

Weekly updates, harvested from around the Web by David Firth of the University of Montana, provide you with the latest IT news and issues. These are posted every Monday morning throughout the year at http://wileyinformationsystemsupdates.com and include links to articles and videos as well as discussion questions to assign or use in class.

# OfficeGrader

OfficeGrader is an Access-based VBA macro that enables automatic grading of Office assignments. The macros compare Office files and grade them against a master file. OfficeGrader is available for Word, Access, Excel, and PowerPoint for Office 2010 and Office 2013. For more information, contact your Wiley sales representative or visit the book companion site and click on "OfficeGrader."

# WileyPlus

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Instructor Resources include:

- Lecture Videos—The authors provide an extensive series of lecture videos, ranging in length from 3 minutes to 10 minutes. The videos explain key concepts throughout

the book, with each clip addressing a single concept. In this way, the lecture videos reinforce key concepts in the text without being confusing to the students. (*Note:* This feature is only available in WileyPLUS.)

- Data Analytics & Business Module—With the emergence of data analytics transforming the business environment, Wiley has partnered with business leaders in the Business-Higher Education Forum (BHEF) to identify the competencies graduates need to be successful in their careers. As a result, WileyPLUS includes a new data analytics module with industry-validated content that prepares operations management students for a changing workforce. (*Note:* This feature is only available in WileyPLUS.)
- Activity Links and Starter Files—Apply the Concept activities link out to the Web, providing videos for students to view and use in the activities. When appropriate, students are provided with starter files to complete as part of the deliverable.
- Database Activity Solution Files—Every database activity in the book comes with a solution file that can be used in the Office Grader Application or by an individual to grade the students' submissions.
- Database Activity Starter Files—When appropriate, students are provided with starter files to complete as part of the deliverable.
- Instructor's Manual—This guide contains detailed solutions to all questions, exercises, and problems in the textbook.
- Practice Quizzes—These quizzes give students a way to test themselves on course material before exams. Each chapter exam contains fill-in-the-blank, application, and multiple-choice questions that provide immediate feedback with the correct answer.
- Reading Quizzes—These quizzes reinforce basic concepts from the reading.
- Spreadsheet Activity Solution Files—Every spreadsheet activity in the book comes with a solution file that can be used in the Office Grader Application or by an individual to grade the students' submissions.

Student Resources include:

- Video Lectures—The authors are featured in these video lectures, which provide explanations of key concepts throughout the book. (*Note:* This feature is only available in WileyPLUS.)
- Practice Quizzes—These quizzes give students a way to test themselves on course material before exams. Each chapter exam contains fill-in-the-blank, application, and multiple-choice questions that provide immediate feedback with the correct answer.
- *Microsoft Office 2013/2016/2019 Lab Manual & Instructor Resources*—by Ed Martin, CUNY-Queensborough is a thorough introduction to the Microsoft Office products of Word, Excel, Access, and PowerPoint with screenshots that show students step-by-step instructions on basic MS Office tasks.

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# Brief Contents

# Contents

# Introduction to Information Systems

| CHAPTER OUTLINE | LEARNING OBJECTIVES |
|---|---|
| **1.1 Why Should I Study Information Systems?** | **1.1** Identify the reasons why being an informed user of information systems is important in today's world. |
| **1.2 Overview of Computer-Based Information Systems** | **1.2** Describe the various types of computer-based information systems in an organization. |
| **1.3 How Does IT Impact Organizations?** | **1.3** Discuss ways in which information technology can affect managers and nonmanagerial workers. |
| **1.4 Importance of Information Systems to Society** | **1.4** Identify positive and negative societal effects of the increased use of information technology. |

## Opening Case

### MIS POM The Digital and Physical Transformation of Grocery Stores

#### The Problem

In 1916, Piggly Wiggly invented the full-service grocery store that we know today. The grocer launched the shopping cart, checkout lanes, browsable aisles, and price tags on items, all of which were technological disruptions at that time. Significantly, customers buy groceries today in almost the same way that they did in 1916. They travel to a brick-and-mortar store, select products off the shelves, and self-deliver their products to their homes.

The modern grocery business is huge and complex, has very small profit margins, and is intensely competitive. The global volume of grocers is approximately $6 trillion annually. In the United States, the industry volume totals some $700 billion per year and represents roughly half of all retail sales. In May 2020 the United States was home to more than 32,000 chain supermarket physical locations and almost 7,000 independent locations.

Although many grocery stores now offer online services, overall the industry has concentrated on operating with physical locations for two main reasons. First, many shoppers prefer to select their own products, especially meat, produce, and other perishable goods. Second, few grocers find it profitable to invest in the highly efficient, large-scale cold chains required to make home deliveries. A *cold chain* is a temperature-controlled supply chain that maintains a low-temperature range to preserve and extend the shelf life of products, particularly food and pharmaceuticals.

Competitive pressures, technological advances, and evolving consumer attitudes and behaviors are transforming the grocery industry. In addition, the COVID 19 pandemic brought new demands on grocers as these essential businesses had to adapt to meet new social distancing requirements and increased demand for contact-less shopping.

To address these trends, stores are deploying *omnichannel strategies*. This strategy encompasses physical environments such as storefronts as well as digital environments such as electronic commerce, mobile applications, and social media. Omnichannel enables customers to seamlessly engage with a company through multiple channels at one time. The question becomes: How should grocers most effectively enter the online market?

Online-grocery startups first appeared in the late 1990s. Notable examples were Webvan and HomeGrocer. Neither company survived the dot-com bubble, which was the result of excessive speculation in

Internet-related companies in the late 1990s. In January 2020, roughly half of book and music sales occurred online, along with 40 percent of consumer electronics sales, 30 percent of apparel sales, and 20 percent of furniture purchases. In contrast, only 3 percent of grocery sales occurred online at that time. By mid-2020, online grocery sales had increased to 12.5 percent of all purchases.

## A Number of Solutions

The grocery industry is implementing many solutions, both physical and digital, in its transformation. For clarity, we can classify these solutions along the supply chain of grocery stores (see Chapter 11): supply-chain solutions for managing their vendors (upstream), in-store solutions, and delivery solutions (downstream).

**Supply-chain solutions.** Grocery stores typically source goods from hundreds of separate vendors. The largest stores stock up to 50,000 items. Consequently, the industry must manage its supply chains effectively and efficiently. Supply chain management software and automated warehouses help in this process.

- *Supply chain management software*: Walmart, the largest grocer in the United States, is an example of superior supply chain management. In 1983, Walmart began using bar codes in conjunction with its point-of-sale system to track products. In 1992, the retailer deployed Retail Link, its sophisticated supply chain management system. By sharing point-of-sale data from Walmart stores with suppliers, Retail Link tightly integrated Walmart and its suppliers. Other grocers have only recently begun to deploy these technologies.
- *Automated warehouses*: In 2012, Amazon acquired Kiva Systems, a manufacturer of warehouse robots with an accompanying inventory system. The concept behind Kiva was to use robots to bring items to humans rather than have humans find items in a warehouse and take them to a packing point (a process called *picking*). Today, Amazon has more than 200,000 robots in its warehouses transporting bins, picking items, and stacking pallets.

**In-store solutions.** Grocery stores deploy many technologies. These technologies include electronic labels on products, Internet of Things (IoT) sensors, smart shelves, radio-frequency identification (RFID) tags on products, personalized advertisements, cashierless checkout, facial recognition checkout, and robots.

- *Electronic labels* will eliminate paper bar codes on each item and enable stores to change all the prices in a store within minutes, a process called *digital pricing*. In 2018, Kroger deployed the Enhanced Display for Grocery Environment (EDGE), which displays prices, advertisements, nutritional data, and coupon availability.
- *Internet of Things sensors* have many uses in supermarkets. For example, they can measure the weight of products on a store's smart shelves. Also, they are valuable in measuring and controlling the temperature of products.
- *Smart shelves* are wirelessly connected shelves that have weight sensors. The sensors report on the quantity of items on the shelves, thus enabling stores, grocers' warehouses, and vendors to practice real-time inventory management. The sensors communicate with *product RFID tags* to report misplaced items that do not belong on certain shelves. RFID tags provide more information on products than bar codes, and they enable cashierless checkout.

Smart shelves can interact with apps on customers' smartphones to offer *personalized advertisements*. Additionally, if customers use the store's app to create a shopping list, then the smart shelves can interact with their lists and show them where to find the items they want.

- *Facial recognition* aims to simplify and accelerate the checkout process even more. Customers scan their items at an automated checkout booth, have their identity checked by scanning their faces and matching the scans to their online shopping account, and then enter their mobile phone number to complete the transaction. Chinese supermarket chain 7Fresh (owned by Chinese e-commerce firm **JD.com**) is using this technology.
- Industry analysts note that almost half of in-store tasks could be automated. *Robots* can answer shoppers' questions, suggest products based on a shopper's previous purchases, track inventory, keep track of expiration dates, stock shelves, pick and pack products for delivery, clean up spills, and even assemble sandwiches and salads.

Retailers are using some or all of these technologies to launch *cashierless checkout options* for several reasons, including the high costs associated with cashiers (about 30 percent of store's labor costs), customer frustration with slow checkout lanes, and the demand for contactless shopping brought on by the COVID 19 pandemic. Retailers are offering self-checkout (also known as self-service checkout and as semi-attended customer-activated terminal, SACAT). The customer performs the job of the cashier themselves by scanning the items' barcodes, weighing produce on digital scales, placing the groceries in an electronically monitored bagging area, and then paying for the items themselves.

*Cashierless stores* (called *scan and go*) take this process a step further using a combination of ceiling mounted cameras and shelf-weight sensors to automatically track customers as they move about a store and the items they place in their carts. Once a customer has finished shopping, they can walk out of the store without needing to scan any item or interact with a cashier. Examples of cashierless stores are Amazon Go, Ahold Delhaize's "tap to go," and China's BingoBox, a chain of unstaffed convenience stores.

Let's look more closely at Amazon Go. To enter the store, customers scan the Amazon Go app at entry turnstiles. From that moment, cameras and sensors identify them by their Amazon account as they shop. Taking an item off the smart shelf adds it to the customer's virtual cart. Putting an item back on the shelf removes it from the customer's cart. When customers are finished shopping, they simply leave the store. Amazon then sends them an email receipt and charges their Amazon account.

**Delivery solutions.** Online grocery systems have difficulty telling shoppers exactly what is in stock, what they might like, and what substitutions exist. The online systems also require inventory pickers and delivery personnel. Unfortunately, the industry's narrow profit margins make it difficult to assume the added costs of these employees. Grocery delivery can occur in several ways.

***Delivery at the store***. Customers can order online, go to the store, and pick up their products inside the store, at a drive-through, or curbside, a process called *click-and-collect*. Click-and-collect does not require delivery, thereby keeping costs down.

***Delivery to customers***. As noted, delivery to customers involves additional costs for grocers. To keep these costs to a minimum, grocers have been investing in drop density analytics, warehouse location, automation, and subscription business models.

With delivery to customers, grocers must analyze *drop density*, which is the number of deliveries made per trip. Lower drop density—that is, fewer deliveries per trip—results in higher delivery costs.

To increase drop density, a grocer can provide delivery service to specific communities only at specified times each week. A Dutch grocer, Picnic (**www.picnic.app**), has achieved a drop density of 14 deliveries per hour with this model.

Another solution is pooled deliveries, where grocers collaborate with their competitors or with other businesses. In China, an app links some 50 companies with thousands of independent drivers to deliver

goods. The app contains profiles and user ratings of drivers, and indicates whether they are available and will help to unpack items. The app provides drivers with trip planners and route maps. Early trials have indicated that this approach could reduce retailers' delivery costs by 30 percent.

Amazon, Walmart, and Instacart are the largest competitors in the online grocery space. Let's take a look at their delivery services. Keep in mind that Kroger, Albertson's, and Target also offer delivery services.

Amazon Prime Now (**www.amazon.com**) delivers fresh foods directly from Whole Foods stores. (Amazon purchased Whole Foods in 2017.) Another Amazon service, AmazonFresh, delivers groceries only from Amazon fulfillment centers.

As of February 2021, Walmart offered same-day delivery from some 2,000 stores. Walmart Plus, offered from 1,400 stores, offers free shipping with no order minimum, free delivery from a local store, member pricing on fuel, and mobile scan and go.

Instacart (**www.instacart.com**)—the largest independent grocery-delivery service—is available in all 50 U.S. states and all 10 Canadian provinces in partnership with more than 350 retailers that operate more than 25,000 grocery stores.

Farmstead (**www.farmsteadapp.com**) is a same-day, locally sourced grocery startup based in San Francisco that employs a subscription service. Launched in 2016, the company does not charge for delivery, and it focuses on fresh products.

Farmstead uses machine learning (see Chapter 14) to determine the best routes for its fleet of contracted drivers, who make multiple deliveries per outing.

Farmstead also uses machine learning for picking and managing their produce. The grocer captures data on every product it carries, including sell-by dates and how fast inventory moves. It then inputs these data into a machine-learning model that determines exactly how much stock to buy.

- *Store goods closer to customers*. Another strategy to make deliveries cheaper is to store goods closer to where people live. For example, a company called Fabric (**http://getfabric.com**) has built several micro-fulfillment centers in dense urban areas that can deliver e-commerce orders to customers in less than an hour. These centers, known as *dark stores*, are not open to the public. Instead, they are organized solely for order fulfillment.

As another example, startup Takeoff Technologies (**www.takeoff.com**) is building small (10,000 square feet) micro-fulfillment centers in unused space inside supermarkets. (A typical Kroger supermarket contains roughly 160,000 square feet.) Customers place orders through established grocers, and Takeoff fulfills the orders locally and quickly, utilizing robotic picking and artificial intelligence.

Some stores are opening smaller locations that offer a smaller selection of products but are more convenient to customers. For example, by May 2020 Target had added 100 small-format stores with plans to open more, and Amazon had plans to open 12 small grocery stores in the Los Angeles area.

- *Driverless vehicles and drones*. Grocers are also exploring driverless vehicles and drone deliveries for last-mile delivery. These technologies are expensive to implement, and they require customers to be home at the scheduled time of delivery. For example, Kroger has partnered with Nuro (**http://nuro.ai**), a company that makes self-driving cars, to pilot a grocery delivery service in Scottsdale, Arizona, and Houston, Texas.

## Results

In 2019, online sales accounted for about 3 percent of the U.S. grocery market, totaling about $29 billion. Analysts predict that online sales could exceed 22 percent by 2025, as major grocers invest in automation and innovative operations to solve challenges in fulfillment and last-mile delivery.

As a result of the COVID-19 pandemic, more Americans than ever before are ordering groceries online, either for delivery or pickup. From January to May 2020, Instacart's order volume increased by 150 percent, and new downloads of its app had increased by 700 percent. In response, the company hired 300,000 new personal shoppers, its name for the gig workers who pick and deliver groceries. A gig worker is an independent contractor who does not receive the benefits that an employee receives, such as workers' compensation and health and retirement plans.

Amazon grocery orders increased by 5,000 percent during the COVID-19 lockdown. The company hired 175,000 new delivery and operations employees, but it had to limit new grocery sign-ups until it could ramp up its service.

However, some grocers are resisting digital transformation as they maintain their focus on the preferences and demands of their current customer base. For example, on March 1, 2019, Trader Joe's discontinued its delivery services in New York City, stating that its stores were already close to customers and that the firm was unwilling to pass on delivery costs to them.

**Sources:** Compiled from I. Bogost, "The Supermarket after the Pandemic," *The Atlantic*, April 17, 2020; S. Begley, et al., "Digital Disruption at the Grocery Store," *McKinsey Consulting*, February, 2020; S. Ivry, "Can Grocery Stores Survive the Age of Big Tech?" *Food52*, October 6, 2019; R. Kestenbaum, "Turmoil Is Coming to the Grocery Business and Industry Leaders Don't Want to Talk about It," *Forbes*, October 2, 2019; C. Walton, "Grocery Stores of the Future Will Likely Share These 3 Important Characteristics," *Forbes*, September 8, 2019; G. Szatvanyi, "5 Trends Shaping the Grocery Store of the Future," *Grocery Dive*, July 3, 2019; "4 Trends Disrupting Brick-and-Mortar Grocery," *Winsight Grocery Business*, June 21, 2019; T. Stanger, "What's the Difference between AmazonFresh and Amazon Prime Now?" *Consumer Reports*, June 7, 2019; "11 Predictions for the Future of Grocery," *Produce Retailer*, May 28, 2019; K. Tyko, "Walmart Takes Shot in Shipping Wars by Announcing Free 'Next Day' Delivery," *USA Today*, May 14, 2019; "Automation in Retail: An Executive Overview for Getting Ready," *McKinsey Consulting*, May 2019; K. Alldredge et al., "'Power Partnerships': Manufacturer-Retailer Collaborations that Work," *McKinsey Consulting*, May 2019; N. Taylor, "Is This What the Future of Grocery Will Look Like?" *Winsight Grocery Business*, April 16, 2019; J. Dumont, "Trader Joe's Exits Grocery Delivery in NYC," *Grocery Dive*, January 31, 2019; D. Kuijpers, et al., "Reviving Grocery Retail: Six Imperatives," *McKinsey Consulting*, December 2018; A. Chua, "Cash Not Accepted at Honestbee's First Brick-and-Mortar Chop Space," *Today*, October 17, 2018; B. Ladd, "Takeoff Technologies Launches the World's First Robotic Supermarket," *Forbes*, October 2, 2018; L. Bu, Y. Li, and M. Shao, "An 'Uber' for Chinese E-Commerce," *McKinsey Consulting*, January 2017.

## Questions

1. Provide examples to describe the physical transformations undertaken by the grocery industry.
2. Provide examples to describe the digital transformations undertaken by the grocery industry.
3. Which transformations are more important for the grocery industry: physical or digital? Support your answer.
4. Explain why implementing these physical and digital transformations is a strategic necessity for the grocery industry.

# Introduction

Before we proceed, we need to define information technology and information systems. **Information technology (IT)** refers to any computer-based tool that people use to work with information and support an organization's information and information-processing needs. An **information system (IS)** collects, processes, stores, analyzes, and disseminates information for a specific purpose.

IT has far-reaching effects on individuals, organizations, and our planet. Although this text is largely devoted to the many ways in which IT is transforming modern organizations, you will also learn about the significant impacts of IT on individuals and societies, the global economy, and our physical environment. IT is making our world smaller, enabling more and more people to communicate, collaborate, and compete, thereby leveling the playing field.

The COVID-19 pandemic forced people to depend on IT in new ways and demonstrated how far-reaching technology can be. Specifically, IT has come to the forefront of electronic commerce, distance education, and politics (consider social media and the 2020 elections). As you will see, we draw attention to IT's impact on the pandemic throughout this book.

This text focuses on the successful applications of IT in organizations; that is, how organizations can use IT to solve business problems and achieve competitive advantage in the marketplace. However, not all business problems can be solved with IT. Therefore, you must continue to develop your business skills!

When you graduate, either you will start your own business or you will work for an organization, whether it is public sector, private sector, for-profit, or not-for-profit. Your organization will have to survive and compete in an environment that has been radically transformed by information technology. This environment is global, massively interconnected, intensely competitive, 24/7/365, real-time, rapidly changing, and information-intensive. To compete successfully, your organization must use IT effectively.

As you read this chapter and this text, keep in mind that the information technologies you will learn about are important to businesses of all sizes. No matter which area of business you major in, which industry you work for, or the size of your company, you will benefit from learning about IT. Who knows? Maybe you will use the tools you learn about in this class to make your great idea a reality by becoming an entrepreneur and starting your own business!

The modern environment is intensely competitive not only for your organization, but for you as well. You must compete with human talent from around the world. Therefore, you personally will have to make effective use of IT.

Accordingly, this chapter begins with a discussion of three reasons why you should become knowledgeable about IT. Next, it distinguishes among data, information, and knowledge, and it differentiates computer-based information systems from application programs. Finally, it considers the impacts of information systems on organizations and on society in general.

## 1.1 Why Should I Study Information Systems?

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**Apply the Concept activities are available in the Appendix and in *WileyPLUS*.**

Your use of IT makes you part of the most connected generation in history: you have grown up online; you are, quite literally, never out of touch; you use more information technologies (in the form of digital devices) for more tasks; and you are bombarded with more information than any generation in history. The *MIT Technology Review* refers to you as *Homo conexus*. Information technologies are so deeply embedded in your lives that your daily routines would be almost unrecognizable to a college student just 20 years ago.

Essentially, you practice *continuous computing*, surrounded by a movable information network. This network is created by constant communication among the digital devices you carry and wear (for example: laptops, tablets, smartphones, and wearables); the wired and wireless networks that you access as you move about; and Web-based tools for finding information and communicating and collaborating with other people. Your network enables you to pull information about virtually anything from anywhere at any time, and to push your own ideas back to the Web, from wherever you are, via a mobile device. Think of everything you do online, often

with your smartphone: register for classes; take classes (not just at your university); access class syllabi, information, PowerPoints, and lectures; research class papers and presentations; conduct banking; pay your bills; research, shop, and purchase products from companies and other people; sell your "stuff"; search for, and apply for, jobs; make your travel reservations (hotel, airline, rental car); create your own blog and post your own podcasts and videos to it; design your own page on Facebook and LinkedIn; make and upload videos to YouTube; take, edit, and print your own digital photographs; stream music and movies to your personal libraries; use RSS feeds to create your personal electronic newspaper; text and Tweet your friends and family throughout your day; send Snaps; order a ride from Uber or Lyft; track the location and arrival time of the next campus bus; select a place or room to rent on Airbnb; and many other activities. (*Note*: If any of these terms are unfamiliar to you, don't worry. You will learn about everything mentioned here in detail later in this text.)

Let's put the preceding paragraph in perspective. What would a typical day for you be like if you had no access to computing devices of any kind, including your phone? This scenario also means that you have no access to the Internet.

## The Informed User—You!

So, the question is: Why should you learn about information systems and information technology? After all, you can comfortably use a computer (or other electronic devices) to perform many activities, you have been surfing the Web for years, and you feel confident that you can manage any IT application that your organization's MIS department installs. Let's look at three reasons why you should learn about ISs and IT.

MIS The first reason to learn about information systems and information technology is to become an **informed user**; that is, a person knowledgeable about ISs and IT. In general, informed users obtain greater value from whichever technologies they use. You will enjoy many benefits from being an informed user of IT, including:

- You will benefit more from your organization's IT applications because you will understand what is "behind" those applications (see **Figure 1.1**). That is, what you see on your computer screen is brought to you by your MIS department, who are operating "behind" your screen.


iStock.com/Slawomir Fajer

**FIGURE 1.1** **MIS provides what users see and use on their computers.**

- You will be in a position to enhance the quality of your organization's IT applications with your input.
- Even as a new graduate, you will quickly be in a position to recommend—and perhaps to help select—which IT applications your organization will use.
- Being an informed user will keep you abreast of both new information technologies and rapid developments in existing technologies. Remaining "on top of things" will help you to anticipate the impacts that "new and improved" technologies will have on your organization and to make recommendations regarding the adoption and use of these technologies.
- You will understand how using IT can improve your organization's performance and teamwork as well as your own productivity.
- If you have ideas of becoming an entrepreneur, then being an informed user will help you to utilize IT when you start your own business.

The second reason to learn about ISs and IT is that the organization you join will undoubtedly be undergoing a digital transformation. In fact, digital transformation has become one of the most important strategies for organizations. A December 2019 survey by *Forbes* magazine noted that 70 percent of companies surveyed had a digital transformation strategy in place or were working on such a strategy, and 27 percent of companies stated that digital transformation was a matter of survival.

**Digital transformation** is the business strategy that leverages IT to dramatically improve employee, customer, and business partner relationships; to support continuous improvement in business operations and business processes; and to develop new business models and businesses. The information technologies that drive digital transformation include:

- Big Data (see Chapter 5);
- Business Analytics (see Chapter 12);
- Broadband Internet access (see Chapter 6);
- Mobile Computing (see Chapter 8);
- The Internet of Things (see Chapter 8);
- Social Computing (see Chapter 9);
- Agile Systems Development methods (see Chapter 13);
- Cloud Computing (see Technology Guide 3);
- Artificial Intelligence (see Chapter 14);

You see examples of digital transformation throughout this chapter. In fact, IT's About Business 1.1 shows how broadband Internet access and mobile computing transformed the country of Vietnam.

The third reason to learn about ISs and IT is that managing the IS function within an organization is no longer the exclusive responsibility of the IS department. Rather, users now play key roles in every step of this process. The overall objective in this text is to provide you with the necessary information to contribute immediately to managing the IS function in your organization. In short, our goal is to help you become a very informed user!

## IT Offers Career Opportunities

**MIS** Because IT is vital to the operation of modern businesses, it offers many employment opportunities. The demand for traditional IT staff—programmers, business analysts, systems analysts, and designers—is substantial. In addition, many well-paid jobs exist in areas such as the Internet and electronic commerce (e-commerce), mobile commerce (m-commerce), network security, telecommunications, and multimedia design.

The IS field includes the people in various organizations who design and build information systems, the people who use those systems, and the people responsible for managing those systems. At the top of the list is the chief information officer (CIO).

The CIO is the executive in charge of the IS function. In most modern organizations, the CIO works with the chief executive officer (CEO), the chief financial officer (CFO), and other senior

## IT's About Business 1.1

### MIS FIN MKT The Digital Transformation of Vietnam

#### The Problem

In 1975, Vietnam reunified after having been at war for 30 years. At that time, the country was isolated from the international community due to the Cold War, and it faced a U.S. economic embargo. As a result, it was one of the poorest countries in the world. By the mid-1980s, Vietnam's per capita gross domestic product (GDP) was only between $200 and $300. The country's economy exhibited small-scale production, low labor productivity, and insufficient supplies of food and consumer goods.

#### The Solution

In 1986, the Vietnamese government began to transition from its highly centralized, planned economy to a market-based economy. The government decided to maintain some centralized government planning but also provide free market incentives, such as encouraging people to establish private businesses.

These reforms also helped to transform the country's telecommunications industry, which was the key technological driver behind Vietnam's digital transformation. From 1945 until 1985, the Communist Party had controlled the country's telecommunications industry. In this capacity it restricted access to telecommunications services to high-ranking government officials.

Vietnam's telecommunications transformation occurred slowly. As late as 1995 the country had only 3.8 telephones per 100 people. Furthermore, the Vietnamese people had to pay 3–4 times more than average global telecommunications prices for telecom services. Further, the government continued to restrict competition from foreign telecommunications companies.

In the early 2000s, Vietnam finally began to encourage foreign investment in the development of its telecommunications infrastructure. Specifically, the government designated Siemens, a German-based multinational corporation, to build the entire Vietnamese microwave system. The government also increased the number of primary telecommunications links across the country, and it ensured that all provinces were connected to Vietnam's three major cities—Hanoi, Da Nang, and Ho Chi Minh City (formerly Saigon), with fiber-optic cable and microwave links.

Following these developments, mobile networks began to emerge. Today, the five major companies in Vietnam's mobile market are Viettel Mobile, MobiFone, VinaPhone, VietnamMobile, and Gmobile.

A modern telecommunications infrastructure is changing the way the Vietnamese people conduct business, manufacture goods, entertain themselves, shop, manage their finances, and communicate. Let's take a closer look at five businesses that have benefited from Vietnam's digital transformation: Appota, Tiki, Skinlosophy, and Timo.

#### Appota

Founded in 2011, Appota (**www.appota.com**) is one of the top three game publishers in Vietnam. The firm has developed an e-wallet for gaming purchases, and its apps include a Wi-Fi password-sharing facility, a book reader, news, movies, comics, and other forms of entertainment. The company also has a business-to-business advertising group, and it is planning to expand its mobile payments operations.

Appota took advantage of the rapid growth of smartphones in Vietnam by operating only in the mobile space. The company has more than 50 million users and more than 5 million monthly active users.

Appota's next venture was to develop physical products that function via smartphones. For example, in 2019 the company launched a smart lock, operated by an app, that secures everything from front doors to suitcases.

#### Tiki

Tiki (**http://tiki.vn**), launched in 2010, is an online bookseller that specializes in English-language titles. Today, the firm is one of the top electronic-commerce platforms in Vietnam as well as the fastest growing. Tiki's growth has paralleled the rapid expansion of electronic commerce in Vietnam. Each month, Tiki ships 4.5 million items from a large selection of consumer goods. Tiki's best sellers are consumer electronics. In addition, sales of lifestyle and fashion products are increasing rapidly.

With an average of 17 million monthly customer visits, logistics is critical. Tiki maintains 33 warehouses in 13 cities, and it offers its customers a two-hour delivery option. However, although many Vietnamese people are moving to cities, almost two-thirds of the population still lives in rural areas. Delivery to remote areas typically takes longer and costs more.

Tiki's customers currently pay for more than half of their purchases with cash on delivery. The company wants digital payments to become more widely adopted. Digital payments enable sellers to be paid more quickly. In addition, Tiki delivery personnel do not have to handle cash. Fortunately for Tiki, the use of e-wallets is expanding at 28 percent per year in Vietnam, so the number of digital transactions will continue to grow.

#### Skinlosophy

As recently as 2010, Vietnam's beauty market had two major types of brands. The first type—international brands—consisted of sophisticated, science-based, well-designed, packaged, and marketed beauty products. The second type consisted of homegrown Vietnamese beauty products. Skinlosophy (http://skinlosophy.vn) is working to combine the benefits of both types by using scientific processes to purify herbal ingredients traditionally grown in Asia. The firm's traditional ingredients include green tea, red ginseng, silk, and lingzhi mushrooms.

Skinlosophy designs their products for use in Vietnam's hot, humid climate. Their products are dry to the touch, do not clog pores, and "feel nonexistent on the skin." Their most popular products are cleansers, acne remedies, and skin formulas. Significantly, 80 percent of the firm's sales are online, primarily to professional women between the ages of 22 and 30. By May 2020 Skinlosophy employed 20 people and sold, on average, more than 1,000 products per week.

#### Timo

Opened in 2016, Timo (http://timo.vn) was Vietnam's first digital bank. Timo Hangouts serve as bank branches. Instead of a traditional branch with tellers, however, Hangouts have coffee shops and are used to open accounts or simply to meet with friends. By May 2020 Timo had more than 500,000 customers.

Timo is appealing to consumers for several reasons. First, nearly every transaction, including money transfers, payments, making a deposit or a withdrawal, and managing accounts, can be done remotely through the bank's mobile app. Customers need to meet a Timo Care Representative in person at a Hangout only

when they open an account. Second, Timo provides nearly all of its services for free. Finally, customers can conveniently buy insurance products and invest directly through the app.

### The Results

Vietnam's population in 2020 was 97 million with an average age of 31. In May 2020, the country had 66 million Internet users for a market penetration of 68 percent. Moreover, 96 percent of users accessed the Internet via mobile devices.

The development of Vietnam's telecommunications infrastructure has increased Internet access for its citizens and has been the key to the rapid development of Vietnam's digital economy. According to analysts, 88 percent of urban and 38 percent of rural households now have digital access. Further, 95 percent of Vietnam's urban population owns a smartphone, as do 69 percent of the country's rural population.

In 2019, Vietnam's GDP had grown to $255 billion. In early 2020, the country's per capita GDP had increased dramatically from $200 to $300 to more than $6,000. By early 2020, more than 45 million people had risen out of poverty as the country developed industries that spanned textiles, agriculture, furniture, plastics, paper, tourism, and telecommunications.

Vietnam has evolved into one of the most digital of all economies in Southeast Asia. In May 2020, the country's digital economy was valued at USD $12 billion. Further, it was the second fastest-growing digital economy in the region after Indonesia. Analysts estimate that by 2025 the value of the country's digital economy will reach USD $43 billion.

Further, in May 2020, Vietnam's mobile e-commerce market value exceeded $3 billion. A 2019 report by Google and the Mobile Marketing Association identified Vietnam as a "mobile-first market" with more than 51 million smartphones, representing more than 80 percent of the population aged 15 and older. Further, network coverage is extensive. The Vietnamese population has access to 3G (third-generation wireless) and 4G (fourth-generation wireless) even in rural and mountainous areas.

Unfortunately, the news is not all positive, as digital technologies can be used to monitor citizens. Vietnam's government has been widely criticized for its surveillance of citizens and restrictions on freedom of speech. In fact, the Vietnamese government's approach to human rights and privacy is questionable. Press freedom is one of the worst in the world, and the government increasingly monitors Vietnamese citizens online.

For example, the Vietnamese government arrested blogger Nguyen Ngoc Nhu Quynh on October 10, 2016, and sentenced her to 10 years in prison. The government contended that she conducted "anti-State propaganda."

Nguyen was known by her blogging pseudonym Me Nam, which translates to "Mother Mushroom." Her blog was often critical of the government, and it addressed such issues as land confiscation, freedom of speech, and police brutality. In October 2018 Nguyen arrived in the United States, where she had been granted asylum following her release from prison in Vietnam.

**Sources:** S. Lazarus, "How New Technology Is Transforming Vietnam's Economy," *CNN*, April 6, 2020; S. Lazarus, "Vietnamese Beauty Brand Skinlosophy Fuses Tradition with Technology," *CNN Style*, March 25, 2020; "Vietnam Takes a Leap in Digital Transformation with Foreign Participation," *Vietnam.net Global*, January 6, 2020; "Vietnam Internet Statistics 2019," *Vnetwork.vn*, November 11, 2019; "The World Bank in Vietnam: Overview," *The World Bank*, October 18, 2019; "How Much Do Our Wardrobes Cost to the Environment," *The World Bank*, September 23, 2019; "Vietnam's Digital Bank Timo Celebrates Its Third Birthday," *Fintechnews Vietnam*, June 28, 2019; E. McKirdy, "'Stalinist' Vietnamese Cybersecurity Law Takes Effect, Worrying Rights Groups ad Online Campaigners," *CNN*, January 2, 2019; "E-Commerce Payments Trends: Vietnam," *J.P. Morgan Global Payment Trends*, 2019; "The State of Mobile in Rural Vietnam Report," *Google and the Mobile Marketing Association*, 2019; "Vietnamese Economic Outline," *Santander Trade Markets*, 2019; "e-Conomy SEA 2018: Southeast Asia's Internet Economy Hits an Inflection Point," *Google-Temasek*, November 2018; E. McKirdy, "Vietnamese Activist 'Mother Mushroom' Freed from Prison, Granted Asylum in the U.S.," *CNN*, October 18, 2018; P. Vanham, "The Story of Vietnam's Economic Miracle," *World Economic Forum*, September 11, 2018; S. Ray, "Vietnam and Its Telecom Sector: How the Country Answered the Call for Reform," *Yourstory.com*, November 16, 2017; E. McKirdy, "Vietnamese Blogger Mother Mushroom Jailed for 10 Years," *CNN*, June 29, 2017; J. Hookway, "Vietnam's Mobile Revolution Catapults Millions into the Digital Age," *The Wall Street Journal*, June 12, 2015.

### Questions

1. **Information technologies do not always lead transformation in organizations (or countries).**
   a. **Explain how the policies of the Vietnamese government led to the digital transformation of the country.**
   b. **Consider the Royal Spirit Group's DBW factory. Provide examples of both technological and nontechnological initiatives that drove the factory's sustainable operations.**
   c. **Consider Appota, Tiki, Skinlosophy, and Timo. Did technological initiatives drive each company's success? If so, provide examples of such initiatives for each company.**
2. **Explain how the development of the telecommunications infrastructure (fiber-optic cables and wireless) was a key driver of the country's digital transformation.**
3. **Why was Vietnam's digital transformation a strategic necessity for the country? Consider examples from the country's economic development in your answer.**

executives. Therefore, he or she actively participates in the organization's strategic planning process. In today's digital environment, the IS function has become increasingly strategic within organizations. As a result, although most CIOs still rise from the IS department, a growing number are coming up through the ranks in the business units (e.g., marketing, finance). Regardless of your major, you could become the CIO of your organization one day. This is another reason to be an informed user of information systems!

**Table 1.1** provides a list of IT jobs, along with a description of each one. For further details about careers in IT, see **www.linkedin.com**, **www.computerworld.com/category/careers/**, and **www.monster.com**.

Career opportunities in IS are strong and are projected to remain strong over the next 10 years. The *U.S. News & World Report* listed its "25 best jobs of 2020" and Glassdoor listed its

**TABLE 1.1 Information Technology Jobs**

| Position | Job Description |
|---|---|
| Chief Information Officer | Highest-ranking IS manager; responsible for all strategic planning in the organization |
| IS Director | Manages all systems throughout the organization and the day-to-day operations of the entire IS organization |
| Information Center Manager | Manages IS services such as help desks, hotlines, training, and consulting |
| Applications Development Manager | Coordinates and manages new systems development projects |
| Project Manager | Manages a particular new systems development project |
| Systems Analyst | Interfaces between users and programmers; determines information requirements and technical specifications for new applications |
| Operations Manager | Supervises the day-to-day operations of the data and/or computer center |
| Programming Manager | Coordinates all applications programming efforts |
| Social Media Manager | Coordinates all social media development efforts and all social media monitoring and response efforts |
| Business Analyst | Focuses on designing solutions for business problems; interfaces closely with users to demonstrate how IT can be used innovatively |
| Systems Programmer | Creates the computer code for developing new systems software or maintaining existing systems software |
| Applications Programmer | Creates the computer code for developing new applications or maintaining existing applications |
| Emerging Technologies Manager | Forecasts technology trends; evaluates and experiments with new technologies |
| Network Manager | Coordinates and manages the organization's voice and data networks |
| Database Administrator | Manages the organization's databases and oversees the use of database-management software |
| Auditing or Computer Security Manager | Oversees the ethical and legal use of information systems |
| Webmaster | Manages the organization's website |
| Web Designer | Creates websites and pages |

"50 best jobs in America for 2020." Glassdoor (**www.glassdoor.com**) is a website where current and former employees anonymously review companies. Let's take a look at these rankings. (Note that the rankings differ because the magazine and Glassdoor used different criteria in their research.) As you can see, jobs suited for MIS majors appear in both lists, many of them quite high. The job rankings are as follows:

***U.S. News & World Report* (out of 25)**

#1 Software Developer
#12 IT Manager
#23 Web Developer

***Glassdoor* (out of 50)**

#1 User Interface Designer
#2 Java Developer
#3 Data Scientist
#4 Product Manager
#5 DevOps Engineer
#6 Data Engineer
#7 Software Engineer
#18 Applications Engineer
#26 Business Analyst
#27 Systems Engineer
#29 Scrum Master
#32 Software Developer
#33 Cloud Engineer
#46 Automation Engineer
#49 Network Engineer

Not only do IS careers offer strong job growth, but the pay is excellent as well. The Bureau of Labor Statistics, an agency within the Department of Labor that is responsible for tracking and analyzing trends relating to the labor market, notes that the median salary in 2019 for "computer and information systems managers" was approximately $146,360, and predicted that the profession would grow by an average of 11 percent per year through 2026.

In addition, LinkedIn analyzed thousands of profiles of members who graduated between 2018 and 2019. LinkedIn collected salary information using the LinkedIn Salary tool. It discovered that of the 10 highest-paying entry-level jobs, 7 were in the technology industry. These jobs include:

| Job | Median Starting Salary |
|---|---|
| #1 Data Scientist | $95,000 |
| #2 Software Engineer | $90,000 |
| #6 User Experience Designer | $73,000 |
| #7 IT Consultant | $72,000 |
| #8 Java Developer | $72,000 |
| #9 Systems Engineer | $70,000 |
| #10 Software Developer | $68,600 |

## Managing Information Resources

Managing information systems in modern organizations is a difficult, complex task. Several factors contribute to this complexity. First, information systems have enormous strategic value to organizations. Firms rely on them so heavily that, in some cases, when these systems are not working (even for a short time), the firm cannot function. (This situation is called "being hostage to information systems.") Second, information systems are very expensive to acquire, operate, and maintain.

A third factor contributing to the difficulty in managing information systems is the evolution of the management information systems (MIS) function within the organization. When businesses first began to use computers in the early 1950s, the MIS department "owned" the only computing resource in the organization: the mainframe. At that time, end users did not interact directly with the mainframe.

MIS In contrast, in the modern organization, computers are located in all departments, and almost all employees use computers in their work. This situation, known as *end user computing*, has led to a partnership between the MIS department and the end users. The MIS department now acts as more of a consultant to end users, viewing them as customers. In fact, the main function of the MIS department is to use IT to solve end users' business problems.

MIS As a result of these developments, the responsibility for managing information resources is now divided between the MIS department and the end users. This arrangement raises several important questions. Which resources are managed by whom? What is the role of the MIS department, its structure, and its place within the organization? What is the appropriate relationship between the MIS department and the end users? Regardless of who is doing what, it is essential that the MIS department and the end users work in close cooperation.

There is no standard way to divide responsibility for developing and maintaining information resources between the MIS department and the end users. Instead, that division depends on several factors: the size and nature of the organization, the amount and type of IT resources, the organization's attitudes toward computing, the attitudes of top management toward computing, the maturity level of the technology, the amount and nature of outsourced IT work, and even the countries in which the company operates. Generally speaking, the MIS department is responsible for corporate-level and shared resources, and the end users are responsible for departmental resources. **Table 1.2** identifies both the traditional functions and various new, consultative functions of the MIS department.

So, where do the end users come in? Take a close look at Table 1.2. Under the traditional MIS functions, you will see two functions for which you provide vital input: managing systems development and infrastructure planning. Under the consultative MIS functions, in contrast, you exercise the primary responsibility for each function, while the MIS department acts as your advisor.

**TABLE 1.2 The Changing Role of the Information Systems Department**

| Traditional Functions of the MIS Department |
|---|
| Managing systems development and systems project management<br>• As an end user, you will have critical input into the systems development process. You will learn about systems development in Chapter 13. |
| Managing computer operations, including the computer center |
| Staffing, training, and developing IS skills |
| Providing technical services |
| Infrastructure planning, development, and control<br>• As an end user, you will provide critical input about the IS infrastructure needs of your department. |
| **New (Consultative) Functions of the MIS Department** |
| Initiating and designing specific strategic information systems<br>• As an end user, your information needs will often mandate the development of new strategic information systems. |
| You will decide which strategic systems you need (because you know your business needs and requirements better than the MIS department does), and you will provide input into developing these systems. |
| Incorporating the Internet and electronic commerce into the business<br>• As an end user, you will be primarily responsible for effectively using the Internet and electronic commerce in your business. You will work with the MIS department to accomplish these tasks. |
| Managing system integration, including the Internet, intranets, and extranets<br>• As an end user, your business needs will determine how you want to use the Internet, your corporate intranets, and extranets to accomplish your goals. You will be primarily responsible for advising the MIS department on the most effective use of the Internet, your corporate intranets, and extranets. |
| Educating non-MIS managers about IT<br>• Your department will be primarily responsible for advising the MIS department on how best to educate and train your employees about IT. |
| Educating the MIS staff about the business<br>• Communication between the MIS department and business units is a two-way street. You will be responsible for educating the MIS staff on your business, its needs and requirements, and its goals. |
| Partnering with business unit executives<br>• Essentially, you will be in a partnership with the MIS department. You will be responsible for seeing that this partnership is one "between equals" and ensuring its success. |
| Managing outsourcing<br>• Outsourcing is driven by business needs. Therefore, the outsourcing decision resides largely with the business units (i.e., with you). The MIS department, working closely with you, will advise you on technical issues such as communications bandwidth and security. |
| Proactively using business and technical knowledge to see innovative ideas about using IT<br>• Your business needs will often drive innovative ideas about how to effectively use information systems to accomplish your goals. The best way to bring these innovative uses of IS to life is to partner closely with your MIS department. Such close partnerships have amazing synergies! |
| Creating business alliances with business partners<br>• The needs of your business unit will drive these alliances, typically along your supply chain. Again, your MIS department will act as your advisor on various issues, including hardware and software compatibility, implementing extranets, communications, and security. |

## Before you go on…

1. Rate yourself as an informed user. (Be honest; this isn't a test!)
2. Explain the benefits of being an informed user of information systems.
3. Discuss the various career opportunities offered in the IT field.

# 1.2 Overview of Computer-Based Information Systems

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**Apply the Concept activities are available in the Appendix and in *WileyPLUS*.**

Organizations refer to their management information systems functional area by several names, including the MIS Department, the Information Systems (IS) Department, the Information Technology (IT) Department, and the Information Services Department. Regardless of the name, however, this functional area deals with the planning for—and the development, management, and use of—information technology tools to help people perform all the tasks related to information processing and management. Recall that **information technology** relates to any computer-based tool that people use to work with information and support the information and information-processing needs of an organization.

As previously stated, an **information system** collects, processes, stores, analyzes, and disseminates information for a specific purpose. The purpose of information systems has been defined as getting the right information to the right people, at the right time, in the right amount, and in the right format. Because information systems are intended to supply useful information, we need to differentiate between information and two closely related terms: data and knowledge (see **Figure 1.2**).

**Data items** refer to an elementary description of things, events, activities, and transactions that are recorded, classified, and stored but are not organized to convey any specific meaning. Data items can be numbers, letters, figures, sounds, and images. Examples of data items are collections of numbers (e.g., 3.11, 2.96, 3.95, 1.99, 2.08) and characters (e.g., B, A, C, A, B, D, F, C).

**Information** refers to data that have been organized so that they have meaning and value to the recipient. For example, a grade point average (GPA) by itself is data, but a student's name coupled with his or her GPA is information. The recipient interprets the meaning and draws conclusions and implications from the information. Consider the examples of data provided in the preceding paragraph. Within the context of a university, the numbers could be grade point averages, and the letters could be grades in an Introduction to MIS class.

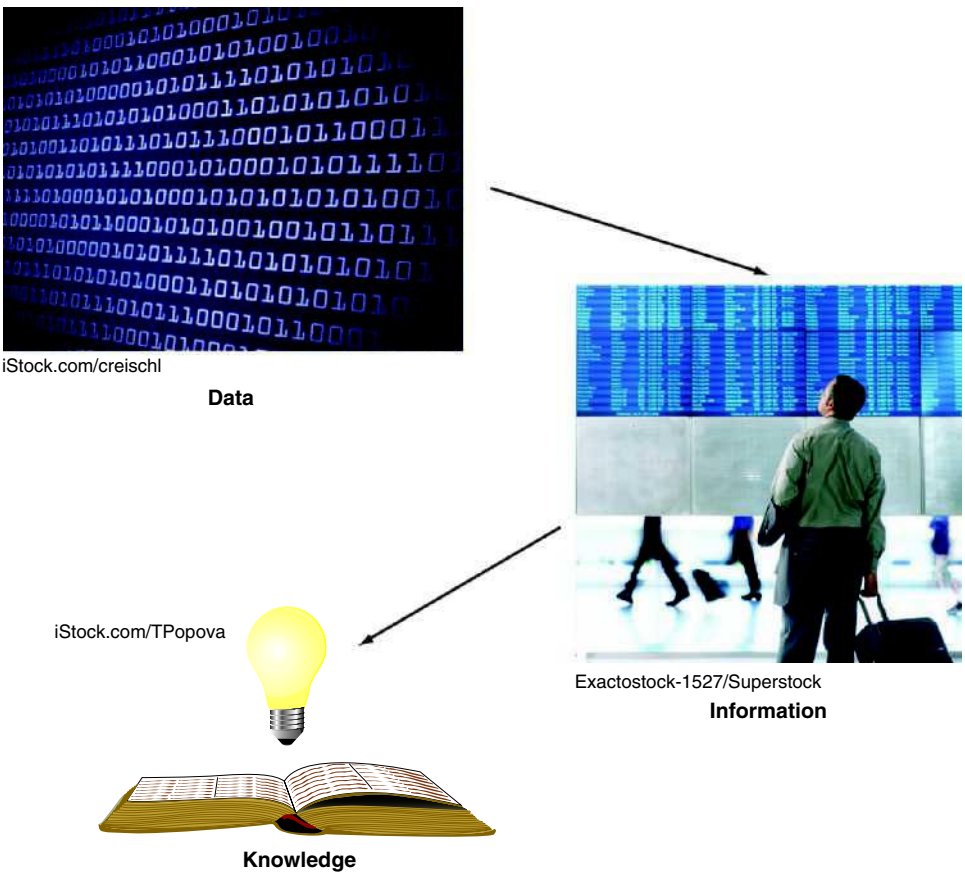


**FIGURE 1.2** **Data, information, and knowledge.**

**Knowledge** consists of data and/or information that have been organized and processed to convey understanding, experience, accumulated learning, and expertise as they apply to a current business problem. For example, suppose that a company recruiting at your school has found over time that students with grade point averages over 3.0 have experienced the greatest success in its management program. Based on this accumulated knowledge, that company may decide to interview only those students with GPAs over 3.0. This is an example of knowledge because the company utilizes information—GPAs—to address a business problem—hiring successful employees. As you can see from this example, organizational knowledge, which reflects the experience and expertise of many people, has great value to all employees.

Consider this example:

| Data | Information | Knowledge |
|---|---|---|
| [No context] | [University context] | |
| 3.16 | 3.16 + John Jones = GPA | * Job prospects |
| 2.92 | 2.92 + Sue Smith = GPA | * Graduate school prospects |
| 1.39 | 1.39 + Kyle Owens = GPA | * Scholarship prospects |
| 3.95 | 3.95 + Tom Elias = GPA | |
| **Data** | **Information** | **Knowledge** |
| [No context] | [Professional baseball pitcher context] | |
| 3.16 | 3.16 + Corey Kluber = ERA | |
| 2.92 | 2.92 + Chris Sale = ERA | * Keep pitcher, trade pitcher, or send pitcher to minor leagues |
| 1.39 | 1.39 + Clayton Kershaw = ERA | * Salary/contract negotiations |
| 3.95 | 3.95 + Shane Bieber = ERA | |

GPA = Grade point average (higher is better)

ERA = Earned run average (lower is better); ERA is the number of runs per nine innings that a pitcher surrenders.

You see that the same data items with no context can have entirely different meanings in different contexts.

Now that you have a clearer understanding of data, information, and knowledge, let's shift our focus to computer-based information systems. As you have seen, these systems process data into information and knowledge that you can use.

A **computer-based information system (CBIS)** is an information system that uses computer technology to perform some or all of its intended tasks. Although not all information systems are computerized, today most are. For this reason the term "information system" is typically used synonymously with "computer-based information system." The basic components of computer-based information systems are listed below. The first four are called **information technology components**. **Figure 1.3** illustrates how these four components interact to form a CBIS.

- **Hardware** consists of devices such as the processor, monitor, keyboard, and printer. Together, these devices accept, process, and display data and information.
- **Software** is a program or collection of programs that enable the hardware to process data.
- A **database** is a collection of related files or tables containing data.
- A **network** is a connecting system (wireline or wireless) that enables multiple computers to share resources.
- **Procedures** are the instructions for combining the above components to process information and generate the desired output.
- *People* use the hardware and software, interface with it, or utilize its output.

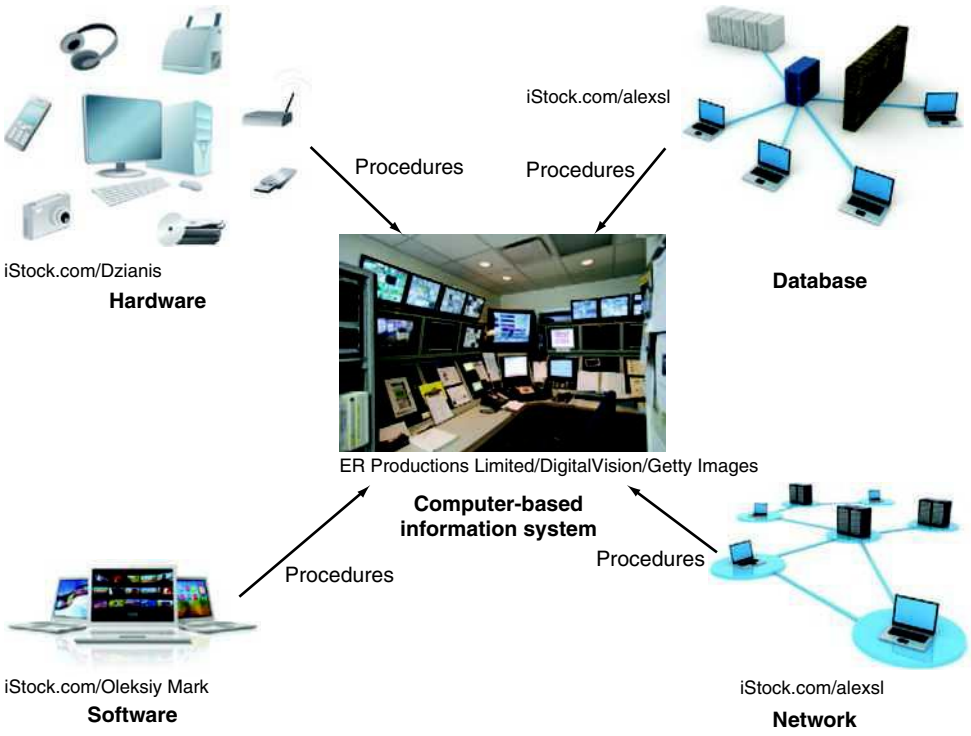


**FIGURE 1.3** **Computer-based information systems consist of hardware, software, databases, networks, procedures, and people.**

Figure 1.4 illustrates how these components are integrated to form the wide variety of information systems found within an organization. Starting at the bottom of the figure, you see that the IT components of hardware, software, networks (wireline and wireless), and databases form the **information technology platform**. IT personnel use these components to develop information systems, oversee security and risk, and manage data. These activities cumulatively are called **information technology services**. The IT components plus IT services comprise the organization's **information technology infrastructure**. At the top of the pyramid are the various organizational information systems.

Computer-based information systems have many capabilities. Table 1.3 summarizes the most important ones.

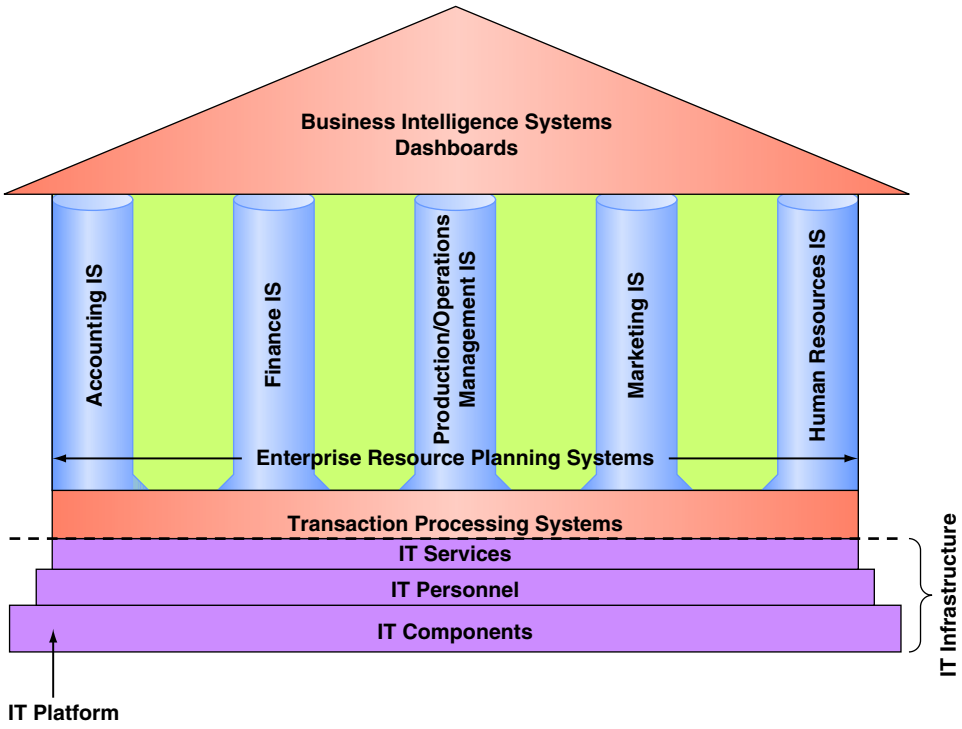


**FIGURE 1.4** **Information technology inside your organization.**

**TABLE 1.3 Major Capabilities of Information Systems**

| |
|---|
| Perform high-speed, high-volume numerical computations. |
| Provide fast, accurate communication and collaboration within and among organizations. |
| Store huge amounts of information in an easy-to-access yet small space. |
| Allow quick and inexpensive access to vast amounts of information worldwide. |
| Analyze and interpret vast amounts of data quickly and efficiently. |
| Automate both semiautomatic business processes and manual tasks. |

Information systems perform these various tasks via a wide spectrum of applications. An **application** (or **app**) is a computer program designed to support a specific task or business process. (A synonymous term is **application program**.) Each functional area or department within a business organization uses dozens of application programs. For instance, the human resources department sometimes uses one application for screening job applicants and another for monitoring employee turnover. The collection of application programs in a single department is usually referred to as a **departmental information system** (also known as a **functional area information system (FAIS)**). For example, the collection of application programs in the human resources area is called the human resources information system (HRIS). There are collections of application programs—that is, departmental information systems—in the other functional areas as well, such as accounting, finance, marketing, and production/operations.

The importance of information systems cannot be understated. In fact, a 2016 report from the Software Alliance shows that information systems added more than *$1 trillion of value* to the United States gross domestic product.

## Types of Computer-Based Information Systems

Modern organizations employ many different types of information systems. Figure 1.4 illustrates the different types of information systems that function *within* a single organization, and **Figure 1.5** shows the different types of information systems that function *among* multiple

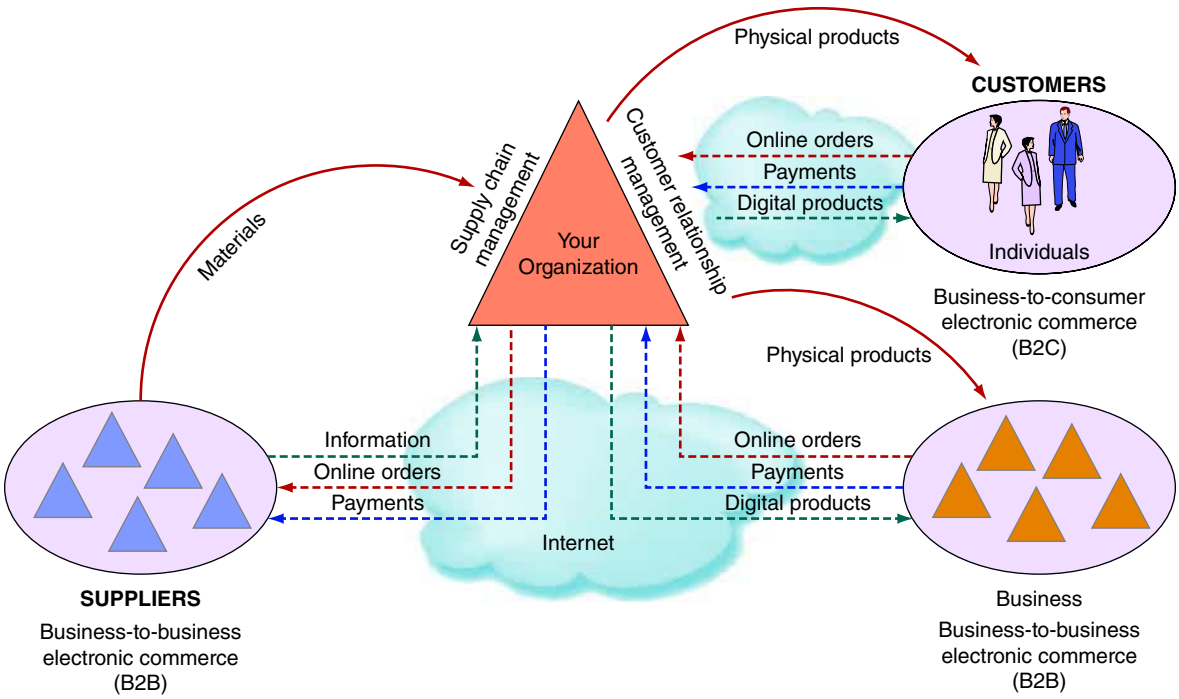


**FIGURE 1.5 Information systems that function among multiple organizations.**

organizations. You will study transaction processing systems, management information systems, and enterprise resource planning systems in Chapter 10. You will learn about customer relationship management (CRM) systems in Chapter 11 and supply chain management (SCM) systems in Chapter 11.

In the next section you will learn about the numerous and diverse types of information systems employed by modern organizations. You will also read about the types of support these systems provide.

## Breadth of Support of Information Systems

Certain information systems support parts of organizations, others support entire organizations, and still others support groups of organizations. This section addresses all of these systems.

Recall that each department or functional area within an organization has its own collection of application programs, or information systems. These functional area information systems are the supporting pillars for the information systems located at the top of Figure 1.4, namely, business intelligence systems and dashboards. As the name suggests, each FAIS supports a particular functional area within the organization. Examples are accounting IS, finance IS, production/operations management (POM) IS, marketing IS, and human resources IS.

ACCT FIN Consider these examples of IT systems in the various functional areas of an organization. In finance and accounting, managers use IT systems to forecast revenues and business activity, to determine the best sources and uses of funds, and to perform audits to ensure that the organization is fundamentally sound and that all financial reports and documents are accurate.

MKT In sales and marketing, managers use information technology to perform the following functions:

- *Product analysis*: Developing new goods and services
- *Site analysis*: Determining the best location for production and distribution facilities
- *Promotion analysis*: Identifying the best advertising channels
- *Price analysis*: Setting product prices to obtain the highest total revenues

Marketing managers also use IT to manage their relationships with their customers.

POM In *manufacturing*, managers use IT to process customer orders, develop production schedules, control inventory levels, and monitor product quality. They also use IT to design and manufacture products. These processes are called *computer-assisted design (CAD)* and *computer-assisted manufacturing (CAM).*

HRM Managers in *human resources* use IT to manage the recruiting process, analyze and screen job applicants, and hire new employees. They also employ IT to help employees manage their careers, to administer performance tests to employees, and to monitor employee productivity. Finally, they rely on IT to manage compensation and benefits packages.

Two information systems that support the entire organization, **enterprise resource planning (ERP) systems** and transaction processing systems, are designed to correct a lack of communication among the functional area ISs. For this reason, Figure 1.4 shows ERP systems spanning the FAISs. ERP systems were an important innovation because organizations often developed the various functional area ISs as stand-alone systems that did not communicate effectively (if at all) with one another. ERP systems resolve this problem by tightly integrating the functional area ISs via a common database. In doing so, they enhance communications among the functional areas of an organization. For this reason, experts credit ERP systems with greatly increasing organizational productivity.

A **transaction processing system (TPS)** supports the monitoring, collection, storage, and processing of data from the organization's basic business transactions, each of which generates data. When you are checking out at Walmart, for example, a transaction occurs each time the cashier swipes an item across the bar code reader. Significantly, within an organization, different functions or departments can define a transaction differently. In accounting, for example, a transaction is anything that changes a firm's chart of accounts. The information system definition of a transaction is broader: a transaction is anything that changes the firm's database.

The chart of accounts is only part of the firm's database. Consider a scenario in which a student transfers from one section of an Introduction to MIS course to another section. This move would be a transaction to the university's information system, but not to the university's accounting department (the tuition would not change).

The TPS collects data continuously, typically in *real time*—that is, as soon as the data are generated—and it provides the input data for the corporate databases. TPSs are considered critical to the success of any enterprise because they support core operations. Significantly, nearly all ERP systems are also TPSs, but not all TPSs are ERP systems. In fact, modern ERP systems incorporate many functions that previously were handled by the organization's functional area information systems. You study both TPSs and ERP systems in detail in Chapter 10.

ERP systems and TPSs function primarily within a single organization. Information systems that connect two or more organizations are referred to as **interorganizational information systems (IOSs)**. IOSs support many interorganizational operations, of which *supply chain management* is the best known. An organization's **supply chain** is the flow of materials, information, money, and services from suppliers of raw materials through factories and warehouses to the end customers.

Note that the supply chain in Figure 1.5 shows physical flows, information flows, and financial flows. Digitizable products are those that can be represented in electronic form, such as music and software. Information flows, financial flows, and digitizable products go through the Internet, whereas physical products are shipped. For example, when you order a computer from **www.dell.com**, your information goes to Dell via the Internet. When your transaction is completed (that is, your credit card is approved and your order is processed), Dell ships your computer to you. (We discuss supply chains in more detail in Chapter 11.)

**Electronic commerce (e-commerce) systems** are another type of interorganizational information system. These systems enable organizations to conduct transactions, called business-to-business (B2B) electronic commerce, and customers to conduct transactions with businesses, called business-to-consumer (B2C) electronic commerce. Figure 1.5 illustrates B2B and B2C electronic commerce. Electronic commerce systems are so important that we discuss them in detail in Chapter 7, with additional examples interspersed throughout the text. IT's About Business 1.2 shows how various technologies have enabled Lemonade Insurance to grow rapidly via e-commerce.

## IT's About Business 1.2

### MIS FIN Lemonade Disrupts the Insurance Industry

***Traditional insurance companies***. The business model of insurance companies involves pooling (combining) funds from many insured entities to pay for the losses that some of the entities may incur. That is, insurers pool risk from individual entities and redistribute it across a larger group of entities. Insurers protect insured entities from risk for a fee, which is the insurance premium. The premium depends on the frequency with which an event might occur and the severity of that event.

The essential task of any insurer is to price risk and then charge the customer a premium for assuming that risk. When a customer files a claim, the company must process the claim, check it for accuracy, and submit payment. Before paying a claim, insurance companies use an adjusting process to filter out fraudulent claims and minimize the risk of loss to the company.

Most insurance companies generate revenue in three ways. First, they charge premiums in exchange for insurance coverage. Second, they reinvest those premiums into other investments. Finally, to save money, they keep their administrative expenses as low as possible. Unfortunately, the public often believes that traditional insurers try to save money by denying legitimate claims.

Some companies engage in reinsurance to reduce risk. *Reinsurance* is insurance that insurers purchase to protect themselves from excessive losses as a result of high exposure to a risk. Reinsurance is an integral component of insurance companies' efforts to avoid default due to excessive, unexpected payouts. For example, a hurricane makes landfall in Florida, causing billions of dollars in damages. An insurance company that sold many homeowners' policies might not be able to cover the losses. Instead, that company spreads parts of the coverage to other insurance companies (reinsurance), thereby spreading the cost of risk among many insurance companies.

***Lemonade***. Launched in 2015, Lemonade Insurance Company (**www.lemonade.com**) is a U.S. property and casualty insurance company that offers renters and home insurance policies for homes, apartments, co-ops, and condominiums. The company operates in 26 states and Washington, D.C., as well as in Germany and the Netherlands. Lemonade is a regulated insurance carrier, meaning that the firm must maintain cash reserves equal to at least a third of its revenue.

Lemonade acts as an insurance carrier rather than a broker. An *insurance carrier* is the company that holds your insurance policy. In contrast, *insurance brokers* work directly with clients to help find policies that meet their needs. *Insurance underwriters* evaluate risks and decide the specific terms and costs associated with those policies.

Acting as a carrier means that Lemonade does not sell policies backed by traditional insurers the way competitors Hippo (**www.hippo.com**) and Jetty (**www.jetty.com**) do. Rather, the insurer retains claim liabilities on its own balance sheet. The firm underwrites its own policies and is reinsured at Lloyd's of London.

Lemonade uses technology in developing its electronic commerce business model. Using artificial intelligence algorithms, a desktop and mobile app, and behavioral economics, Lemonade is disrupting the traditional insurance industry. The company delivers insurance policies and handles claims using chatbots. The chatbot guides customers through the application process by asking a series of questions and producing a quote very quickly. A *chatbot* is a software application that conducts an online chat conversation with a customer via text or text-to-speech instead of direct contact with a human agent. (We discuss chatbots in Chapter 7.)

Lemonade uses its algorithms to approve applicants, price risk, and determine whether a claim should be paid, all without human involvement. (Lemonade states that it pays 30 percent of its claims this way.) If a claim is not instantly approved, then a human claims representative reviews it. Lemonade's technologies enable the company to offer policies at a very low price. For example, renters' insurance starts at $5 per month, and homeowners' insurance starts at $25 per month.

Demonstrating the value of its algorithms, Lemonade paid one customer's claim for his stolen Canada Goose parka in three seconds. That was the time that it took Lemonade's claims algorithms to run 18 antifraud algorithms and send bank instructions to deposit $729 in the man's account.

Lemonade's business model is paperless and has no brokers, and is low-cost, easy to interact with, and trustworthy. The insurer's model differs from those of traditional insurance companies in that the insurer takes 25 percent of insurance premium revenue for administrative costs and potential profits. The company uses the other 75 percent to pay customer claims, purchase reinsurance (lessening some risk), and pay taxes and fees. They donate any remaining funds from the 75 percent (called leftover premiums) to charities that customers choose in the firm's annual Giveback program. As of May 2020 the Giveback program was partnering with almost 100 nonprofit organizations.

Lemonade maintains that its Giveback program is designed to solve the conflicts of interest that are inherent in traditional insurance. Every dollar that insurance companies pay out in claims is a dollar less to their bottom line. According to Lemonade, this fact creates distrust between insurers and their customers. By introducing charities into its model, Lemonade contends that it has changed its customers' incentives. That is, if they file false claims, they are not hurting an insurance company, but a charitable cause that they selected.

Significantly, the Giveback program has elicited fascinating customer behavior. Even after their claims have been paid, some Lemonade customers contact the firm to admit that their goods have been found and they want to return the money. They cite Giveback as their motivation.

Lemonade has also rewritten the insurance policy itself. Similar to the policies of traditional insurers, the firm's original policy was 40 pages long and difficult to understand. Lemonade's Policy 2.0 provides their customers with a clear and easy way to understand what their policy does and does not cover.

Interestingly, Lemonade has open-sourced its policy on GitHub (**http://github.com**), a web-based platform for version control. This site simplifies the process of working with other people and makes it easy to collaborate on projects. Anyone, from state legislators, to consumer advocacy groups, to Lemonade competitors, to interested customers, can make edits and contributions to the policy. Lemonade retains final control of this process.

Like all insurance companies, Lemonade must conform to certain regulations. Much of the language in typical insurance policies is legally required to be in the document. As a result, Lemonade is working with regulators to allow Policy 2.0 to be sold, and that process differs from state to state and country to country.

At the end of 2017, Lemonade's loss ratio—the amount it pays in claims divided by the premiums it collects—was an unsustainable 166 percent, compared to 65–70 percent for large insurers. Two years later, this ratio had dropped to 73 percent. The reason for the decline was that Lemonade had collected increasing amounts of customer data, which it utilized to refine its algorithms.

By May 2020 Lemonade claimed a 0.1 percent share of the combined homeowners' and renters' insurance markets, compared with 19 percent for State Farm and 10 percent for Allstate, according to data from 17 states collected by the Insurance Information Institute. Although a tiny company, on the crowdsourced insurance company review site Clearsurance (**www.clearsurance.com**), Lemonade ranked second in customer satisfaction for renters' insurance, behind only USAA. By May 2020 the startup had received $480 million in several rounds of funding, and financial analysis firm Demotech (**www.demotech.com**) rated Lemonade's financial stability as A-Exceptional.

It is important to note that while Lemonade promises speed and convenience, traditional insurance companies do not tend to draw out the claims process. Furthermore, although Lemonade can offer great prices, customers can also find competitive prices at traditional insurers. The price of insurance depends on many factors, so it is important to obtain quotes from multiple insurers before you decide on a company.

**Sources:** Compiled from M. Gallo, "Lemonade Review: We Tested an Insurance Company Designed for People Who Hate to Talk on the Phone," *Chicago Tribune*, May 18, 2020; M. High, "How Is Digital Technology Disrupting Insurtech?" *FinTech Magazine*, May 4, 2020; M. High, "Next Generation Financial Services: Technology and Disruption," *FinTech Magazine*, April 28, 2020; "Lemonade Launches in the Netherlands," *Bloomberg*, April 2, 2020; A. Aziz, "The Power of Purpose: How Lemonade Is Disrupting Insurance with Goodness (and a New Foundation)," *Forbes*, March 9, 2020; J. Crook, "Lemonade Is Getting into Pet Insurance," *TechCrunch*, February 4, 2020; C. Morris, "Americans Will Spend $75 Billion on Their Pets This Year," *Fortune*, December 16, 2019; S. Ross, "What Is the Main Business Model for Insurance Companies?," *Investopedia.com*, June 25, 2019; J. Kauflin and K. Stoller, "Brokers Begone," *Forbes*, May 31, 2019; A. Simpson, "Lemonade Proposes Open Source Insurance Policy for All to Change, Adopt," *Insurance Journal*, May 21, 2018; J. Crook, "Lemonade Wants to Rewrite the Insurance Policy Itself," *TechCrunch*, May 16, 2018; L. Howard, "Insurance Flipsides: Countering the Industry's Negative Perception Problem," *Insurance Journal*, May 10, 2018; S. Jenks, "Pet Insurance Is the Latest Work Perk," *New York Times*, June 7, 2017; **www.lemonade.com**, accessed May 25, 2020.

## Questions

1. **Discuss some of the problems with traditional insurance companies that Lemonade is trying to solve.**
2. **Provide three examples of how Lemonade uses information technologies to develop and support its business model.**
3. **What steps should traditional insurance companies take to compete with Lemonade? Provide examples to support your answer.**

## Support for Organizational Employees

So far, you have concentrated on information systems that support specific functional areas and operations. Now you will learn about information systems that typically support particular employees within the organization.

*Clerical workers*, who support managers at all levels of the organization, include bookkeepers, secretaries, electronic file clerks, and insurance claim processors. *Lower-level managers* handle the day-to-day operations of the organization, making routine decisions such as assigning tasks to employees and placing purchase orders. *Middle managers* make tactical decisions, which deal with activities such as short-term planning, organizing, and control.

**Knowledge workers** are professional employees such as financial and marketing analysts, engineers, lawyers, and accountants. All knowledge workers are experts in a particular subject area. They create information and knowledge, which they integrate into the business. Knowledge workers, in turn, act as advisors to middle managers and executives. Finally, *executives* make decisions that deal with situations that can significantly change the manner in which business is conducted. Examples of executive decisions are introducing a new product line, acquiring other businesses, and relocating operations to a foreign country.

*Functional area information systems* summarize data and prepare reports, primarily for middle managers, but sometimes for lower-level managers as well. Because these reports typically concern a specific functional area, report generators (RPGs) are an important type of functional area IS.

**Business analytics (BA) systems** (also known as **business intelligence (BI) systems**) provide computer-based support for complex, nonroutine decisions, primarily for middle managers and knowledge workers. (They also support lower-level managers, but to a lesser extent.) These systems are typically used with a data warehouse, and they enable users to perform their own data analysis. You will learn about BA systems in Chapter 12.

**Expert systems (ESs)** attempt to duplicate the work of human experts by applying reasoning capabilities, knowledge, and expertise within a specific domain. They have become valuable in many application areas, primarily but not exclusively areas involving decision making. For example, navigation systems use rules to select routes, but we do not typically think of these systems as expert systems. Significantly, expert systems can operate as stand-alone systems or be embedded in other applications. We examine ESs in greater detail in Chapter 14.

**Dashboards** (also called **digital dashboards**) are a special form of IS that support all managers of the organization. They provide rapid access to timely information and direct access to structured information in the form of reports. Dashboards that are tailored to the information needs of executives are called *executive dashboards*. Chapter 12 provides a thorough discussion of dashboards.

**Table 1.4** provides an overview of the different types of information systems used by organizations.

**TABLE 1.4 Types of Organizational Information Systems**

| Type of System | Function | Example |
|---|---|---|
| Transaction processing system | Processes transaction data from terminal | Walmart checkout point-of-sale business events |
| Enterprise resource planning | Integrates all functional areas of the organization | Oracle, SAP system |
| Functional area IS | Supports the activities within a specific functional area | System for processing payroll |
| Decision support system | Provides access to data and analysis tools | "What-if" analysis of changes in budget |
| Expert system | Mimics human expert in a particular area and makes decisions | Credit card approval analysis |
| Dashboards | Present structured, summarized information about aspects of business important to executives | Status of sales by product |
| Supply chain management system | Manages flows of products, services, and information among organizations | Walmart Retail Link system connecting suppliers to Walmart |
| Electronic commerce system | Enables transactions among organizations and between organizations and customers | **www.dell.com** |

## Before you go on…

1. What is a computer-based information system?
2. Describe the components of computer-based information systems.
3. What is an application program?
4. Explain how information systems provide support for knowledge workers.
5. As we move up the organization's hierarchy from clerical workers to executives, how does the type of support provided by information systems change?

# 1.3 How Does IT Impact Organizations?

**Author Lecture Videos are available exclusively in *WileyPLUS*.**
**Apply the Concept activities are available in the Appendix and in *WileyPLUS*.**

Throughout this text you will encounter numerous examples of how IT affects various types of organizations. These examples will make you aware of just how important IT actually is to organizations. In fact, for the vast majority of organizations, if their information systems fail, then they cease operations until the problems are found and fixed. Consider the following examples.

- Bluelink (**http://bluelink.org**) is a technology company that develops mobile apps designed to register, organize, and mobilize voters. During the 2020 Iowa Democratic caucuses, the company's app (IowaReporterApp) failed. As a result, the results of the caucuses were delayed as officials had to manually count the votes.
- In November 2019 a British Airways software problem caused pilots to be unable to file their flight plans. The outage led to delays that snowballed into cancellations, affecting flights to and from London's Gatwick and Heathrow airports. Pilots were forced to plot their courses on old-fashioned charts and thousands of passengers were stuck on the ground for up to 24 hours before the system was restored.

This section provides an overview of the impact of IT on modern organizations. As you read this section, you will learn how IT will affect you as well.

## IT Impacts Entire Industries

As of mid-2020, the technology required to transform industries through software had been developed and integrated and could be delivered globally. In addition, software tools and Internet-based services enabled companies in many industries to launch new software-powered startups without investing in new infrastructure or training new employees. For example, in 2000, operating a basic Internet application cost businesses approximately $150,000 per month. By mid-2020, operating that same application in Amazon's cloud could cost as little as $100 per month, depending on the amount of data traffic to and from the website. (We discuss cloud computing in Technology Guide 3.)

In essence, software is impacting every industry, and every organization must prepare for these impacts. Let's examine a few examples of software disruption across several industries. Many of these examples focus on two scenarios: (1) industries where software disrupted the previous market-leading companies and (2) industries where a new company (or companies) used software to achieve a competitive advantage.

**The Book Industry.** In mid-2020, the largest book publisher and bookseller in the United States was Amazon, a software company. Amazon's core capability is its software engine, which can sell virtually anything online without building or maintaining any retail stores. Now even books themselves have become software products, known as electronic (or digital) books, or e-books. In 2020, physical books accounted for approximately 81 percent of total book sales, and electronic books accounted for approximately 19 percent of total book sales. Keep in mind

that electronic book sales increased from 0 percent in 1994 when Amazon was founded to 19 percent 26 years later.

Interestingly, according to the 2018 Academic Student Ebook Experience Survey, 74 percent of respondents said that they preferred print books when reading for pleasure. Furthermore, 68 percent said that they preferred print books for assigned readings.

**The Music Industry.** Total U.S. album sales peaked at 785 million in 2000, which was the year after Napster was created. Napster was a service that allowed anyone with a computer and a reasonably fast Internet connection to download and trade music for free. From 2000 to 2018, the major music labels (companies) worked diligently to eliminate illegal downloading and sharing, begun by Napster in 2001. Despite these efforts, however, album sales continued to decline.

However, by 2019 music fans had shifted from illegal downloads to paid streaming platforms such as Spotify (**www.spotify.com**), Apple Music (**www.music.apple.com**), Amazon Prime (**www.amazon.com**), and Pandora (**www.pandora.com**), which generally charge $5 to $10 per month for unlimited access to millions of songs. Even though the record labels receive only about 0.3 cents each time a song is streamed, these small amounts are significant. In 2019, the global record industry reported revenues of $21.5 billion, with streaming generating $11.4 billion.

**The Video Industry.** Blockbuster—which rented and sold videos and ancillary products through its chain of stores—was the industry leader until it was disrupted by a software company, Netflix (**www.netflix.com**). By the first quarter, 2020, Netflix had the largest global subscriber base of any video service, with 167 million subscribers. Meanwhile, Blockbuster declared bankruptcy in February 2011 and was acquired by satellite television provider Dish Network (**www.dish.com**) a month later. In May 2020, only one Blockbuster store—located in Bend, Oregon—was still open.

**MIS The Software Industry.** Incumbent software companies such as Oracle and Microsoft are increasingly threatened by software-as-a-service (SaaS) products—for example, Salesforce (**www.salesforce.com**) and Android, an open-source operating system. (We discuss operating systems in Technology Guide 2 and SaaS in Technology Guide 3.)

**The Video Game Industry.** Today, the fastest growing entertainment companies are video game makers—again, software. Examples are Zynga (**www.zynga.com**), the creator of FarmVille; Rovio (**www.rovio.com**), the maker of Angry Birds; and Minecraft (**www.minecraft.net**), now owned by Microsoft (**www.microsoft.com**).

**The Photography Industry.** Software disrupted this industry years ago. Today it is virtually impossible to buy a mobile phone that does not include a software-powered camera. In addition, people can upload photos automatically to the Internet for permanent archiving and global sharing. Leading photography companies include Instagram (**www.instagram.com**), Shutterfly (**www.shutterfly.com**), Snapfish (**www.snapfish.com**), and Flickr (**www.flickr.com**). Meanwhile, Kodak, the longtime market leader—whose name was almost synonymous with cameras—declared bankruptcy in January 2012.

**MKT The Marketing Industry.** Today's largest direct marketing companies include Facebook (**www.facebook.com**), Google (**www.google.com**), and Amazon (**www.amazon.com**). All of these companies are using software to disrupt the retail marketing industry.

**HRM The Recruiting Industry.** LinkedIn (**www.linkedin.com**) is disrupting the traditional job-recruiting industry. For the first time, employees and job searchers can maintain their résumés on a publicly accessible website that interested parties can search in real time.

**FIN The Financial Services Industry.** Software has transformed the financial services industry. Practically every financial transaction—for example, buying and selling stocks—is now performed by software. Also, many of the leading innovators in financial services are software companies. See our discussion of FinTech in Chapter 7.

**The Motion Picture Industry.** The process of making feature-length computer-generated films has become incredibly IT intensive. Studios require state-of-the-art information technologies, including massive numbers of servers, sophisticated software, and an enormous amount of storage (all described in Technology Guide 1).

Consider DreamWorks Animation (**www.dreamworks.com**), a motion picture studio that creates animated feature films, television programs, and online virtual worlds. For a single motion picture, the studio manages more than 500,000 files and 300 terabytes (a terabyte is 1 trillion bytes) of data, and it uses about 80 million central processing unit (CPU; described in Technology Guide 1) hours. As DreamWorks executives state, "In reality, our product is data that looks like a movie. We are a digital manufacturing company."

Software is also disrupting industries that operate primarily in the physical world. Consider these examples:

- *The Automobile Industry*: In modern cars, software is responsible for running the engine, controlling safety features, entertaining passengers, guiding drivers to their destinations, and connecting the car to mobile, satellite, and GPS networks. Other software functions include Wi-Fi receivers, which turn your car into a mobile hot spot; software, which helps maximize fuel efficiency; and ultrasonic sensors, which enable some models to parallel park automatically.

  The next step is to network all vehicles together, a necessary step toward the next major breakthrough: self-driving or driverless cars. Google, Tesla (**www.tesla.com**), Apple, and all of the major automobile companies are now developing driverless vehicles.
- *The Agriculture Industry*: Agriculture is increasingly powered by software, including satellite analysis of soils linked to per-acre seed-selection software algorithms. In addition, precision agriculture makes use of automated, driverless tractors controlled by global positioning systems (GPS) and software. *Precision agriculture* is an approach to farm management that uses information technology to ensure that crops receive exactly what they need—for example, water, fertilizer, and pesticides—for optimum health and productivity. (See IT's About Business 1.3.)
- *The Fashion Industry*: Women have long "borrowed" special-occasion dresses from department stores, buying them and then returning them after wearing them for one evening. Now, Rent the Runway (**www.renttherunway.com**) has redefined the fashion business, making expensive clothing available to more women than ever before. The firm is also disrupting traditional physical retailers. After all, why buy a dress when you can rent one for a very low price? Some department stores feel so threatened by Rent the Runway that they have reportedly told vendors that they will remove floor merchandise if it ever shows up on that company's website.
- *The Legal Profession*: Today, electronic discovery (e-discovery) software applications can analyze documents in a fraction of the time that human lawyers would take, at a fraction of the cost. For example, Blackstone Discovery (**www.blackstonediscovery.com**) helped one company analyze 1.5 million documents for less than $100,000. That company estimated that the process would have cost $1.5 million had it been performed by lawyers.

  Law firms are now beginning to use a new artificial intelligence software package called ROSS (**www.rossintelligence.com**). For example, law firm BakerHostetler has hired ROSS to serve as a legal researcher in bankruptcy cases. In May 2020 ROSS offered its full set of features, unlimited searches, and access to its entire database of U.S. federal and state cases for prices starting at $69 per month per user.

## IT Reduces the Number of Middle Managers

HRM IT makes managers more productive, and it increases the number of employees who can report to a single manager. Thus, IT ultimately decreases the number of managers and experts. It is reasonable to assume, therefore, that in coming years organizations will have fewer managerial levels and fewer staff and line managers. If this trend materializes, promotional opportunities will decrease, making promotions much more competitive. Bottom line: pay attention in school!

## IT Changes the Manager's Job

One of the most important tasks of managers is making decisions. A major consequence of IT has been to change the manner in which managers make their decisions. In this way, IT ultimately has changed managers' jobs.

IT often provides managers with near-real-time information, meaning that managers have less time to make decisions, making their jobs even more stressful. Fortunately, IT also provides many tools—for example, business analytics applications such as dashboards, search engines, and intranets—to help managers handle the volumes of information they must deal with on an ongoing basis.

So far in this section, we have been focusing on managers in general. Now let's focus on you. Due to advances in IT, you will increasingly supervise employees and teams who are geographically dispersed. Employees can work from anywhere at any time, and teams can consist of employees who are literally dispersed throughout the world. Information technologies such as telepresence systems (discussed in Chapter 6) can help you manage these employees even though you do not often see them face-to-face. For these employees, electronic or "remote" supervision will become the norm. Remote supervision places greater emphasis on completed work and less emphasis on personal contacts and office politics. You will have to reassure your employees that they are valued members of the organization, thereby diminishing any feelings they might have of being isolated and "out of the loop."

## Will IT Eliminate Jobs?

One major concern of every employee, part-time or full-time, is job security. Relentless cost-cutting measures in modern organizations often lead to large-scale layoffs. Put simply, organizations are responding to today's highly competitive environment by doing more with less. Regardless of your position, then, you consistently will have to add value to your organization and make certain that your superiors are aware of this value.

Many companies have responded to difficult economic times, increased global competition, demands for customization, and increased consumer sophistication by increasing their investments in IT. In fact, as computers continue to advance in terms of intelligence and capabilities, the competitive advantage of replacing people with machines is increasing rapidly. This process frequently leads to layoffs. At the same time, however, IT creates entirely new categories of jobs, such as electronic medical record-keeping and nanotechnology.

## IT Impacts Employees at Work

Many people have experienced a loss of identity because of computerization. They feel like "just another number" because computers reduce or eliminate the human element present in non-computerized systems.

The Internet threatens to exert an even more isolating influence than have computers and television. Encouraging people to work and shop from their living rooms could produce some unfortunate psychological effects, such as depression and loneliness.

HRM **IT Impacts Employees' Health and Safety.** Although computers and information systems are generally regarded as agents of "progress," they can adversely affect individuals' health and safety. In fact, the average American worker spends seven hours per day in front of some type of screen (consider laptops, tablets, smartphones, computers, and televisions). Let's consider two issues associated with IT: job stress and long-term use of the keyboard.

An increase in an employee's workload and/or responsibilities can trigger *job stress*. Although computerization has benefited organizations by increasing productivity, it also has created an ever-expanding workload for some employees. Some workers feel overwhelmed and have become increasingly anxious about their job performance. These feelings of stress and anxiety can actually diminish rather than improve workers' productivity

while jeopardizing their physical and mental health. Management can help alleviate these problems by providing training, redistributing the workload among workers, and hiring more workers.

On a more specific level, the long-term use of keyboards can lead to *repetitive strain injuries* such as backaches and muscle tension in the wrists and fingers. *Carpal tunnel syndrome* is a particularly painful form of repetitive strain injury that affects the wrists and hands.

Designers are aware of the potential problems associated with the prolonged use of computers. To address these problems, they continually attempt to design a better computing environment. The science of designing machines and work settings that minimize injury and illness is called *ergonomics*. The goal of ergonomics is to create an environment that is safe, well lit, and comfortable. Examples of ergonomically designed products are antiglare screens that alleviate problems of fatigued or damaged eyesight and chairs that contour the human body to decrease backaches. **Figure 1.6** displays some sample ergonomic products.

**HRM** **IT Provides Opportunities for People with Disabilities.** Computers can create new employment opportunities for people with disabilities by integrating speech-recognition and vision-recognition capabilities. For example, individuals who cannot type can use a voice-operated keyboard, and individuals who cannot travel can work at home.

Going further, adaptive equipment for computers enables people with disabilities to perform tasks they normally would not be able to do. For example, the Web and graphical user interfaces (GUIs; e.g., Windows) can be difficult for people with impaired vision to use. To address this problem, manufacturers have added audible screen tips and voice interfaces, which essentially restore the functionality of computers to the way it was before GUIs became standard.

Other devices help improve the quality of life in more mundane, but useful, ways for people with disabilities. Examples are a two-way writing telephone, a robotic page turner, a hair brusher, and a hospital-bedside video trip to the zoo or the museum. Several organizations specialize in IT designed for people with disabilities.


Media Bakery


Media Bakery


Media Bakery


Media Bakery

**FIGURE 1.6** **Ergonomic products protect computer users.**

## Before you go on…

1. Why should employees in all functional areas become knowledgeable about IT?
2. Describe how IT might change the manager's job.
3. Discuss several ways in which IT impacts employees at work.

# 1.4 Importance of Information Systems to Society

This section explains in greater detail why IT is important to society as a whole. Other examples of the impact of IT on society appear throughout the text.

**Author Lecture Videos are available exclusively in *WileyPLUS*.**
**Apply the Concept activities are available in the Appendix and in *WileyPLUS*.**

## IT Affects Our Quality of Life

IT has significant implications for our quality of life. The workplace can be expanded from the traditional 9-to-5 job at a central location to 24 hours a day at any location. IT can provide employees with flexibility that can significantly improve the quality of leisure time, even if it doesn't increase the total amount of leisure time.

From the opposite perspective, however, IT also can place employees on "constant call," which means they are never truly away from the office, even when they are on vacation. In fact, surveys reveal that the majority of respondents take their laptops and smartphones on their vacations, and 100 percent take their cell phones. Going further, the majority of respondents did some work while vacationing, and almost all of them checked their e-mail regularly.

## The Robot Revolution Is Here Now

Once restricted largely to science fiction, robots that can perform practical tasks are now a reality. Two major types of robot are industrial robots and collaborative robots, or cobots.

An *industrial robot* is an automated, programmable machine used in manufacturing operations. Applications for industrial robots include welding, painting, assembly, disassembly, packaging and labeling, palletizing, and many others. *Collaborative robots*, or *cobots*, are machines designed to be used in collaborative applications where there are interactions with humans within a shared space. Applications for cobots include providing information in public spaces, transporting materials and products within a building, inspection of goods, patrolling perimeters, securing facilities, and many others. Now let's look at the differences between the two types.

POM **Industrial robots versus cobots.** Cobots are designed to work alongside human employees, while industrial robots perform work in place of those employees. A cobot can assist employees with work that may be too dangerous, strenuous, or tedious for them to accomplish on their own. This assistance can create a safer, more efficient workplace without eliminating factory jobs. In contrast, industrial robots are used to automate the manufacturing process almost entirely without human help on the manufacturing floor. This process can free employees for more meaningful tasks that are less mundane and less prone to repetitive-motion injuries.

Cobots are also more easily programmable than industrial robots because they are capable of "learning" on the job. A factory worker can re-program a cobot simply by moving the cobot's arms along a desired path. At that point, the cobot will "remember" the new movement and be able to repeat it on its own. Industrial robots cannot be so easily reprogrammed and require an engineer to write new software for any changes in the process that the robot is to perform.

Industrial robots are designed for heavy manufacturing, while cobots are designed for light manufacturing. Industrial robots require safety cages to keep humans out of the workspace, while cobots are safe enough to function around people and do not require the same type of safety infrastructure that industrial robots require. Last but certainly not least, industrial robots are much more expensive ($100,000 to $150,000) than cobots ($35,000 to $50,000).

Cobots have become increasingly common on factory floors, in hospital corridors, and in farm fields. Amazon Robotics is an excellent example of cobots in a distribution center.

Traditionally, companies moved goods around their distribution centers with human-operated conveyors or with human-operated machines such as forklifts. That is, orders would enter the distribution center and humans would locate, pick, and pack the items for shipment.

Amazon Robotics, formerly Kiva Systems, reversed the process with cobots. In the new approach, the company stores items on portable storage units. When an order enters the company database, software locates the closest cobot to the item and directs it to retrieve that item. The cobots navigate around the distribution center by following bar code stickers on the floor. Each cobot has sensors that read the bar codes and prevent collisions. When the cobot reaches the correct storage unit, it slides underneath it and lifts it off the ground through a corkscrew action. The cobot then carries the storage units to a human operator who picks the item(s).

The bottom line with this system is that, rather than humans going to the items, the cobots bring the items to the humans. The system is much more efficient and accurate than the traditional one.

**Drones.** A *drone* is an unmanned aerial vehicle (UAV) (a flying robot, if you will) that either is controlled by pilots from the ground or autonomously follows a preprogrammed mission. Commercial drones function in a variety of business purposes, in contrast to drones used by hobbyists for recreational purposes.

An interesting use of drones is in the fight against deforestation. A good example of this process is in Yangon, Myanmar, where Dendra Systems (**www.dendra.io**) is working with a non-profit organization called Worldview International Foundation (**http://wif.foundation**) to plant mangrove saplings. Dendra, formerly BioCarbon Engineering, is a startup company that makes drones to plant trees and grasses.

Drones first fly over the area to be planted, map it, and collect data about the topography and soil conditions. Dendra integrates these data with satellite data of the area and determines the best locations to plant seeds. Once the company analyzes the data, drones fire biodegradable pods filled with germinated seeds and nutrients into the ground at the preselected locations. Over the next months, drones fly over the planted areas and monitor how the mangroves are growing.

**Autonomous Vehicles.** An autonomous, or self-driving, car (essentially a robot car) is a vehicle that is capable of sensing its environment and moving safely to its destination with little or no human input. When you think about autonomous vehicles, consider these statistics:

- Human error accounts for more than 90 percent of automobile accidents.
- Each year more than 6 million vehicle accidents are reported to law enforcement.
- In 2019, a total of 38,800 Americans and 1.35 million people worldwide died in automobile accidents.
- The average car in the United States is used two hours per day, which is only 8 percent of the time. Therefore, a car owner owns a rapidly depreciating asset that is idle the vast majority of the time.

These statistics offer compelling reasons for autonomous vehicles, and the development of these vehicles is proceeding rapidly. Leading autonomous vehicle companies are Waymo (**www.waymo.com**), GM Cruise (**https://getcruise.com**), and Ford Autonomous (**www.ford.com**).

There is some bad news, however. Several fatalities have been reported with Tesla automobiles on full autopilot (self-driving mode). Whether these deaths were caused by the automobiles is under investigation.

It probably will be a long time before we see robots making decisions by themselves, handling unfamiliar situations, and interacting with people. Nevertheless, robots are extremely helpful in various environments, particularly those that are repetitive, harsh, or dangerous to humans. Consider the use of robots in hospitals during the COVID-19 pandemic.

## The Emergence of Cognitive Computing: IBM Watson

MIS IBM Watson (**www.ibm.com/watson**) is a suite of enterprise-ready artificial intelligence services, applications, and software tools. Watson integrates advanced natural language processing, information retrieval, knowledge representation and reasoning, and machine learning technologies in order to answer open-domain (general) questions. IBM has labeled the type of processing demonstrated by Watson as *cognitive computing*. Watson has four primary capabilities:

- The ability to understand human language, with all of its nuance and ambiguity;
- The ability to learn and absorb information;
- The ability to formulate hypotheses;
- The ability to understand the context of a question.

By mid-2020, organizations in at least 20 industries were using Watson in a variety of applications. IT's About Business 1.3 illustrates how a number of technologies, including robots, drones, autonomous vehicles, and artificial intelligence, are transforming the agriculture industry.

### IT's About Business 1.3

#### POM The Agriculture Industry's Transformations

Global agriculture, critical to all of us, is a $5 trillion industry. In addition, the increasing global population is placing ever greater demands on agriculture.

Agriculture has experienced transformations throughout its history. The first transformation was the introduction of mechanized agriculture, which began during the Industrial Revolution of the 19th century. Farm mechanization is the process of using powered machinery to perform farm jobs previously carried out by humans and animals. As a result, farming productivity increased markedly while becoming much less labor intensive.

The second agricultural transformation, called the Green Revolution, dates to the 1950s and 1960s. During this period agriculture benefitted from new chemical fertilizers and synthetic herbicides and pesticides. The chemical fertilizers provided crops with extra nutrients, and the herbicides and pesticides controlled weeds, killed insects, and prevented diseases. Also during this period, scientists used genetic modification to develop high-yield crops. As a result of these innovations, agricultural productivity again rapidly increased.

The third agricultural transformation, *precision agriculture*, is a process designed to apply the precise and correct amounts of inputs such as water, fertilizer, pesticides, and herbicides at the correct time in the correct place to maximize crop yields. This process also targets environmental impacts and has become critical to sustainable agriculture.

Precision agriculture uses a number of technologies such as global positioning systems (GPS; see Chapter 8), digital imagery (see Chapter 6), sensors (see Chapter 8), robotics, drones, autonomous vehicles, and artificial intelligence (we discuss these last four technologies in Chapter 14). Communications among these technologies uses fifth-generation (5G) wireless technology (see Chapter 8), expected to be widely deployed by 2020. Let's examine these technologies.

*Global positioning systems*. GPS allow farmers to construct precise maps of their fields. These maps enable farmers to accurately navigate to specific locations in their fields to collect soil samples or to monitor various crop conditions.

*Digital imagery*. Precision agriculture uses geospatial technologies—for example, images from satellites and drones integrated with GPS coordinates—to map specific areas that vary in crop and soil conditions. Farmers can then match inputs—water, seed, fertilizer, herbicides, and pesticides—to those areas by applying them at variable rates. *Variable-rate technology* is the process of applying these inputs in precise amounts at precise locations across a field without manually changing the settings on the equipment or having to make multiple passes over a field.

These specific areas in fields are depicted with zone maps and prescription maps. Zone maps display the difference between healthy and stressed plants by representing the amount of light they are reflecting. Prescription maps tell farmers how much input to apply to each small area of a field. Precision farming has become so precise that farmers today are able to treat individual plants.

*Sensors*. A sensor is a device that detects or measures and then records a physical property. In agriculture, sensors help farmers monitor and optimize crops and keep up with changing environmental factors. In essence, sensors enable farmers to understand their crops at a very small scale. Drones and farm equipment can

carry sensors, and farmers can place stationary sensors in and around their fields.

Sensors measure various soil properties such as chemical composition, compactness, and temperatures at various depths. Environmental sensors measure air temperature, rainfall, leaf wetness, wind speed and direction, dew point temperature, solar radiation, and atmospheric pressure. Animal sensors enable farmers to identify each cow and to track each cow's activity level, health, and the optimal time for breeding.

*Robotics*. A wide variety of robots are being utilized in precision agriculture. Let's take a look at some of them.

- A robot named TerraSentia navigates a field by generating laser pulses to scan its environment. The robot produces a detailed map of a field, from the size and health of the plants to the number and quality of ears each corn plant will produce by the end of the season. The robot also measures plant height, stem diameter, and the total number of grain- and fruit-producing plants.
- Agrobot (**www.agrobot.com**) uses imaging technology to assess a strawberry's ripeness before it harvests the particular fruit.
- The Oz weeding robot by Naio Technologies has a camera capable of identifying weeds that sprout between rows of crops like broccoli and cauliflower. One machine replaces 11 workers.
- A robot from Abundant Robotics (**www.abundantrobotics.com**) recognizes when an apple is ready for harvesting and then picks the apple without bruising the fruit.
- In a processing plant, a pair of robots have arms that end with a round suction head. They grip five-pound packages of shredded lettuce and place them into boxes moving along a conveyor belt. Next, larger robots lift and stack the filled boxes.
- Robots can be equipped with sensors for pest control. When the robot detects a concentration of insects that exceeds the critical limit (typically set by the insecticide manufacturer), it sprays the affected area.

*Drones*. An agricultural drone is an unmanned aerial vehicle used to help optimize farming operations, increase crop production, and monitor crop health and growth. Drones carry sensors and digital cameras that provide farmers with a detailed picture of their fields. Specifically, drones can perform soil and field analysis, plant seeds, monitor crops, spray crops (down to individual plants), map crops precisely, and monitor irrigation and livestock.

*Autonomous vehicles*. GPS systems and artificial intelligence are underlying technologies for autonomous (self-driving) farm equipment such as tractors, combines, and harvesters. Although self-driving is the ultimate goal, as of May 2020 the equipment still required a human driver. If farming machinery were to become fully autonomous and be equipped with precisely accurate maps of fields, it could then function on a continuous (24/7/365) basis without a human operator.

One company, Bear Flag (**www.bearflagrobotics.com**), is developing autonomous tractors. The firm is integrating sensors and software into existing equipment from major manufacturers to allow farmers to automate many of their most common tasks, such as spraying and mowing in orchards.

*Artificial intelligence (AI)*. Precision agriculture generates vast amounts of data, which AI helps to analyze. Let's look at an example.

In 2016, IBM bought the Weather Company and then integrated that firm's weather data into its IBM Watson Decision Platform for Agriculture. (We discuss IBM Watson in the next section.) The platform analyzes data from satellite imagery and from sensors on farm equipment that monitor seed counts, nutrient levels, and fertilizer flow, among other variables of interest to farmers. The system provides hyperlocal—meaning a very small geographical area—six-month weather predictions based on satellite and atmospheric conditions. The system also provides management models for corn, soybeans, wheat, barley, and other crops.

The platform furnishes farmers with a dashboard of controls. For instance, a farmer inspecting field conditions can take an image from a smartphone, upload it to the decision platform, and receive a diagnosis of crop health along with suggested remedies if needed.

And the result of these agricultural transformations? In 1800, about 90 percent of the U.S. workforce was involved with agriculture. By 1900, that number had declined to just under 40 percent. Today, 1 percent of American workers are in agriculture.

Significantly, despite the rapid decline in the number of U.S. workers employed in agriculture, agricultural productivity has vastly increased. In 1800, one farmer could produce slightly more food than was needed to support a family. By 1930, each farmer produced enough food to feed about 26 people. In the 1960s, each farmer was able to feed about 155 people. Today, each farmer can feed 265 people.

**Sources:** Compiled from L. Calderone, "Satellite Imaging for Agriculture," *Agritech Tomorrow*, April 23, 2020; J. de Koff, "Beginner's Guide to Agricultural Drones," *Future Farming*, April 14, 2020; "How to Improve Farm Productivity with Satellite Technology in 2020," *AgPro*, February 27, 2020; K. Sheikh, "A Growing Presence on the Farm," *New York Times*, February 13, 2020; A. Meola, "Smart Farming in 2020: How IoT Sensors Are Creating a More Efficient Precision Agriculture Industry," *Business Insider*, January 24, 2020; P. Melgares, "Robots, Drones Becoming Workhorses for Agriculture," *AgFax*, January 3, 2020; S. Verma, "5 Unparalleled Advantages Offered by IoT to Farming Business," *Data Science Central*, November 13, 2019; J. Wilson, "How High Tech Is Transforming One of the Oldest Jobs: Farming," *New York Times*, September 6, 2019; K. Sheikh, "A New Way to Fight Crop Diseases, with a Smartphone," *New York Times*, July 30, 2019; K. Walch, "How AI Is Transforming Agriculture," *Forbes*, July 5, 2019; V. Kuprenko, "IoT in Agriculture: Why It Is a Future of Connected Farming World," *The IoT Magazine*, June 21, 2019; L. Bandoim, "How Self-Driving Tractors and AI Are Changing Agriculture," *Forbes*, April 27, 2019; T. Maddox, "Agriculture 4.0," *TechRepublic*, December 12, 2018; M. Jordan, "As Immigrant Farmworkers Become More Scarce, Robots Replace Humans," *New York Times*, November 20, 2018.

## Questions

1. **We addressed eight technologies that are transforming the agriculture industry. Provide examples of how these technologies work together synergistically in this transformation.**
2. **Discuss the impact of the transformation of the agriculture industry as our planet's population continues to increase. Provide examples to support your answer.**

## IT Impacts Health Care

IT has brought about major improvements in health care delivery. Medical personnel use IT to make better and faster diagnoses and to monitor critically ill patients more accurately. IT has also streamlined the process of researching and developing new drugs. Expert systems now help doctors diagnose diseases, and machine vision is enhancing the work of radiologists. Surgeons use virtual reality to plan complex surgeries. They also employ surgical robots to perform long-distance surgery. Finally, doctors discuss complex medical cases via videoconferencing. New computer simulations re-create the sense of touch, allowing doctors-in-training to perform virtual procedures without risking harm to an actual patient.

Information technology can be applied to improve the efficiency and effectiveness of healthcare. Among the thousands of other health care applications, administrative systems are critically important. These systems perform functions ranging from detecting insurance fraud to creating nursing schedules to performing financial and marketing management.

The Internet contains vast amounts of useful medical information. Despite the fact that this information exists on the Internet, physicians caution against self-diagnosis. Rather, people should use diagnostic information obtained from Google and medical websites such as WebMD (**www.webmd.com**) only to ask questions of their physicians.

One of the earliest applications of IBM Watson was in the field of medicine. Watson is able to analyze vast amounts of medical data and provide insights.

Although some health data are structured—for example, blood pressure readings and cholesterol counts—the vast majority are unstructured. These data include textbooks, medical journals, patient records, and nurse and physician notes. In fact, modern medicine entails so much unstructured data that their rapid growth has surpassed the ability of health care practitioners to keep up. IBM emphasizes that Watson is *not* intended to replace health care professionals. Rather, its purpose is to assist them in avoiding medical errors and fine-tuning their medical diagnoses.

By mid-2020, Watson had digested millions of medical and scientific articles as well as information from thousands of clinical trials collected form clinicaltrials.gov, the federal government's public database. Watson can read, and remember, patient histories, monitor the latest drug trials, examine the potency of new therapies, and closely follow state-of-the-art guidelines that help doctors choose optimal treatments for their patients. Watson can also analyze images such as magnetic resonance imaging (MRI) scans and radiographs (X-rays). To exploit these capabilities, two top-ranked hospitals are collaborating with Watson in the field of oncology (cancer care): Memorial Sloan Kettering (**www.mskcc.org**) and the Mayo Clinic (**www.mayoclinic.org**).

### Before you go on…

1. What are some of the quality-of-life improvements made possible by IT? Has IT had any negative effects on our quality of life? If so, then explain, and provide examples.
2. Describe the robotic revolution, and consider its implications for humans. How do you think robotics will affect your life in the future?
3. Explain how IT has improved health care practices. Has the application of IT to health care created any problems or challenges? If so, then explain, and provide examples.

### What's in IT for me?

In Section 1.2, we discussed how IT supports each of the functional areas of the organization. Here we examine the MIS function.

#### MIS For the MIS Major

The MIS function directly supports all other functional areas in an organization. That is, the MIS function is responsible for providing the information that each functional area needs in order to make decisions. The overall objective of MIS personnel is to help users improve performance and solve business problems using IT. To accomplish this objective, MIS personnel must understand both the information requirements and the technology associated with each functional area. Given their position, however, they must think "business needs" first and "technology" second.

# Summary

**1.1** Identify the reasons why being an informed user of information systems is important in today's world.

The benefits of being an informed user of IT include the following:

- You will benefit more from your organization's IT applications because you will understand what is "behind" those applications.
- You will be able to provide input into your organization's IT applications, thus improving the quality of those applications.
- You will quickly be in a position to recommend or to participate in the selection of IT applications that your organization will use.
- You will be able to keep up with rapid developments in existing information technologies, as well as the introduction of new technologies.
- You will understand the potential impacts that "new and improved" technologies will have on your organization. Consequently, you will be qualified to make recommendations concerning their adoption and use.
- You will play a key role in managing the information systems in your organization.
- You will be in a position to use IT if you decide to start your own business.

**1.2** Describe the various types of computer-based information systems in an organization.

- Transaction processing systems (TPS) support the monitoring, collection, storage, and processing of data from the organization's basic business transactions, each of which generates data.
- Functional area information systems (FAISs) support a particular functional area within the organization.
- Interorganizational information systems (IOSs) support many interorganizational operations, of which supply chain management is the best known.
- Enterprise resource planning (ERP) systems correct a lack of communication among the FAISs by tightly integrating the functional area ISs via a common database.
- Electronic commerce (e-commerce) systems enable organizations to conduct transactions with other organizations (called business-to-business (B2B) electronic commerce), and with customers (called business-to-consumer (B2C) electronic commerce).
- Business intelligence (BI) systems provide computer-based support for complex, nonroutine decisions, primarily for middle managers and knowledge workers.
- Expert systems (ESs) attempt to duplicate the work of human experts by applying reasoning capabilities, knowledge, and expertise within a specific domain.

**1.3** Discuss ways in which information technology can affect managers and nonmanagerial workers.

Potential IT impacts on managers:

- IT may reduce the number of middle managers.
- IT will provide managers with real-time or near real-time information, meaning that managers will have less time to make decisions.
- IT will increase the likelihood that managers will have to supervise geographically dispersed employees and teams.

Potential IT impacts on nonmanagerial workers:

- IT may eliminate jobs.
- IT may cause employees to experience a loss of identity.
- IT can cause job stress and physical problems, such as repetitive stress injury.

**1.4** List positive and negative societal effects of the increased use of information technology.

Positive societal effects:

- IT can provide opportunities for people with disabilities.
- IT can provide people with flexibility in their work (e.g., work from anywhere, anytime).
- Robots will take over mundane chores.
- IT will enable improvements in health care.

Negative societal effects:

- IT can cause health problems for individuals.
- IT can place employees on constant call.
- IT can potentially misinform patients about their health problems.

# Chapter Glossary

**application (or app)** A computer program designed to support a specific task or business process.

**business analytics systems** See **business intelligence systems**

**business intelligence (BI) systems** Systems that provide computer-based support for complex, nonroutine decisions, primarily for middle managers and knowledge workers.

**computer-based information system (CBIS)** An information system that uses computer technology to perform some or all of its intended tasks.

**dashboard** A special form of IS that supports all managers of the organization by providing rapid access to timely information and direct access to structured information in the form of reports.

**data items** An elementary description of things, events, activities, and transactions that

are recorded, classified, and stored but are not organized to convey any specific meaning.

**database** A collection of related files or tables containing data.

**digital transformation** The business strategy that leverages IT to dramatically improve employee, customer, and business partner relationships; support continuous improvement in business operations and business processes; and develop new business models and businesses.

**electronic commerce (e-commerce) systems** A type of interorganizational information system that enables organizations to conduct transactions, called business-to-business (B2B) electronic commerce, and customers to conduct transactions with businesses, called business-to-consumer (B2C) electronic commerce.

**enterprise resource planning (ERP) systems** Information systems that correct a lack of communication among the functional area ISs by tightly integrating the functional area ISs via a common database.

**expert systems (ES)** An attempt to duplicate the work of human experts by applying reasoning capabilities, knowledge, and expertise within a specific domain.

**functional area information systems (FAISs) (departmental information system)** ISs that support a particular functional area within the organization.

**hardware** A device such as a processor, monitor, keyboard, or printer. Together, these devices accept, process, and display data and information.

**information** Data that have been organized so that they have meaning and value to the recipient.

**information system (IS)** A system that collects, processes, stores, analyzes, and disseminates information for a specific purpose.

**information technology (IT)** Any computer-based tool that people use to work with information and support the information and information-processing needs of an organization.

**information technology components** Hardware, software, databases, and networks.

**information technology infrastructure** IT components plus IT services.

**information technology platform** The name given to the combination of the IT components of hardware, software, networks (wireline and wireless), and databases.

**information technology services** Activities performed by IT personnel using IT components; specifically, developing information systems, overseeing security and risk, and managing data.

**informed user** A person who is knowledgeable about information systems and information technology.

**interorganizational information systems (IOSs)** Information systems that connect two or more organizations.

**knowledge** Data and/or information that have been organized and processed to convey understanding, experience, accumulated learning, and expertise as they apply to a current problem or activity.

**knowledge workers** Professional employees such as financial and marketing analysts, engineers, lawyers, and accountants, who are experts in a particular subject area and who create information and knowledge, which they integrate into the business.

**network** A connecting system (wireline or wireless) that enables multiple computers to share resources.

**procedures** The set of instructions for combining hardware, software, database, and network components in order to process information and generate the desired output.

**software** A program or collection of programs that enable the hardware to process data.

**supply chain** The flow of materials, information, money, and services from suppliers of raw materials through factories and warehouses to the end customers.

**transaction processing system (TPS)** A system that supports the monitoring, collection, storage, and processing of data from the organization's basic business transactions, each of which generates data.

# Discussion Questions

**1.** Would your university be a good candidate for digital transformation? Why or why not? Support your answer.

**2.** If you responded yes, then what types of digital initiatives should your university undertake to transform itself?

**3.** Describe a business that you would like to start. Discuss how information technology could: (a) help you find and research an idea for a business, (b) help you formulate your business plan, and (c) help you finance your business.

**4.** Your university wants to recruit high-quality high school students from your state. Provide examples of (a) the data that your recruiters would gather in this process, (b) the information that your recruiters would process from these data, and (c) the types of knowledge that your recruiters would infer from this information.

**5.** Can the terms data, information, and knowledge have different meanings for different people? Support your answer with examples.

**6.** Information technology makes it possible to "never be out of touch." Discuss the pros and cons of always being available to your employers and clients (regardless of where you are or what you are doing).

**7.** Robots have the positive impact of being able to relieve humans from working in dangerous conditions. What are some negative impacts of robots in the workplace?

**8.** Is it possible to endanger yourself by accessing too much medical information on the Web? Why or why not? Support your answer.

**9.** Describe other potential impacts of IT on societies as a whole.

**10.** What are the major reasons why it is important for employees in all functional areas to become familiar with IT?

**11.** Given that information technology is impacting every industry, what does this mean for a company's employees? Provide specific examples to support your answer.

**12.** Given that information technology is impacting every industry, what does this mean for students attending a college of business? Provide specific examples to support your answer.

**13.** Is the vast amount of medical information on the Web a good thing? Answer from the standpoint of a patient and from the standpoint of a physician.

# Problem-Solving Activities

**1.** Visit some websites that offer employment opportunities in IT. Prominent examples are: **www.linkedin.com**, **www.dice.com**, **www.monster.com**, **www.collegerecruiter.com**, **www.careerbuilder.com**, **www.jobcentral.com**, **www.job.com**, **www.career.com**, **www.simplyhired.com**, and **www.truecareers.com**. Compare IT salaries to salaries offered to accountants, marketing personnel, financial personnel, operations personnel, and human resources personnel. For other information on IT salaries, check *Computerworld*'s annual salary survey.

**2.** Go to **www.ups.com**.

**a.** Find out what information is available to customers before they send a package.

**b.** Find out about the "package tracking" system.

**c.** Compute the cost of delivering a box, weighing 40 pounds, from your hometown to Long Beach, California (or to Lansing, Michigan, if you live in or near Long Beach). Compare the fastest delivery against the least cost. How long did this process take? Look into the business services offered by UPS. How do they make this process easier when you are a business customer?

**3.** Search the Web for information about the Department of Homeland Security (DHS). Examine the available information, and comment on the role of information technologies in the department.

**4.** Access **www.irobot.com**, and investigate the company's Education and Research Robots. Surf the Web for other companies that manufacture robots, and compare their products with those of iRobot.

# Closing Case

## MIS POM Digital Transformation of Equipment Manufacturers Has Negative Consequences

Digital transformation has caused equipment manufacturers to fundamentally change their business models. In the past, these manufacturers generated revenue one time, with each sale. Today, they embed software and sensors (see the Internet of Things in Chapter 8) into their products that enable equipment to communicate with other equipment, with their users, and with the manufacturers themselves.

Analyzing the data that the software and sensors provide, the manufacturers are able to offer additional services after each sale, creating more continuous revenue flows from each customer. Let's take a closer look at two major equipment manufacturers in different industries: John Deere (Deere; **www.deere.com**) in agriculture and Medtronic (**www.medtronic.com**) in health care.

Founded in 1837, Deere is the largest agricultural equipment manufacturer in the world, with 2019 global revenues of $39 billion. Software and sensors in Deere equipment enable the machines to steer themselves, creating more accurate paths with less overlap. As a result, farmers can work longer with less fatigue. The technologies also enable farmers to monitor and operate machinery, check crop health, and monitor environmental conditions. In essence, farmers use the data generated by these technologies to plant, spray, fertilize, and harvest at optimal times.

Further, self-monitoring sensors implanted in the equipment can detect when it is not operating properly. Deere can then recommend preventive maintenance (a function of predictive analytics; see Chapter 12), thereby reducing the possibility of expensive downtime.

Medtronic, founded in 1949, is the largest medical equipment manufacturer in the world, with 2019 global revenues of $30.5 billion. Consider Medtronic ventilators, which, in May 2020, had come to the forefront of global needs during the COVID-19 pandemic.

Software and sensors in the ventilators monitor patients' breathing and the amount of oxygen that patients are receiving. The ventilators also gather and analyze data from self-monitoring sensors to detect when they are not operating properly. When necessary, the ventilator can recommend preventive maintenance, thereby reducing the possibility of negative outcomes for patients.

### A Negative Consequence of the Digital Transformation of Equipment Manufacturers

Unfortunately, the equipment manufacturers' digital transformations have led to a serious, negative consequence. The companies are making it difficult for customers and independent repair shops and technicians to repair today's equipment, which operates on copyright-protected software.

As a result, farmers who buy Deere tractors and hospitals that buy Medtronic equipment cannot repair their equipment themselves. Instead, they must work with company-approved technicians, who may take time to arrive and can be expensive. Essentially, Deere sells their tractors to farmers and Medtronic sells medical equipment to hospitals, and both companies use software to control every aspect of the equipment use after the sale.

Consequently, many farmers and hospitals are supporting "right to repair" legislation. Such bills, which have been proposed in 22 states, contain two basic elements.

- They allow owners to repair their equipment themselves without voiding warranties or agreements.
- They require equipment manufacturers such as Deere and Medtronic to offer the diagnostic tools, manuals, and other supplies that farmers need to fix their own machines.

As expected, Deere and Medtronic oppose this legislation.

Interestingly, Apple also opposes the right-to-repair legislation. Apple argues that the bills could result in poor repair work or make consumers vulnerable to hackers. Right-to-repair advocates respond that Apple, which offers iPhone repair services at every Apple store, wants to maintain control of its share of the approximately $4 billion smartphone-repair business.

The equipment-manufacturers controversy had its beginning in the debate over jailbreaking iPhones and other high-tech devices. *Jailbreaking* refers to the process of bypassing the restrictions that Apple puts on its operating system and taking full control of the device. The legal question underlying this controversy centers on the Digital Millennium Copyright Act (DMCA) of 1998.

The Digital Millennium Copyright Act (DMCA) is a U.S. copyright law that criminalizes the production and dissemination of technology, devices, or services intended to circumvent measures that control access to copyrighted works as well as the act of circumventing an access control. The DMCA was originally meant to prevent people from pirating music and movies, but it has arguably been taken advantage of by companies selling a wide variety of devices that contain software.

After the passage of the DMCA, regulators considered whether there should be exceptions to the law. In such cases, consumers might have the right to circumvent *technical protection measures* (TPMs) intended to protect intellectual property and the rights of intellectual property holders. The U.S. Copyright Office subsequently exempted 27 classes of intellectual property from TPMs. Class 21 covers a variety of types of motor vehicles, including mechanized farm equipment, and Class 27 covers networked medical devices.

Deere and Medtronic have noted that the exemptions are for the equipment owners themselves, but they prevent owners from transferring the right to modify software "to third parties, such as repair shops or hackers." The manufacturers argue further that they need to control access to their equipment's software to ensure that their machines operate properly and safely and to preserve product warranties.

After the Copyright Office granted the exemptions, the manufacturers began to require their customers to sign an updated end-user license agreement (EULA) that restricted their ability to repair or modify their equipment, in essence requiring them to use certified diagnostic and repair software. In response, farmers and hospitals contend that, despite the exemptions, Deere and Medtronic maintain tight control over how their customers service their equipment. Violation of the EULAs would be considered a breach of contract, meaning that Deere and Medtronic would have to sue their own customers if they want to enforce these agreements.

Farmers note that this problem poses a threat to their livelihood if their tractor breaks at an inopportune time. One farmer stated that he does not have time to wait for a dealership employee to come to his farm and repair his tractor, particularly at harvest time. The farmer went on to claim that almost all repairs on new equipment require software downloads. Significantly, a Massachusetts law already guarantees the same type of access to passenger vehicle software that right-to-repair advocates want from agricultural equipment manufacturers.

Hospitals contend that this problem could not only cause a loss of income, but it could present a serious threat to their patients if medical equipment breaks at an inopportune time. As with farmers, hospitals simply do not have the time to wait for certified technicians to make needed repairs.

Interestingly, in 2018 the U.S. Food and Drug Administration (FDA; **www.fda.gov**) asserted "the continued availability of third-party entities to service and repair medical devices is critical to the functioning of the U.S. healthcare system." More recently, as the COVID-19 pandemic led to critical shortages of ventilators, hospitals had even greater need of keeping the ventilators that they do have in operating order. Therefore, hospitals had even greater urgency to be able to repair the ventilators themselves.

The question remains: What is the disconnect between the FDA's 2018 statement and the fact that manufacturers still oppose right-to-repair? In an unfortunate example from Italy, manufacturers threatened to sue volunteers who 3D-printed parts for ventilators that could not be obtained from any other source. The parts from the manufacturer cost $11,000, and the 3D-printed parts cost $1! As of mid-September 2020 it was unclear if the original manufacturer had actually proceeded with the lawsuit.

**Sources:** Compiled from J. Koebler, "Hospitals Need to Repair Ventilators. Manufacturers Are Making That Impossible," *Motherboard*, March 18, 2020; G. Moody, "Volunteers 3D-Print Unobtainable $11,000 Valve for $1 to Keep COVID-19 Patients Alive; Original Manufacturer Threatens to Sue," *Techdirt*, March 17, 2020; P. Waldman and L. Mulvany, "Who Really Owns a John Deere?" *BusinessWeek*, March 9, 2020; J. List, "John Deere and Nebraska's Right to Repair," *Hackaday*, March 9, 2020; R. Jensen, "Hackers, Farmers, and Doctors Unite! Support for Right to Repair Laws Slowly Grows," *Ars Technica*, June 20, 2019; A. Minter, "U.S. Farmers Are Being Bled by the Tractor Monopoly," *Bloomberg.com*, April 23, 2019; A. Shah, "Who Has the Right to Repair Your Farm or Medical Tools?" *ASME.org*, April 16, 2019; J. Hirsch, "As Farmers Fight for the Right to Repair Their Tractors, an Antitrust Movement Gains Steam," *The Counter*, April 8, 2019; K. Wiens and E. Chamberlain, "John Deere Just Swindled Farmers out of Their Right to Repair," *Wired*, September 19, 2018; D. Swinhoe, "How Tractor Seller John Deere Became a Technology Company," *IDG Connect*, June 5, 2018; D. Newman, "Top Six Digital Transformation Trends in Agriculture," *Forbes*, May 14, 2018; J. Hightower, "John Deere Is Against the Right to Repair Its Equipment," *AlterNet*, August 1, 2017; J. Roberts, "One Controversial Thing Tractors and iPhones Have in Common," *Fortune*, June 29, 2017; A. Fitzpatrick, "Hand Me that Wrench: Farmers and Apple Fight over the Toolbox," *Time*, June 22, 2017; A. Ebrahimzadeh, "Will Farmers or 3rd Party Repair Shops Sue John Deere for Allegedly Contractually Prohibiting Unlicensed Tractor Repairs?," *aeesq.com*, May 8, 2017; J. Bloomberg, "John Deere's Digital Transformation Runs Afoul of Right-to-Repair Movement," *Bloomberg BusinessWeek*, April 30, 2017; D. Grossman, "There's a Thriving John Deere Black Market as Farmers Fight for 'Right to Repair'," *Popular Mechanics*, March 22, 2017; M. Reilly, "A Fight over Tractors in America's Heartland Comes Down to Software," *MIT Technology Review*, March 22, 2017; J. Koebler, "Why American Farmers Are Hacking Their Tractors with Ukrainian Firmware," *Motherboard*, March 21, 2017; C. Perlman, "From Product to Platform: John Deere Revolutionizes Farming," *Harvard Business School Digital Innovation and Transformation*, February 26, 2017; "How John Deere Turned Technology into Business Transformation," **www.digitalsocialstrategy.org**, December 10, 2016; K. Wiens, "How Copyright Law Stifles Your Right to Tinker with Tech," *MIT Technology Review*, July 26, 2016; K. Wiens, "We Can't Let John Deere Destroy the Very Idea of Ownership," *Wired*, April 21, 2015; **www.deere.com**, accessed May 2, 2020; **www.medtronic.com**, accessed May 2, 2020.

## Questions

1. Describe how Deere's and Medtronic's digital transformations changed their business models.
2. Discuss why Deere's and Medtronic's digital transformations are "not all good news."

## Look ahead to Chapter 3 for the next three questions:

3. Discuss the ethicality and the legality of the end-user license agreements that the two companies require their customers to sign.
4. Discuss the ethicality and the legality of customers who use unlicensed shops to repair their equipment using hacked software.
5. The fundamental tenets of ethics include responsibility, accountability, and liability. Discuss each of these tenets as it applies to John Deere's actions and Medtronic's actions toward their customers.

CHAPTER 2

# Organizational Strategy, Competitive Advantage, and Information Systems

| CHAPTER OUTLINE | LEARNING OBJECTIVES |
|---|---|
| **2.1 Business Processes** | **2.1** Discuss ways in which information systems enable business processes for a single functional area and cross-functional processes. |
| **2.2 Business Process Reengineering, Business Process Improvement, and Business Process Management** | **2.2** Differentiate among business process reengineering, business process improvement, and business process management. |
| **2.3 Business Pressures, Organizational Responses, and Information Technology Support** | **2.3** Identify effective IT responses to different kinds of business pressures. |
| **2.4 Competitive Advantage and Strategic Information Systems** | **2.4** Describe the strategies that organizations typically adopt to counter Porter's five competitive forces. |

## Opening Case

### MIS The Coronavirus Pandemic Magnifies the Digital Divide

#### Background

The United States has a long history of bringing utility access to all Americans. To illustrate this point, let's consider three government actions: the Rural Electrification Administration (REA), the Communications Act of 1934, and the Telecommunications Act of 1996.

In the early 1930s, when President Franklin D. Roosevelt established the REA, 90 percent of U.S. farmers lived without electricity. The cost of installing electric lines to the country's most remote areas was prohibitive for profit-seeking businesses. Therefore, the REA provided loans to rural electric cooperatives to construct their electric networks. By the end of the 1940s, most farms in the United States had electricity. In hindsight, it is clear that Americans should have access to electricity. The country's economic and social well-being depend on it.

With the Communications Act of 1934, the U.S. government provided a universal service guarantee that mandates that every resident have a baseline level of telecommunications services. The government recognized that telephone services provide a vital link to emergency services, government services, and surrounding communities. Because of the universal service guarantee, providers frequently must offer and maintain—even at a loss—expensive copper twisted-pair phone lines in rural areas to support small populations. The carriers are compensated for these costs through a tax on customers' phone bills, called the Universal Service Fund. Again, in hindsight it is clear that universal access to telecommunications service—today, broadband access to the Internet—is essential to the nation's prosperity. Advocates of

universal broadband Internet access contend that broadband Internet is not a luxury but a right of all 21st century Americans.

The overall objective of the Telecommunications Act of 1996 was to provide higher-quality services for consumers. The act wanted to ensure that all Americans are connected to the Internet, regardless of their income.

The 1996 act recognized that broadband Internet access provides many significant benefits, in the areas of public health, telework, and education. The coronavirus pandemic has magnified the importance of the digital divide, particularly in these areas. **Digital divide** refers to the gap between people who have access to modern information and communications technologies, and those who have restricted access, limited access, or no access.

- *Public health*: Rural areas suffer from a shortage of physicians and hospitals. Being able to conduct a video conference with a physician, nurse practitioner, or nurse without having to drive miles to an office or a hospital can literally save lives.
- *Teleworking*: Being able to work from home provides flexibility to workers. Teleworking has received far more attention during the COVID-19 pandemic.

For example, an unemployed person who has Internet access at home will be employed seven weeks faster than a person who does not. In addition, he or she will earn more than $5,000 in additional income annually, according to an analysis of data from the Bureau of Labor Statistics (BLS; **www.bls.gov**).

- *Education*: Before the coronavirus pandemic, 70 percent of primary and secondary school teachers assigned homework online. The *homework gap*, referring to children who cannot do online homework because they do not have reliable broadband access, is now extending to higher education.

Significantly, students are 7 percent more likely to earn a high school diploma and attend college when they are connected to the Internet at home. Furthermore, these students will earn more than $2 million more over their lifetimes.

## The Problem

As of May 2020 the United States still had a persistent digital divide. The divide was once only a problem of Internet access. Today, it encompasses access speed and connection quality.

To effectively use modern Internet, people must have a broadband connection, which the FCC defines as the ability to download data at 25 megabits per second (Mbps) and to upload data at 3 Mbps. In addition, consumers must have a consistent Internet connection; that is, a connection that does not fluctuate unpredictably.

Let's consider two questions:

**(1)** How big is the digital divide?

**(2)** Whom does the digital divide impact the most?

*Question #1*: In 2020 the FCC reported that approximately 16 million Americans did not have consistent broadband Internet access. Further, many people could not obtain broadband service because they lived in an area where it was not cost effective for providers to provide such access.

However, industry analysts contend that the number of Americans without reliable broadband service is much higher than what the FCC reports. For example, a 2019 Microsoft study found that almost 163 million Americans were not using the Internet at broadband speeds. Two serious problems in the way the FCC gathers its data account for the large disparity in these statistics.

First, the FCC asks Internet providers if they are "providing or could provide, without an extraordinary commitment of resources, broadband service to an area." If the answer is yes to either (providing or could provide), then the FCC considers that area to have broadband access. As a result, many places are counted as having broadband access when they not only have no such access, but providers have no plans to provide it anytime soon.

Second, the FCC bases its data on census blocks, which are the smallest units used by the U.S. Census Bureau. A *census block* is a statistical area bounded by visible features such as roads, streams, and railroad tracks, and by nonvisible boundaries such as streets, roads, transmission lines, property lines, city, township, school district, county limits, and line-of-sight extensions of roads. In rural areas, these blocks can be very large. If broadband access is delivered to a single customer in that block, then the FCC counts the entire block as having access.

For example, in 2019 the FCC stated that 100 percent of Ferry County, Washington, residents had broadband Internet access. However, local officials contended that very few residents of the rural county had broadband access and that those who did were using broadband in their businesses. In fact, Microsoft data indicated that only 2 percent of Ferry County residents were using broadband Internet.

*Question #2*: The problem with the digital divide is that Americans who live in rural areas are more likely than Americans who live in urban areas to lack reliable broadband Internet access. The Rural Broadband Association (**www.ntca.org**) cites a 2016 study from the Hudson Institute that found that nearly 70 percent of the economic impact of broadband Internet access went to urban rather than rural economies.

Consider workers, veterans, and retirees who face economic and health challenges. The pandemic caused the closing of government benefits offices that assist these people at the same time that government websites were crashing due to surges in traffic. Even if government websites could meet the challenge, few agencies have established online or remote options for citizens who must meet with civil servants for hearings and other official proceedings.

For example, although some states have enacted measures to make unemployment insurance readily available by allowing people to apply online without going to an office, this process requires reliable Internet access. People must be able to access and fill out forms online, sign the forms online, and submit them online.

## Covid's Impact on the Digital Divide

Although the Internet has provided the opportunity for many people to experience some sort of normalcy during the pandemic, millions of Americans do not have reliable broadband Internet access. Unfortunately, underserved areas and communities have not been able to access health care or transition to an online workplace or school environment. We now examine the impact of the digital divide during the coronavirus pandemic in the areas of telehealth, telework, and distance education.

## Telehealth

*Telehealth* is the distribution of health-related services and information via electronic information and telecommunications technologies. Telehealth enables long-distance patient and health-care professional contact, care, advice, reminders, intervention, monitoring, and education.

Jane Fox, a social worker in a rural town, uses telehealth technology to help psychiatrists evaluate their patients. Unfortunately, she cannot work from home because her broadband Internet connection is too unreliable. She cannot afford to lose her connection in the middle of a telehealth videoconference. As a result, she must drive 35 miles to the closest hospital to videoconference with patients and psychiatrists.

During the pandemic, people seeking medical care were cautioned to avoid hospitals and physicians' offices in favor of video or phone calls with their healthcare professionals. However, conducting video sessions with these professionals requires broadband Internet access.

The Centers for Disease Control and Prevention (CDC) estimates that 60 percent of Americans have chronic health conditions and cannot simply stop seeing their physicians. Telehealth is the obvious solution, especially for older adults who face the greatest risk from the coronavirus. Unfortunately, many of these individuals do not have broadband Internet access at home.

The federal government took some steps to accelerate access to telehealth services by expanding Medicare coverage to phone and video consultations and modifying the rules that prevent health-care workers in one state from practicing in another. One coronavirus stimulus package also included $200 million to increase connectivity for rural health-care providers and improve telehealth options for veterans. However, physicians will have to start using such technology to make it widely available for patients.

## Telework

*Telework* is the practice of performing your job away from the office. During the coronavirus pandemic, telework came to mean working from home while socially distancing. To be able to telework effectively, employees must have a computer, laptop, or phone, and, most importantly, a consistent broadband connection. Without these technologies, telework is very difficult, if not impossible.

According to the BLS, under normal circumstances about 7 percent of U.S. employees have a flexible workplace, meaning that they have the option of working part-time or full-time from home. White-collar workers are much more likely to have a telework option. Roughly 22 percent of employees with jobs in management, business, or finance can telework, compared to only 1 percent of service workers.

When we take race and ethnicity into account, 37 percent of Asian employee and 30 percent of Caucasian employees have a telework option, compared with 20 percent of Black employees and 16 percent of Hispanic employees, according to the BLS. In June 2020 the U.S. unemployment rate had reached 11.1 percent and was highest among the Black and Hispanic populations.

## Distance Education

As of May 2020 many school districts and universities had closed for physical classes through the end of the school year. These institutions implemented distance learning policies so that students could continue their lessons via the Internet. Unfortunately, the shift to distance education was not smooth, and it highlighted the problems stemming from the digital divide.

As an example, one rural school in California switched to distance learning and discovered that 42 of its 168 students—that is, 25 percent—did not have *any* Internet connection at home. As a result, teachers lost touch with some of those students. Furthermore, some areas did not have a reliable cellular signal, meaning that students could not go online using free Internet services offered by their schools during the pandemic.

To enable students to access the Internet, education officials in South Carolina and Texas dispatched school buses equipped as Wi-Fi hotspots to rural and low-income neighborhoods. Another school in Texas set up a stationary Wi-Fi hotspot in the parking lot of its football stadium where students could park and connect. In Prince George County in Virginia, the school district distributed laptops to students who did not have a computer at home and paid for Internet access for students who did not have it.

In South Dakota, one district printed out hard copies of work for students who did not have broadband Internet access. Families picked up and dropped off students' work at the school. After families turned in completed work, teachers waited 72 hours to grade it to ensure that any coronavirus on the schoolwork had died.

## Stopgap "Solutions"

Many libraries, schools, and other municipal buildings are leaving their Wi-Fi connections on overnight because they are the only source of connectivity in their towns. Also, in April 2020 Google announced it would provide free Wi-Fi to 100,000 rural California families through the end of the school year, plus 4,000 Chromebook laptops for students.

Eight of the nation's major Internet service providers (ISPs) have announced various steps to improve broadband access and connectivity during the pandemic. Providers are raising caps on data bandwidth or offering two months of free broadband to households with students.

The FCC stated that more than 650 broadband Internet providers, telephone companies, and trade associations signed its Keep Americans Connected pledge not to terminate internet service over pandemic-related financial troubles, to waive late fees, and to allow free access to Wi-Fi services. Offers from ISPs are available only in locations where those companies already provided service.

In 2017, Microsoft began its Airband Initiative, a five-year commitment to bring broadband access to underserved Americans by using TV white space devices and other low-cost wireless technologies. These devices detect the presence of existing but unused areas of airwaves and utilize them to transmit wireless internet signals. By mid-2020, the Airband Initiative reached people in 25 states.

Closing the digital divide is a step toward shrinking the persistent gaps in economic opportunity, educational achievement, and health outcomes in the United States. According to Deloitte Consulting, it would take a $150 billion investment in fiber-optics infrastructure to modernize rural broadband across the country. Improving broadband Internet access requires political will and incentives for private telecommunications companies to build broadband networks in remote communities that offer minimal profit.

One possible "benefit" of the pandemic is a broader recognition of how central to our society broadband Internet access has become. Policymakers must realize that normal supply-and-demand economics do not work with critical infrastructure. (Recall our discussion earlier in this case about U.S. policy for providing electricity, telephone service, and Internet access to all Americans.)

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### Questions

1. Describe some impacts on individuals and families (not mentioned in the case) resulting from a lack of Internet access.
2. Is affordable broadband Internet access strategically important to cities? Why or why not? Support your answer.
3. Is affordable broadband Internet access strategically important to the United States? Why or why not? Support your answer.
4. Does everyone deserve access to affordable high-speed Internet, just as they have for water, sewers, electricity, and telephone service? That is, is broadband Internet access a right or a privilege? Support your answer.

# Introduction

Organizations operate in the incredible complexity of the modern high-tech world. As a result, they are subject to myriad business pressures. Information systems are critically important in helping organizations respond to business pressures and in supporting organizations' global strategies. As you study this chapter, you will see that any information system can be *strategic*, meaning it can provide a competitive advantage if it is used properly. The chapter-opening case, as well as all the other cases in this chapter, illustrate how information technology (IT) can provide a competitive advantage to organizations.

**Competitive advantage** refers to any assets that provide an organization with an edge against its competitors in some measure such as cost, quality, or speed. A competitive advantage helps an organization control a market and accrue larger-than-average profits. Significantly, both strategy and competitive advantage take many forms.

Although many companies use technology in very expensive ways, an entrepreneurial spirit coupled with a solid understanding of what IT can do for you will provide competitive advantages to entrepreneurs just as it does for Wall Street CIOs. As you study this chapter, think of the small businesses in your area that are utilizing popular technologies in interesting and novel ways. Have any of them found an innovative use for Twitter? Facebook? Amazon? PayPal? Square? Zoom? If not, then can you think of any businesses that would benefit from employing these technologies?

This chapter is important for you for several reasons. First, the business pressures we address in the chapter will affect your organization. Just as important, however, they also will affect *you.* Therefore, you must understand how information systems can help you—and eventually your organization—respond to these pressures.

Acquiring a competitive advantage is also essential for your organization's survival. Many organizations achieve competitive advantage through the efforts of their employees. Therefore, becoming knowledgeable about strategy and how information systems affect strategy and competitive position will help you throughout your career.

This chapter encourages you to become familiar with your organization's strategy, mission, and goals and to understand its business problems and how it makes (or loses) money. It will help you understand how information technology contributes to organizational strategy. Furthermore, you likely will become a member of business or IT committees that decide (among many other things) how to use existing technologies more effectively and whether to adopt new ones. After studying this chapter, you will be able to make immediate contributions in these committees.

Essentially, organizations consist of a large number of diverse business processes. In this chapter, you will first learn about the different types of business processes and the support that information systems provide for all business processes.

The need for organizations to optimize their business processes has led to efforts such as business process improvement (BPI), business process reengineering (BPR), and business process management (BPM). You will learn how organizations address these important efforts and the key role that information systems play in supporting and enabling these efforts.

Next, you will see how information systems enable organizations to respond to business pressures. Finally, you will learn how information systems help organizations acquire competitive advantages in the marketplace.

# 2.1 Business Processes

**Author Lecture Videos are available exclusively in *WileyPLUS*.**
**Apply the Concept activities are available in the Appendix and in *WileyPLUS*.**

A **business process** is an ongoing collection of related activities that create a product or a service of value to the organization, its business partners, and its customers. The process involves three fundamental elements:

- *Inputs:* Materials, services, and information that flow through and are transformed as a result of process activities
- *Resources:* People and equipment that perform process activities
- *Outputs:* The product or a service created by the process

If the process involves a customer, then that customer can be either internal or external to the organization. A manager who is the recipient of an internal reporting process is an example of an internal customer. In contrast, an individual or a business that purchases the organization's products is the external customer of the fulfillment process.

Successful organizations measure their process activities to evaluate how well they are executing these processes. Two fundamental metrics that organizations employ in assessing their processes are efficiency and effectiveness. *Efficiency* focuses on doing things well in the process; for example, progressing from one process activity to another without delay or without wasting money or resources. *Effectiveness* focuses on doing the things that matter; that is, creating outputs of value to the process customer—for example, high-quality products.

Many processes cross functional areas in an organization. For example, product development involves research, design, engineering, manufacturing, marketing, and distribution. Other processes involve only a single functional area. **Table 2.1** identifies the fundamental business processes performed in an organization's functional areas.

## Cross-Functional Processes

All the business processes in Table 2.1 fall within a single functional area of the company. However, many other business processes, such as procurement and fulfillment, cut across multiple functional areas; that is, they are cross-functional business processes, meaning that no single functional area is responsible for their execution. Rather, multiple functional areas collaborate to perform the process. For a cross-functional process to be successfully completed, each functional area must execute its specific process steps in a coordinated, collaborative way. To clarify this point, let's take a look at the procurement and fulfillment of **cross-functional processes**. We discuss these processes in greater detail in Chapter 10.

**POM** The *procurement process* includes all of the tasks involved in acquiring needed materials externally from a vendor. Procurement comprises five steps that are completed in three different functional areas of the firm: warehouse, purchasing, and accounting.

**ACCT** The process begins when the warehouse recognizes the need to procure materials, perhaps due to low inventory levels. The warehouse documents this need with a purchase requisition, which it sends to the purchasing department (step 1). In turn, the purchasing department identifies a suitable vendor, creates a purchase order based on the purchase requisition, and sends the order to the vendor (step 2). When the vendor receives the purchase order, it ships the materials, which are received in the warehouse (step 3). The vendor then sends an invoice, which is received by the accounting department (step 4). Accounting sends payment to the vendor, thereby completing the procurement process (step 5).

**TABLE 2.1 Examples of Business Processes**

| | |
|---|---|
| **ACCT Accounting Business Processes** | |
| Managing accounts payable | Managing invoice billings |
| Managing accounts receivable | Managing petty cash |
| Reconciling bank accounts | Producing month-end close |
| Managing cash receipts | Producing virtual close |
| **FIN Finance Business Processes** | |
| Managing account collection | Producing property tax assessments |
| Managing bank loan applications | Managing stock transactions |
| Producing business forecasts | Generating financial cash-flow reports |
| Applying customer credit approval and credit terms | |
| **MKT Marketing Business Processes** | |
| Managing post-sale customer follow-up | Handling customer complaints |
| Collecting sales taxes | Handling returned goods from customers |
| Applying copyrights and trademarks | Producing sales leads |
| Using customer satisfaction surveys | Entering sales orders |
| Managing customer service | Training sales personnel |
| **POM Production/Operations Management Business Processes** | |
| Processing bills of materials | Managing quality control for finished goods |
| Processing manufacturing change orders | Auditing for quality assurance |
| Managing master parts list and files | Receiving, inspecting, and stocking parts and materials |
| Managing packing, storage, and distribution | Handling shipping and freight claims |
| Processing physical inventory | Handling vendor selection, files, and inspections |
| Managing purchasing | |
| **HRM Human Resources Business Processes** | |
| Applying disability policies | Producing performance appraisals and salary adjustments |
| Managing employee hiring | Managing resignations and terminations |
| Handling employee orientation | Applying training and tuition reimbursement |
| Managing files and records | Managing travel and entertainment |
| Applying health-care benefits | Managing workplace rules and guidelines |
| Managing pay and payroll | Overseeing workplace safety |
| **MIS Management Information Systems Business Processes** | |
| Antivirus control | Applying electronic mail policy |
| Computer security issues incident reporting | Generating Internet use policy |
| Training computer users | Managing service agreements and emergency services |
| Computer user and staff training | Applying user workstation standards |
| Applying disaster recovery procedures | Managing the use of personal software |

POM ACCT The *fulfillment process* is concerned with processing customer orders. Fulfillment is triggered by a customer purchase order that is received by the sales department. Sales then validates the purchase order and creates a sales order. The sales order communicates data related to the order to other functional areas within the organization, and it tracks the progress of the order. The warehouse prepares and sends the shipment to the customer. Once accounting is notified of the shipment, it creates an invoice and sends it to the customer. The customer then makes a payment, which accounting records.

An organization's business processes can create a competitive advantage if they enable the company to innovate or to execute more effectively and efficiently than its competitors. They can also be liabilities, however, if they make the company less responsive and productive. Consider the airline industry. It has become a competitive necessity for all of the airlines to offer electronic ticket purchases through their websites. To provide competitive advantage, however, these sites must be highly responsive and they must provide both current and accurate information on flights and prices. An up-to-date, user-friendly site that provides fast answers to user queries will attract customers and increase revenues. In contrast, a site that provides outdated or inaccurate information, or has a slow response time, will hurt rather than improve business.

Clearly, good business processes are vital to organizational success. But how can organizations determine if their business processes are well designed? The first step is to document the process by describing its steps, its inputs and outputs, and its resources. The organization can then analyze the process and, if necessary, modify it to improve its performance.

To understand this point, let's consider the e-ticketing process. E-ticketing consists of four main process activities: searching for flights, reserving a seat, processing payment, and issuing an e-ticket. These activities can be broken down into more detailed process steps. The result may look like the process map in **Figure 2.1**. Note that different symbols correspond to different

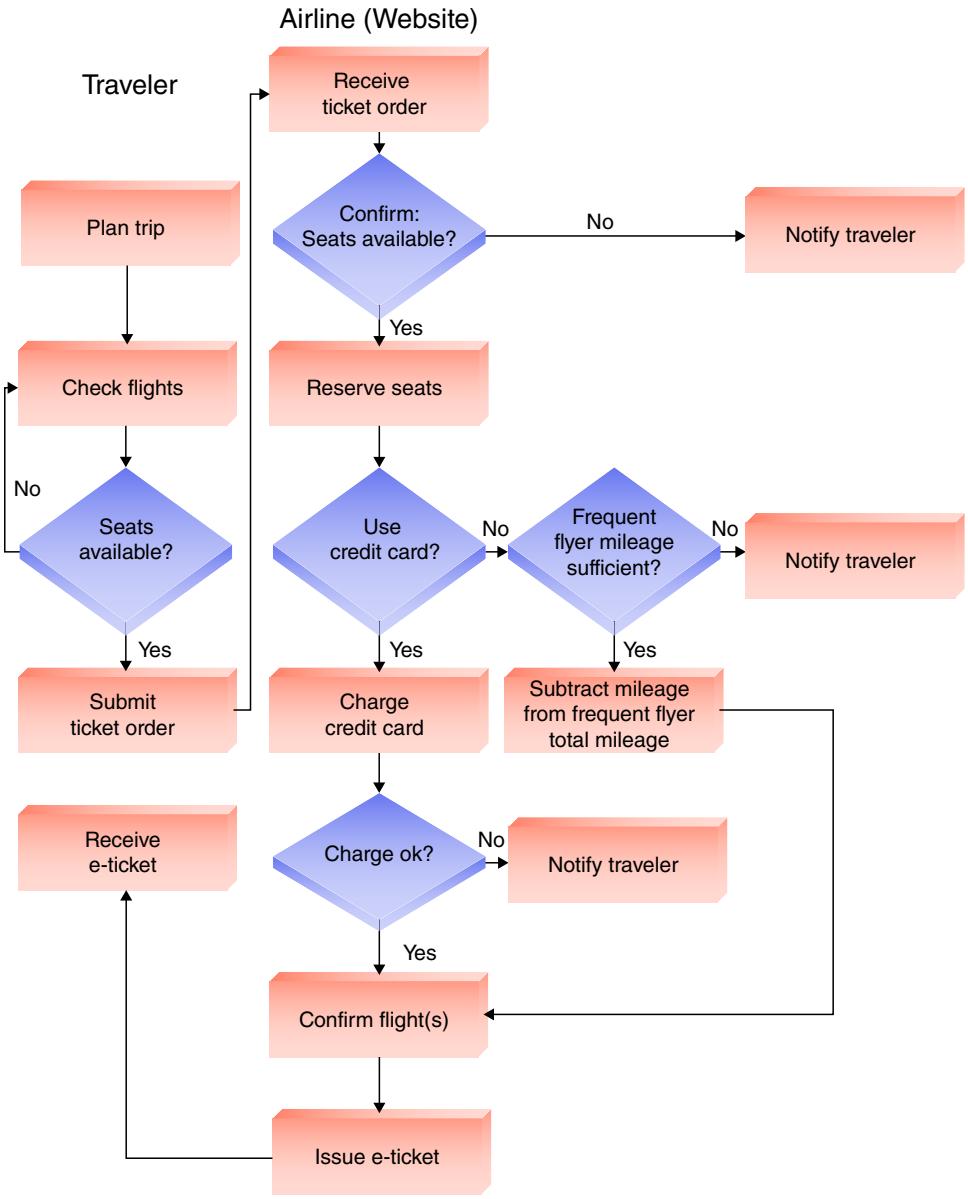


**FIGURE 2.1** **Business process for ordering an e-ticket from an airline website.**

types of process steps. For example, rectangles (steps) are activities that are performed by process resources (reserve seats, issue e-ticket). Diamond-shaped boxes indicate decisions that need to be made (seats available?). Arrows are used as connectors between steps; they indicate the sequence of activities.

These symbols are important in the process flowchart (which is similar to a programming flowchart). Other symbols may be used to provide additional process details. For example, D-shaped boxes are used instead of rectangles when a waiting period is part of a process, ovals can show start and stop points, and process resources can be attached to activities with resource connector lines or included as an annotation or property for each activity box.

The customers of the process are travelers planning a trip, and the process output is an e-ticket. Travelers provide inputs to the process: the desired travel parameters to begin the search, the frequent flyer miles number, and their credit card information. Also, a computerized reservation system that stores information for many airlines provides some of the process inputs such as the seat availability and prices. The resources used in the process are the airline website, the computerized reservation system, and, if the customer calls the airline call center at any time during the process, the call center system and the human travel agents. The process creates customer value by efficiently generating an output that meets the customer search criteria—dates and prices. The performance of the process depends on efficiency metrics such as the time required to purchase an e-ticket, from the moment the customer initiates the ticket search until he or she receives the e-ticket. Effectiveness metrics include customer satisfaction with the airline website. Finally, the performance of the process may be affected if the quality or the timeliness of the inputs is low—for example, if the customer enters the wrong dates—or if the process resources are not available—for example, if the website crashes before the purchase is finalized.

## Information Systems and Business Processes

MIS An information system (IS) is a critical enabler of an organization's business processes. Information systems facilitate communication and coordination among different functional areas, and allow easy exchange of, and access to, data across processes. Specifically, ISs play a vital role in three areas:

- Executing the process
- Capturing and storing process data
- Monitoring process performance

In this section, you will learn about each of these roles. In some cases, the role is fully automated—that is, it is performed entirely by the IS. In other cases, the IS must rely on the manager's judgment, expertise, and intuition. IT's About Business 2.1 shows how NASCAR uses information technology to streamline its prerace process.

MIS **Executing the Process.** An IS helps organizations execute processes efficiently and effectively. ISs are typically embedded into the processes, and they play a critical role in executing the processes. In other words, an IS and the processes are usually intertwined. If the IS does not work, the process cannot be executed. An IS helps execute processes by informing people when it is time to complete a task by providing the necessary data to complete the task and, in some cases, by providing the means to complete the task.

In the procurement process, for example, the IS generates the purchase requisitions and then informs the purchasing department that action on these requisitions is needed. The accountant will be able to view all shipments received to match an invoice that has been received from a supplier and verify that the invoice is accurate. Without the IS, these steps, and therefore the process, cannot be completed. For example, if the IS is not available, how will the warehouse know which orders are ready to pack and ship?