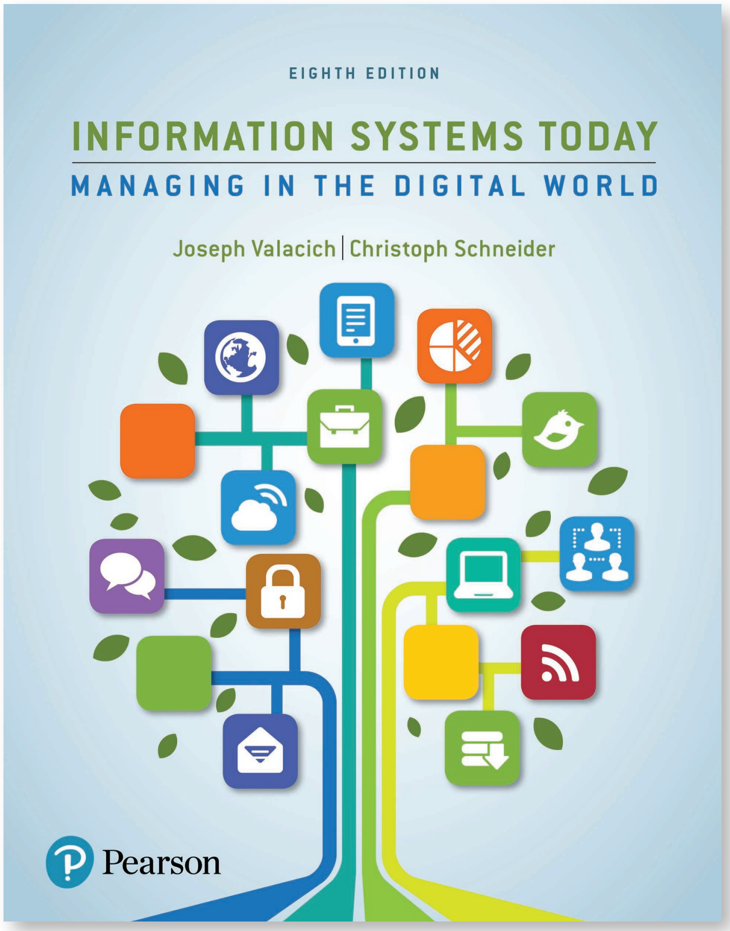
EIGHTH EDITION

INFORMATION SYSTEMS TODAY

MANAGING IN THE DIGITAL WORLD

Joseph Valacich | Christoph Schneider

Pearson



Information systems have become *pervasive*. *Mobile devices*, *social media*, and *cloud computing* have transformed organizations and society. The *Internet of Things* can generate a wealth of potentially useful *Big Data*. The rapid development of transportation and telecommunication technologies, national and global infrastructures, and information systems as well as a host of other factors has created a number of pressing societal issues that tremendously influence the world we live in. These issues include *demographic changes*, *urbanization*, *shifts in economic power*, *resource scarcity*, and *climate change*. As a consequence, *sustainable development* will become an ever increasingly important aspect for organizations. Throughout this revision, we discuss how organizations can harness radical innovations and other technological developments, as well as the role of information systems in influencing and addressing pressing societal issues; further, we added a new chapter element about the role of *Green IT*. We designed the book's cover to emphasize how IT resides within and influences various societal issues.

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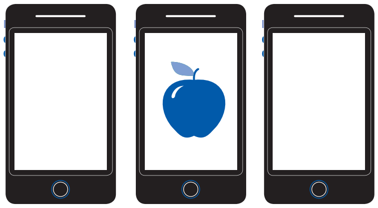

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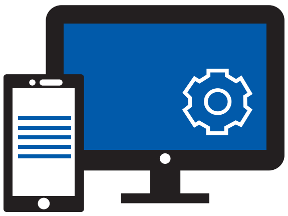

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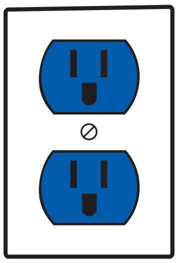

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Cenveo® Publisher Services
Cover Art: Kanate/Shutterstock; Zera93/Shutterstock; Maglara/Shutterstock; iDesign/Shutterstock; Fine Art/Shutterstock
Full-Service Project Management:
Cenveo® Publisher Services
Composition: Cenveo® Publisher Services
Printer/Binder: RR Donnelley/Menasha
Cover Printer: Phoenix Color
Text Font: 10/12 Times LT Pro
Unattributed figures in text: Joseph Valacich, Christoph Schneider, Information Systems Today, 8Ed., © 2018. Pearson Education, Inc., New York, NY.

Library of Congress Cataloging-in-Publication Data
On file with the Library of Congress.

Pearson

ISBN 10: 0-13-463520-5
ISBN 13: 978-0-13-463520-0

Dedication

To my mother Mary, you are the best.
—Joe

To Birgit for your love and support.
—Christoph

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About the Authors

Joseph (Joe) Valacich is an *Eller Professor of MIS* within the Eller College of Management at the University of Arizona, a Fellow of the Association for Information Systems (2009), and the Chief Science Officer (CSO) of Neuro-ID, Inc. He was previously on the faculty at Indiana University, Bloomington, and Washington State University, Pullman. He has had visiting faculty appointments at City University of Hong Kong, Buskerud College (Norway), the Helsinki School of Economics and Business, the Norwegian University of Life Sciences, and Riga Technical University (Latvia). He received a PhD degree from the University of Arizona (MIS) and MBA and BS (Computer Science) degrees from the University of Montana. Prior to his academic career, Dr. Valacich worked in the software industry in Seattle in both large and startup organizations.

Dr. Valacich has served on various national task forces designing model curricula for the information systems discipline, including *IS '97*, *IS 2002*, and *IS 2010: The Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems,* where he was co-chairperson. He also served on the task force that designed *MSIS 2000* and *2006: The Master of Science in Information Systems Model Curriculum.* He served on the executive committee, funded by the National Science Foundation, to define the *IS Program Accreditation Standards* and served on the board of directors for CSAB (formally the Computing Sciences Accreditation Board) representing the Association for Information Systems (AIS). He was the general conference co-chair for the 2003 International Conference on Information Systems (ICIS) and the 2012 Americas Conference on Information Systems (AMCIS); both were held in Seattle.

Dr. Valacich has conducted numerous corporate training and executive development programs for organizations, including AT&T, Boeing, Dow Chemical, EDS, Exxon, FedEx, General Motors, Microsoft, and Xerox. He has served in a variety of editorial roles within various academic journals and conferences. His primary research interests include human–computer interaction, deception detection, technology-mediated collaboration, mobile and emerging technologies, and e-business. He is a prolific scholar, having published more than 200 scholarly articles in numerous prestigious journals and conferences, including: *MIS Quarterly, Information Systems Research, Management Science, Academy of Management Journal, Journal of MIS, Decision Sciences, Journal of the AIS, Communications of the ACM, Organizational Behavior and Human Decision Processes,* and *Journal of Applied Psychology*. He is a coauthor of the leading textbooks *Modern Systems Analysis and Design* (8th ed.) and *Essentials of Systems Analysis and Design* (6th ed.), both published by Pearson.

In 2016, Dr. Valacich was awarded the University of Arizona, Tech Launch Arizona, "Innovation & Impact Award" for Information Technology. He was awarded the "Distinguished Alumnus Award" from the University of Montana Alumni Association in 2012 and the "Outstanding Alumnus Award" from the University of Montana's School of Business Administration in 2009. Dr. Valacich is also ranked as one of the most prolific authors in the history of *MIS Quarterly*—his discipline's top journal—over the life of the journal (1977–2016) (see misq.org). Throughout his career, he has also won numerous teaching, service, and research awards.

Christoph Schneider is an assistant professor in the Department of Information Systems at City University of Hong Kong and previously held a visiting faculty appointment at Boise State University. He earned a Swiss Higher Diploma in Hotel Management at the University Centre César Ritz in Brig, Switzerland, a BA in Hotel and Restaurant Administration at Washington State University, and a PhD in Business Administration (Management Information Systems) at Washington State University. His teaching interests include the management of information systems and web design.

Dr. Schneider is an active researcher. His primary research interests include human–computer interaction, electronic commerce, and computer-mediated collaboration. His research has appeared in peer-reviewed journals, such as *Information Systems Research, Management Information Systems Quarterly, Management Science,* and *IEEE Transactions on Professional Communication*; further, he has presented his research at various international conferences, such as the International Conference on Information Systems, the European Conference on Information Systems, and the Hawaii International Conference on System Sciences. He serves as a member of the International Steering Committee of the International Conference on Information Systems Development (ISD) and as senior editor at *Information Systems Journal*.

Brief Contents

Contents

Preface

Approach

Information systems have become *pervasive*. *Mobile devices, social media,* and *cloud computing* have transformed organizations and society. Organizations see the possibilities of the *Internet of Things*, in that not only computers but various sensors, motors, actuators, or even cameras can generate a wealth of potentially useful data. Businesses face unprecedented opportunities, but also challenges, through the ability to utilize *Big Data*. What does all this mean? What are the catalysts of these concepts and of all this change? More important, how can organizations thrive in this dynamic and highly competitive marketplace? The answer to these and many similar questions is that information systems and related information technologies are driving innovation, new business models, and hypercompetition. It is little wonder that teaching an introductory course on information systems has never been more crucial—or more challenging.

One of the greatest challenges that we face in teaching information systems courses is how to keep pace in the classroom with what is happening out in the real world. Being relevant to students while at the same time providing the necessary foundation for understanding the breadth, depth, and complexity of information systems has never been more difficult. We wrote *Information Systems Today,* Eighth Edition, with this overarching goal in mind, to be both rigorous *and* relevant. To accomplish this, we want students not only to learn about information systems but also to clearly understand the importance of information systems for individuals, organizations, and society. Additionally, we do not want to simply spoon-feed students with technical terms and the history of information systems. Instead, students must understand exactly what innovative organizations are doing with contemporary information systems and, more important, where things are heading. Finally, we want to empower students with the essential knowledge needed to be successful in the use and understanding of information systems in their careers.

To this end, we wrote *Information Systems Today,* Eighth Edition, so that it is contemporary, fun to read, and useful, focusing on what business students need to know about information systems to survive and thrive in the digital world.

Audience

Information Systems Today, Eighth Edition, is primarily for the undergraduate introductory information systems course required of all business students. The introductory information systems course typically has a diverse audience of students majoring in many different areas, such as accounting, economics, finance, marketing, general management, human resource management, production and operations, international business, entrepreneurship, and information systems. This book was also written for students studying topics outside of business, especially in the growing and broad area of information sciences. Given the range of students taking this type of course, we have written this book so that it is a valuable guide to all students, providing them with the essential information they need to know. Therefore, this book has been written to appeal to a diverse audience.

Information Systems Today, Eighth Edition, can also be used for the introductory course offered at the graduate level—for example, in the first year of an MBA program. Such usage would be especially appropriate if the course heavily focused on the diverse set of cases provided in each chapter.

What's New to the Eighth Edition

Our primary goal for *Information Systems Today,* Eighth Edition, was to emphasize the importance of information systems to all business students as the role of information technology and systems continues to expand within organizations and society. Most notably, we extensively examine how five big megatrends—mobile, social media, the Internet of Things, cloud computing, and Big Data—are transforming individuals, organizations, and society. Given this clear focus, we are better able to identify those topics most critical to students and future business professionals. Consequently, we have made substantial revisions to the basic content of the chapters and pedagogical elements as well as introduced several new elements that we believe help achieve this goal. New or expanded chapter topics include the following:

- An extensively revised chapter—Chapter 1, "Managing in the Digital World"—focuses not only on defining what an information system consists of but also provides new content on globalization and societal issues in the digital world as well as the role of five IT megatrends in fueling and addressing these issues.
- An extensively revised chapter—Chapter 2, "Gaining Competitive Advantage Through Information Systems"—provides new content describing how information systems play a key part in enabling different types of innovation and innovative business models.
- A revised chapter—Chapter 3, "Managing the Information Systems Infrastructure and Services"—provides updated content on the need for a reliable, adaptable, and scalable infrastructure to support the needs of today's organizations as well as on essential infrastructure concepts related to hardware, software, storage, networking and the Internet, data centers, and cloud computing.
- A revised chapter—Chapter 4, "Enabling Business-to-Consumer Electronic Commerce"—provides updated content related to e-commerce involving the end consumer as well as new and expanded coverage of e-finance, fintech, and related issues.
- A revised chapter—Chapter 5, "Enhancing Organizational Communication and Collaboration Using Social Media"—centers around various topics related to the need for organizational communication and provides updated content on how individuals and organizations use both traditional communication and collaboration tools and social media for communication, collaboration, cooperation, and connection.
- An extensively revised chapter—Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics"—provides extended coverage on business intelligence and advanced analytics and greatly expanded content on machine learning, predictive modeling, artificial intelligence, unstructured data analytics, and spatial decision support.
- A revised chapter—Chapter 8, "Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management"—provides updated content on business-to-business electronic commerce and supply chain management as well as customer relationship management (CRM).
- A revised chapter—Chapter 9, "Developing and Acquiring Information Systems"—provides updates to various topics and extended content on alternative system development methodologies.
- A revised chapter—Chapter 10, "Securing Information Systems"—provides an update to all topics and deeper coverage on industrial espionage and cyberterrorism.
- A revised Technology Briefing covers foundational concepts related to various information technologies. The Technology Briefing provides the foundations for a deeper understanding of the topics introduced in Chapter 3 and is intended for use in more technically oriented courses. Each section of this briefing was designed to stand alone—it can be read with or without the other sections.

In addition to the changes within the main chapter content, we have also added two new features to each chapter—Green IT and Security Matters. Green IT presents environmental issues arising from the use of information systems. For example, in Chapter 4, we discuss the environmental impacts of online shopping. Security Matters presents some current issues and threats arising from the ubiquitous use of information systems. For example, in Chapter 5, we discuss how hacktivists challenged the extramarital dating website Ashley Madison.

Beyond the chapter content and features, we have also made substantial changes and refinements to the end of each chapter. In particular, we carefully revised many of the end-of-chapter problems and exercises to reflect content changes and new material. Further, we have carefully updated the end-of-chapter cases about contemporary organizations and issues to illustrate the complexities of the digital world. Each case mirrors the primary content of its chapter to better emphasize its relevancy within the context of a real organization. All these elements are discussed more thoroughly next.

Our goal has always been to provide only the information that is relevant to all business students, nothing more and nothing less. We believe that we have again achieved this goal with *Information Systems Today,* Eighth Edition. We hope you agree.

Key Features

As authors, teachers, developers, and managers of information systems, we understand that in order for students to best learn about information systems with this book, they must be motivated to learn. To this end, we have included a number of unique features to help students quickly and easily assess the true value of information systems and their impact on everyday life. We show how today's professionals are using information systems to help modern organizations become more efficient and competitive. Our focus is on the application of technology to real-world, contemporary situations. Next, we describe each of the features that contribute to that focus.

Pedagogy—A Multitiered Approach

Each chapter provides a list of learning objectives to lay the foundation for the chapter content, followed by an opening case to highlight how contemporary organizations are utilizing information systems to gain competitive advantage, streamline organizational processes, or improve customer relationships or how information systems fuel societal change. In addition, throughout each chapter, various short pedagogical elements are presented to highlight key information systems issues and concepts in a variety of contexts. These elements help to show students the broader organizational and societal implications of various topics. At the end of each chapter, the Key Points Review repeats the learning objectives and describes how each objective was achieved; a variety of questions and exercises helps students assess their understanding of the chapter material and encourages them to synthesize and apply the concepts learned. A list of references appears at the end of each chapter.

OPENING CASE—MANAGING IN THE DIGITAL WORLD. Each chapter begins with an opening case describing a real-world company, technology, and/or issue to spark students' interest in the chapter topic. We have chosen engaging cases that relate to students' interests and concerns by highlighting why information systems have become central for managing in the digital world. Each opening case includes a series of associated questions the students will be able to answer after reading the chapter contents. The organizations, technologies, or issues highlighted in these cases are as follows:

- The rise of open innovation
- How information systems fuel startups and new business models
- Google's meteoric rise and its transition to Alphabet
- How Chinese e-commerce company Taobao became a leader in the world of e-commerce
- How Facebook has emerged as one of the most successful and powerful social media sites
- Intelligence through drones
- Amazon.com's use of its sophisticated infrastructure to automate the supply chain for both large and small customers
- How Walmart became a leader in managing its global supply chains
- The rise of the maker movement
- How the hacking group "Anonymous" uses various tactics to further its ideological goals

Green IT Case

Climate change and resource scarcity are among the most pressing issues societies face. To highlight the role of information systems in this context, each chapter includes a Green IT case. This new feature discusses important issues related to the environmental impacts of information systems as well as how information systems can be used to reduce negative environmental impacts. The Green IT cases are embedded in the text of the chapter and highlight concepts from the surrounding chapter material. The issues and organizations highlighted in these cases are as follows:

- Green IT and the Internet of Things
- How the U.S. Navy is using alternative energy sources to address power consumption of its fleets

- How Alphabet uses renewably energy to power its data centers
- The environmental impacts of online shopping
- How green IT is fueling the use of renewable energy
- How the Internet of Things, Big Data, and analytics fuel greener facilities
- Why your ERP system should be in the cloud
- How Nike builds a greener supply chain
- How companies are trying to reduce the carbon footprint of modern data centers
- How Anonymous protests the killing of dolphins and whales in Japan

Security Matters

With information systems becoming ever more ubiquitous, security is of growing concern, not only for organizations but also for individuals. While we dedicate an entire chapter to issues surrounding securing information systems, this new feature presents some current issues and threats. The topics discussed in this element are as follows:

- How computer criminals use ransomware to extort money from organizations and everyday people
- How attackers use the SWIFT system to conduct virtual bank robberies
- How attackers can remotely hack into a car's onboard systems
- How even small companies are not immune from being targeted
- How terrorism is winning the social media battle
- How hacktivists challenged the extramarital dating website Ashley Madison
- How companies have to weigh the benefits and dangers of not updating ERP systems
- How VTech's attackers disclosed the customer data of the most vulnerable
- How attackers use mobile malware to steal online banking users' login credentials
- How analog may be the future of securing critical infrastructure

Coming Attractions

We worked to ensure that this book is contemporary. We cover literally hundreds of different current and emerging technologies throughout the book. This feature, however, focuses on innovations that are likely to soon have an impact on organizations or society. The topics discussed are as follows:

- Storing the history of humankind in memory crystals
- CITE—a city-sized test lab for innovations
- Extending the human lifetime indefinitely
- Using artificial intelligence to manage hedge funds
- Dissolvable electronics to fight bacteria
- Emotion aware gaming
- Transforming ERP and organizations using the Internet of Things
- Reducing supply chain problems using augmented reality
- Harvesting human energy
- Using brainwaves to verify people's identities

When Things Go Wrong

Textbooks don't usually describe what not to do, but this can be very helpful to students. This feature enables students to learn about a real-world situation in which information systems did not work or were not built or used well. The topics and issues discussed are as follows:

- The negative effects of technology addiction
- The pains of Uber in China
- Dirty data centers and the environmental impact of cloud computing
- How companies are trying to rig "likes" to gain reputation on social networking sites
- Crowdfunding failures
- How Twitter can quickly disseminate *mis*information, with unforeseen consequences

- How a software error freed prisoners early
- How a supply chain failure caused SpaceX rocket failure
- Top security threats
- How the “heartbleed” bug almost killed the Internet

Who’s Going Mobile

Mobile technologies have become pervasive throughout society. New opportunities and issues have emerged with the growing importance of mobile devices, such as smartphones and tablets, which are in people’s immediate reach 24/7. Related to each chapter’s content, this feature examines topics related to the growth in mobile device usage throughout the world. The topics discussed are as follows:

- The rise of wearable technologies
- How information systems support the lifestyle of the digital nomads
- How mobile payment systems have transformed developing countries
- The rise of mobile payments
- Going SoLoMo: Yelp
- Identifying malaria hotspots using mobile phone data
- Managing businesses on the road using mobile ERP
- Developing mobile CRM apps for customers
- How to succeed in mobile app development
- Backdoors in mobile phones

Ethical Dilemma

Ethical business practices are now a predominant part of contemporary management education and practice. This feature examines contemporary dilemmas related to the chapter content and highlights the implications of these dilemmas for managers, organizations, and society. Discussion questions are provided to seed critical thinking assignments or class discussions. The topics discussed are as follows:

- The social and environmental costs of the newest gadgets
- The ethics of the sharing economy
- The ethics of publishing street photography on the web
- The ethics of reputation management
- Anonymity, trolling, and cyberharassment
- The Orwellian Internet of Things
- Privacy issues of radio frequency identification
- Using CRM systems to target or exploit consumers
- Ethical app development
- The ethics of cyberwar

Industry Analysis

Every industry is being transformed by the Internet and the increasing use of information systems by individuals and organizations. To give students a feel for just how pervasive and profound these changes are, each chapter presents an analysis of a specific industry to highlight the new rules for operating in the digital world. Given that no industry or profession is immune from these changes, each Industry Analysis highlights the importance of understanding information systems for *every* business student, not only for information systems majors. Discussion questions help students better understand the rapidly changing opportunities and risks of operating in the digital world. Chapter 1 examines how the digital world is transforming the opportunities for virtually all business professions. Subsequent chapters examine how globalization and the digital world have forever transformed various industries, including education, entertainment, retail, travel, health care, automobile, manufacturing, broadcasting, and law enforcement. Clearly, we are in a time of tremendous change, and understanding this evolution will better equip students to not only survive but also thrive in the digital world.

End-of-Chapter Material

Our end-of-chapter material is designed to accommodate various teaching and learning styles. It promotes learning beyond the book and the classroom. Elements include the following:

- ***Key Terms***—Highlight key concepts within the chapter.
- ***Review Questions***—Test students' understanding of basic content.
- ***Self-Study Questions***—Enable students to assess whether they are ready for a test.
- ***Problems and Exercises***—Push students deeper into the material and encourage them to synthesize and apply it.
- ***Application Exercises***—Challenge students to solve two real-world management problems using spreadsheet and database applications from a running case centered on a university travel agency. Student data files referenced within the exercises are available on the book's website: www.pearsonhighered.com/valacich.
- ***Team Work Exercise***—Encourage students to keep up with, discuss, visualize, and present interesting, important trends and forecasts related to Internet usage within a variety of contexts.

We have extensively updated these elements to reflect new chapter content and the natural evolution of the material.

End-of-Chapter Cases

To test and reinforce chapter content, we present two current real-world cases at the end of each chapter. Like the Opening Cases of each chapter, these cases are taken from the news and are contemporary. However, these are longer and more substantive than the Opening Cases. Sources for these cases include *BusinessWeek, CIO* magazine, *InformationWeek, Wired,* and various websites. They too are followed by discussion questions that help the student apply and master the chapter content. The organizations, products, and issues highlighted in these cases are as follows:

- Apple's rise, fall, and reemergence as a global technology giant
- How electronic health records are transforming healthcare
- How Groupon achieved a first-mover advantage by reinventing the business model of group buying
- How streaming video is disrupting the movie rental and TV broadcasting industries
- How Amazon Web Services are a catalyst for innovation
- How the dark web fuels illegal activities
- How web analytics are providing unprecedented insights into online consumer behavior
- How Rocket Internet aims to become a European Internet giant by cloning business models
- How algorithms determine news feeds
- How scammers use like farming and clickbait to game Facebook's newsfeed algorithms
- How the National Security Agency, or NSA, is being viewed as the National *Surveillance* Agency
- How companies gather social intelligence through social media
- How software as a service has enabled small and medium-sized organizations to utilize enterprise resource planning (ERP) systems
- How Amazon's order fulfillment fuels technological unemployment
- How natural disasters disrupt global supply chains
- How companies attempt to use information systems to efficiently deliver products to the "last mile"
- How the Federal Bureau of Investigation and Department of Homeland Security joined forces in developing a comprehensive database of biometric information to better track and apprehend criminals
- How Hadoop and MapReduce fuel the use and analysis of Big Data
- How the National Security Agency is attempting to stop insider leaks
- How China limits information exchange within its society through its "great firewall"

Organization

The content and organization of this book are based on our own teaching as well as on feedback from reviewers and colleagues throughout the field. Each chapter builds on the others to reinforce key concepts and allow for a seamless learning experience. Essentially, the book has been structured to answer three fundamental questions:

1. What are contemporary information systems, and how are they being used in innovative ways?
2. Why are information systems so important and interesting?
3. How best can we build, acquire, manage, and safeguard information systems?

The ordering and content of our chapters were also significantly influenced by the "IS 2010 Curriculum Guidelines for Undergraduate Degree Programs in Information Systems"[1]; these guidelines, written by prominent information systems scholars, define the information systems core body of knowledge for all business students. By design, the content of *Information Systems Today,* Eighth Edition, carefully follows these guidelines, and we are, therefore, very confident that our book provides a solid and widely agreed-on foundation for any introductory information systems course.

The chapters are organized as follows:

- ***Chapter 1: Managing in the Digital World***—Information systems are fueling change in the digital world. Here, we help students understand what information systems are, the pressing issues societies in the digital world are facing, how five IT megatrends—mobile, social media, the Internet of Things, cloud computing, and Big Data—influence organizations and society, and how information systems have become a vital part of modern organizations. We walk the student through the technology, people, and organizational components of an information system, and lay out types of jobs and career opportunities in information systems and in related fields. We also focus on how technology is creating countless ethical concerns.
- ***Chapter 2: Gaining Competitive Advantage Through Information Systems***—Given the rapid advancement of new technologies, we explain why and how companies are continually looking for innovative ways to use information systems for competitive advantage, and how information systems support organizations' business strategies. Here, we discuss how companies from GE to Uber can use information systems for automation, organizational learning, and strategic advantage by creating new and innovative business models.
- ***Chapter 3: Managing the Information Systems Infrastructure and Services***—With the ever-increasing complexity of maintaining a solid information systems infrastructure, it becomes increasingly important for organizations such as Google to design a reliable, robust, and secure infrastructure. Here, we provide an overview of the essential information systems infrastructure components and describe why they are necessary for satisfying an organization's informational needs. We also examine the rapid evolution toward the delivery of infrastructure capabilities through a variety of cloud-based services.
- ***Chapter 4: Enabling Business-to-Consumer Electronic Commerce***—Perhaps nothing has changed the landscape of business more than the use of the Internet for electronic commerce. Here, we describe how firms such as Amazon.com, Dell, or Taobao; governments; financial services providers; and e-finance startups use the Internet to conduct commerce in cyberspace. Further, we describe the requirements for successful e-commerce websites and discuss Internet marketing and mobile commerce as well as consumer-to-consumer and consumer-to-business e-commerce. Finally, we discuss payment and legal issues in e-commerce.
- ***Chapter 5: Enhancing Organizational Communication and Collaboration Using Social Media***—Social media have forever changed how people interact. In addition to enabling various business opportunities, social media have also enabled companies to better harness the power and creativity of their workforce. Here, we provide an overview of traditional communication and collaboration tools and examine how different social media can

[1] Topi, H., Valacich, J., Wright, R. T., Kaiser, K., Nunamaker Jr., J. F., Sipior, J. C., & de Vreede, G. J. (2010). IS 2010: Curriculum guidelines for undergraduate degree programs in information systems. *Communications of the Association for Information Systems, 26*(18).

enhance communication, collaboration, cooperation, and connection within organizations but also between organizations and their customers. Further, we discuss the importance of carefully managing the use of social media within organizations. Finally, using examples such as Twitter and Facebook, we describe how companies can deal with potential pitfalls associated with social media.

- ***Chapter 6: Enhancing Business Intelligence Using Big Data and Analytics***—A key to effective management in a global, highly competitive, and rapidly changing environment is high-quality and timely information to support decision making in order to realize the strategic goals of the organization. Here, we first describe the need for enhanced decision making and explain how databases serve as a foundation for gaining business intelligence. We then discuss concepts related to business intelligence and advanced analytics, including data mining, machine learning, and predictive modeling. Finally, we discuss how knowledge management and geographic information systems help organizations make better business decisions.
- ***Chapter 7: Enhancing Business Processes Using Enterprise Information Systems***—Enterprise systems have become a critical technology in a broad range of organizations, both large and small, to integrate information and span organizations' boundaries to better connect a firm with customers, suppliers, and other partners. Here, we focus on foundational concepts related to enterprise systems, walking students through various core business processes, and then examine how enterprise resource planning systems can be applied to improve these processes and organizational performance.
- ***Chapter 8: Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management***—Two additional types of enterprise systems, supply chain management systems and customer relationship management systems, are being used to facilitate various business processes between suppliers and customers. Here, we begin by introducing business-to-business electronic commerce. Next, we examine how supply chain management systems can support the effective management of supply networks. Finally, we examine customer relationship management systems and their role in attracting and retaining customers and, using examples from companies such as Dell, discuss how organizations can integrate social media in their CRM efforts.
- ***Chapter 9: Developing and Acquiring Information Systems***—Nearly every organization needs to develop or acquire information systems. Here, we begin by describing how to formulate and present the business case to build or acquire a new information system. We then walk the student through the traditional systems development approach and explain how numerous other approaches, such as agile development, can be utilized depending on the situation. Finally, we examine the steps followed when acquiring an information system from an outside vendor.
- ***Chapter 10: Securing Information Systems***—With the pervasive use of information systems, new dangers have arisen for organizations, and the interplay between threats, vulnerabilities, and potential impacts has become a paramount issue within the context of global information management. Here, we contrast several types of computer crime and discuss the growing significance of cyberwar and cyberterrorism. We then highlight the primary threats to information systems security and explain how systems can be compromised and safeguarded. We conclude this chapter with a discussion of the role of auditing, information systems controls, and the Sarbanes–Oxley Act. Note that some instructors may choose to introduce this chapter prior to the discussion of the information systems infrastructure in Chapter 3.
- ***Technology Briefing***—In addition to these 10 chapters, we include a Technology Briefing that focuses on foundational concepts regarding hardware, software, networking and the Internet, and databases. While Chapter 3, "Managing the Information Systems Infrastructure and Services," provides a more managerial focus to these enabling technologies, this foundational material provides a more in-depth examination of these topics. By delivering this material as a Technology Briefing, we provide instructors the greatest flexibility in how and when they can apply it.

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Instructor Resources

At the Instructor Resource Center, www.pearsonhighered.com/irc, instructors can easily register to gain access to a variety of instructor resources available with this text in downloadable format. If assistance is needed, our dedicated technical support team is ready to help with the media supplements that accompany this text. Visit http://support.pearson.com/getsupport for answers to frequently asked questions and toll-free user support phone numbers.

The following supplements are available with this text:

- Instructor's Resource Manual
- Test Bank
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John Wells, *University of Massachusetts*
Nilmini Wickramasinghe, *Cleveland State University*
Yue Zhang, *California State University–Northridge*

Acknowledgments

Although only our two names are listed as the authors for this book, this was truly a team effort that went well beyond the two of us. Pearson has been an outstanding publishing company to work with. Pearson is innovative, has high standards, and is as competitive as we are.

Among the many amazingly helpful people at Pearson, there are a handful of people we wish to thank specifically. First, Katrina Ostler, our project manager, helped to whip us and this book into shape and get it finished on time. Additionally, Ann Pulido from SPI Global helped in getting approval for photos, figures, websites, and other graphics, as well as coordinating refinements as the book moved through the stages of production. Finally, we want to thank our editor, Samantha Lewis.

In addition to our colleagues at Pearson Prentice Hall, several individuals have been particularly instrumental in making the eighth edition the best ever. First, Michael Byrd, PhD candidate at the University Arizona, did an outstanding job on creating and revising several of our case elements. Also, a special thanks goes out to Dave Wilson (University of Oklahoma) and Catherine Chan (Hong Kong Baptist University), who were instrumental in drafting earlier chapter elements. Thanks, team! We could not have done it without you.

Most important, we thank our families for their patience and assistance in helping us to complete this book. Joe's wife Jackie, daughter Jordan, and son James were a constant inspiration, as was Christoph's wife Birgit. This one is for all of you.

1 Managing in the Digital World

Preview

Today, organizations from Apple to Zappos use information systems to better manage their organizations in the digital world. These organizations use information systems to provide high-quality goods and services as well as to gain or sustain competitive advantage over rivals. In addition to helping organizations to be competitive, information systems have contributed to tremendous societal changes. Our objective for this chapter is to help you understand the role of information systems as we continue to move further into the digital world, the role of information systems in current issues faced by societies in the digital world, and the role of information technology (IT) megatrends in influencing the digital future. We then highlight what information systems are, how they have evolved to become a vital part of modern organizations, and why this understanding is necessary for you to become an effective manager in the digital world. We conclude by discussing ethical issues associated with the use of information systems.

MANAGING IN THE DIGITAL WORLD:

Open Innovation

Where do good ideas come from? An eccentric inventor toiling alone? A secretive lab filled with researchers in white coats? Views of innovation are shifting away from these traditional stereotypes. For decades, corporations funded internal research and development units and tightly controlled both the inputs and outputs of these operations. Opportunities to interact with customers were limited, and the possibility of spending months or years and millions of dollars developing products that no one wanted was a real threat. New technologies are enabling a shift in the way innovation occurs.

Traditionally, universities would conduct basic and applied research, but the results of this research only sometimes would make their way to the private sector. Corporations would fund their own research and development operations, often at great expense. Such operations took years to set up and were often highly constrained in the types of research they could carry out. Programs of research were evaluated against business plans that had been studied, reviewed, and approved by multiple layers of management. The time and complexity involved in these bureaucratic processes often left the actual research out of date and out of touch with the realities of the marketplace and actual customer wants and needs. The resulting products

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

1. **Describe the characteristics of the digital world, contemporary societal issues of the digital world, and IT megatrends shaping the digital future.**
2. **Explain what an information system is, contrasting its data, technology, people, and organizational components.**
3. **Describe the dual nature of information systems in the success and failure of modern organizations.**
4. **Describe how computer ethics affect the use of information systems and discuss the ethical concerns associated with information privacy and intellectual property.**

would often fail in the market due to being years late or no longer being relevant.

Open innovation is a new approach. Instead of relying on tightly controlled internal research projects, companies are opening up their research and development efforts to a broad audience (Figure 1.1). Customers, suppliers, and other companies are invited to participate more directly in different phases of the innovation process, and companies are working more collaboratively with universities.

Many companies take these ideas even further and open up the research and development efforts to anyone who wishes to participate online or in person. For example, Starbucks introduced "My Starbucks Idea," where customers can post ideas and suggestions as well as vote on or discuss others' ideas. Hundreds of customer-generated ideas have been launched over the years. Likewise, more than 37,000 ideas have been submitted to Dell's "IdeaStorm" website, with more than 550 ideas implemented, and Heineken's "Innovators Brewhouse" uses open innovation to generate ideas related to topics ranging from methods for counterfeit detection to brewing closer to the consumer or new, more convenient packaging. Further, new tools like interactive 3D visualization and rapid prototyping technologies like 3D printing allow for tremendously lowered barriers to entry to innovation. Many companies and institutions have set up collaborative spaces to share resources and encourage the fusion of ideas and skills that can lead to exciting breakthroughs. As with many innovations themselves, this innovative way of innovating would not be possible without information systems.

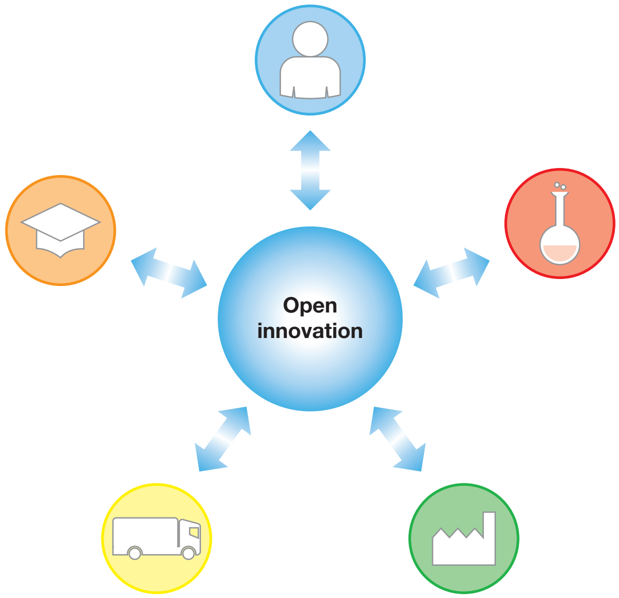

FIGURE 1.1

Open innovation entails opening up the innovation process to outside entities, including academia, individual innovators, research labs, other companies, or suppliers.

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

1. How do the five IT megatrends fuel open innovation?
2. What are the primary information systems components that enable open innovation?
3. What intellectual property issues arise from engaging in open innovation?

Based on:

Board of Innovation. (n.d.). List of open innovation and crowdsourcing examples. Retrieved June 20, 2016, from http://www.boardofinnovation.com/list-open-innovation-crowdsourcing-examples

GE. (2016). GE open innovation. *GE.com*. Retrieved April 24, 2016, from http://www.ge.com/about-us/openinnovation

Open Innovation Community. (2016). Open innovation. Retrieved April 24, 2016, from http://openinnovation.net/about-2/open-innovation-definition

Information Systems Today

Today, information systems (IS) are ubiquitous: Be it traditional desktop computers, laptop computers, smartphones, tablets, you name it; information systems are all around us, whether you see them or not. Companies such as FedEx and UPS use information systems to route trucks and track packages. Retailers such as Walgreens and Walmart use information systems for everything from optimizing supply chains to recording purchases and analyzing customer tastes and preferences. Cities use information systems for adaptive traffic control systems or variable speed limits. Cars use information systems for everything from ignition control to airbags to distance control and park assist systems. Many innovative business models, ranging from Airbnb to Uber, are built on or around information systems. Alternatively, just look around your school or place of work. At your school, you register for classes online; use e-mail, Twitter, or Facebook to communicate with fellow students and your instructors; access e-books from your library; and complete or submit assignments on online learning platforms such as Blackboard, Moodle, Canvas, or Sakai. At work, you may use a PC for e-mail and many other tasks. Your paychecks are probably generated by computer and automatically deposited into your bank account via high-speed networks. Even in your spare time, information systems are ubiquitous: You use social networking sites like Facebook to stay connected with your friends and family, you watch videos on YouTube, you upload pictures taken with your smartphone to picture-sharing sites like Instagram, you listen to music on Pandora or Spotify, and you use your smartphone for playing games, sending e-mails, or reading books. Chances are that each year you see more information systems than you did the year before, and these systems are a more fundamental and important part of your social, academic, and work life than ever before.

The Emergence of the Digital World

Over the past decades, the advent of powerful, relatively inexpensive, easy-to-use computers has had a major impact on business and society. When you stop and think about it, it is easy to see why information systems are important. Increasing global competitiveness has forced companies to find ways to be better and to do things less expensively. The answer for many firms continues to be to use information systems to do things better, faster, and cheaper. Many organizations use information systems to support innovative business models, or build their entire business models around technological innovations. Likewise, using global telecommunications networks, companies can more easily integrate their operations to access new markets for their products and services as well as access a large pool of talented labor in countries with lower wages.

Clearly, we are living in a digital world. Given the proliferation of mobile devices such as tablets or smartphones, some have even argued that we are living in the post-PC era, where wireless, mobile devices will replace traditional desktop and laptop computers. In fact, already in the last quarter of 2011, Apple sold more iPads than HP (traditionally one of the world's leading PC makers) sold PCs, and in the United States, smartphone penetration has reached 82 percent (Nielsen, 2016). Initially created as consumer devices, tablets have become commonplace in various professional settings, including warehouses, showrooms, airplane cockpits, and hospitals (Figure 1.2).

Yet desktop PCs and laptops are unlikely to go away. Rather, devices with newer form factors will work in tandem with older form factors to provide truly ubiquitous experiences; mobile devices complement traditional computers, providing different devices for different users and different tasks, where not the device but the services and data provided are of primary importance. Further, the changes we've seen so far have given rise to developments such as wearable computers, augmented reality devices, or surface computers.

Changes in technology have enabled new ways of working and socializing; whereas traditionally, people were bound to a stationary PC to do essential tasks, they can now perform such tasks from almost anywhere they have a cell phone signal. Likewise, workdays traditionally had a clear beginning and a clear end—from when you powered your computer on to when you turned it off at night. Today, many tasks (especially more casual tasks such as reading or sending e-mails) can be done at any time, often in small chunks in between other tasks, such as when waiting in line at the supermarket cashier.

Computing has changed from an activity primarily focused on automating work to encompass various social and casual activities. Devices such as smartphones or tablets, paired with mobile broadband networks, allow for instant-on computing experiences, whenever and

FIGURE 1.2

Mobile devices are increasingly being used in various professional settings.
Source: William Perugini/Shutterstock.

wherever; advances in *cloud computing* (think Gmail, Office Online, or Dropbox) allow for accessing e-mails, files, notes, and the like, from different devices, further enhancing portability and mobility.

In effect, we are in a virtuous cycle (or in a vicious cycle, considering the creep of work life into people's leisure time and the increasing fixation on being permanently "on call"), where changes in technology lead to social changes and social changes shape technological changes. For example, communication, social networking, and online investing almost necessitate mobility and connectivity, as people have grown accustomed to checking e-mails, posting status updates, or checking on real-time stock quotes while on the go. In addition, the boundaries between work and leisure time are blurring, so that employees increasingly demand devices that can support both and often bring their own devices into the workplace.

KNOWLEDGE WORKERS AND THE KNOWLEDGE SOCIETY. In 1959, Peter Drucker predicted that information and information systems would become increasingly important, and at that point, more than half a century ago, he coined the term **knowledge worker**. Knowledge workers are typically professionals who are relatively well educated and who create, modify, and/or synthesize knowledge as a fundamental part of their jobs.

Drucker's predictions about knowledge workers were accurate. As he predicted, they are generally paid better than their prior agricultural and industrial counterparts; they rely on and are empowered by formal education, yet they often also possess valuable real-world skills; they are continually learning how to do their jobs better; they have much better career opportunities and far more bargaining power than workers ever had before. Knowledge workers make up about a quarter of the workforce in the United States and in other developed nations, and their numbers are rising quickly.

Drucker also predicted that, with the growth in the number of knowledge workers and with their rise in importance and leadership, a **knowledge society** would emerge. He reasoned that, given the importance of education and learning to knowledge workers and the firms that need them, education would become the cornerstone of the knowledge society. Possessing knowledge, he argued, would be as important as possessing land, labor, or capital (if not more so) (Figure 1.3). Indeed, research shows that people equipped to prosper in the knowledge society, such as those with a college education, earn far more on average than people without a college education, and that gap is increasing. In fact, the most recent data from the U.S. Census Bureau's American Community Survey (2014 data) reinforce the value of a college education: Median earnings for workers 25 and over with a bachelor's degree were US$50,450 a year, while those for workers with a high school diploma were US$27,809. Median earnings for workers with a graduate or professional degree were US$66,175, and for those without a high school diploma US$20,542. These data suggest that a bachelor's degree is worth about US$1 million in additional lifetime earnings compared to a worker with only a high school diploma.

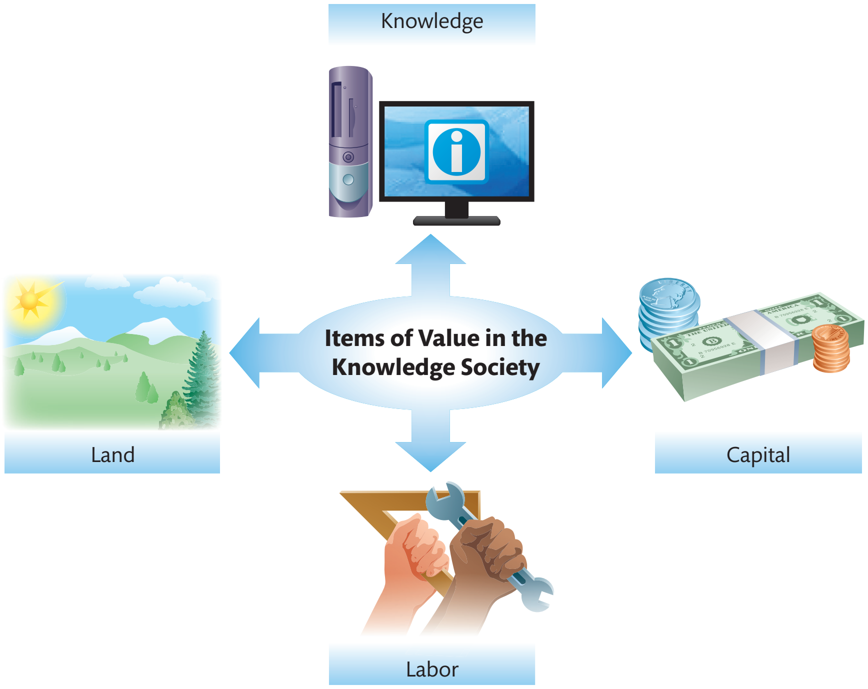

FIGURE 1.3

Knowledge has become as important as—and many feel more important than—land, labor, and capital resources.

Additionally, getting a college degree will qualify you for many jobs that would not be available to you otherwise and will distinguish you from other job candidates. Finally, a college degree is often a requirement to qualify for career advancement and promotion opportunities once you do get that job.

People generally agree that Drucker was accurate about knowledge workers and the evolution of society. While people have settled on Drucker's term *knowledge worker*, there are many alternatives to the term *knowledge society*. Others have referred to this phenomenon as the *knowledge economy*, the *new economy*, the *digital society*, the *network era*, the *Internet era*, and other names. We simply refer to this as the *digital world*. All these ideas have in common the premise that information and related technologies and systems have become indispensable and that knowledge workers are vital.

Today, not only knowledge workers use information systems as integral parts of their work lives; many "traditional" occupations now increasingly use information systems—from the UPS package delivery person using global positioning system (GPS) technology to take the best route to deliver parcels to the farmer in Iowa who uses precision agriculture to plan the use of fertilizers to increase crop yield. In essence, (almost) every organization can now be considered an e-business. An **e-business** is an organization that uses information technologies or systems to support nearly every part of its business. Thus, the lines between "knowledge workers" and "manual workers" are blurring, to the point that some argue that "every worker is a knowledge worker" (Rosen, 2011).

THE DIGITAL DIVIDE. Some have argued, however, that there is a downside to being a knowledge worker and to living in the digital world. For example, some have argued that knowledge workers will be the first to be replaced by automation with information systems. Others have argued that in the new economy there is a **digital divide**, where those with access to information systems have great advantages over those without access to information systems. The digital divide is one of the major ethical challenges facing society today when you consider the strong linkage between computer literacy and a person's ability to compete in the digital world. For example, access to raw materials and money fueled the Industrial Revolution, "but in the informational society, the fuel, the power, is knowledge," emphasized John Kenneth Galbraith, an American economist who specialized in emerging trends in the U.S. economy. "One has now come to see a new class structure divided by those who have information and those who must function out of ignorance. This new class has its power not from money, not from land, but from knowledge" (Galbraith, 1987).

The good news is that the digital divide in America is rapidly shrinking, but there are still major challenges to overcome. In particular, people in rural communities, the elderly, people with disabilities, and minorities lag behind national averages for Internet access and computer literacy. Outside the United States and other developed countries, the gap gets even wider and the obstacles get much more difficult to overcome, particularly in the developing countries where infrastructure and financial resources are lacking. For example, most developing countries are lacking modern informational resources such as affordable Internet access or efficient electronic payment methods.

To be sure, there is a downside to overreliance on information systems, but one thing is for certain: Knowledge workers and information systems are now critical to the success of modern organizations, economies, and societies. At the same time, information systems play a crucial role in various major issues societies face. These issues are examined next.

Globalization and Societal Issues in the Digital World

The past decades have brought about a number of dramatic global changes, many of which will continue to influence individuals, businesses, economies, and societies well into the future. Many of such interrelated societal "megatrends," discussed by consulting firms such as PricewaterhouseCoopers (PwC) or Ernst & Young (EY), local and national governments, or global political and business leaders at the World Economic Forum, are related to ever-increasing **globalization**—the integration of economies throughout the world, enabled by innovation and technological progress (International Monetary Fund, 2002). You can see the effects of globalization in many ways, such as the greater international movement of commodities, money, information, and labor as well as the development of technologies, standards, and processes to facilitate this movement.

COMING ATTRACTIONS

Memory Crystals

In the *Superman* films and many other sci-fi movies and books, characters make use of data storage devices that resemble large crystals. In the stories, these crystals often store incredibly large amounts of data and last for extraordinary lengths of time. Now scientists have taken a step toward making such technology a reality. Researchers at the University of Southampton (UK) have created a nanostructured glass storage device that resembles the fictional technologies. The technique uses self-assembling nanostructures written into fused quartz using tiny femtosecond (one-quadrillionth, or one-millionth of one-billionth, of a second) laser light pulses. The data are encoded in five dimensions (5D): height, length, width, position, and orientation. Using these multiple dimensions along with the nanoscale laser writing allows a small glass disc, about the size of a large coin, to store 360 terabytes (TB) of data. As a terabyte is equal to 1,024 gigabytes (GB), the amount of data stored on each tiny disk is several hundred times the amount of data stored on a standard desktop computer (1–4 TB) and several thousand times the data storage capacity of most smartphones (16–128 GB). The quartz material is highly stable (up to 13.8 billion years at 190 degrees Celsius), so data can be archived essentially forever.

To demonstrate the technology, the scientists recorded several major documents from human history on the disks, including the Universal Declaration of Human Rights, Newton's *Opticks*, the Magna Carta, and the King James Bible. The technology could be used by any organization or business seeking to store large volumes of data for long periods of time. Museums, libraries, national archives, and others could preserve their information and records for nearly unlimited time. Data stored using the technique could well outlast any other aspects of not just our technology but our civilization. Professor Peter Kazansky from the university's research team says: "It is thrilling to think that we have created the technology to preserve documents and information and store it in space for future generations. This technology can secure the last evidence of our civilization: all we've learnt will not be forgotten." The scientists are looking for industry partners to further develop and commercialize the technology.

Based on:

Mullen, M. (2016, February 17). New "Superman" crystals can store data for billions of years. *CNN Money*. Retrieved April 14, 2016, from http://money.cnn.com/2016/02/17/technology/5d-data-storage-memory-crystals/index.html

Phys.org. (2016, February 15). Eternal 5D data storage could record the history of humankind. Retrieved April 14, 2016, from http://phys.org/news/2016-02-eternal-5d-storage-history-humankind.html

GLOBALIZATION: OPPORTUNITIES AND CHALLENGES. For organizations, globalization has opened up many opportunities, brought about by falling transportation and telecommunication costs. Today, shipping a bottle of wine from Australia to Europe costs merely a few cents, and people can make voice or video calls around the globe for free using services such as Skype, Google Hangouts, or WhatsApp. To a large extent fueled by movies, television, and other forms of media, the increasing globalization has moved cultures closer together. The streaming movie provider Netflix is available in almost every country of the world, people in all corners of the world can receive television programming from other countries, and major movies are increasingly international. Developments such as these help create a shared understanding about norms of behavior or interaction, desirable goods or services, or even forms of government (though such shared understanding is still often lacking, and many of these developments have not yet happened). The rapid rise of a new middle class in many developing countries has enabled established companies to reach new markets, enabling them to sell their products to literally millions of new customers. At the same time, with the decrease in communication costs, companies can now draw on a large pool of skilled professionals from all over the globe. Countries such as Russia, China, and India offer high-quality education, leading to an ample supply of well-trained people at low cost. Some countries have even built entire industries around certain competencies, such as software development or tax preparation in India and call centers in Ireland.

The tremendous decrease in communication costs has increased the use of **outsourcing**—the moving of business processes or tasks (such as accounting, manufacturing, or security) to another company or another country—as now companies can outsource business processes on a global scale (Figure 1.4). Companies are choosing to outsource business activities for a variety of reasons; the most important reasons include the following (King, 2003):

- To reduce or control costs
- To free up internal resources
- To gain access to world-class capabilities
- To increase the revenue potential of the organization
- To reduce time to market
- To increase process efficiencies
- To be able to focus on core activities
- To compensate for a lack of specific capabilities or skills

Often, companies located in countries such as India can provide certain services much cheaper because of lower labor costs, or companies perform certain functions in a different country to reduce costs or harness skilled labor. For example, in India, two companies—Wipro and Infosys—have emerged as the leaders in providing IT services that range from business consulting to systems development. In addition, a wide variety of other services—ranging from telephone support to tax returns—are candidates for outsourcing to different countries, be it Ireland, China, or India. Even highly specialized services, such as reading of X-rays by skilled

FIGURE 1.4

Companies are outsourcing production to overseas countries (such as China) to utilize talented workers or reduce costs.
Source: Lianxun Zhang/Fotolia.

radiologists, are outsourced by U.S. hospitals to doctors around the globe, often while doctors in the United States are sleeping.

Yet globalization has also brought about a number of operational challenges for organizations. Organizations face governmental challenges related to differences in political systems, regulatory environments, laws, standards, or individual freedoms. Likewise, geoeconomic challenges include differences in infrastructure, demographics, welfare, or workers' expertise. Lastly, organizations face cultural challenges, such as dealing with differences in languages, beliefs, attitudes, religions, or life focus but also different viewpoints regarding intellectual property. As a result, companies intending to outsource services or production have to carefully choose outsourcing locations, considering numerous different factors, such as English proficiency, salaries, or geopolitical risk. While countries such as India remain popular, other formerly popular countries (such as Singapore, Canada, or Ireland) are declining because of rising salaries. With these shifts, outsourcers are constantly looking at nascent and emerging countries such as Bulgaria, Egypt, Ghana, Bangladesh, or Vietnam.

Obviously, organizations have to weigh the potential benefits (e.g., cost savings) and drawbacks (e.g., higher geopolitical risk or less experienced workers) of outsourcing to a particular country, and often, cost savings prove to be negligible due to added overhead, such as customs, shipping, or training as well as quality problems. In fact, *InformationWeek*, a leading publication targeting business IT users, found that 20 percent of the 500 most innovative companies in terms of using IT took back projects previously outsourced to another country. Nevertheless, IT outsourcing is big business: Research firm IDC forecasted the market for IT outsourcing to be $103 billion in 2019 (Tapper, 2015).

SOCIETAL ISSUES IN THE DIGITAL WORLD. The rapid development of transportation and telecommunication technologies, national and global infrastructures, and information systems as well as a host of other factors has created a number of pressing societal issues that will tremendously influence the world we live in (PWC, 2016; Schreiber, 2016). In this section, we will highlight a few of these issues (Figure 1.5). One such issue is **demographic changes**—changes in the structure of populations such as related to age, birth rates, and migration. While many countries in the developed world see rapidly aging populations, developing regions such as Africa are expected to rapidly rise in population, fueling a massive global population growth. These differences in demographic changes will also shift the balance of demand and supply of labor; further, differences in welfare are likely to further increase, and many countries are already experiencing both positive and negative effects of mass migrations. In addition, many regions of the world are seeing rapid **urbanization**—the movement of rural populations to urban areas, to a point where 50 percent of the world's population is now living in cities (PWC, 2016); sustaining this growth while providing livable environments for the inhabitants will pose major challenges. Another major trend is the global **shifts in economic power**—changes in countries' purchasing power and control over natural resources—where established economies are losing

FIGURE 1.5

Societal issues in the digital world.
Source: Pichaitun/Fotolia.

their dominating positions in the world's economy, resulting in the need to resolve political struggles (PWC, 2016). Many of these issues interact, affect each other, and/or fuel other issues, such as issues related to **resource scarcity** due to limited availability of fossil fuels and other natural resources and **climate change**—large-scale and long-term regional and global changes in temperatures and weather patterns. Population growth, global trade, consumerism, and other factors contribute to increasing waste and pollution, as well as a growing need for resources, at a time where humans already live beyond the finite natural resources the planet can provide. Likewise, climate change—regardless of its causes—and its associated changes in weather patterns, rise in sea levels, and increase in the severity of storms pose a number of challenges for individuals, societies, and the world. As a consequence, **sustainable development**—"development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987)—will become an ever increasingly important aspect. In addition to these societal issues, we have witnessed a number of breakthroughs and transformations enabled by technology; these breakthroughs are disrupting traditional business models but can also help address pressing societal issues. Next we will discuss five IT megatrends that shape the digital future.

Five IT Megatrends That Shape the Digital Future

In most developed societies, information technologies have become pervasive—information technologies are in fact used throughout society, and the speed of innovations is increasing at a tremendous pace, with many *radical innovations* marginalizing or displacing existing products or industries (see Chapter 2, "Gaining Competitive Advantage Through Information Systems").

WHO'S GOING MOBILE

Wearable Technologies

For a long time, the smart fridge has been touted as the prime example of possibilities enabled by the *Internet of Things*, a network of physical objects that are connected over the Internet. While the smart fridge has yet to take off, many much smaller "things" have become tremendously popular—wearable technologies, such as smartwatches or activity trackers. The term **wearable technologies** refers to clothing or accessories that incorporate electronic technologies. For example, the Apple Watch, Samsung's Galaxy Gear, or the Fitbit incorporate various sensors; depending on the device, the sensors record physiological data such as body movements or heart rate but also environmental data such as ambient light, orientation, or altitude. Smartwatches such as the Apple Watch or Samsung's Galaxy Gear are designed to be an extension of the user's phones, used to display notifications from the phone or tablet devices, providing quick access to some of the phone's or tablet's functions, in addition to enabling the user to monitor various fitness activities. Activity trackers such as the Fitbit are designed to be worn and passively used on a regular basis, supporting the "**quantified self**"—the logging of all aspects of one's daily life, ranging from monitoring and recording of activities, performance, or intakes to monitoring bodily states (such as moods or physiological data) to improve one's overall health and performance. Yet other devices are intended for special use cases—as in the "Climbax," a rock-climbing device that tracks your climbing technique.

Whereas many wearable technologies are designed to support the quantified self, many see social relationships as the next big thing in wearables and experiment with social wearables that allow users to connect with each other in novel ways. For example, experimental concepts include a social fan jersey, which allows sports fans to experience vibration patterns as their favorite rugby player hits the ground. Many of these technologies are both exciting and futuristic, but there remain security, privacy, and other issues to resolve: Early wearable devices have been demonstrated to be easily hackable, and there is also broad concern about the potential distractions to automobile drivers or students in classrooms from such wearable devices. While offering great promises, these exciting technologies will require adjustments and compromises if they are to obtain the extensive adoption their manufacturers are aiming for.

Based on:

Cosco, A. (2016, March 7). The social age of wearable tech: From quantified self to emotional second skin. *Wareable*. Retrieved March 18, 2016, from http://www.wareable.com/wearable-tech/the-social-age-of-wearable-tech-beyond-the-quantified-self

Green, C. (2014, May 12). Wearable technology creates $50 billion investment frenzy. *Information Age*. Retrieved March 18, 2016, from http://www.information-age.com/technology/mobile-and-networking/123457988/wearable-technology-creates-50-billion-investment-frenzy

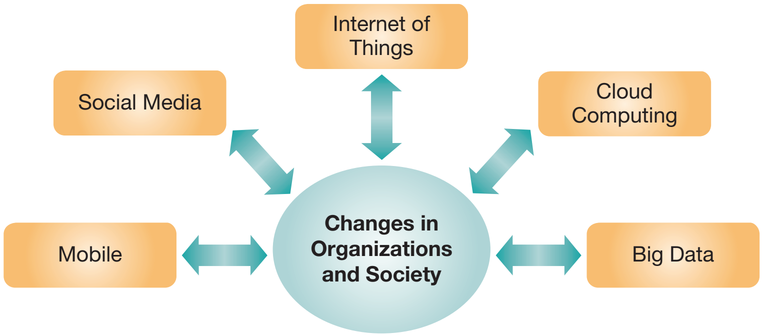

FIGURE 1.6

Five IT megatrends.

For example, within just a few years, drones evolved from being primarily used by the military to being used by farmers, aerial photographers, filmmakers, and hobbyists alike. Self-parking systems are already available in many vehicles, self-driving cars and trucks are being actively tested by various companies, and autonomous Caterpillar mining trucks are already in use. Likewise, the development of sophisticated web technologies has brought about a fundamental shift in types of information technologies that are being used, and we're seeing five (intertwined) "megatrends" that influence individuals, organizations, and society (Figure 1.6). Understanding the influence of these megatrends will be increasingly important: Individuals will increasingly feel the impact of these megatrends on their private and work lives, and businesses need to have a business strategy that is fit for today's digital world and the digital future.

- ***Mobile.*** One of the biggest trends we're seeing today is the move toward mobile devices, as indicated in the opening section of this chapter. In most developed countries, the vast majority of adults have a mobile phone, and typically, people have their mobile phones within their reach 24/7. Compare that with the access to your laptop or PC. In the developing world, mobile devices are frequently seen leapfrogging traditional PCs; owing to the lack of stable, reliable power or landline telephone infrastructure, mobile devices are often the primary means of accessing the Internet. For organizations, this increase in mobility has a wide range of implications, from increased collaboration to the ability to manage a business in real time—at any time, from anywhere—to changes in the way new (or existing) customers can be reached (Figure 1.7). With the increase in mobile devices, organizations not only have to create mobile-device-friendly versions of their websites but often

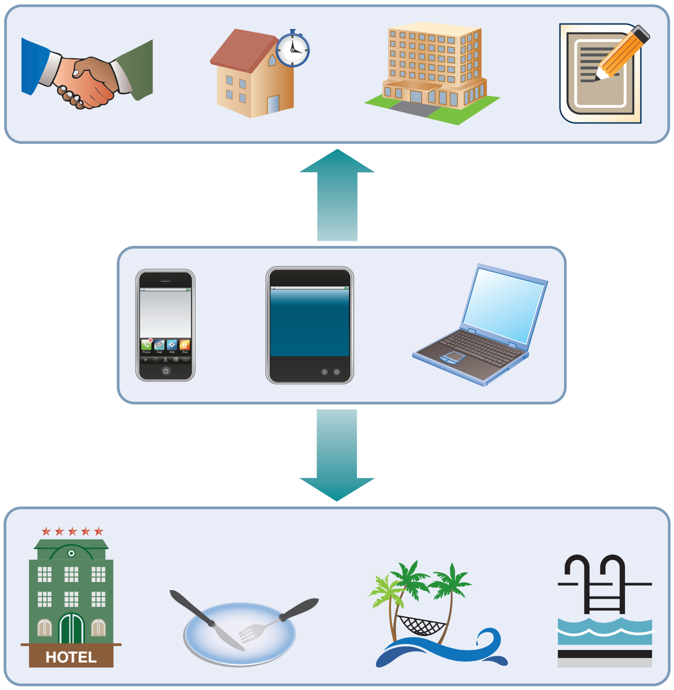

FIGURE 1.7

Mobile devices allow running business in real time—at any time, from anywhere.

build mobile **apps** (software programs designed to perform a particular, well-defined function) to market their products or services. In addition, fueled by advances in consumer-oriented mobile devices (such as smartphones and tablets) and the ability to access data and applications "in the cloud," today's employees are increasingly using their own devices for work-related purposes or are using software they are used to (such as social networks for communicating) in the workplace. While initially, workers tended to use their own devices primarily for checking e-mails or visiting social networking sites, they now use their own devices for various other important tasks, including customer relationship management or enterprise resource planning. For organizations, this trend can be worrying (due to concerns related to security or compliance or increasing need to support the workers' own devices), but it can also provide a host of opportunities, such as increased productivity, higher retention rates of talented employees, or higher customer satisfaction. Managing this trend of "bring your own device" (**BYOD**) is clearly a major concern of business and IT managers alike. Further, we have witnessed the **consumerization of IT**; many technological innovations are first introduced in the consumer marketplace before being used by organizations, and businesses have to constantly evaluate how a wide variety of new technologies might influence their ways of doing business. Throughout the text, we will introduce issues and new developments associated with increases in mobility.

- ***Social Media.*** A second megatrend, as you have undoubtedly noticed, is social media. The rise of social media is largely based on the **network effect**—referring to the notion that the value of a network (or tool or application based on a network) increases with the number of other users. In other words, if a network has few users, it has little or no value. You may be one of the more than 1.6 billion (and growing) Facebook users who share status updates or pictures with friends and family, or you may use apps such as Snapchat, Twitter, or WhatsApp to communicate with your friends. How useful would these social media platforms be if none of your friends or family members had access to them? Today, the use of social media has gone way beyond friends and families. University professors use social networks to provide students with updates about course-related topics, and organizations use social media to encourage employee collaboration or to connect with their customers (Figure 1.8). In addition, companies can harness the power of the crowd by using social media to get people to participate in innovation and other activities. With the rise of social media, we have witnessed a shift in roles, where users are not mere consumers of information but have become important creators and contributors. As you can imagine, social media are here to stay; while we will touch on social media–related aspects throughout the book, we will devote Chapter 5, "Enhancing Organizational Communication and Collaboration Using Social Media," to social media and related topics.
- ***The Internet of Things.*** A third megatrend is the **Internet of Things (IoT)**—a network of a broad range of physical objects that can automatically share data over the Internet. Such objects (or "things") can range from an automobile tire equipped with a pressure sensor to a smart meter enabling remote monitoring of energy consumption to a cow with an injectable ID chip. Already in 2008, more devices were connected to the Internet than there were people living on earth. Fueled by advances in chips and wireless radios and decreasing costs of **sensors** (devices that can detect, record, and report changes in the physical environment), in the not-too-distant future everything that can generate useful information

FIGURE 1.8

Social media are used in various personal and business settings.

will be equipped with sensors and wireless radios (Figure 1.9). In other words, anything that can generate data or uses data can be connected, accessed, or controlled via the Internet (sometimes referred to as "pervasive computing"). With the ability to connect "things" such as sensors, meters, signals, motors, actuators, or cameras, the potential for gathering useful data is almost limitless. For example, the market for **smart home technologies** (sometimes called **home automation**)—technologies enabling the remote monitoring and controlling of lighting, heating, or home appliances—such as the Nest Learning Thermostat, is expected to reach almost US$60 billion by 2020. Using smart home technology, one can monitor home temperatures when on vacation or remotely adjust the air-conditioning; likewise, sensors integrated in a road's surface can monitor temperatures and trigger dynamic speed limits in case there is the risk of ice or snow. Similarly, sensors can monitor availability of parking spaces or traffic flow, alerting drivers of changes in conditions. Millions of sensors connected to the Internet can monitor weather conditions, helping to generate more accurate local weather predictions, or can monitor soil moisture in golf courses, reducing the need for watering. Cardiac monitors can alert physicians of patients' health risks. The use of IoT technologies in manufacturing—referred to as **Industrial Internet of Things (IIoT)**—enables the convergence of information technology and operations technology, offering the potential for tremendous improvements in efficiency, product quality, agility, and flexibility, allowing companies to mass-produce customized products, better monitor supply chains, and so on. In sum, the applications of sensor technology for home automation, smart cities, smart metering, smart farming, e-health, manufacturing, and other areas are almost limitless. As the number of sensors and devices connected to the Internet grows, the Internet of Things will evolve to become the Internet of Everything (IoE), where just about any device's functionality is enhanced through connectivity and intelligence.

- ***Cloud Computing.*** The fourth megatrend is **cloud computing**. Whereas traditionally each user would install a number of different applications for various tasks—from creating documents to listening to music—as well as store documents, pictures, and other data on

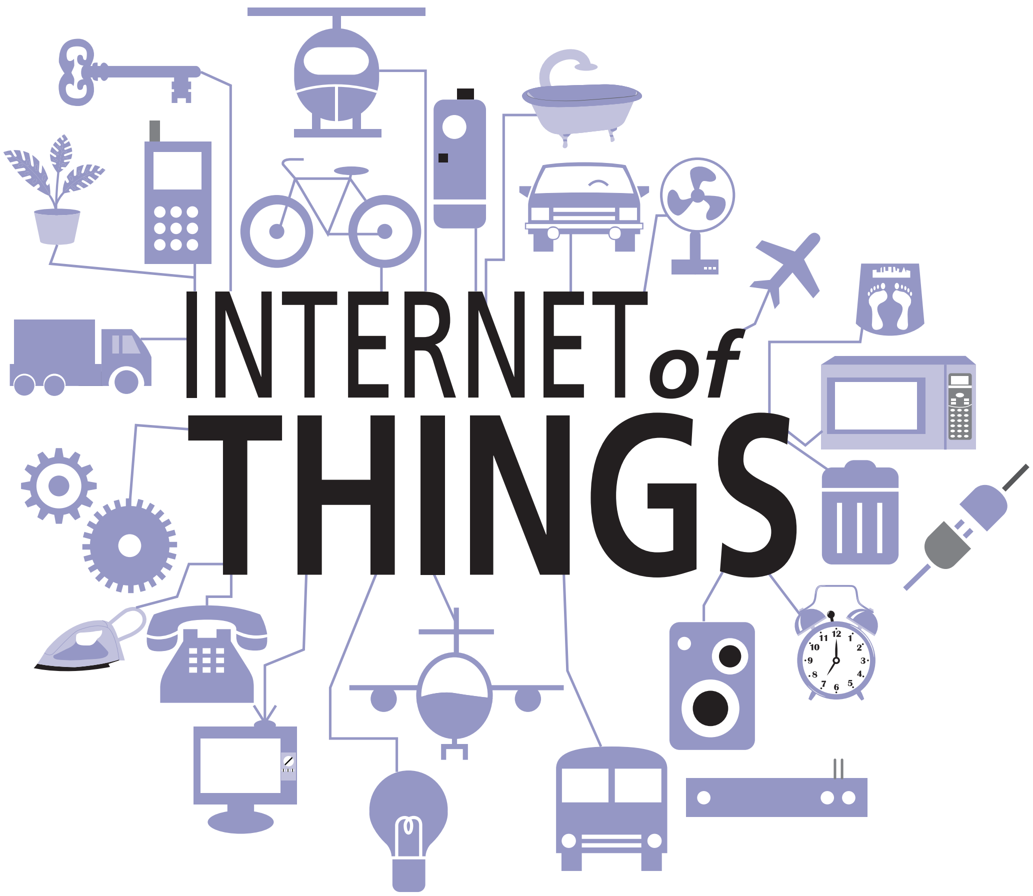

FIGURE 1.9

The Internet of Things.

FIGURE 1.10

Applications and data stored in the cloud can be accessed from different devices.

his or her computer, web technologies enable using the Internet as the platform for applications and data. Now, much of the functionality previously offered by applications installed on each individual computer is offered by applications "in the cloud," accessed via a web browser. Increasingly, not only the applications but also the data reside in the cloud, to be accessed at any time from anywhere (Figure 1.10). A good example of cloud computing is the various services offered by Google, such as Gmail (e-mail), Google Docs (word processing), and Google Calendar, all of which are accessed via a web browser, freeing users from the task of installing or updating traditional desktop applications or worrying about storing or backing up data. Cloud computing has made inroads in a variety of organizational applications, and many organizations rely on an information systems infrastructure in the cloud. Further, cloud computing can enable advanced analytics of massive amounts of Big Data generated by mobile devices, sensors, or users of social networks. We will extensively discuss cloud computing in Chapter 3, "Managing the Information Systems Infrastructure and Services."

- ***Big Data.*** Together, these transformations of our social and work interactions enabled by 24/7 connectivity have given rise to a fifth trend, **Big Data**. Big Data are typically described as extremely large and complex datasets, which are characterized as being of high volume, variety (i.e., many different types of data), and velocity (i.e., the data are being collected and analyzed at ever-increasing rates). Following the old adage that information is power, organizations are continuously seeking to get the right information to make the best business decisions. Yet organizations are generating and collecting ever more data from internal and external sources. The rise of social media has further increased the amount of unstructured data available to organizations; for example, people frequently voice their thoughts about products or companies on blogs or social networks. In addition, the Internet of Things, allowing for connecting devices and sensors to the Internet, further contributes to the growth of data available to organizations and individuals. With decreasing costs for capturing and storing data, data are now not only ubiquitous but also cheap. A study by research firm IDC estimated that in 2013, 4.4 zettabytes of data were generated and consumed. How much is 4.4 zettabytes? Well, 4.4 zettabytes equals 4.4 trillion gigabytes, or the equivalent of 32 billion 128GB iPads. As the number of devices connected to the Internet is expected to reach 30 billion in 2020, the amount of digital data generated worldwide is forecast to reach 44 zettabytes in 2020 and 180 zettabytes by 2025. For many organizations today, value is created from data. Consider, for example, that the largest/most valuable organizations in the "old economy" (such as GE, Dow, or Ford) have 100,000–300,000 employees, and the largest organizations in the "new economy" (such as Microsoft, HP, or Oracle) have 50,000–100,000 employees; in contrast, modern companies of the digital world (such as Facebook, Twitter, or Groupon) have risen to the top with a mere 5,000–15,000 employees by creating value from data (Hofmann, 2011) (Figure 1.11). Ever-increasing amounts of data increase the ability to detect meaningful relationships and regularities, and insights gained from analyzing Big Data not only can contribute to business success but can also help to address some of the tremendous challenges society faces.

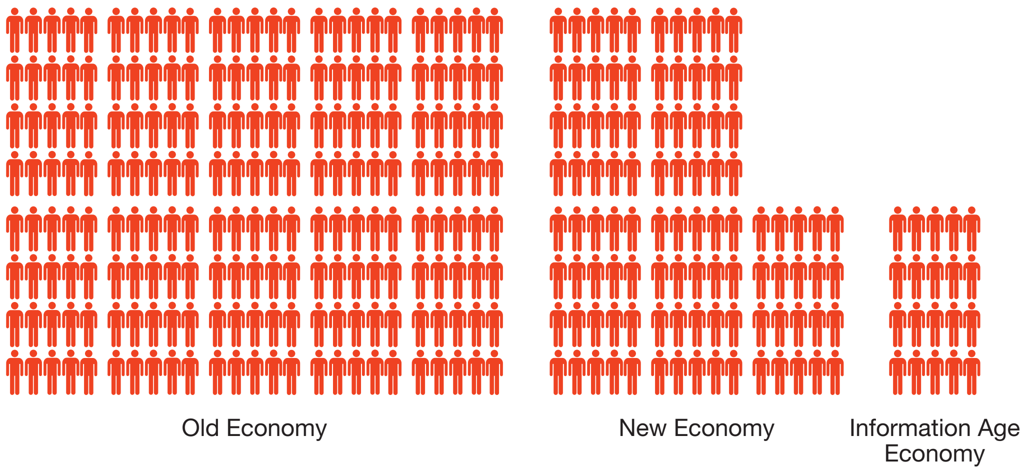

FIGURE 1.11

Companies in the Information Age economy are creating value not from people but from data.

For example, Big Data is a key factor enabling research ranging from genomics to climate change. However, analyzing tremendous amounts of (often unstructured) data (i.e., Big Data) poses tremendous challenges for organizations. In Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics," we will discuss how organizations can harness Big Data to make better business decisions.

Just as the societal issues interact and affect each other, so do the IT megatrends. For example, cloud computing allows for generating new machine learning algorithms to analyze Big Data, continuously improving *artificial intelligence* capabilities. Similarly, continuous input from various sensors, paired with artificial intelligence to make sense of such Big Data streams, enables tremendous advances in **robotics** (i.e., the use of robots to perform manual tasks). The different megatrends have also enabled various business model innovations that disrupt established industries. For example, fueled by mobile devices, social media, and cloud computing, Uber and Airbnb are examples of innovative business models based on the concept of a *sharing economy* and disrupt traditional taxi and lodging companies. Likewise, the Internet of Things and the massive amounts of data generated enable the creation of service-oriented business models (sometimes referred to *servitization*), where companies shift from selling physical products to providing these as services (see Chapter 2); for example, using sensors to monitor performance, temperature, or mileage enables tire manufacturers Bridgestone and Michelin to sell tires as a service, where truck operators pay based on usage, whereas the manufacturer is responsible for the tires' performance. Other industries being disrupted range from the financial industry to healthcare providers, where information systems allow for various radical innovations.

While these megatrends open up an almost unlimited potential for innovative products, services, or processes, they also pose a variety of challenges for organizations operating in the digital world. Throughout the book, we will discuss not only the opportunities but also the challenges organizations face when trying to harness the potential of these megatrends. What do these megatrends mean for you and for today's workforce? On a most basic level, they imply that being able to use information systems, to assess the impacts of new technologies on one's work or private life, and to learn new technologies as they come along will be increasingly important skills.

Most modern-day high school and university students have grown up in a computerized world. If by some chance they do not know how to operate a computer by the time they graduate from high school, they soon acquire computer skills because in today's work world, knowing how to use a computer—called **computer literacy** (or information literacy)—can not only open up myriad sources of information but can also mean the difference between being employed and being unemployed. In fact, some fear that the Information Age will not provide the same advantages to "information haves"—those computer-literate individuals who have almost unlimited access to information—and "information have-nots"—those with limited or no computer access or skills.

Computer-related occupations have evolved as computers have become more sophisticated and more widely used. Where once we thought of computer workers as primarily programmers, data entry clerks, systems analysts, or computer repairpersons, today many more job categories in virtually all industries, from accounting to the medical field, involve the use of computers. In

GREEN IT

The Green Internet of Things

The Internet and associated technologies have been busy disrupting business and society for the past several decades. Next up, another revolution in information technology is going to shake things up again. Green IT (or green computing, see Chapter 3) refers to the study and practice of using computing resources more efficiently to reduce environmental impacts as well as the use of information systems to reduce negative environmental impacts. The Internet of Things brings connectivity and information technology to places never before considered. Together, these technologies are once again poised to revolutionize business and society.

Traditionally, IT resources were seen as an ever-expanding pool—as business needs grew, more servers and data centers were installed. Eventually a limit has to be reached; the impact of power consumption alone from a modern data center can be profound. New technologies and techniques are having a large impact on both how we provision IT resources and how we interact with our world's resources. New servers are designed for low power consumption. Cloud computing architectures allow resources to be allocated on an as-needed basis.

With the Internet maturing into an established platform, new opportunities have become apparent. By combining ubiquitous connectivity with inexpensive processing power and sensor devices, nearly anything can be connected to the Internet. To be considered a part of the IoT, a device simply needs to be connected to the Internet, collect and transmit sensory data, and be something physical that interacts with the real world. Umbrellas notify us of the weather, smartwatches monitor our steps and vital signs, and nano-scale sensors are helping scientists collect unprecedented data about natural phenomena and ecosystems. Power companies can instrument our houses, our cars, and their distribution systems to gain unprecedented insights into energy use and demand.

Internet technologies disrupted many businesses and social processes by changing the scope and scale of interactions between people. By making large-scale interaction and communication possible almost instantaneously, supply chains could be redesigned, globalization was accelerated, and political processes were altered (for better and for worse). Individuals became citizen journalists. Together with the IoT, green technologies are enabling more accurate forecasting of resource needs and allow businesses and governments alike to become more informed and responsive. Tomorrow's leaders will need to incorporate such devices and systems into their planning to stay ahead of customer and citizen wants and needs.

Based on:

Byles, D. (2016, January 13). Technology, disruption, the Internet of Things… and you. *Businessgreen.com*. Retrieved April 24, 2016, from http://www.businessgreen.com/bg/opinion/2441499/technology-disruption-the-internet-of-things-and-you

McCabe, L. (2009, December 30). What is green IT, and why should you care? *Smallbusinesscomputing.com*. Retrieved April 24, 2016, from http://www.smallbusinesscomputing.com/testdrive/article.php/3855806/What-Is-Green-IT-and-Why-Should-You-Care.htm

fact, today there are few occupations where computers are not somehow in use. Computers manage air traffic, perform medical tests, monitor investment portfolios, control construction machinery, and more. Because they are especially adept at processing large amounts of data, they are used extensively by universities and public schools, in businesses of all sizes, and in all levels and departments of government. Engineers, architects, interior designers, and artists use special-purpose computer-aided design programs. Musicians play computerized instruments, and they write and record songs with the help of computers. Professionals in the medical industry use **healthcare IS** to support everything from patient diagnosis and treatment to analyzing patient and disease data to running doctors' offices and hospitals (see Chapter 6). Not only do we use computers at work, we also use them in our personal lives. We teach our children on them, manage our finances, do our taxes, compose letters and term papers, create greeting cards, send and receive e-mail, surf the Internet, purchase products, and play games on them. With the increasing use of computers in all areas of society, many argue that being computer literate—knowing how to use a computer and use certain applications—is not sufficient in today's world; rather, **computer fluency**—the ability to independently learn new technologies as they emerge and assess their impact on one's work and life—is what will set you apart in the future.

Information Systems Defined

An **information system (IS)** is the combination of people and information technology that create, collect, process, store, and distribute useful data. **Information technology (IT)** includes **hardware**, **software**, and **telecommunications networks**. Hardware refers to physical computer equipment, such as a computer, tablet, or printer, as well as components like a computer monitor or keyboard. Software refers to a program or set of programs that tell the computer to perform certain tasks. Telecommunications networks refer to a group of two or more computer systems linked together with communications equipment. Although we discuss the design, implementation, use, and implications of hardware, software, and telecommunications throughout the text, the specifics on hardware, software, and telecommunications networks are discussed in Chapter 3 and the Technology Briefing. While traditionally the term *information technology* referred to the hardware, software, and networking components of an information system, the difference is shrinking, with many using the terms *IS* and *IT* synonymously. It is important to note that while many of today's technologies operate autonomously, they don't build themselves and do not exist for their own sake; rather, they are created to serve a useful purpose for people. Also, any information system involves data that are useful, for someone, somewhere. For example, transactional data are useful for businesses, status updates in your news feed on Facebook are useful for your friends as well as for Facebook itself, scores in a computer game are useful for the player as well as for the game developers, and so on. In Figure 1.12, we show the relationships among these IS components.

People in organizations use information systems to process sales transactions, manage loan applications, or help financial analysts decide where, when, and how to invest. Product managers also use them to help decide where, when, and how to market their products and related services, and production managers use them to help decide when and how to manufacture products. Information systems also enable us to get cash from ATMs, communicate by live video with people in other parts of the world, or buy concert or airline tickets. (Note that the term *information systems* is also used to describe the field comprising people who develop, use, manage, and study information systems in organizations.)

It is important to note that people use various terms to describe the field of information systems, such as *management information systems*, *business information systems*, *computer information systems*, and simply *systems*. Next, we more thoroughly examine the key components of the IS definition.

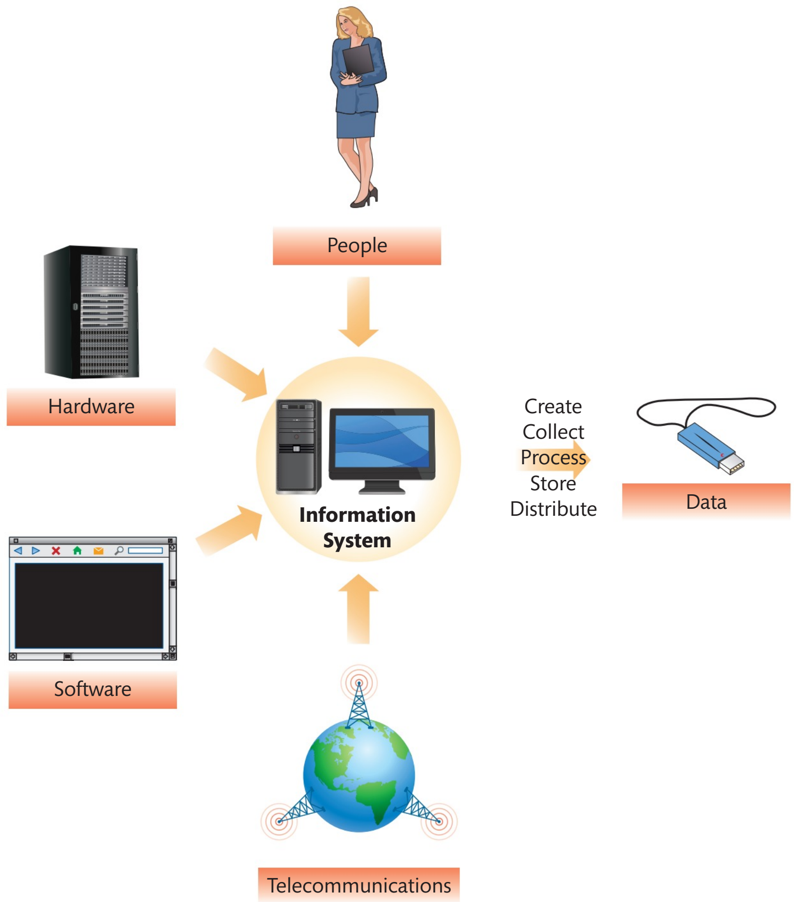

FIGURE 1.12

An information system is the combination of people and information technology that create, collect, process, store, and distribute useful data.

Data: The Root and Purpose of Information Systems

Earlier, we defined information systems as the combination of people and information technology that create, collect, process, store, and distribute useful data. We begin by talking about data, the most basic element of any information system.

DATA. Before you can understand how information systems work, it is important to distinguish between raw, unformatted data, information, and knowledge. Unformatted data, or simply **data**, are raw symbols, such as characters and numbers. Data have no meaning in and of themselves and are of little value until processed (Ackoff, 1989). For example, if we asked you what 465889727 meant or stood for, you could not tell us (Figure 1.13). However, if we presented the same data as 465-88-9727 and told you it was located in a certain database, in John Doe's record, in a field labeled *SSN*, you might rightly surmise that the number was actually the Social Security number of someone named John Doe. While data have no inherent meaning, the old adage "garbage in, garbage out" applies to data as well; thus, a key consideration of assessing whether data are reliable for making decisions is **data quality**, consisting of completeness, accuracy, timeliness, validity, and consistency.

INFORMATION. Data can be formatted, organized, or processed to be *useful*; they are transformed into **information**, which can be defined as a representation of reality, and can help to answer questions about who, what, where, and when (Ackoff, 1989). In the previous example, 465-88-9727 was used to represent and identify an individual person, John Doe (see Figure 1.13). Contextual cues, such as a label, are needed to turn data into information that is familiar and useful to the reader. Think about your experience with ATMs. A list of all the transactions at a bank's ATMs over the course of a month would be fairly useless data. However, a table that divided ATM users into two categories, bank customers and non-bank customers, and compared the two groups' use of the machine—their purpose for using the ATMs and the times and days on which they use them—would be incredibly useful information. A bank manager could use this information to create marketing mailings to attract new customers. Without information systems, it would be difficult to transform raw data into useful information.

KNOWLEDGE. In order to actually use information, knowledge is needed. **Knowledge** is the ability to understand information, form opinions, and make decisions or predictions based on the information. For example, you must have knowledge to be aware that only one Social Security number can uniquely identify each individual (see Figure 1.13). Knowledge is a body of governing procedures, such as guidelines or rules, that are used to organize or manipulate data to make them suitable for a given task.

Understanding the distinctions between data, information, and knowledge is important because all are used in the study, development, and use of information systems.

Hardware, Software, and Telecommunications Networks: The Components of Information Systems

Ever since the dawn of humankind, there was a need to transform data into useful information for people, and people have invented various calculating devices, such as the abacus or the slide rule. Before the introduction of the first computers (which worked on a mechanical basis using punch cards), almost all business and government information systems consisted of file folders,

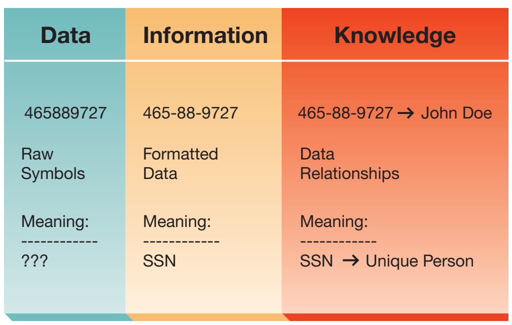

FIGURE 1.13

Data, information, and knowledge.

filing cabinets, and document repositories. Computer hardware has replaced these physical artifacts, providing the technologies to input and process data and output useful information; today, hardware includes not only "traditional" computer components but a variety of other input and output devices, including sensors, cameras, actuators, and the like. Software enables organizations to utilize the hardware to execute their business processes and competitive strategy by providing the computer hardware with instructions on what processing functions to perform. Finally, the telecommunications networks allow computers to share data and services, enabling the global collaboration, communication, and commerce we see today. The rapid evolution of the various hardware, software, and networking components make the ability to tie everything together ever more important.

People: The Builders, Managers, and Users of Information Systems

The IS field includes a vast collection of people who develop, maintain, manage, and study information systems. Yet an information system does not exist in a vacuum and is of little use if it weren't for you—the user. We will begin by discussing the IS profession and then talk about why knowing about fundamental concepts of information systems is of crucial importance in your personal and professional life.

If you are choosing a career in the IS field, you will find countless opportunities. With the growing value of data for competitive advantage, every company can now be considered a technology company, needing people with the right skill set to help optimize its business processes. The career opportunities for a person with IS training continue to be strong, and they are expected to continue to improve over the next 10 years. For example, the 2016–17 edition of the *Occupational Outlook Handbook* published by the U.S. Bureau of Labor Statistics predicted that employment for computer and IS managers will grow 15 percent through 2024, much faster than the average for all occupations (www.bls.gov/ooh/management/computer-and-information-systems-managers.htm). As more and more organizations rely more heavily on IS professionals, this boost in employment will occur in nearly every industry, not just computer hardware and software companies. *Money* magazine (http://money.cnn.com/pf/best-jobs) ranked software architect as the best job in America, with database developer and information assurance analyst also being among the top 10 best jobs in America (Table 1.1); also, *U.S. News* magazine (http://money.usnews.com/careers/best-jobs/rankings/the-100-best-jobs) rated computer systems analyst and web developer among the top 20 jobs (two of the few nonmedical jobs in that list). Likewise, a degree in information systems can provide the foundation for becoming a data scientist, currently one of the jobs with highest demand (Florentine, 2016).

In addition to an ample supply of jobs, earnings for IS professionals will remain strong. According to the U.S. Bureau of Labor Statistics, median annual earnings of these managers in May 2014 were US$127,640, with the top 10 percent earning more than US$187,200. Also, according to Salary.com, the median salary in 2016 for IT managers was US$109,701. According to a 2016 report by the National Association of Colleges and Employers, management

TABLE 1.1 Best Jobs in America (2015)

Rank	Career	Job Growth (10-year forecast)	Median Pay (in US$)
1	Software architect	23%	124,000
2	Video game designer	19%	79,900
3	Landman	13%	103,000
4	Patent agent	13%	126,000
5	Hospital administrator	23%	114,000
6	Continuous improvement manager	12%	96,600
7	Clinical nurse specialist	19%	89,300
8	Database developer	23%	88,200
9	Information assurance analyst	37%	96,400
10	Yoga instructor	13%	62,400

Source: Based on 100 Best Jobs in America, published by CNN Money, © 2016.

information systems was expected to be the highest-paid business major, with a mean starting salary of US$56,846. Likewise, information systems graduates with a master's degree had an average starting salary of US$67,632, higher than business majors such as accounting, finance, or marketing, according to a study by Temple University. Finally, computer and IS managers, especially those at higher levels, often receive more employment-related benefits—such as expense accounts, stock option plans, and bonuses—than do nonmanagerial workers in their organizations (a study by Payscale.com found that IS majors were—post-graduation—among the most satisfied with their careers).

As you can see, there continues to be a very strong need for people with IS knowledge, skills, and abilities—in particular, people with advanced IS skills, as we describe here. In fact, IS careers are regularly selected as not only one of the fastest growing but also a career with far-above-average opportunities for greater personal growth, stability, and advancement. Although technology continues to become easier to use, there is still and is likely to continue to be an acute need for people within the organization who have the responsibility of planning for, designing, developing, maintaining, and managing technologies. Much of this will happen within the business units and will be done by those with primarily business duties and tasks as opposed to systems duties and tasks. However, we are a long way from the day when technology is so easy to deploy that a need no longer exists for people with advanced IS knowledge and skills. In fact, many people believe that this day may never come. Although increasing numbers of people will incorporate systems responsibilities within their nonsystems jobs, there will continue to be a need for people with primarily systems responsibilities. In short, IS staffs and departments will likely continue to exist and play an important role in the foreseeable future.

Given that information systems continue to be a critical tool for business success, it is not likely that IS departments will go away or even shrink significantly. Indeed, all projections are for long-term growth of information systems in both scale and scope. Also, as is the case in any area of business, those people who are continually learning, continuing to grow, and continuing to find new ways to add value and who have advanced and/or unique skills will always be sought after, whether in information systems or in any area of the firm.

The future opportunities in the IS field are likely to be found in a variety of areas, which is good news for everyone. Diversity in the technology area can embrace us all. It really does not matter much which area of information systems you choose to pursue—there will likely be a promising future there for you. Even if your career interests are outside information systems, being a well-informed and capable user of information technologies will greatly enhance your career prospects.

CAREERS IN INFORMATION SYSTEMS. The field of information systems includes those people in organizations who design and build systems, those who use these systems, and those responsible for managing these systems. The people who help develop and manage systems in organizations include systems analysts, systems programmers, systems operators, network administrators, database administrators, systems designers, systems managers, and chief information officers. (In Table 1.2 we describe some of these careers.) This list is not exhaustive; rather, it is intended to provide a sampling of IS management positions. Furthermore, many firms will use the same job title, but each is likely to define it in a different way, or different companies will have different titles for the same basic function. As you can see from Table 1.2, the range of career opportunities for IS managers is broad, and salary expectations are high.

WHAT MAKES IS PERSONNEL SO VALUABLE? In addition to the growing importance of people in the IS field, there have been changes in the nature of this type of work. No longer are IS departments in organizations filled only with nerdy men with pocket protectors. Many more women are in IS positions now. Also, it is now more common for an IS professional to be a polished, professional businessperson who can speak fluently about both business and technology. IS personnel are now well-trained, highly skilled, valuable professionals who garner high wages and prestige and who play a pivotal role in helping firms be successful.

Many studies have been aimed at helping us understand what knowledge and skills are necessary for a person in the IS area to be successful. Interestingly, these studies also point out just what it is about IS personnel that makes them so valuable to their organizations. In a nutshell, good IS personnel possess valuable, integrated knowledge and skills in three areas—technical, business, and systems—as outlined in Table 1.3 (see also Figure 1.14).

TABLE 1.2 Some IS Management Job Titles and Brief Job Descriptions

IS Activity	Job Title	Job Description	Salary Range, in US$, in Percentiles (25%–75%)
Develop	Systems analyst	Analyze business requirements and select information systems that meet those needs	63,000–80,000
	Software developer	Code, test, debug, and install programs	71,000–91,000
	Software architect	Create customized software for large corporations	98,000–130,000
	IT consultant	Provide IT knowledge to external clients	57,000–93,000
	Database developer	Develop, modernize, and streamline databases	57,000–68,000
Maintain	IT auditor	Audit information systems and operating procedures for compliance with internal and external standards	64,000–83,000
	Database administrator	Manage database and database management software use	75,000–99,000
	Webmaster	Manage a firm's website	59,000–80,000
Manage	IT manager	Manage existing information systems	95,000–126,000
	IS security manager	Manage security measures and disaster recovery	102,000–125,000
	Information assurance analyst	Ensure availability and security of information stored on networks and in the cloud	60,000–93,000
	E-commerce manager	Manage development, maintenance, and strategy related to e-commerce systems	97,000–126,000
	Chief information officer (CIO)	Highest-ranking IS manager; oversee strategic planning and IS use throughout the firm	213,000–316,000
	Chief digital officer (CDO)	Executive focused on converting traditional "analog" businesses to digital; oversee operations in rapidly changing digital sectors like mobile apps and social media	150,000–200,000
Study	University professor	Teach undergraduate and graduate students; study the use of information systems in organizations and society	70,000–180,000
	Government scientist	Perform research and development of information systems for homeland security, intelligence, and other related applications	60,000–200,000

Source: Based on http://www.salary.com, http://www.payscale.com.

TABLE 1.3 IS Professional Core Competencies

Domain	Description
Technical Knowledge and Skills	
Hardware	Hardware platforms, infrastructure, cloud computing, virtualization, peripherals, mobile devices
Software	Operating systems, application software, mobile apps
Networking	Network administration, cabling and network interface cards, wireless, Internet, security
Business Knowledge and Skills	
Business integration, industry	Business processes, functional areas of businesses and their integration, industry characteristics
Managing people and projects	Planning, organizing, leading, controlling, managing people and projects
Social	Interpersonal, group dynamics, political
Communication	Verbal, written, and technological communication and presentation
Systems Knowledge and Skills	
Systems integration	Connectivity, compatibility, integrating subsystems and systems
Development methodologies	Steps in systems analysis and design, systems development life cycle, alternative development methodologies
Critical thinking	Challenging one's and others' assumptions and ideas
Problem solving	Information gathering and synthesis, problem identification, solution formulation, comparison, choice

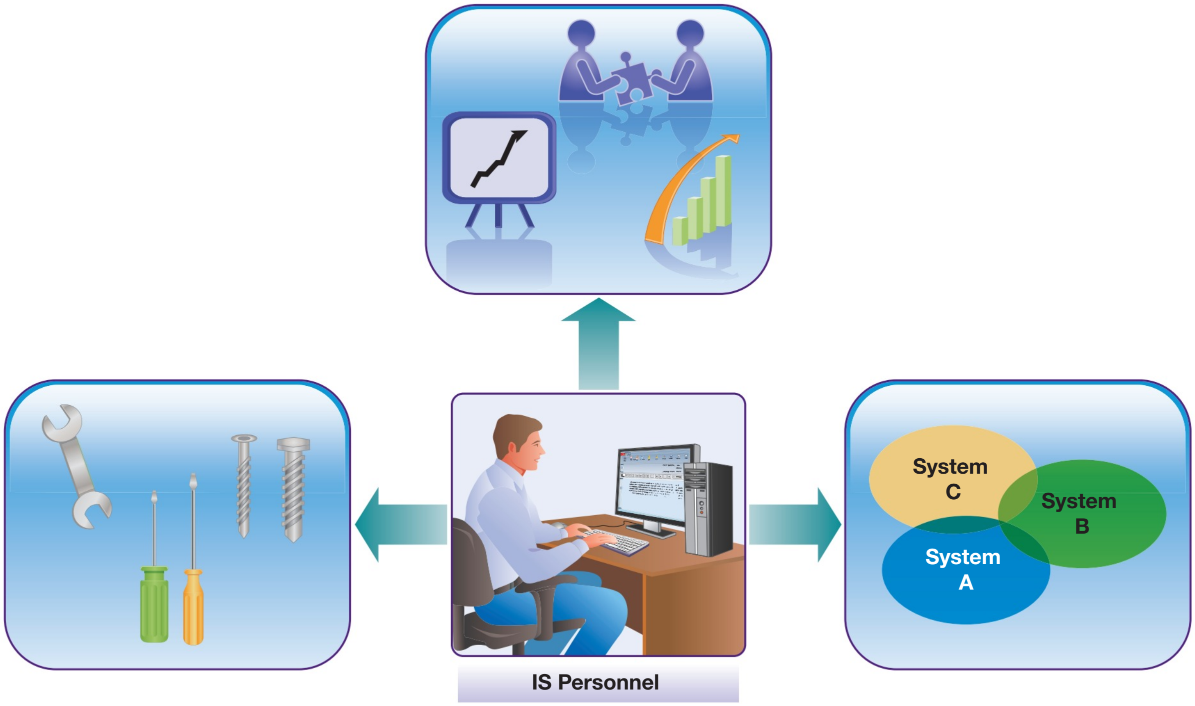

FIGURE 1.14

Good IS personnel possess valuable, integrated knowledge and skills in three areas—technical, business, and systems.

Technical Competency The technical competency area includes knowledge and skills in hardware, software, networking, and security. In a sense, this is the "nuts and bolts" of information systems. This is not to say that the IS professional must be a technical expert in these areas. On the contrary, the IS professional must know just enough about these areas to understand how they work, what they can do for an organization, and how they can and should be applied. Typically, the IS professional manages or directs those who have deeper, more detailed technical knowledge.

The technical area of competency is, perhaps, the most difficult to maintain because of the rapid pace of technological innovation in the digital world. With the economy rebounding, organizations are starting new projects or are reviving projects put on hold during the economic downturn; hence, while it once appeared as if most programming jobs or support jobs would be outsourced to third-party providers abroad, there is an increased demand in many companies for people with application development skills, especially in combination with sound business analysis and project management skills (Brandel, 2013). In fact, many of the hot skills listed in Table 1.4 are focused on the business domain, which is discussed next.

Business Competency The business competency area is one that sets the IS professional apart from others who have only technical knowledge and skills, and in an era of increased outsourcing, it may well save a person's job. For example, even though some low-level technology jobs may be outsourced, the Bureau of Labor Statistics recently reported that there is an increased need for IS managers as organizations embrace mobility and cloud computing (www.bls.gov/ooh/management/computer-and-information-systems-managers.htm). As a result, it is absolutely vital for IS professionals to understand the technical areas *and* the nature of the business. IS professionals must also be able to understand and manage people and projects, not just the technology. These business skills propel IS professionals into project management and, ultimately, high-paying middle- and upper-level management positions.

Systems Competency Systems competency is another area that sets the IS professional apart from others with only technical knowledge and skills. Those who understand how to build and integrate systems and how to solve problems will ultimately manage large, complex systems projects as well as manage those in the firm who have only technical knowledge and skills.

TABLE 1.4 Hot Skills for the Next Decade

Domain	Hot Skills
Business	Business–IT alignment; business analysis; enterprise solutions; business process modeling; project management; third-party provider management; enterprise-oriented social media
Technology infrastructure and services	Virtualization; cloud computing/infrastructure as a service; cloud integration; serverless computing; systems analysis and design; network design; systems auditing; wireless; telecommunications/VoIP (Voice over Internet Protocol); database administration; data centers
Security	IT security planning and management; BYOD; governance, risk, and compliance; cybersecurity
Applications	Customer-facing application development; mobile app development; web development; open source; portal technologies; cloud computing; user experience; legacy systems integration; interface design; content management systems
Internet	Social media; customer-facing web applications; mobile apps; search engine optimization; artificial intelligence; web mining; Internet of Things
Business analytics/ data science	Business intelligence; advanced analytics; data warehousing; data mining; unstructured data analysis; Big Data

Source: Based on Broom (2016), Florentine (2015), Pratt (2015), Leung (2009).

Perhaps now you can see why IS professionals are so valuable to their organizations. These individuals have a solid, integrated foundation in technical, business, and systems knowledge and skills. Perhaps most important, they also have the social skills to understand how to work well with and motivate others. It is these core competencies that continue to make IS professionals valuable employees.

Given how important technology is, what does this mean for your career? Technology is being used to radically change how business is conducted—from the way products and services are produced, distributed, and accounted for to the ways they are marketed and sold. Whether you are majoring in information systems, finance, accounting, operations management, human resource management, business law, or marketing, knowledge of technology is critical to a successful career in business.

FINDING QUALIFIED PERSONNEL. Unfortunately, given the increased sophistication of modern information systems, organizations can often have a difficult time finding qualified personnel, and attracting the right people with the right skills is not possible in some areas. Consequently, many technology-focused organizations tend to cluster in areas where talented workers are available. Such areas are often characterized by a high quality of life for the people living there, and it is no surprise that many companies in the IT sector within the United States are headquartered in Silicon Valley, California; Boston, Massachusetts; Austin, Texas; or Seattle, Washington. With increasing globalization, other regions throughout the world are boasting about their highly skilled personnel. One such example is the Indian city of Bangalore, where, more than a century ago, Maharajas started to lure talented technology-oriented people to the region, building a world-class human resource infrastructure that attracted companies from around the world. In other areas, organizations may have to find creative ways to attract and retain people, such as by offering favorable benefits packages that include educational grants or expense-matching programs to encourage employees to improve their education and skills. Other human resource policies, such as telecommuting, flextime, and creative benefit packages, can also help to attract and retain the best employees.

YOU—THE USER. Clearly, the field of information systems offers a wide variety of interesting career choices, and you will likely find a career that offers a host of opportunities for lifelong learning and advancement. Yet understanding fundamental concepts related to information systems will be critical in almost any career as well as in your private life. In almost any

SECURITY MATTERS

Ransomware

As more and more of our business and professional lives are lived online, the security of our personal and business data has become increasingly important. In recent years, attackers have gotten more sophisticated and have shifted tactics. A new tactic is the distribution of ransomware, a novel approach to extracting money from victims. Ransomware refers to a type of virus that, once it has infected a victim's system or network, encrypts the data it finds in place in a format that renders them impossible for the victim to access. The attacker then demands a ransom payment in return for releasing the decryption keys that can be used to access and recover the data (though many victims have painfully experienced that paying the ransom does not guarantee regaining access to the data). Victims range from individuals, who may stand to lose years of family photos or personal records, to businesses large and small, who may lose customer records, financial data, intellectual property, or other valuable data. The malicious software usually arrives as an attachment to a spam e-mail or is downloaded in the guise of a video or other content from a website.

Until recently, attackers have largely focused on individuals and small businesses and demanded relatively small ransoms that are affordable enough that the victim will seriously consider paying the ransom. The average payment demanded in 2015 was just US$300 according to security firm Symantec. By early 2016, however, there has been an apparent shift to larger, higher-value organizations. Hollywood Presbyterian Medical Center in Los Angeles was forced to pay a US$17,000 ransom after its network was broadly infected with ransomware. Another hospital in Ottawa decided not to pay the ransom demanded of it and was able to restore data from backups. Security researchers warn that attackers are increasingly not just attempting to lock down the data but are threatening to release the data to the public if not paid. For organizations dealing with sensitive or personally identifiable information, lawsuits and reporting requirements can make such public release an even more costly threat than simply losing access to their data.

With threats like ransomware becoming increasingly prevalent, individuals and organizations will need to increase their security awareness and vigilance to better avoid potential infections and also improve their backup and disaster recovery preparations in order to become more resilient to such attacks.

Based on:

Colwey, S., & Stack, L. (2016, February 18). Los Angeles hospital pays hackers $17,000 after attack. *The New York Times*. Retrieved April 14, 2016, from http://www.nytimes.com/2016/02/19/business/los-angeles-hospital-pays-hackers-17000-after-attack.html

Pilieci, V. (2016, March 16). Ottawa Hospital hit with ransomware, information on four computers locked down. *Ottawa Citizen*. Retrieved April 14, 2016, from http://ottawacitizen.com/news/local-news/ottawa-hospital-hit-with-ransomware-information-on-four-computers-locked-down

Savage, K., Coogan, P., & Lau, H. (2015, August 6). The evolution of ransomware. *Symantec.com*. Retrieved April 14, 2016, from http://www.symantec.com/content/en/us/enterprise/media/security_response/whitepapers/the-evolution-of-ransomware.pdf

business-related field, you will be extensively using information systems, and you will likely be involved in various information systems–related decisions within your organization. Understanding what information systems are capable of doing (as well as what they cannot do), being able to communicate with the "techies," and being able to make educated IS-related decisions are likely to set you apart from your competition. Especially in smaller organizations (that may not have dedicated IS departments), you are likely to be involved in IS-related investment decisions, and lacking a basic understanding of fundamental issues associated with topics such as IS infrastructure, systems analysis and design, or information systems security will put you at the mercy of outside consultants or (worse yet) vendors who are likely to act out of their own interests, often trying to sell you their "technology of the week/month/year."

In addition, as you have undoubtedly noticed, you are facing a number of IS-related decisions in your private life. Examples of such decisions abound; for example, you may face the question of what mobile phone to purchase next: an iPhone, a phone using some version of the Android operating system, or a phone sporting Microsoft's Windows 10 Mobile operating system. Such decisions are likely to include your own preferences or influence by your peers, but there are a number of critical differences in terms of privacy, security, available apps, and the like. Likewise, you may face the problem of how to best secure your wireless network at home or may wonder how to best keep your various files in sync across different computers or mobile devices.

Finally, you may have a great idea for a new product or service and want to launch a startup. Having the idea is but the first step, and you will soon realize the role of information systems in all phases of the process of bringing your idea to the market. Thus, understanding how information systems can fuel the development and commercialization of your idea is crucial. Throughout this text, we will touch on those issues and hope that you will gain valuable knowledge to understand the trade-offs involved when selecting new information systems.

Organizations: The Context of Information Systems

We have talked about data versus information, the technology side of information systems, and the people side of information systems. Information systems do not exist in a vacuum; they are built and/or used within a certain context. Organizations use information systems to become more productive and profitable, to gain competitive advantage, to reach more customers, or to improve customer service. This holds true for all types of organizations—professional, social, religious, educational, and governmental—and for all types of industries—medical, legal, manufacturing, and so on. In fact, the U.S. Internal Revenue Service launched its own website for the reasons just described (Figure 1.15). The website was so popular that approximately 220,000 users visited it during the first 24 hours and more than 1 million visited it in its first week—even before the web address for the site was officially announced. Today, popular websites like Facebook.com and WSJ.com receive millions of visitors every day.

TYPES OF INFORMATION SYSTEMS. Throughout this text, we explore various types of information systems commonly used in organizations. It makes sense, however, for us to describe briefly a few of the various types of systems used so that you will better understand what we mean by the term *information system* as we use it throughout the rest of the book. Table 1.5 provides a list of the major categories of information systems used in organizations.

Topping the list in the table are some of the more traditional, major categories that are used to describe information systems. For example, not only are **transaction processing systems (TPS)** used by a broad range of organizations to process customer transactions more efficiently, these systems also generate a tremendous amount of data that can be used by the organization to learn about customers or ever-changing product trends. Your local grocery store uses a TPS at the checkout that scans bar codes on products; as this occurs, many stores will print discount coupons on the backs of receipts for products related to current purchases. Every hour, online retailer Amazon.com's website processes thousands of transactions from around the world. This massive amount of data is fed into large data warehouses and is then analyzed to provide purchase recommendations to future customers. In addition, TPS data are sorted and organized to support a broad range of managerial decision making using a variety of systems; the most common of these is generally referred to as **management information systems**. TPS data also provide input into a variety of other information systems within organizations, including *decision*

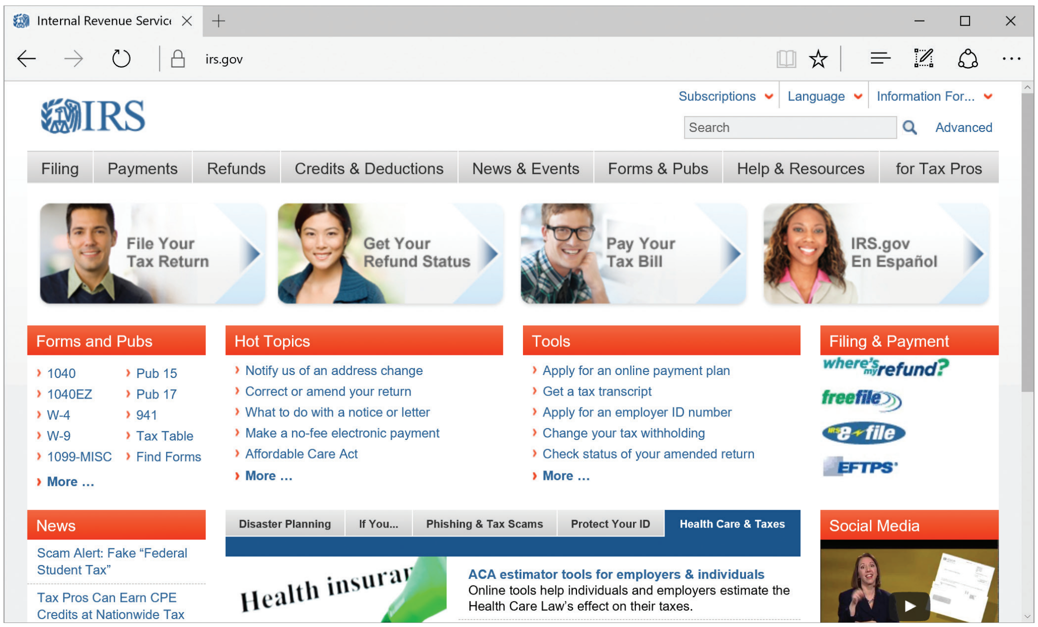

FIGURE 1.15

Website of the U.S. Department of the Treasury, Internal Revenue Service, http://www.irs.gov.

Source: Courtesy of the United States Department of the Treasury.

TABLE 1.5 Categories of Information Systems Used in Organizations

Category of System	Purpose	Sample Application(s)
Transaction processing system	Process day-to-day business event data at the operational level of the organization	Grocery store checkout cash register with connection to network, student registration system
Management information system	Produce detailed information to help manage a firm or part of a firm	Inventory management and planning system, student enrollment management
Decision support system	Provide analysis tools and access to databases in order to support quantitative decision making	Product demand forecasting system, loan and investment analysis
Intelligent system	Emulate or enhance human capabilities	Automated system for analyzing bank loan applications, self-driving car
Business intelligence system	Analyze Big Data to better understand various aspects of a business	Online analytical processing (OLAP) system
Office automation system (personal productivity software)	Support a wide range of predefined day-to-day work activities of individuals and small groups	Word processor, spreadsheet, presentation software, e-mail client
Collaboration system	Enable people to communicate, collaborate, and coordinate with each other	E-mail system with automated, shared calendar
Knowledge management system	Enable the generation, storage, sharing, and management of knowledge assets	Knowledge portal for finding answers to common questions
Social software	Facilitate collaboration and knowledge sharing	Social network, connecting colleagues and friends
Geographic information system	Create, store, analyze, and manage geographically referenced data	Site selection for new shopping mall
Functional area information system	Support the activities within a specific functional area of the firm	Planning system for personnel training and work assignments
Customer relationship management system	Support interaction between the firm and its customers	Sales force automation, lead generation
Enterprise resource planning system	Support and integrate all facets of the business, including planning, manufacturing, sales, marketing, and so on	Financial, operations, and human resource management
Supply chain management system	Support the coordination of suppliers, product or service production, and distribution	Procurement planning
Electronic commerce system	Enable customers to buy goods and services from a firm's website	Amazon.com, eBay.com, Nordstrom.com
Mobile app	Perform a particular, well-defined function, typically on a mobile device	Instagram, Snapchat, WhatsApp, Facebook app

support systems, intelligent systems, business intelligence systems, knowledge management systems, social software, geographic information systems, and *functional area information systems*. Five to 10 years ago, it would have been typical to see systems that fell cleanly into one of these categories. Today, many organizations have replaced standalone systems with *enterprise systems* that span the entire organization. Likewise, with **internetworking**—connecting host computers and their networks together to form even larger networks like the Internet—and **systems integration**—connecting separate information systems and data to improve business processes and decision making—it is difficult to say that any given information system fits into only one of these categories (e.g., that a system is a management information system only and nothing else). In addition, many of these systems are not housed within organizations anymore but are located "in the cloud" and accessed via the users' browsers when needed. Modern-day information systems tend to span several of these categories of information systems, helping not only to collect data from throughout the firm and from customers but also to integrate data from diverse sources and present them to busy decision makers along with tools to manipulate and analyze those data. *Customer relationship management*, *supply chain management*, and *enterprise resource planning* systems are good examples of these types of systems that encompass many features and types of data and cannot easily be categorized.

Office automation systems such as Microsoft Office and the OpenOffice.org Productivity Suite provide word processing, spreadsheet, and other personal productivity tools, enabling knowledge workers to accomplish their tasks; *collaboration systems*, such as Microsoft's Exchange/Outlook, Lotus Notes, or Google Apps, provide people with e-mail, automated calendaring, and online, threaded discussions, enabling close collaboration with others, regardless of their location.

Systems for *electronic commerce* (or *e-commerce*), such as corporate websites, are also popular and important. These systems enable (1) consumers to find information about and to purchase goods and services from each other and from business firms and (2) business firms to electronically exchange products, services, and data. In Chapter 4, "Enabling Business-to-Consumer Electronic Commerce," we talk about different forms of electronic commerce involving the end consumer; in Chapter 8, "Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management," we discuss how organizations use the Internet to enable or facilitate business-to-business transactions.

While many modern-day information systems span several of these IS categories or integrate different types of systems, it is still useful to understand these categories. Doing so enables you to better understand the myriad approaches, goals, features, and functions of modern information systems.

We have talked about each of the parts of our definition of information systems, and we have talked about different types of information systems. In the next section, we focus on how information systems can be managed within organizations.

ORGANIZING THE IS FUNCTION. Old-school IS personnel believed that they owned and controlled the computing resources, that they knew better than users did, and that they should tell users what they could and could not do with the computing resources; in addition, early IS departments typically had huge project backlogs, and IS personnel would often deliver systems that were over budget, were completed much too late, were difficult to use, and did not always work well. The increasing pervasiveness of technology in businesses and societies has led to a shifting mindset about information systems within organizations. Increasingly fast-paced competition is forcing businesses to regard IS as an enabler for streamlining business processes, providing better customer service, and better connecting and collaborating with various stakeholders inside and outside the organization. Many organizations, for example, have realized that some of the best ideas for solving business problems come from the employees using the system; as a result, personnel within many IS units have taken on more of a consulting relationship with their users, helping the users solve problems, implement ideas, and be more productive. IS personnel are increasingly reaching out to their internal customers and proactively seek their input and needs rather than waiting for customers to come in with systems complaints. They modify the systems at a moment's notice just to meet customer needs quickly and effectively. They celebrate the customers' new systems ideas rather than putting up roadblocks and giving reasons that the new ideas cannot or will not work. They fundamentally believe that the customers own the technology and the information and that the technology and information are there for the customers, not for the systems personnel. They create help desks, hotlines, information centers, and training centers to support customers. These service-oriented IS units structure the IS function so that it can better serve the customer.

The implications of this new service mentality for the IS function are staggering. It is simply amazing how unproductive a company can be when the IS personnel and other people within the firm are at odds with one another. On the other hand, it is even more amazing how productive and enjoyable work can be when people in the IS function work hand in hand with people throughout the organization. Technology is, potentially, the great lever, but it works best when people work together, not against each other, to use it.

THE SPREAD OF TECHNOLOGY IN ORGANIZATIONS. Another phenomenon that shows how integral and vital information systems and their proper management have become to organizations is the extent to which the technology is firmly integrated and entrenched within the various business units (such as accounting, sales, and marketing).

In many organizations today, you will find that the builders and managers of a particular information system or subsystem spend most of their time out in the business unit, along with the users of that particular system. Many times, these systems personnel are permanently placed—with an office, desk, phone, and PC—in the business unit along with the users.

In addition, it is not uncommon for systems personnel to have formal education, training, and work experience in information systems as well as in the functional area that the system supports, such as finance. It is becoming increasingly more difficult to separate the technology from the business or the systems staff from the other people in the organization. For this reason, how information systems are managed is important to you, no matter what career option you pursue.

As information systems are used more broadly throughout organizations, IS personnel often have dual-reporting relationships—reporting both to the central IS group and to the business function they serve. Therefore, at least some need for centralized IS planning, deployment, and management continues—particularly with respect to achieving economies of scale in systems acquisition and development and in optimizing systems integration, enterprise networking, and the like. Even in organizations that are decentralizing technology and related decisions, a need to coordinate technology and related decisions across the firm still persists. This coordination is likely to continue to happen through some form of a centralized (or, at least, centrally coordinated) IS staff. Organizations are likely to continue to want to reap the benefits of IS decentralization (flexibility, adaptability, and systems responsiveness), but it is equally likely that they

WHEN THINGS GO WRONG

Technology Addiction

In 2015, the average person in the United Kingdom spent 9 hours and 53 minutes consuming media each day, 50 percent of 18- to 24-year-olds checked their phone within 5 minutes of waking up, and a third of 25- to 34-year-olds visited social media sites or used mobile apps more than 10 times a day. Between the near-ubiquitous availability of network connectivity and the sheer number of options when it comes to ways to interact online, we are increasingly distracted by information technology, to the point where some doctors argue that we are actually becoming addicted. Dopamine—the brain chemical associated with pleasure—is released when we are stimulated, whether by food, sex, excitement, or interacting online. The hit of dopamine we get when we get a "like," update our status, or read the latest tidbit of news or gossip can have the same addicting effect on our bodies as drugs like cocaine or heroin. In addition, being plugged in all the time reduces the brain's ability to let us relax. Hyper-stimulation from having a screen in front of us from when we wake up to when we finally fall asleep causes a type of hyper-arousal—we walk around in a constant state of distraction.

As we find more and more uses for technology in our daily lives, the threat of technology addiction is getting worse. Cognitive psychologist and neuroscientist Daniel J. Levitin claims that, on average, we are taking in information equivalent to the content of 175 newspapers every day—five times more than we did 30 years ago. Children are affected as well. Too much screen time can affect memory and lead to a decline in grades—the part of the brain that helps us focus may not develop properly. A study carried out in Canada in 2015 by Microsoft revealed that the average human attention span has fallen from 12 seconds at the turn of this century to a mere 8 seconds—less than that of a goldfish. However, there may be a bright side. Because the younger generations have been immersed in the technology their entire lives, they may be better able to adjust and adapt—they may develop a better feel for their limits and how to avoid exceeding them.

So what can we do to improve the situation? Start by turning off the gadgets for a while each day. Improving your overall health helps as well—eat right, stay hydrated, and work out regularly. Finally, get enough sleep and don't fall asleep to Netflix or Facebook.

Based on:

Foot, G. (2016). Why can't I concentrate? *BBC*. Retrieved April 24, 2016, from http://www.bbc.co.uk/guides/zshv9qt

Kleinman, Z. (2015, August 31). Are we addicted to technology? *BBC News*. Retrieved April 24, 2016, from http://www.bbc.com/news/technology-33976695

will not want to—and will not be able to—forgo the benefits of IS centralization (coordination, economies of scale, compatibility, and connectivity).

Given the trend toward pushing people from the IS staff out into the various business units of the firm and given the need for people within each of the functional areas of the business to have technology skills, there is clearly a need for people who understand both the technology side *and* the business side of the organization. This is becoming increasingly important due to ever-faster IT cycles: Where traditionally, IS departments thought in time frames of about 5 years, nowadays, new devices (such as new versions of Apple's iPad) come out every 6–18 months, and organizations wanting to harness the opportunities brought about by new devices have to adjust to this change in pace.

The Dual Nature of Information Systems

Given how important and expensive information systems have become, information technology is like a sword—you can use it effectively as a competitive weapon, but, as the old saying goes, those who live by the sword sometimes die by the sword. The two following cases illustrate this dual nature of information systems.

Case in Point: An Information System Gone Awry: Outages Outrage Gamers

Computer gaming has increasingly become interactive, with more and more games offering multiplayer experiences. Riding on the bandwagon, Sony introduced the PlayStation Network in 2006 to accompany its successful PlayStation game consoles. In 2010, Sony added a service named PlayStation Plus, offering subscription-based premium services. In the war of the game consoles, PlayStation Plus was regarded as a way for Sony to get ahead of the competition from Microsoft's Xbox and Nintendo's Wii. However, since its inception, the PlayStation Network has been plagued with all-too-frequent system outages. Most notably, in 2011, a system outage following a malicious attack lasted 23 days. On Christmas Day 2014, a denial-of-service attack (see Chapter 10, "Securing Information Systems") caused the PlayStation Network to be unavailable, ruining the holidays for many users (Figure 1.16). In 2016, the first outage happened only a few days into the new year, with further outages following just a few weeks later. Built to help achieve competitive advantage, the PlayStation Network continues to be Sony's Achilles heel.

Case in Point: An Information System That Works: FedEx

Just as there are examples of information systems gone wrong, there are many examples of information systems gone right. FedEx, a US$47.5 billion family of companies (2016 data), is the world's largest express transportation company, delivering millions of packages and millions of pounds of freight to 220 countries and territories each business day. FedEx uses extensive,

FIGURE 1.16

System outages annoy online gamers.

Source: phoenix21/Fotolia.

interconnected information systems to coordinate more than 340,000 employees, hundreds of aircraft, and more than 100,000 ground vehicles worldwide. To improve its services and sustain a competitive advantage, FedEx continuously updates and fine-tunes its systems. For example, FedEx.com has more than 50 million unique visitors per month and more than 50 million tracking requests per day, and FedEx strives to provide the most accurate tracking information to each visitor. Similarly, in FedEx's ground hubs, automation is another enabler of competitive advantage. En route to its destination, each package typically travels through at least one sorting facility, where it is routed to its intermediate and final destinations (Figure 1.17). Traveling through an extensive network of conveyor belts, each package is scanned multiple times and can be rerouted as needed. Once a package passes an overhead scanner, there is between 1 and 2 seconds of time to divert a package, so decisions have to be made in a few hundred milliseconds (King, 2011). On average, FedEx reengineers and improves the performance twice a year and now manages to deliver a quarter of all daily packages handled within 1 business day. These and other information systems have positioned FedEx as the global leader in express transportation.

Information Systems for Competitive Advantage

The PlayStation Network and FedEx systems are typical of systems that are pervasive in today's life or used in large, complex organizations. These systems are so large in scale and scope that they are difficult to build. It is important to handle the development of such systems the right way the first time around. These examples also show that as we rely more and more on information systems, the capabilities of these systems are paramount to business success.

Not only were these systems large and complicated, but they were—and continue to be—critical to the success of the organizations that built them. The choices made in developing the systems at Sony and FedEx were **strategic** in their intent. Both Sony's PlayStation Network and FedEx's systems were developed and are continuously updated to help the companies gain or sustain some **competitive advantage** (Porter, 1985; Porter & Millar, 1985) over their rivals. Let us not let this notion slip by us—while the use of technology can enable efficiency and while information systems must provide a return on investment, technology use can also be strategic and a powerful enabler of competitive advantage.

Although we described the use of information systems at two very large organizations, firms of all types and sizes can use information systems to gain or sustain a competitive advantage over their rivals. Whether it is a small mom-and-pop boutique or a large government agency, every organization can find a way to use information technology to beat its rivals.

Some argue that as information systems have become standardized and ubiquitous, they are now more of a commodity that is absolutely necessary for every company, and companies should focus information technology strictly on cost reduction and risk mitigation and that investing in information technology for differentiation or for competitive advantage is futile. Yet, as evidenced by the advances in smartphones, the emergence of social networks, or changes in various creative industries, IT is changing rapidly, and many companies have gained competitive advantage by innovatively using the potential of new technologies. Specifically, companies from

FIGURE 1.17

Packages travel through an extensive network of conveyor belts, where they are routed to their intermediate and final destinations.

Source: Steve Design/Shutterstock.

Amazon.com to Zappos created competitive advantage by combining certain commoditized technologies with proprietary systems and business processes. Companies with bad business models tend to fail regardless of whether they use information technology, but companies that have good business models and use information technology successfully to carry out those business models tend to be very successful. For companies such as Google or Facebook, data generated by the customers create value, and how data are being gathered, processed, and used can be a source of sustained competitive advantage (Vellante, 2011); other companies, such as Amazon.com, use their IT expertise to sell cloud computing services to other businesses, directly generating revenue from their IT investments.

In sum, we believe that information systems are a necessary part of doing business and that they can be used to create efficiencies but that they can also be used as an enabler of competitive advantage. Organizations should also note, however, that the competitive advantage from the use of information systems can be fleeting, as competitors can eventually do the same thing.

ETHICAL DILEMMA

The Social and Environmental Costs of the Newest Gadgets

We all face ethical dilemmas. Such situations, sometimes called moral dilemmas, occur when one has to choose between two different options, each of which involves breaking a moral imperative. Throughout this book, we will present situations that involve ethical dilemmas for the players involved. For most (if not all) of these situations, there are no definite solutions. In trying to resolve ethical dilemmas, decision makers should take into consideration both the consequences of and the actions involved in each approach: First, consider the *consequences* of each potential course of action, in terms of benefits and harms (considering degree and time horizon), so as to identify the option that maximizes benefits while minimizing harms. The second step is to consider the *actions* involved (irrespective of the consequences) and to evaluate which actions are least problematic from a moral standpoint (in terms of honesty, fairness, respect, and so on). While you may not arrive at a perfect solution, taking these two factors into account should give you some guidance on how to arrive at a decision.

There are various ethical dilemmas surrounding the production, use, and disposal of electronic devices, and Apple is no exception. For example, tiny silver letters printed on the back of an iPhone say: "Designed by Apple in California—Assembled in China." Globalization has enabled Apple to focus on designing electronics consumers crave while outsourcing the manufacturing of components and assembling of the devices to contract manufacturers on a global scale. However, while Apple keeps tight control over the designs of its devices, it does not always have complete control over *how* its suppliers build the devices.

As a case in point, Foxconn, one of Apple's primary Chinese assembly partners, was recently scrutinized following a series of complaints of poor working conditions. The pressures of huge production volumes and tight deadlines resulted in pushing workers to their limit, causing twitching hands, uncontrollable mimicking of the motion after work, a rapid burnout rate, the resignation of 50,000 workers each month, and even up to 14 suicides. An independent audit at various factories confirmed that laborers worked excessive overtime and faced health and safety issues. In addition to labor, rare earth minerals are crucial for manufacturing electronic devices. Used for everything from magnets to superconductors, many of today's high-tech products would not exist without rare earths. However, the mining of these minerals, primarily done in China, poses an enormous threat to the environment as well as to the health of the mining workers.

As the leaders of other technology companies, Apple's CEO Tim Cook faces a number of dilemmas. For its shareholders, Apple pursues a goal of profit maximization. In pursuing this goal, Apple introduces gadgets consumers crave at an ever-increasing pace, creating a hype around each new device, which, in turn, creates huge demand. There are few suppliers worldwide who can, on relatively short notice, produce the numbers needed to meet the demand for Apple's products, so shifting suppliers is not easy for Apple. At the same time, reducing working hours, raising salaries, or offering other fringe benefits negatively affects Apple's profit margin. Further, for many young Chinese, working at Foxconn for a few months is better than the alternative of tilling the fields on their families' small farming operations or not working at all, as evidenced by the thousands of workers lining up for Foxconn's recruiting sessions every week.

Questions

1. If you were in Tim Cook's shoes, what would you do?
2. As a consumer, what are your ethical dilemmas associated with the ever-increasing desire for new gadgets?

Based on:

Anonymous. (2012, March 29). Apple addresses China Foxconn factory report. *BBC News*. Retrieved March 21, 2016, from http://www.bbc.com/news/technology-17557630

Kaiman, J. (2014, March 20). Rare earth mining in China: the bleak social and environmental costs. *The Guardian*. Retrieved March 21, 2016, from http://www.theguardian.com/sustainable-business/rare-earth-mining-china-social-environmental-costs

IS Ethics

A broad range of ethical issues have emerged through the use and proliferation of computers. Especially with the rise of companies such as Google, which generate tremendous profits by collecting, analyzing, and using their customers' data, and the emergence of social networks such as Facebook, many people fear negative impacts such as social decay, increased consumerism, or loss of privacy. **Computer ethics** is used to describe moral issues and standards of conduct as they pertain to the use of information systems. In 1986, Richard O. Mason wrote a classic and very insightful article on the issues central to this debate—information privacy, accuracy, property, and accessibility (aka "PAPA"). These issues focus on what information an individual should have to reveal to others in the workplace or through online transactions, ensuring the authenticity and fidelity of information, who owns information about individuals and how that information can be sold and exchanged, and what information a person or organization has the right to obtain about others and how this information can be accessed and used.

With the societal changes brought about by information systems, the issues surrounding privacy have moved to the forefront of public concern; in addition, the ease of digitally duplicating and sharing information has raised not only privacy concerns but also issues related to intellectual property. Next, we examine these issues.

Information Privacy

If you use the Internet regularly, sending e-mail messages, posting status updates on Facebook, or just visiting websites, you may have felt that your personal privacy is at risk. Several e-commerce websites where you like to shop greet you by name and seem to know which products you are most likely to buy (Figure 1.18); other websites provide you with advertising that appears to be targeted accurately at you. As a result, you may feel as though eyes are on you every time you go online. **Information privacy** is concerned with what information an individual should have to reveal to others in the workplace or through other transactions, such as online shopping.

Although the Information Age has brought widespread access to information, the downside is that others may now have access to personal information that you would prefer to keep private. Personal information, such as Social Security numbers, credit card numbers, medical histories, and even family histories, is now available on the Internet. Using search engines,

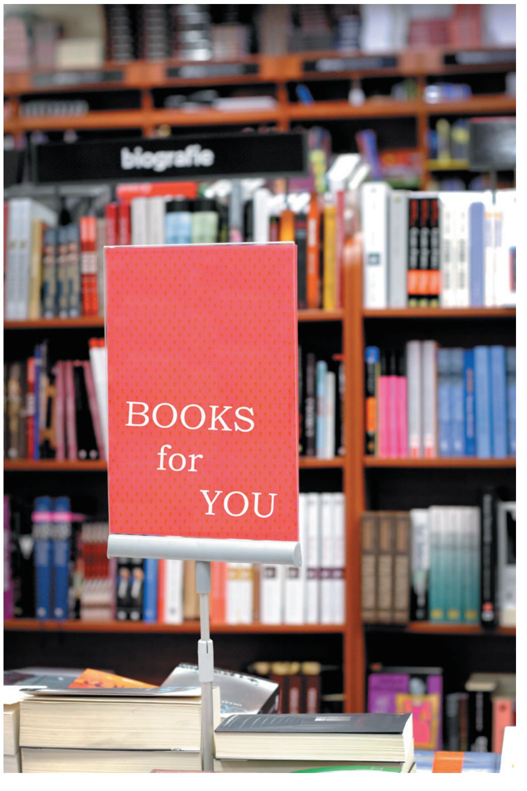

FIGURE 1.18

Just like the owners of your neighborhood bookstore, online merchants such as Amazon.com greet you by name and personalize their websites to individual customers.

Source: Jurgita Genyte/Shutterstock.

your friends, coworkers, spouse, or even current or future employers can find out almost anything that has been posted by or about you on the Internet. For example, it is very easy to locate your personal blog, your most recent party pictures posted on Facebook, or even sensitive questions you asked in a public discussion forum about drug use or mental health. Moreover, many of these pages are stored in the search engines' long-term cache, so they remain accessible for a long time even after they have been taken off the web. Yet some countries are seeking to protect their citizens from this. In 2014, the European Court of Justice ruled that individuals have the "right to be forgotten" and that search engines may have to remove links with personal information if the "information is inaccurate, inadequate, irrelevant or excessive for the purposes of the data processing" (European Commission, n.d.). This ruling, however, creates yet another set of ethical issues, this time centering around censorship of web content. In order to uphold freedom of expression and freedom of the media, such requests are handled on a case-by-case basis.

INFORMATION PROPERTY ON THE WEB. It happens to all of us. Nearly every day in our physical or virtual mailboxes, we receive unwanted solicitations from credit card companies, department stores, magazines, or charitable organizations. Many of these items are never opened. We ask the same question over and over again: "How did I get on another mailing list?" Our names, addresses, and other personal data were most likely sold from one company to another for use in mass mailings.

Who owns the computerized data about people—the data that are stored in thousands of databases by retailers, credit card companies, and marketing research companies? The answer is the company that maintains the database of customers or subscribers legally owns the data and is free to sell them. Your name, address, and other data are all legally kept in a company database to be used for the company's future mailings and solicitations, and the company can sell its customer list or parts of it to other companies who want to send similar mailings.

There are limits, however, to what a company can do with such data. For example, if a company stated at one time that its collection of marketing data was to be used strictly internally as a gauge of its own customer base and then sold those data to a second company years later, it would be unethically and illegally breaking its original promise. Companies collect data from credit card purchases (by using a credit card, you indirectly allow this) or from surveys and questionnaires you fill out when applying for a card. They also collect data when you fill in a survey at a bar, restaurant, supermarket, or the mall about the quality of the service or product preferences. By providing these data, you implicitly agree that the data can be used as the company wishes (within legal limits, of course).

What is even more problematic is the combination of survey data with transaction data from your credit card purchases. As information systems are becoming more powerful, it becomes easier to collect and analyze various types of data about people. For example, using demographic data (Who am I, and where do I live?) and psychographic data (What do I like, what are my tastes and preferences?), companies can piece together bits of data about people, creating highly accurate profiles of their customers or users, with each additional bit helping to create a more accurate picture. Such pictures, sometimes referred to as "the Database of Intentions" (Battelle, 2010), can contain information about what people want, purchase, like, are interested in, or are doing; where they are; who they are; and whom they know (Figure 1.19).

Needless to say, just because people provide data at different points does not mean that they agree for the data to be combined to create a holistic picture. Companies are often walking a fine line, as data about customers are becoming increasingly valuable. Especially in the age of Big Data analytics, there are various concerns, for example, related to discrimination or the selling of personal data but also related to embarrassments resulting from data breaches. Further, advanced analytics of vast amounts of structured and unstructured data about people's behavior enables building predictive models pertaining to people's behavior. Ultimately, this allows manipulating people (e.g., by targeted advertising) and essentially reduces human beings to objects that can be quantified and manipulated and whose value is primarily of commercial nature.

How do you know who is accessing these databases? This is an issue that each company must address at both a strategic/ethical level (Is this something that we should be doing?) and a tactical level (If we do this, what can we do to ensure the security and integrity of the data?). The company needs to ensure proper hiring, training, and supervision of employees who have access to the data and implement the necessary software and hardware security safeguards.

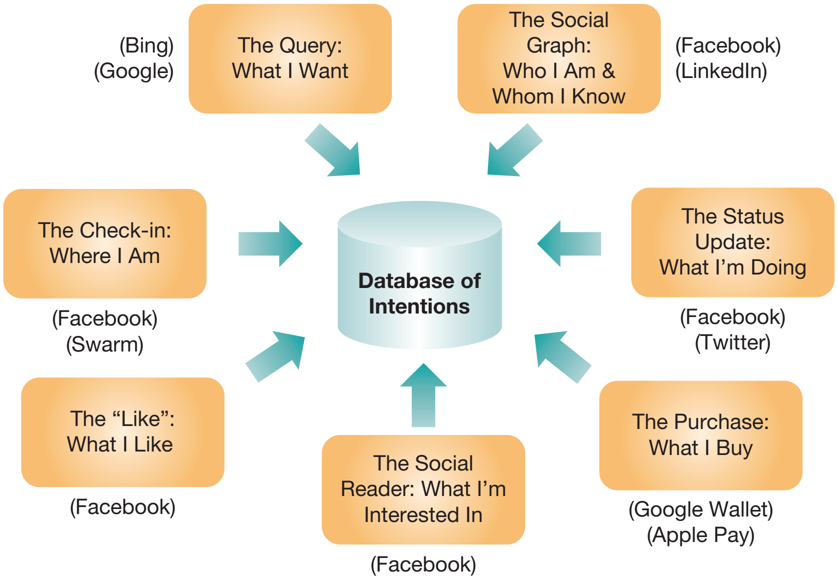

FIGURE 1.19

The database of intentions.

Source: Based on *The Database of Intentions is Far Larger than/Thought* by John Battelle, published by John Battelle.

In today's interconnected world, there are even more dangers to information privacy. Although more and more people are concerned about their privacy settings on social networks such as Facebook, there are things that you may not be able to control. For example, if one of your friends (or even a stranger) posts a photo of you on Facebook, it will be there for many others to view, whether you like it or not. By the time you realize it, most of your friends, coworkers, and family members may have already seen it. At other times, you may divulge sensitive data (such as your address or date of birth) when signing up for yet another social network; as newer, more exciting applications come up, you abandon your profile, but your data stay out there. Sometimes, you may forget who's following your activities at the various social networking sites, and you may tell people things you never wanted them to know. As these examples show, there are many more threats to your privacy than you may have thought.

E-MAIL PRIVACY. The use of e-mail raises further privacy issues, as nowadays, almost everyone sends and receives electronic mail. Although it is slowly being supplanted by social networking services and text messages, e-mail is still one of the most popular software applications of all time, having contributed greatly to a steady decline of physical mail. However, recent court cases have not supported computer privacy for employee e-mail transmissions and Internet usage. For example, most companies provide employees with access to the Internet and e-mail systems, and many periodically monitor the e-mail messages that employees send and receive. Monitoring employee behavior is nothing new, and for many businesses it was a natural extension to monitor employee e-mail messages.

Surprisingly, there is little legal recourse for those who support e-mail privacy. In 1986, the U.S. Congress passed the Electronic Communications Privacy Act (ECPA), but it offered far stronger support for voice mail than it did for e-mail communications. This act made it much more difficult for anyone (including the government) to eavesdrop on phone conversations. E-mail privacy is, however, much less protected. In addition, no other laws at the federal or state levels protect e-mail privacy. However, some states, most notably California, have passed laws that define how companies should inform their employees of the monitoring and in which situations monitoring is legal. Even so, this law is more of a guideline for ethical practice than a protection of privacy (Sipior & Ward, 1995).

Fortunately, the ECPA and the court case judgments thus far on e-mail monitoring suggest that companies must be prudent and open about their monitoring of e-mail messages and Internet usage. Companies should use good judgment in monitoring e-mail and should make public their policy about e-mail monitoring. One primary reason that employees perceive their e-mail to be private is the fact that they are never told otherwise (Weisband & Reinig, 1995). In addition, employees should use e-mail only as appropriate, based on their company's policy and their own ethical standards. Given recent actions and rulings on the capture and usage of e-mail messages, it appears that online privacy is in jeopardy both in and out of business organizations. As a general rule, we all need to realize that what we type and send via e-mail in and out of the workplace is likely to be read by others for whom the messages were not intended. It is wise to write only those e-mail messages that would not embarrass us if they were made public.

HOW TO MAINTAIN YOUR PRIVACY ONLINE. In general, companies operating in the online world are not required by law to respect your privacy. In other words, a vendor can track what pages you look at, what products you examine in detail, which products you choose to buy, what method of payment you choose to use, and where you have the product delivered. After collecting all those data, unscrupulous vendors can sell them to others, resulting in more direct-mail advertising, electronic spam in your e-mail inbox, or calls from telemarketers.

When surveyed about concerns related to Internet use, most consumers list issues of information privacy as a top concern. As a result, governments have pressured businesses to post their privacy policies on their websites. As outlined in the U.S. Federal Trade Commission's "Fair Information Practice Principles" (www.ftc.gov/reports/privacy3/fairinfo.shtm, see also Figure 1.20), widely accepted fair information practices include:

- ***Notice/Awareness.*** Providing information about what data are gathered, what the data are used for, who will have access to the data, whether provision of the data is required or voluntary, and how confidentiality will be ensured. Such information is typically contained in **data privacy statements** on a website.
- ***Choice/Consent.*** Providing options about what will be done with the data (e.g., subscription to mailing lists after a purchase). Typically, consumers are given a choice to **opt in** (i.e., signal agreement to the collection/further use of the data, e.g., by checking a box) or **opt out** (i.e., signal that data cannot be collected/used in other ways).
- ***Access/Participation.*** Providing customers with means to access data collected about them, check for accuracy, and request correction of inaccuracies.
- ***Integrity/Security.*** Ensuring integrity of the data (e.g., by using only reputable sources of data) as well as implementing controls against unauthorized access, disclosure, or destruction of data (we will discuss these controls in Chapter 10, "Securing Information Systems").
- ***Enforcement/Redress.*** Providing means to enforce these practices, and/or for customers to receive remedies, for example, through self-regulation or appropriate laws and regulations.

Unfortunately, while data privacy statements provide information about, for example, how data will be used, they often do not *protect* the privacy of consumers. To protect yourself, you should always review the privacy policy of all companies you do business with and refuse to do business with those that do not have a clear policy or do not respect your privacy. To make sure

FIGURE 1.20

Fair Information Practice Principles.

Source: Courtesy of the Federal Trade Commission.

your shopping experience is a good one, you can take a few additional steps to maintain your privacy:

- ***Choose Websites That Are Monitored by Independent Organizations.*** Several independent organizations monitor the privacy and business practices of websites (e.g., www.truste.com).
- ***Avoid Having "Cookies" Left on Your Machine.*** Many commercial websites leave cookies on your machine so that the owner of the site can monitor where you go and what you do on the site. To protect your privacy, you should carefully manage your browser's cookie settings or get special "cookie management" software (see Chapter 10 for more on cookies).
- ***Visit Sites Anonymously.*** There are ways to visit websites anonymously. Using services provided by companies such as Anonymizer (www.anonymizer.com), you have a high degree of privacy from marketers, identity thieves, or even coworkers when surfing the web.
- ***Use Caution When Requesting Confirmation E-Mail.*** When you buy products online, many companies will send you a confirming e-mail message to let you know that the order was received or the item has been shipped. A good strategy is to use a separate e-mail account, such as one that is separate from your work e-mail, when making online purchases.
- ***Beware What You Post or Say Online.*** As an old adage goes, "the Internet never forgets"; anything from status updates to Twitter messages to blog posts can be stored forever, and most content remains somewhere on the web, even after the original page has long been taken down. It is safe to say that probably almost everybody engages in some regrettable activities at some point in time. Yet having such activities appear on the web can be devastating for one's career, so use common sense before you post that drunken party pic on Facebook or tweet that you are so bored on your job.

Of course, there are no guarantees that all your online experiences will be problem free, but if you follow the advice provided here, you are much more likely to maintain your privacy.

Intellectual Property

Another set of ethical issues centers around **intellectual property (IP)** (i.e., creations of the mind that have commercial value) and the ability to easily download, copy (and potentially modify), and share or distribute digital information. For example, back in the days of analog music, it was all but impossible to create a copy of a song without sacrificing quality. Nowadays, you can almost effortlessly copy your friend's entire digital music library without any quality loss (Figure 1.21); with just a little more effort, you can share it with your friends or even strangers using peer-to-peer networks. Alternatively, you may come across a great photograph or article on the web and share it on Facebook or Instagram without asking for permission from the creator.

Similarly, your school may have licensing agreements with certain vendors, allowing you to install and use certain software while you are a student; yet you may never uninstall the software

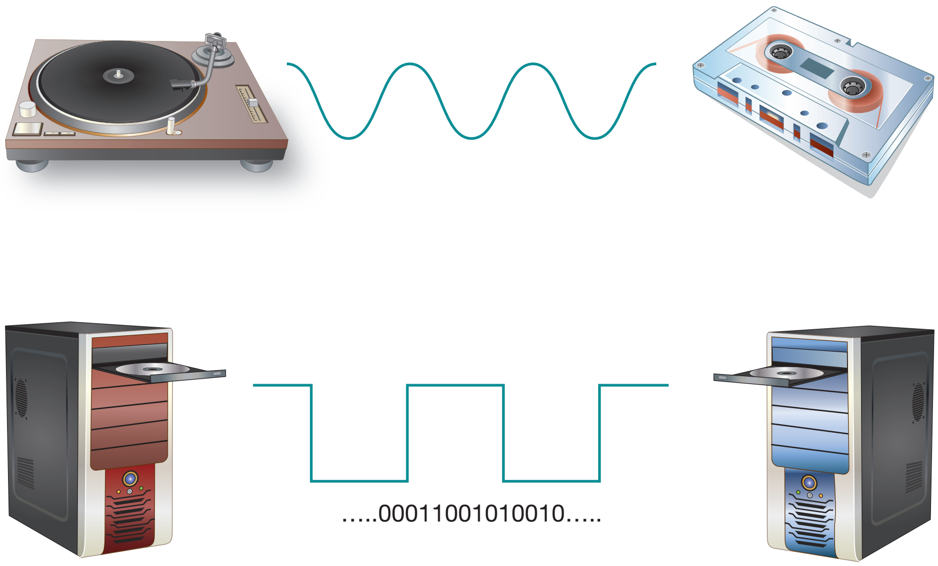

FIGURE 1.21
Digital media allows for lossless duplication.

after graduating, or you may lend the software to some friend or family member for personal use. In other cases, you may not be able to afford certain programs and download a pirated version from the web.

Just as digital technology enables lossless duplication of files, **3D printing** enables creating physical three-dimensional objects from digital models. When building prototypes or manufacturing parts, companies have traditionally used machine tools to drill, cut, or mill the part out of a solid piece of material, leaving up to 90 percent of a slab of material ready to go in the recycling or garbage bin. Instead of removing material, 3D printing successively adds thin layers of material to produce the final object. As 3D printers are becoming better, faster, and more affordable, however, they also open up new avenues for quickly and inexpensively producing counterfeit goods. Obviously, this causes problems for consumers expecting to purchase the original product but also leads to tremendous losses in intellectual property when tools are widely available that enable anyone to manufacture their own copy of a product.

Obviously, there are legal issues associated with each of these scenarios. However, there are also ethical issues associated with such behaviors. You may argue that there was no real loss involved for the creator of the files or software, as otherwise you would have gone for a free alternative or chosen not to purchase the product at all, or you may argue that students do not have the funds to purchase expensive software. These issues become even more complex when viewed from a global perspective. In many non-Western societies, using someone else's work is considered praise for the creator, and it is perfectly alright to use a famous song as background music in a YouTube video or to include another person's writing in one's personal blog (or term paper).

In either case, you are using someone else's intellectual property without permission (and often without attribution) and without compensating the creator.

The Need for a Code of Ethical Conduct

Not only has the Internet age found governments playing catch-up to pass legislation pertaining to computer crime, privacy, and security, but it has also created an ethical conundrum. For instance, the technology exists to rearrange and otherwise change photographs, but is the practice ethical? If you can use a computer at your school or workplace for professional purposes but "steal" computer time to do personal business, is this ethical? Is it ethical for companies to compile information about your shopping habits, credit history, and other aspects of your life for the purpose of selling such data to others? Should guidelines be in place to dictate how businesses and others use information and computers? If so, what should the guidelines include, and who should write them? Should there be penalties imposed for those who violate established guidelines? If so, who should enforce such penalties?

Many businesses have devised guidelines for the ethical use of information technology and computer systems; similarly, most universities and many public school systems have written guidelines for students, faculty, and employees about the ethical use of computers. Most organization and school guidelines encourage all system users to act responsibly, ethically, and legally when using computers and to follow accepted rules of online etiquette as well as federal and state laws.

RESPONSIBLE COMPUTER USE. The Computer Ethics Institute is a research, education, and policy study organization that studies how advances in information technology have affected ethics and corporate and public policy. The institute has issued widely quoted guidelines for the ethical use of computers. The guidelines prohibit the following:

- Using a computer to harm others
- Interfering with other people's computer work
- Snooping in other people's files
- Using a computer to steal
- Using a computer to bear false witness
- Copying or using proprietary software without paying for it
- Using other people's computer resources without authorization or compensation
- Appropriating other people's intellectual output

In addition, the guidelines recommend the following:

- Thinking about social consequences of programs you write and systems you design
- Using a computer in ways that show consideration and respect for others

Responsible computer use includes following the guidelines mentioned here. As a computer user, when in doubt, you should review the ethical guidelines published by your school, place of employment, and/or professional organization. Some users bent on illegal or unethical behavior are attracted by the anonymity they believe the Internet affords. But the fact is that we leave electronic tracks as we wander through the web, and many perpetrators have been traced and successfully prosecuted when they thought they had hidden their trails. The fact is, too, that if you post objectionable material on the Internet and people complain about it, your Internet service provider can ask you to remove the material or remove yourself from the service.

INDUSTRY ANALYSIS

Business Career Outlook

Today, organizations are increasingly moving away from focusing exclusively on local markets. For example, PricewaterhouseCoopers is focusing on forming overseas partnerships to increase its client base and to better serve the regions located away from its U.S. home. This means that not only it is more likely that you will need to travel overseas in your career or even take an overseas assignment, but it is also extremely likely that you will have to work with customers, suppliers, or colleagues from other parts of the world. Given this globalization trend, there is a shortage of business professionals with the necessary "global skills" for operating in the digital world. Three strategies for improving your skills include the following:

1. **Gain International Experience.** The first strategy is straightforward. Simply put, by gaining international experiences, you will more likely possess the necessary cultural sensitivity to empathize with other cultures and, more important, you will be a valuable asset to any global organization.
2. **Learn More Than One Language.** A second strategy is to learn more than your native language. Language problems within global organizations are often hidden beneath the surface. Many people are embarrassed to admit when they don't completely understand a foreign colleague. Unfortunately, the miscommunication of important information can have disastrous effects on the business.
3. **Sensitize Yourself to Global Cultural and Political Issues.** A third strategy focuses on developing greater sensitivity to the various cultural and political differences within the world. Such sensitivity and awareness can be developed through coursework, seminars, and international travel. Understanding current events and the political climate of international colleagues will enhance communication, cohesiveness, and job performance.

In addition to these strategies, prior to making an international visit or taking an international assignment, there are many things you can do to improve your effectiveness as well as enhance your chances of having fun, and social media play a big role. For example, you can join local groups of expats on Facebook to gather useful information, or use online tools such as Babbel to learn a new language or brush up on your language skills. Other suggestions include the following:

1. Read books, newspapers, magazines, and websites about the country.
2. Talk to people who already know the country and its culture.
3. Watch locally produced television as well as follow the local news through international news stations and websites.
4. After arriving in the new country, take time to tour local parks, monuments, museums, entertainment locations, and other cultural venues.
5. Share meals and breaks with local workers and discuss more than just work-related issues, such as current local events and issues.

Regardless of what business profession you choose, globalization is a reality within the digital world. In addition to globalization, the proliferation of information systems is having specific ramifications for all careers. For example, managers use enterprise resource planning systems to manage business operations, doctors use healthcare information systems to analyze patient data and diagnose conditions, law enforcement officers use databases to identify gang members by their tattoos, and farmers use geographical information systems to reduce the application of fertilizers and optimize plant yields. In other words, no matter what your career focus is, information systems will be an important part of your job.

Based on:

Berdan, M. (2014, January 23). Preparing our children for the global economy. *Huffington Post*. Retrieved June 26, 2016, from http://www.huffingtonpost.com/marshall-s-berdan/preparing-our-children-for-the-global-economy_b_4652835.html

Goatham, R. (2016, June 21). What's your 'Employability Score'? *New Era*. Retrieved June 26, 2016, from https://www.newera.com.na/2016/06/21/whats-employability-score

Sophie. (2013, August 19). Global studies programs: Preparing students for a globalized world. *Nerdwallet.com*. Retrieved June 26, 2016, from http://www.nerdwallet.com/blog/nerdscholar/2013/global-studies-programs

Key Points Review

1. ***Describe the characteristics of the digital world, contemporary societal issues of the digital world, and IT megatrends shaping the digital future.*** Today, we live in a knowledge society, and information systems have become pervasive throughout our organizational and personal lives. At the same time, we have seen economic, cultural, and technological changes brought about by globalization, and societies face a number of challenges, including demographic changes, rapid urbanization, shifts in global economic power, resource scarcity, and climate change. Technological advances have enabled five IT megatrends, where mobility, social media, the Internet of Things, cloud computing, and Big Data shape the way we work and interact. Being successful in many careers today requires that people be computer literate because the ability to access and effectively operate computing technology is a key part of many careers.
2. ***Explain what an information system is, contrasting its data, technology, people, and organizational components.*** An information system is the combination of people and information technology that create, collect, process, store, and distribute useful data. Information technology includes hardware, software, and telecommunications networks. When data are organized in a way that is useful to people, these data are defined as information. The field of information systems is huge, diverse, and growing and encompasses many different people, purposes, systems, and technologies. The people who build, manage, use, and study information systems make up the people component. They include systems analysts, systems programmers, IS professors, and many others. Finally, information systems are used by all organizations, in all industries, so they are said to have an organizational component.
3. ***Describe the dual nature of information systems in the success and failure of modern organizations.*** If information systems are conceived, designed, used, and managed effectively and strategically, then together with a sound business model they can enable organizations to be more effective, to be more productive, to expand their reach, and to gain or sustain competitive advantage over rivals. Modern organizations that embrace and manage information systems effectively and strategically and combine that with sound business models tend to be the organizations that are successful and competitive.
4. ***Describe how computer ethics affect the use of information systems and discuss the ethical concerns associated with information privacy and intellectual property.*** Information privacy is concerned with what information an individual should have to reveal to others through the course of employment or through other transactions, such as online shopping. In the Information Age, others may have access to personal information that you would prefer to keep private. This becomes especially problematic as organizations are increasingly able to piece together information about you, forming an ever more complete picture. With the ease of duplicating, manipulating, and sharing digital information, intellectual property becomes an increasingly important issue.

Key Terms

3D printing 37
app 12
Big Data 14
BYOD 12
climate change 10
cloud computing 13
competitive advantage 30
computer ethics 32
computer fluency 16
computer literacy 15
consumerization of IT 12
data 18
data privacy statement 35
data quality 18
demographic changes 9
digital divide 6
e-business 6
globalization 7
hardware 16
healthcare IS 16
home automation 13
Industrial Internet of Things (IIoT) 13
information 18
information privacy 32
information system (IS) 16
information technology (IT) 16
intellectual property (IP) 36
Internet of Things (IoT) 12
internetworking 26
knowledge 18
knowledge society 5
knowledge worker 5
management information system 25
network effect 12
office automation system 27
opt in 35
opt out 35
outsourcing 8
quantified self 10
resource scarcity 10
robotics 15
sensor 12
sustainable development 10
shifts in economic power 9
smart home technologies 13
software 16
strategic 30
systems integration 26
telecommunications network 16
transaction processing system (TPS) 25
urbanization 9
wearable technologies 10

MyMISLab™

Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

1-1. Describe the major challenges societies face.

1-2. Define the term *knowledge worker*. Who coined the term?

1-3. Name your two favorite mobile devices. For each device, discuss how it has influenced your work or personal life.

MyMISLab **1-4.** Describe how cloud computing can improve your personal productivity.

MyMISLab **1-5.** List and describe several opportunities and challenges brought about by globalization.

1-6. Compare and contrast how the digital divide manifests in different parts of the world.

1-7. Define and contrast data, information, and knowledge.

1-8. Describe three or four types of jobs and career opportunities in information systems and in related fields.

1-9. List and define four of the systems knowledge and/or skills core competencies.

1-10. List and define five types of information systems used in organizations.

MyMISLab **1-11.** Discuss the issues surrounding information privacy, and how you can protect yourself.

1-12. Following the guidelines of the Computer Ethics Institute, what behaviors are considered unethical computer use?

Self-Study Questions

1-13. Information systems today are ______________.
A. slower than in the past
B. ubiquitous
C. utilized by only a few select individuals
D. stable and should not change

1-14. Whereas data are raw unformatted symbols or lists of words or numbers, information is ______________.
A. data that have been organized in a form that is useful
B. accumulated knowledge
C. what you enter into your computer
D. what your computer prints out for you

1-15. Information systems were described in this chapter as ______________.
A. any complicated technology that requires expert use
B. the combination of people and information technology that create, collect, process, store, and distribute useful data
C. any technology (mechanical or electronic) used to supplement, extend, or replace human, manual labor
D. any technology used to leverage human capital

1-16. Other terms that can be used to represent the knowledge society include ______________.
A. the new economy
B. the network era
C. the digital world
D. all of the above

1-17. Which of the following was *not* discussed as a common type, or category, of information system used in organizations?
A. transaction processing
B. decision support
C. enterprise resource planning
D. web graphics

1-18. What is meant by BYOD?
A. the increased focus of hardware companies on the mass market
B. the phenomenon that devices are becoming increasingly playful
C. the use of personal devices and applications for work-related purposes
D. the increase of technology in people's households

1-19. A website asking you for permission to send you a weekly newsletter is an example of ______________.
A. opt in
B. permissions
C. opt out
D. data privacy

1-20. Which of the following is *not* considered an intellectual property violation?
A. giving software licensed to your school or workplace to friends or family members
B. downloading pirated movies or music
C. making copies of music for your friends
D. all of the above are considered intellectual property violations

1-21. Being ______________, or knowing how to use the computer as a device to gather, store, organize, and process information, can open up myriad sources of information.
A. technology literate
B. digitally divided
C. computer literate
D. computer illiterate

Answers are on page 43.

Problems and Exercises

1-22. Match the following terms with the appropriate definitions:

i. Information
ii. Internet of Things
iii. Information system
iv. Information privacy
v. Computer fluency
vi. Globalization
vii. Outsourcing
viii. Digital divide
ix. Intellectual property
x. Computer ethics

a. The issues and standards of conduct as they pertain to the use of information systems
b. Data that have been formatted in a way that is useful
c. The integration of economies around the world, enabled by innovation and technological progress
d. The ability to independently learn new technologies as they emerge and assess their impact on one's work and life
e. A network of a broad range of physical objects that can automatically share data over the Internet
f. The combination of people and information technology that create, collect, process, store, and distribute useful data
g. The moving of routine jobs and/or tasks to people in another firm to reduce costs
h. An area concerned with what information an individual should have to reveal to others through the course of employment or through other transactions, such as online shopping
i. The gap between those individuals in our society who are computer literate and have access to information resources, such as the Internet, and those who do not
j. Creations of the mind that have commercial value

1-23. Of the several information systems listed in the chapter, how many do you have experience with? What systems would you like to work with? What types of systems do you encounter at the university you are attending? The web is also a good source for additional information.

1-24. Identify someone who works within the field of information systems as an IS instructor, professor, or practitioner (e.g., as a systems analyst or systems manager). Find out why this individual got into this field and what this person likes and dislikes about working within the field of information systems. What advice can this person offer to someone entering the field?

1-25. As a small group, conduct a search on the web for job placement services. Pick at least four of these services and find as many IS job titles as you can. You may want to try monster.com or careerbuilder.com. How many did you find? Were any of them different from those presented in this chapter? Could you determine the responsibilities of these positions based on the information given to you?

1-26. Visit Walmart China (www.wal-martchina.com/english/index.htm). Compare and contrast www.walmart.com with Walmart China's site. What is the focus of Walmart China's website? Discuss how the focus differs from www.walmart.com. What are possible reasons for the differences?

1-27. What are potential costs and benefits of using your own devices in the workplace? How can organizations balance costs and benefits?

1-28. What is the impact of mobility and social networks on your personal life? On the web, find statistics about these topics. How does your own behavior compare to the statistics you found?

1-29. As a small group, brainstorm what different types of data make up "Big Data" for a company like Amazon.com. What data are easiest/hardest to analyze? What data are least/most important? Justify your answers.

1-30. Compare and contrast the data privacy statements of three different e-commerce websites. What are the similarities and differences? Which business would you be least/most willing to do business with? Why?

1-31. Societies face a variety of challenges. Provide a short report that discusses one of the challenges mentioned in the chapter, and describe five ways in which information systems can help address these challenges.

1-32. The Electronic Frontier Foundation (www.eff.org) has a mission of protecting rights and promoting freedom in the "electronic frontier." The organization provides additional advice on how to protect your online privacy. Review its suggestions and provide a summary of what you can do to protect yourself.

1-33. Find your school's guidelines for ethical computer use and answer the following questions: Are there limitations as to the type of websites and material that can be viewed (e.g., pornography)? Are students allowed to change the programs on the hard drives of the lab computers or download software for their own use? Are there rules governing personal use of computers and e-mail?

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Ticket Sales at Campus Travel

1-34. The local travel center, Campus Travel, has been losing sales. The presence of online ticketing websites, such as Travelocity.com and Expedia.com, has lured many students away. However, given the complexity of making international travel arrangements, Campus Travel could have a thriving and profitable business if it concentrated its efforts in this area. You have been asked by the director of sales and marketing to help with analyzing prior sales data in order to design better marketing strategies. Looking at these data, you realize that it is nearly impossible to perform a detailed analysis of ticket sales given that the data are not summarized or organized in a useful way to inform business decision making. The spreadsheet TicketSales.csv contains the ticket sales data for a 3-month period. Your director has asked you for the following information regarding ticket sales. Modify the TicketSales.csv spreadsheet to provide the following information for your director:

- The total number of tickets sold.
  a. Select the data from the "tickets sold" column.
  b. Then select the "autosum" function.
- The largest amount of tickets sold by a certain salesperson to any one location.
  a. Select the appropriate cell.
  b. Use the "MAX" function to calculate each salesperson's highest ticket total in one transaction.
- The least amount of tickets sold by a certain salesperson to any one location.
  a. Select the appropriate cells.
  b. Use the "MIN" function to calculate the "least tickets sold."
- The average number of tickets sold.
  a. Select the cells.
  b. Use the "AVERAGE" function to calculate the "average number of tickets sold" using the same data you had selected in the previous steps.

Database Application: Tracking Frequent-Flier Miles at the Campus Travel Agency

1-35. The director of sales and marketing at the travel agency would like to increase the efficiency of handling customers who have frequent-flier accounts. Often, frequent fliers have regular travel routes and a preferred seating area or meal category. In previous years, the data have been manually entered into a three-ring binder. In order to handle the frequent fliers' requests more efficiently, your director has asked you to build an Access database containing the traveler's name (first and last name), address, phone number, frequent-flier number, frequent-flier airline, meal category, and preferred seating area.

To do this, you will need to do the following:

- Create an empty database named "Frequent Flier."
- Import the data contained in the file FrequentFliers.txt. Use "Text File" under "Import" in the "External Data" tab. Hint: Use tab delimiters when importing the data; note that the first row contains field names.

After importing the data, create a report displaying the names and addresses of all frequent fliers by doing the following:

- Select "Report Wizard" under "Report" in the "Create" tab.
- Include the fields "first name," "last name," and "address" in the report.
- Save the report as "Frequent Fliers."

Team Work Exercise

Net Stats: Worldwide Internet Usage

In March 2016, there were more than 3.3 billion people worldwide who had access to the Internet at home (i.e., Internet users). Since its inception, the number of users has grown tremendously, from only about 14 million users in 1993 to 1 billion users in 2005, 2 billion users in 2010, and 3 billion users in 2014. Having grown exponentially in the early years, the growth in user numbers has slowed to less than 10 percent per year, after worldwide Internet penetration surpassed 35 percent. In 2016, countries such as the United Kingdom, Japan, and the United States had the highest Internet penetration. However, other countries are catching up. While China had an Internet penetration of 52 percent and India had an Internet penetration of only 35 percent, they had the largest number of users; further, both countries having much room to grow, both in terms of Internet penetration and in terms of numbers (Table 1.6).

TABLE 1.6 Countries with Largest Number of Internet Users

Country	Population	Internet Access	% Population (penetration)
China	1.4 billion	721 million	52
India	1.3 billion	462 million	35
United States	324 million	287 million	89
Brazil	210 million	139 million	66
Japan	126 million	115 million	91
Russia	143 million	102 million	71
Nigeria	186 million	86 million	46
Germany	80 million	71 million	88
UK	65 million	60 million	93
Mexico	129 million	58 million	45

Questions and Exercises

1-36. Search the web for the most up-to-date statistics.

1-37. As a team, interpret these numbers. What is striking/important about these statistics?

1-38. As a team, discuss how these numbers will look like in 5 years and 10 years. What will the changes mean for globalization? What issues/opportunities do you see arising?

1-39. Using your spreadsheet software of choice, create a graph/figure most effectively visualizing the statistics/changes you consider most important.

Based on:

Anonymous. (n.d.). Internet users. Retrieved March 21, 2016, from http://www.internetlivestats.com/internet-users

Answers to the Self-Study Questions

1-13. B, p. 4 **1-14.** A, p. 18 **1-15.** B, p. 16 **1-16.** D, p. 6 **1-17.** D, p. 26

1-18. C, p. 12 **1-19.** A, p. 35 **1-20.** D, p. 36 **1-21.** C, p. 15

CASE 1 | Apple

Apple is the largest, most profitable technology company in the world. Each year, Apple sells hundreds of millions of its popular iMacs, MacBooks, iPods, iPads, and iPhones. Apple's products—and the technology that supports them—have influenced the way people behave and interact. Think how waiting in line at the grocery store or waiting for the next train is more productive, or at least no longer tedious, when you get to check your inbox or watch a video on YouTube. Now remember how insecure you felt the last time you left your smartphone sitting on your living room sofa. Whichever way you look at it, Apple has enjoyed a long streak of successful product launches, with people camping out for days to get their hands on the latest Apple gadgets.

Over the course of its history, Apple had its ups and downs, with Steve Wozniak and Steve Jobs, the company's founders, leaving Apple in the 1980s. After Steve Jobs's return to Apple in 1997, Apple has had an impressive run of successful products, including the iMac, the PowerBook, the iPod, and iTunes. Building on its success with the iPod, Apple introduced the iPhone in 2007 and, shortly thereafter, the "App Store," revolutionizing the way we purchase and use applications on mobile devices. The era of iPhones continued as successive updates to the iPhone line were introduced year after year, each garnering wider adoption than the last. In 2010, Apple introduced the revolutionary iPad, touted as a "third-category" device between smartphones and laptop personal computers (PCs). Clearly, innovations fueled by Apple have changed the lives of many people all over the world.

However, Apple has also seen a number of high-profile product failures. In January 2008, to help celebrate 24 years of the Mac, first introduced to consumers in 1984, *Wired* magazine recalled some of Apple's more infamous failures. One of Apple's most visible flops was the Newton, actually the name of a newly conceived operating system that stuck to the product as a whole. The Newton, which Apple promised would "reinvent personal computing," fell far short of its hype when it was introduced in 1993 as a not-so-revolutionary personal digital assistant (PDA). The Newton was on the market for 6 years—a relatively long time for an unsuccessful product—but one of Steve Jobs's first acts when he returned to Apple's helm in 1997 was to cut the Newton Systems Group. Other Apple product failures include: the Pippin (1993), a gaming device that couldn't compete with Nintendo's 64 or Sony's PlayStation; the Macintosh television (1993), which only sold 10,000 units; the PowerMac G4 Cube (2000), an 8" × 8" × 8" designer machine that was widely regarded as overpriced; the puck mouse included with the iMac G3 (1998), a too-small, awkward-to-control device that users often mistakenly used upside down; and the Lisa (1983), whose whopping US$9,995 price tag (more than US$20,000 in current dollars) made it too expensive for most businesses.

In recent years, Apple has introduced a large variety of new products, all with remarkable success. Innovative products that consumers stand in line to get include the MacBook Air, as well as a line of iPods, iPhones, and iPads. After the death of Steve Jobs in 2011, time will tell if Apple's current success streak continues or if, at some point, Apple will yet again introduce a product that is "too innovative" for the consumers. Introduced in 2015, the Apple Watch may be one such product, with many questioning the usefulness of this wearable technology turned fashion statement.

With its increasing focus on personal devices, Apple has become not only a hardware vendor but also a keeper of people's (often private) information. As it is being stored in the cloud, personal information can easily be (ab)used to predict future behavior, potential trends, music tastes, and more. Connected as we may be to the rest of the world, salient concerns are warranted regarding issues of privacy and information property—that is, who has access to what and how private information is being used. Certainly, there are potential risks associated with being an active participant in the digital world, so the next time you purchase an app, think about how much you reveal about yourself with the swipe of your finger.

Questions

1-40. Given the pace at which technology is converging (e.g., phones, music players, cameras, and so on), what do you think will be Apple's next revolutionary innovation?

1-41. How have Apple's products influenced the way we work and socialize?

1-42. What are the ethical concerns associated with storing and analyzing user data?

Based on:

Apple Inc. (2014, May 2). In *Wikipedia, The Free Encyclopedia*. Retrieved March 21, 2016, from https://en.wikipedia.org/w/index.php?title=Apple_Inc.&oldid=711059018

Gardiner, B. (2008, January 24). Learning from failure: Apple's most notorious flops. *Wired*. Retrieved May 12, 2014, from http://archive.wired.com/gadgets/mac/multimedia/2008/01/gallery_apple_flops

CASE 2 | Healthcare IS

Healthcare information systems are systems that facilitate the collection and processing of data related to healthcare activities. Historically, such systems were largely focused on the operational needs of healthcare institutions like hospitals and doctor's offices. Mirroring the deployment of information systems in other businesses, systems were developed for accounting, billing, insurance claim processing, human resources, and other business functions. In recent years, however, there has been a push to bring the benefits of information technology to the provision of care itself. Systems are being developed to better generate and track data that are useful to improving health outcomes. A key part of this process is the electronic health record (EHR). An EHR is a comprehensive record that includes your medical and immunization history, laboratory results, and other data such as medical imagery.

When properly maintained and handled, EHRs can have many benefits. Up-to-date, complete, and accurate data makes providers more knowledgeable and better able to work with you to make informed decisions about your health. EHRs can enhance patient safety and provide safer care in several ways. EHRs can offer a more complete picture of your health than paper records. Doctors can evaluate your current condition in the proper context of your health history and other treatments you are receiving. EHRs can allow those providing care in an emergency faster access to information they need about your history, allergies, and prescriptions. EHR systems can flag potential conflicts in medication and help pharmacists verify dosages and avoid dispensing the wrong medications. EHRs can also help avoid the need to repeat risky tests and procedures by tracking them better and ensuring the results are available when and where they are needed.

In addition to benefits to individuals, EHRs can lead to better collective health information. Safety hazards, disease outbreaks, high pollution levels, and other risks can be identified more rapidly by analyzing health data in aggregate. Government services and research dollars can be allocated more efficiently focusing on actual community needs. Healthcare processes and procedures can be improved by utilizing modern data analysis techniques on aggregate health data as well. Overall, there is great potential to both improve health outcomes and reduce healthcare delivery costs by utilizing EHR systems.

However, there are also downsides and risks associated with EHR systems. Data privacy and security become even more important when the data in question have to do with such potentially sensitive topics as your health. Records must be properly protected from the same sorts of cyberthreats that other businesses face. Hackers and other malicious actors may seek to steal personal health data in order to make illicit use of it. In addition, now that they are more readily accessible, there is the concern that health data could be used for improper or undesired purposes. Most people feel that health history should not be used in the making of hiring decisions in general, but there may be acceptable exceptions such as public safety workers or airline pilots. The role of health history in the availability and coverage of insurance is also a highly controversial topic.

It has also proven exceptionally difficult to implement EHR systems. Many hospitals and medical facilities rely heavily on paper forms and records. The deployment of EHR systems requires more than simply digitizing the existing forms; in many cases, entire business processes must be redesigned and new information systems developed. There are great opportunities when it comes to healthcare information systems, and there are many great challenges. The benefits for society from improved health and reduced costs must be offset against the potential risks of increasing the amount of our personal and private data available online. The increasing availability of new sources of health data such as activity trackers and other Internet of Things devices will also generate a new set of benefits and risks. Activity trackers can provide data ranging from the number of steps you take each day to vital statistics like heart rate and blood glucose levels. Researchers are even using smartphones to collect data for health studies and clinical trials. Such technologies as Apple's Research Kit, Care Kit, and Health Kit allow millions of people to participate in medical research studies quickly and easily. This type of data collection promises to transform large-scale health research. In summary, IS professionals have a great opportunity to assist in the transition to IT-based health systems and in helping to balance the associated risks and rewards.

Questions

1-43. Have you encountered EHRs? How have they improved or detracted from your healthcare experience?

1-44. How should patient privacy be balanced against social needs? For example, should pilots be required to disclose their mental health information to their employers?

1-45. What opportunities and challenges lay ahead as health records become increasingly integrated into our mobile devices and the Internet of Things?

Based on:

Apple. (2016). Empowering medical researchers, doctors, and now you. *Apple.com.* Retrieved April 24, 2016, from http://www.apple.com/researchkit

HeathIT.gov. (2016). Retrieved April 24, 2016, from https://www.healthit.gov

MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

1-46. How do the five megatrends influence how people work and interact?

1-47. Describe and contrast the economic, cultural, and technological changes occurring in the digital world.

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2 Gaining Competitive Advantage Through Information Systems

Preview

This chapter examines how organizations can use information systems (IS) strategically, enabling them to gain or sustain competitive advantage over their rivals. As described in Chapter 1, "Managing in the Digital World," a firm has competitive advantage over rival firms when it can do something better, faster, more economically, or uniquely. In this chapter, we begin by examining the role of information systems at different levels of the organization. We then examine how information systems support various business models and introduce innovative business models enabled by information systems. Finally, we talk about the continual need to find innovative ways to succeed with and through information systems.

MANAGING IN THE DIGITAL WORLD:

Startups and New Business Models

In addition to enabling new products and services, rapid advances in the capabilities of information technology enable entirely new business models. Some are refinements to existing approaches, others can be highly disruptive. Just because technology enables an innovative business model, however, does not mean that it can be easily or successfully implemented.

Examples of technology-enabled business models include operating a platform, cutting out the middleman, selling subscriptions, and providing on-demand services. Companies building a platform enable others—both other businesses and users—to co-create value. In this business model, companies like Airbnb use technology to facilitate information gathering, identify willing participants, and simplify transactions. Cutting out the middleman (or disintermediation) means bypassing traditional retail channels and interacting directly with customers (Figure 2.1). Using this business model, eyeglass vendor Warby Parker and mattress seller Casper use technology to disrupt traditional distribution channels and directly connect with buyers. Subscription-based services are facilitated by technology through the removal of friction from the transaction—the initial sign-up is greatly simplified through online forms, parameters of the subscription can easily be adjusted,

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

1. **Discuss how information systems can be used for automation, organizational learning, and strategic advantage.**
2. **Describe how information systems support business models used by companies operating in the digital world.**
3. **Explain why and how companies are continually looking for innovative ways to use information systems for competitive advantage.**

and payment is made easy through digital transactions. All this adds up to a great opportunity to gain sustained revenue for startups and hassle-free experiences for customers. Netflix, Spotify, and Dollar Shave Club are examples of businesses that have recently been very successful with the subscription model. Lastly, on-demand services have grown tremendously. Mobile and location-based technologies have allowed substantial new opportunities on both the supply and demand side to enable on-demand services. The most widely cited example is the car-hailing service Uber, with countless others who are trying to replicate Uber's success.

A technology-enabled business model is not a guarantee of success. Many businesses trying to replicate Uber's success in the on-demand arena have struggled, as not all goods and services are well suited to this approach. There are certain aspects of transportation and other services that make them well suited for on-demand delivery. In contrast, markets where there are high and varied standards for customer satisfaction such as house cleaning and dining, with an abundance of ready substitutes such as local cleaners and restaurants, may face particular challenges. However, with the rise in innovative business models, it might be only a matter of time until a startup will come up with a suitable business model.

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

1. What is the role of information systems and strategy in identifying a business model?

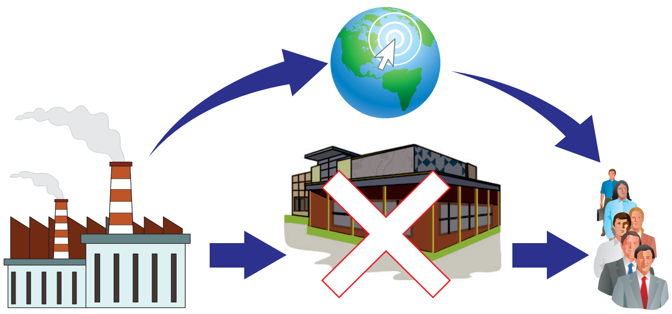

FIGURE 2.1

Technology enables new business models, such as cutting out the middleman and bypassing traditional retail channels to interact directly with customers.

2. How have information systems enabled new, interesting business models like that of Uber, Spotify, and Airbnb?
3. How can organizations identify innovative technologies that form the basis for innovative business models?

Based on:

Kessler, S. (2016, March 29). Why a new generation of on-demand businesses rejected the Uber model. *Fast Company.* Retrieved May 29, 2016, from http://www.fastcompany.com/3058299/why-a-new-generation-of-on-demand-businesses-rejected-the-uber-model

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Enabling Organizational Strategy through Information Systems

In Chapter 1, we introduced the notion that information systems can have strategic value to an organization. Because organizations are composed of different levels and functions, a broad range of information is needed to support an organization's business processes. **Business processes** are the activities organizations perform in order to reach their business goals, including core activities that transform inputs and produce outputs, and supporting activities that enable the core activities to take place. As a review, we briefly describe how organizations are generally structured as well as the common functional areas of most modern organizations. Understanding how organizations are structured helps to illustrate how different types of information systems can support various business processes and provide different levels of value to the organization.

Organizational Decision-Making Levels

Every organization is composed of different decision-making levels, as illustrated in Figure 2.2. Each level of an organization has different responsibilities and, therefore, different informational needs.

OPERATIONAL LEVEL. At the **operational level** of a firm, the routine, day-to-day business processes and interactions with customers occur. Information systems at this level are designed to automate repetitive activities, such as processing sales transactions, and to improve the efficiency of business processes at the customer interface. A **transaction** refers to anything that occurs as part of a firm's daily business of which it must keep a record. Operational planning typically has a time frame of a few hours or days, and the managers at the operational level, such as foremen or supervisors, make day-to-day decisions that are highly structured and recurring. **Structured decisions** are those in which the procedures to follow for a given situation can be specified in advance. Because structured decisions are relatively straightforward, they can be programmed directly into operational information systems so that they can be made with little or no human intervention. For example, an inventory management system for a shoe store in the mall could keep track of inventory and issue an order for additional inventory when levels drop below a specified level. Operational managers within the store would simply need to confirm with the inventory management system that the order for additional shoes was needed. At the operational level, information systems are typically used to increase **efficiency** (i.e., the extent to which goals are accomplished faster, at lower cost, or with relatively little time and effort) by optimizing processes and better understanding the underlying causes of any performance problems. Using information systems to optimize processes at the operational level can offer quick returns on the IS investment, as activities at this level are clearly delineated and well-focused. Figure 2.3 summarizes the general characteristics of the operational level.

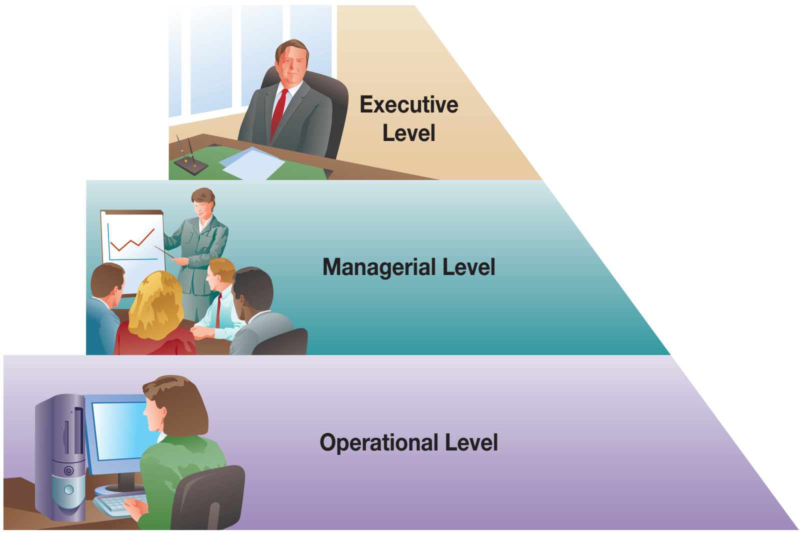


FIGURE 2.2

Organizations are composed of different decision-making levels.

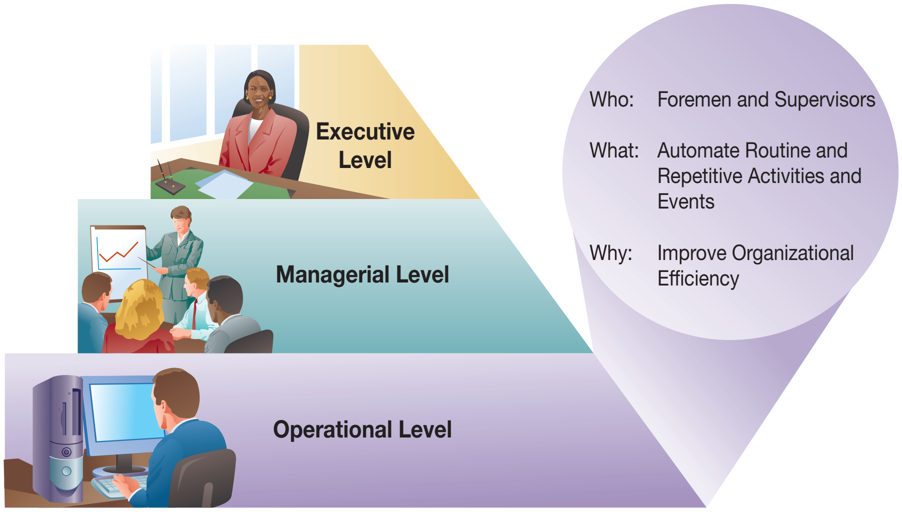


FIGURE 2.3

Information systems at the operational level of an organization help to improve efficiency by automating routine and repetitive activities.

MANAGERIAL/TACTICAL LEVEL. At the **managerial level** (or tactical level) of the organization, functional managers (e.g., marketing managers, finance managers, manufacturing managers, human resource managers) focus on monitoring and controlling operational-level activities and providing information to higher levels of the organization (Figure 2.4). Managers at this level, referred to as midlevel managers, focus on effectively utilizing and deploying organizational resources to increase **effectiveness** (i.e., the extent to which goals or tasks are accomplished well) to achieve the strategic objectives of the organization. Midlevel managers typically focus on problems within a specific business function, such as marketing or finance. Here, the scope of the decision usually is contained within the business function, is moderately complex, and has a time horizon of a few days to a few months (also referred to as tactical planning). For example, a marketing manager at Nike may decide how to allocate the advertising budget for the next business quarter or some other fixed time period.

Managerial-level decision making is not nearly as structured or routine as operational-level decision making. Managerial-level decision making is referred to as semistructured decision making because solutions and problems are not clear-cut and often require judgment and expertise. For **semistructured decisions**, some procedures to follow for a given situation can be specified in advance, but not to the extent where a specific recommendation can be made. For example, a business intelligence system could provide a production manager at Nike with performance analytics and forecasts about sales for multiple product lines, inventory levels, and overall production capacity. The metrics deemed most critical to assessing progress toward a

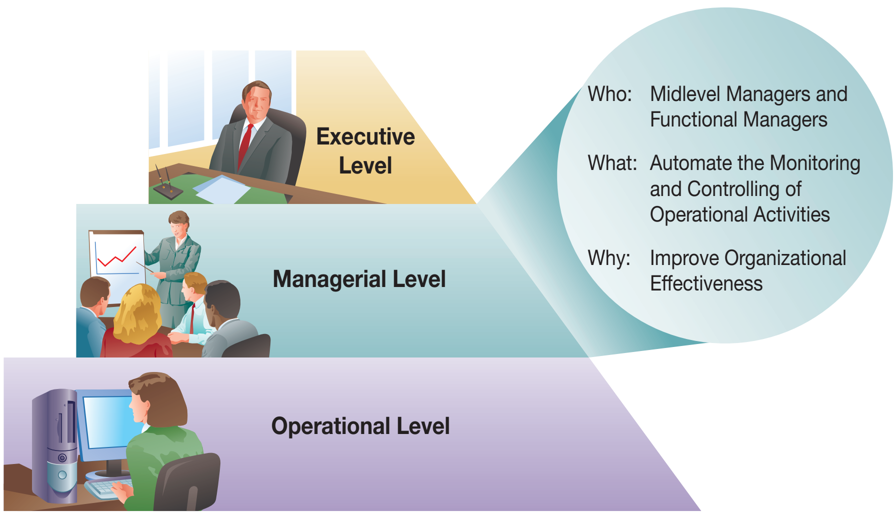


FIGURE 2.4

Information systems at the managerial level of an organization help to improve effectiveness by automating the monitoring and controlling of operational activities.

certain goal (referred to as **key performance indicators [KPIs]**) are displayed on *digital dashboards* (see Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics"). The manager could use this information to create multiple hypothetical production schedules. With these schedules, the manager could then perform predictive analyses to examine inventory levels and potential sales profitability, depending on the order in which manufacturing resources were used to produce each type of product.

EXECUTIVE/STRATEGIC LEVEL. At the **executive level** (or strategic level) of the organization, managers focus on long-term strategic questions facing the organization, such as which products to produce, which countries to compete in, and what organizational strategy to follow (Figure 2.5). Managers at this level include the president and chief executive officer, chief information officer, vice presidents, and possibly the board of directors; they are referred to as "executives." Executive-level decisions deal with complex problems with broad and long-term ramifications for the organization. Executive-level decisions are referred to as unstructured decisions because the problems are relatively complex and nonroutine. In addition, executives must consider the ramifications of their decisions in terms of the overall organization. For **unstructured decisions**, few or no procedures to follow for a given situation can be specified in advance. For example, top managers may decide to develop a new product or discontinue an existing one. Such a decision may have vast, long-term effects on the organization's levels of employment and profitability. To assist executive-level decision making, information systems are used to obtain aggregate summaries of trends and projections of the future. At the executive level, information systems provide KPIs that are focused on balancing performance across the organization, such that, for example, product launches are staggered to smooth out the effects of spikes in demand on the supply chain. Other KPIs are used to benchmark the organization's performance against its competitors. Likewise, information systems used for executive-level decisions need to take into account various types of unstructured data, such as data related to global economic factors, demographic changes, or changing customer tastes and preferences.

In summary, most organizations have three general decision-making levels: operational, managerial, and executive. Each level has unique activities and business processes, each requiring different types of information. In other words, it is common that each decision-making level is supported by different types of information systems.

Organizational Functional Areas

In addition to different decision-making levels within an organization, there are also different functional areas. A functional area represents a discrete area of an organization that focuses on a specific set of activities. For example, people in the marketing function focus on the activities that promote the organization and its products in a way that attracts and retains customers; people in the accounting and finance functions focus on managing and controlling capital assets and

FIGURE 2.5

Information systems at the executive level of an organization help to improve strategy and planning by providing summaries of past data and projections of the future.

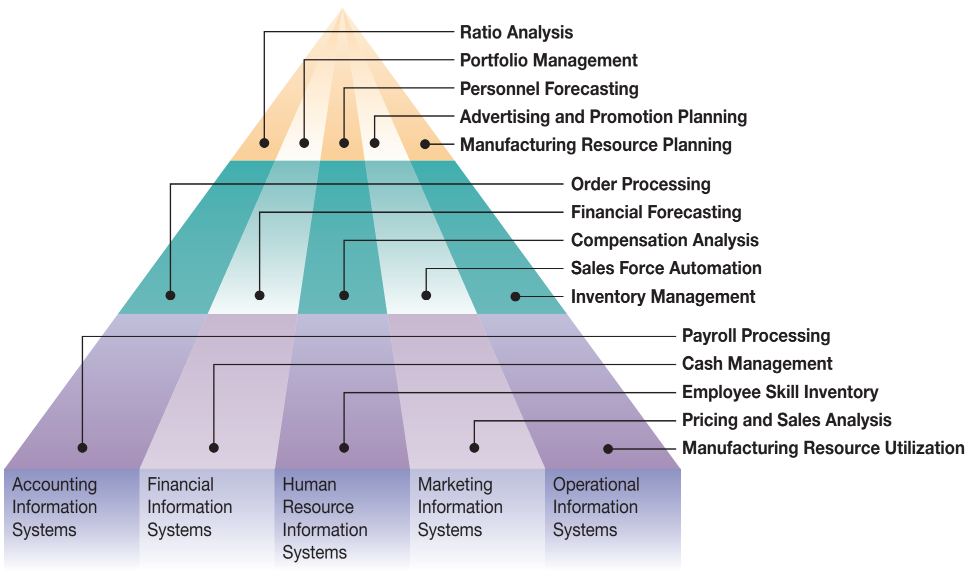


FIGURE 2.6

Business processes supported by various functional area information systems.

financial resources of the organization. Table 2.1 lists various organizational functions and lists examples of the types of information systems that are commonly used. These **functional area information systems** are designed to support the unique business processes of specific functional areas (Figure 2.6).

When deploying information systems across organizational levels and functions, there are three general ways the information system can provide value: to enable automating activities, to enable learning, and to enable the execution of organizational strategy (Figure 2.7). These three ways are not necessarily mutually exclusive, but we believe that each is progressively more useful to the firm and thus adds more value to the business. This is examined next.

Information Systems for Automating: Doing Things Faster

Someone with an **automating** perspective thinks of technology as a way to help complete a task within an organization faster, more cheaply, and perhaps with greater accuracy and/or consistency. Let us look at a typical example. A person with an automating mentality would take a loan application screening process and automate it by inputting the loan applications into a computer database so that those involved in decision making for the loans could process the applications faster, more easily, and with fewer errors. Such a system might also enable customers to complete the loan application online. A transition from a manual to an automated loan application process might enable the organization to deploy employees more efficiently, leading to even more cost savings (Table 2.2). Likewise, advances in Internet of Things technologies can help automate business process in various sectors; for example, the Industrial Internet of Things can tremendously improve the performance of companies in the manufacturing sector. Information systems at the operational level of an organization often help in automating repetitive activities,

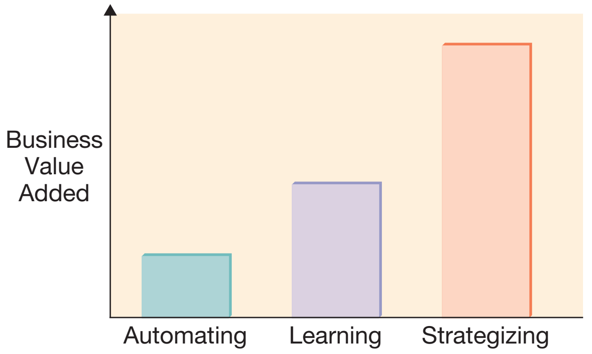


FIGURE 2.7

The business value added from automating, learning, and strategizing with information systems.

TABLE 2.1 Organizational Functions and Representative Information Systems

Functional Area	Information System	Sample Applications
Accounting and finance	Systems used for managing, controlling, and auditing the financial resources of the organization	■ Accounts payable ■ Expense accounts ■ Cash management ■ Payroll processing
Human resources	Systems used for managing, controlling, and auditing the human resources of the organization	■ Recruiting and hiring ■ Education and training ■ Benefits management ■ Employee termination ■ Workforce planning
Marketing	Systems used for managing new product development, distribution, pricing, promotional effectiveness, and sales forecasting of the products and services offered by the organization	■ Market research and analysis ■ New product development ■ Promotion and advertising ■ Pricing and sales analysis ■ Product location analysis
Production and operations	Systems used for managing, controlling, and auditing the production and operations resources of the organization	■ Inventory management ■ Cost and quality tracking ■ Materials and resource planning ■ Job costing ■ Resource utilization

TABLE 2.2 Activities Involved Under Three Different Loan Application Processes and the Average Time for Each Activity

Primary Activity	Manual Loan Process (Time)	Technology-Supported Process (Time)	Fully Automated Process (Time)
1. Complete and submit loan application	Customer takes the application home, completes it, and returns it (1.5 days)	Customer takes the application home, completes it, and returns it (1.5 days)	Customer fills out application from home via the web (15 minutes)
2. Check application for errors	Employee does this in batches (2.5 days)	Employee does this in batches (2.5 days)	Computer does this as it is being completed (1 second)
3. Input data from application into the information system	Applications are kept in paper form, although there is handling time involved (1 hour)	Employee does this in batches (2.5 days)	Done as part of the online application process (no extra time needed)
4. Assess loan applications under $250,000 to determine whether to fund them	Employee does this completely by hand (15 days)	Employee does this with the help of the computer (1 hour)	Computer does this automatically (1 second)
5. Committee decides on any loan over $250,000	(15 days)	(15 days)	(15 days)
6. Applicant notified	Employee generates letters manually in batches (1 week)	Employee generates letters with the help of a computer (1 day)	System notifies applicant via e-mail (1 second)
Total time	Anywhere from 25–40 days, depending on size of loan	Anywhere from 5–20 days, depending on size of loan	Anywhere from 15 minutes to 15 days, depending on size of loan

Note: Many online loan application services can now give you instant "tentative" approval pending verification of data you report in your online application. Also, only some of the activities within the manual and technology-supported processes can occur in parallel.

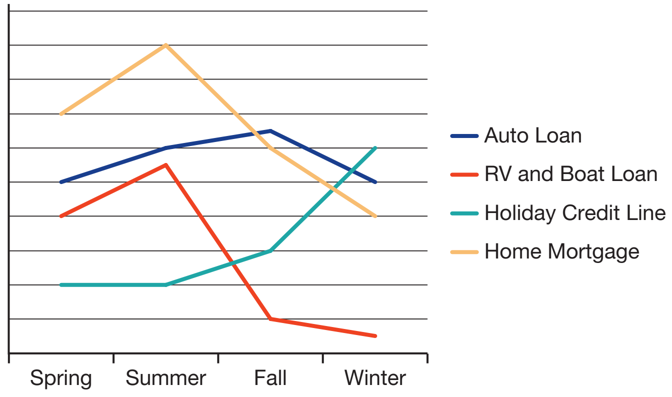


FIGURE 2.8

A computer-based loan processing system enables the bank manager to identify trends in loan applications.

but they can also help to gather valuable data for higher decision-making levels within the organization.

Information Systems for Organizational Learning: Doing Things Better

We can also use information systems to learn and improve. By analyzing data created when automating a process, improved understanding about the underlying work processes can be developed. The learning mentality builds on the automating mentality because it recognizes that information systems can be used as a vehicle for **organizational learning**—the ability of an organization to use past behavior and data to improve its business processes—and for change as well as for automation.

To illustrate a learning mentality, let us think again about our loan processing example. Figure 2.8 shows how a computer-based loan processing system can track types of loan applications by date, month, or season. The manager can easily see the trends and plan for the timely staffing and training of personnel in the loan department. The manager can also more efficiently manage the funds used to fulfill loans. This computer-based loan processing system, focusing on learning, is an example of an information system used at the managerial level of an organization.

A learning approach allows managers to track and learn about the types of applications filed by certain types of people at certain times of the year (e.g., more auto loan applications in the fall, mostly from men in their 20s and 30s), the patterns of the loan decisions made, or the subsequent performance of those loans. This new system creates data about the underlying business process that can be used to better monitor, control, and change that process. In other words, you *learn* from this information system about loan applications and approvals; as a result, you can do a better job at evaluating loan applications.

A combined automating and learning approach, in the long run, is more effective than an automating approach alone. If the underlying business process supported by technology is inherently flawed, a learning use of the technology might help you detect problems with the process and change it. For instance, in our loan processing example, a learning use of technology may help us uncover a pattern among the accepted loans that enables us to distinguish between low- and high-performing loans over their lives and subsequently to change the criteria for loan acceptance.

If, however, the underlying business process is bad and you are using technology only for automating (i.e., you would not uncover the data that would tell you this process is bad), you are more likely to continue with a flawed or less-than-optimal business process. In fact, such an automating use of technology may mask the process problems.

With a bad underlying set of loan acceptance criteria (e.g., rules that would allow you to approve a loan for someone who had a high level of debt as long as he or she had not been late on any payments recently), a person might manually review four applications in a day and, because of the problematic criteria used, inadvertently accept on average two "bad" applications per week. If you automated the same faulty process, with no learning aspects built in, the system might help a person review 12 applications per day, resulting in up to six "bad" applications accepted per week on average. The technology would serve only to magnify the existing

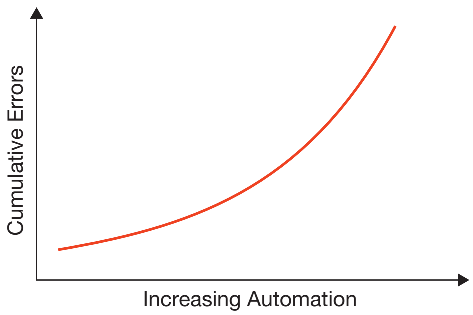


FIGURE 2.9

Automating a loan processing system requires sound underlying business processes, or errors will rapidly increase.

business problems (Figure 2.9). Without learning, it is more difficult to uncover bad business processes underlying the information system.

Information Systems for Supporting Strategy: Doing Things Smarter

Using information systems to automate or improve processes has advantages, as described previously. In most cases, however, the best way to use an information system is to support the organization's strategy. To understand why, think about **organizational strategy**—a firm's plan to accomplish its mission and goals as well as to gain or sustain competitive advantage over rivals—and how it relates to information systems. When senior managers—at the executive level of the organization—conduct **strategic planning**, they form a vision of where the organization needs to head, convert that vision into measurable objectives and performance targets, and craft a strategy to achieve the desired results. A person with a strategic mentality toward information systems goes beyond mere automating and learning and instead tries to find ways to use information systems to achieve the organization's chosen strategy, such as by innovating, streamlining operations, optimizing the supply chain, or better understanding customers. This person wants the benefits of automating and learning but also looks for some strategic, competitive advantage from the system. In fact, in today's business environment, if a proposed information system isn't going to clearly deliver some strategic value (i.e., help to improve the business so that it can compete better) while also helping people to work smarter and save money in the process, then it isn't likely to be funded. Returning to our loan example, a person with a strategic view of information systems would choose a computer-based loan application process because it can help achieve the organization's strategic plan to process loan applications faster and better than rivals and to improve the selection criteria for loans. This process and the supporting information system add value to the organization and match the organization's strategy. The system is, therefore, essential to the long-term survival of the organization. If, on the other hand, managers determine that the organization's strategy is to grow and generate new products and services, the computer-based loan application process and the underlying system might not be an efficient, effective use of resources, even though the system could provide automating and learning benefits.

Identifying Where to Compete: Analyzing Competitive Forces

Organizations struggle with identifying the best uses of their resources to execute their strategy. Whereas some companies have a competitive advantage by being the first to enter a market (i.e., having a **first-mover advantage**), most organizations have to compete within established industries. Given that every industry is different, organizations need to analyze the competitive forces within their industry to better understand where to focus their resources. One framework often used to analyze an industry is Porter's (1979) notion of the five primary competitive forces: (1) the rivalry among competing sellers in your industry, (2) the threat of potential new entrants into your industry, (3) the bargaining power that customers have within your industry, (4) the bargaining power that suppliers have within your industry, and (5) the potential for substitute products or services from other industries (Figure 2.10). Table 2.3 provides examples of how the Internet has influenced the various competitive forces in an industry. Porter's five-forces model of competition can help you determine which forces may be most important and which specific technologies could be used to address these forces. You can then use this knowledge as the basis for identifying particular investments.

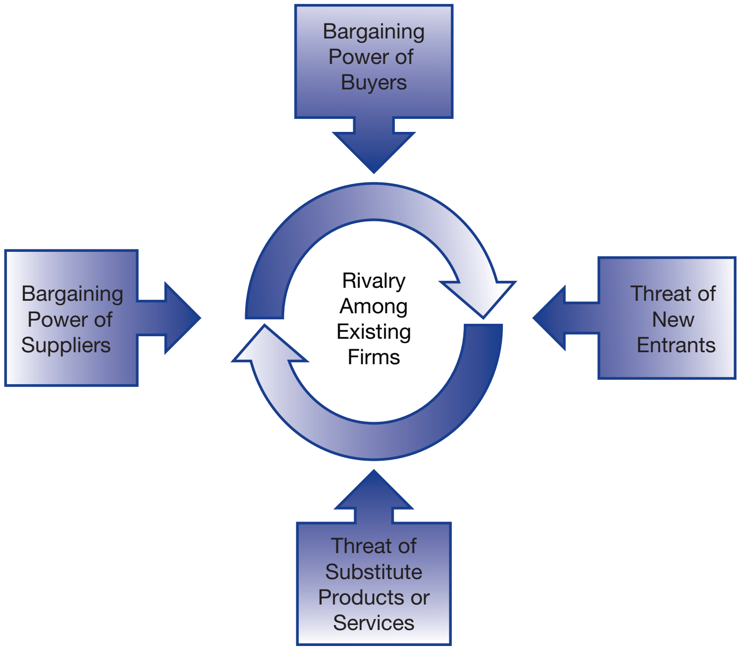


FIGURE 2.10

Five forces influence the profit potential of an industry.

Identifying How to Compete: Choosing a Generic Strategy

In order to achieve superior returns, a company needs to position itself within the industry it operates in so as to be able to counter the effects of the five forces and gain a competitive advantage (Porter, 1985, 2001). In Figure 2.11, we show some common organizational strategies organizations use to position themselves within the industry. An organization might decide to pursue a **low-cost leadership strategy**, as does Walmart, by which it offers the best prices in its industry on its goods and/or services. Alternatively, an organization might decide to pursue a **differentiation strategy**, as do Porsche, Nordstrom, and IBM, by which it tries to provide better products or services than its competitors. A company might aim that differentiation broadly at many different types of consumers, or it might focus on a particular segment of consumers, as Apple did for many years with its focus on high-quality computers for home and educational markets. Still other organizations might pursue a middle-of-the-road strategy, following a **best-cost provider strategy**, offering products or services of reasonably good quality at competitive prices, as does Dell.

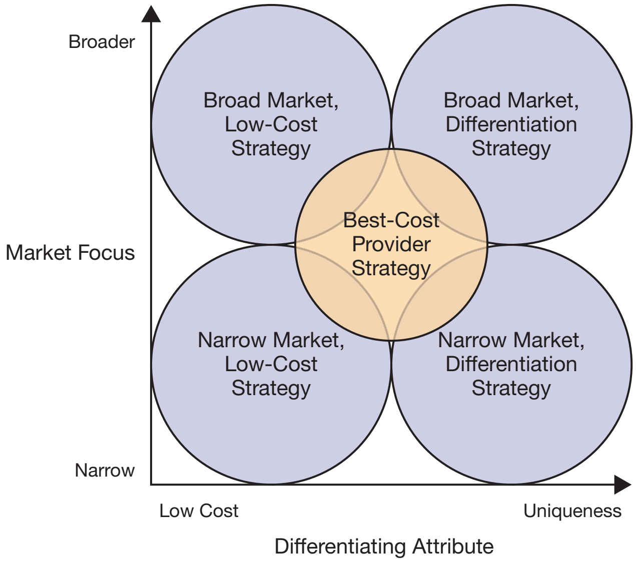
TABLE 2.3 The Influence of the Internet on the Competitive Forces

Competitive Force	Implication for Firm	Influence of the Internet
Traditional rivals within your industry	Competition in price, product distribution, and service	Increase of competitors due to wider geographic reach; customers can more easily compare products, so competition focuses more on price.
Threat of new entrants into your market	Increased capacity in the industry, reduced prices, and decreased market share	Reduced barriers to entry, as the Internet reduces the difficulty of obtaining critical resources or entering new markets.
Customers' bargaining power	Reduced prices, need for increased quality, and demand for more services	Wider choices for customers lead to lower switching costs and higher bargaining power of customers.
Suppliers' bargaining power	Increased costs and reduced quality	Companies have equal access to suppliers; easier to find new suppliers; suppliers have access to more potential buyers.
Threat of substitute products or services from other industries	Product returns from customers, decreased market share, and losing customers for life	New substitutes are created by the Internet and other information technologies.

Source: Based on *Corporate Information Strategy and Management*, 8e by Lynda Applegate, Robert Austin, F. Warren McFarlan, published by McGraw-Hill, 2008.

FIGURE 2.11

Five general types of organizational strategy: broad differentiation, focused differentiation, focused low-cost leadership, overall low-cost leadership, and best-cost provider.



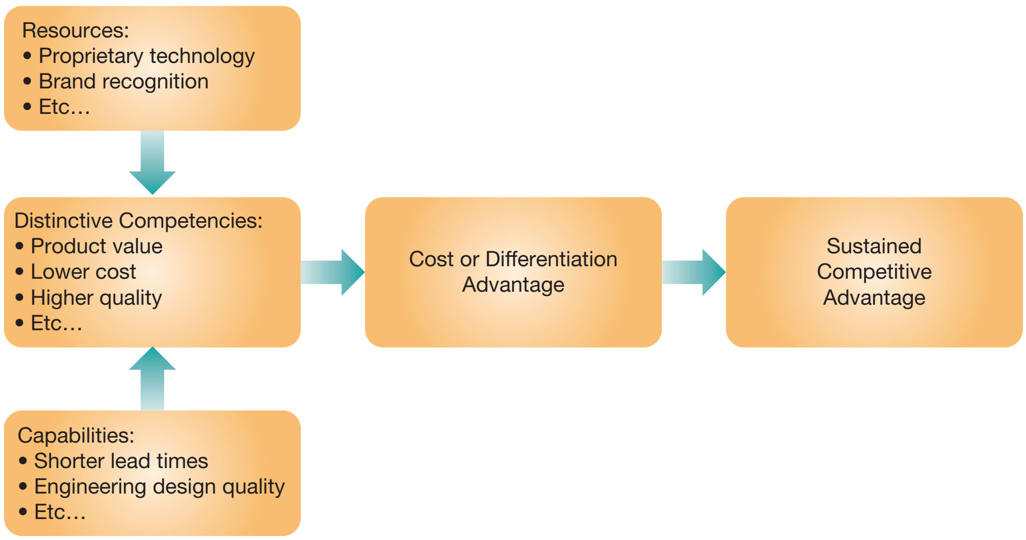
Identifying How to Compete: Resources and Capabilities

Choosing the right position not only helps a company attract customers but also helps focus investments in resources such as information systems and technologies to help gain a competitive advantage. In other words, no matter what generic strategy an organization chooses to pursue, it must have resources and/or capabilities that are superior to those of its competitors so as to gain or sustain a competitive advantage. **Resources** reflect the organization's specific assets that are utilized to achieve cost or product differentiation from its competitors. Examples of resources might include proprietary technology, brand equity, or a loyal and established customer base. **Capabilities** reflect the organization's ability to leverage these resources in the marketplace. For example, design quality or efficient operations could be capabilities that help a firm effectively utilize its resources. Together, the resources and capabilities provide the organization with **distinctive competencies**—such as innovation, agility, quality, or low cost—in the marketplace. These competencies help to pursue the organizational strategy (low-cost leadership, differentiation, etc.) and make the organization's product valuable to its customers relative to its competitors; superior **value creation** occurs when an organization can provide products at a lower cost or with superior (differentiated) benefits to the customer (Figure 2.12). This is how organizations gain a competitive advantage. For many organizations, information systems are at the heart of the different resources, capabilities, or distinctive competencies. Figure 2.13 provides examples of resources, capabilities, and distinctive competencies used by companies to sustain competitive advantage.

FIGURE 2.12

Distinctive competencies lead to value creation and a sustained competitive advantage.

Source: Based on Competitive Advantage, published by Quick MBA.com.



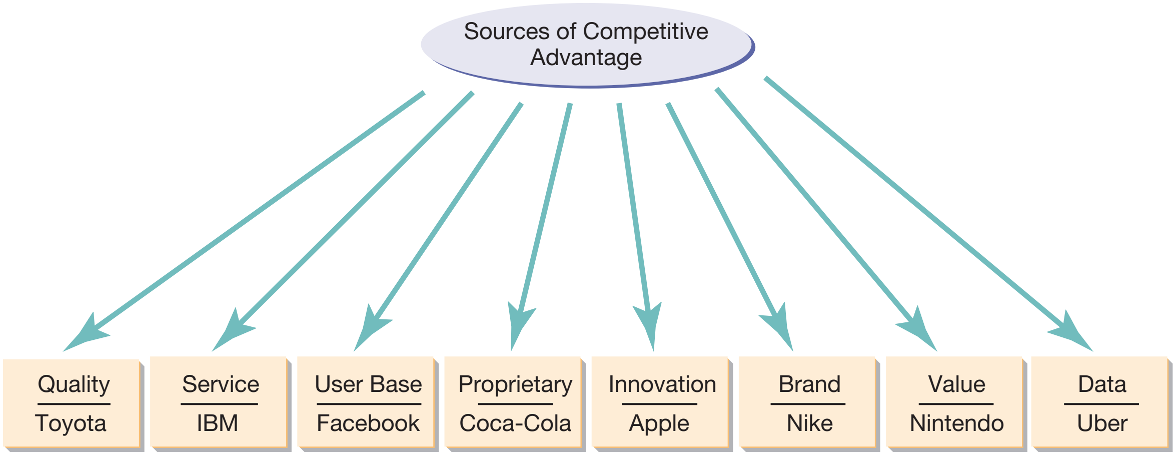


FIGURE 2.13

Sources of competitive advantage.

GREEN IT

The Electric Navy

To effectively execute its mission, the U.S. Navy is constantly testing and developing new technology. On common feature of these new technologies is an increased thirst for electric power. With geopolitical instability threatening access to traditional fuels and environmental concerns ever increasing, the Navy is seeking newer, greener options for powering the next generation of ships.

Modern naval combat can be as much about technological prowess as it is about brute force. The U.S. Navy's new Zumwalt-class destroyers are intended to up the technological ante. Designed with stealth features, the ship has the radar cross-section of a small fishing boat. However, introducing state of-the-art technologies also introduces new challenges. The ship's radar, sonar, and command and control systems draw tremendous amounts of power that on previous generations of ships would have had to come from generators. Next-generation weapons like rail guns, lasers, and particle weapons that are currently under development will increase the need for electric power even more. To help address this challenge, the USS Zumwalt, the first ship of the class, is the first Navy ship with a hybrid propulsion system. Just like a hybrid automobile, the ship has fuel-burning motors that power generators to fill storage batteries. Power from the batteries is then used to run both electric propulsion motors and the ship's systems. This arrangement allows for more efficient generation and flexible distribution of power between propulsion, sensors, and weapons systems.

Given the ever-increasing need for power and fuel, the Navy is also looking for alternatives to fossil fuels. Because technologies like nuclear power generation are too large and complex for smaller ships, the Navy is investigating biofuels as a greener, more available solution. In 2016, the Navy purchased 77 million gallons of biofuel made from beef fat to launch a fleet tour partially powered by green fuel. The fuel only constitutes 10 percent of the fleet's needs, however. The use of biofuels has also been criticized by politicians and environmentalists for not being particularly green—the amount of energy and petrochemicals that goes into growing the biomass used to produce the biofuel can be more than what would be used with traditional fossil fuels. Unfortunately, the use of renewable sources of power like solar and wind has its own challenges, such as requiring great leaps in energy storage technology. Until a better solution is found, the Navy will keep steaming ahead.

Based on:

Anonymous. (2016, February 16). Navy to launch carrier group powered partly by biofuels. *CBS8.com*. Retrieved May 29, 2016, from http://www.cbs8.com/story/31016171/navy-to-launch-carrier-group-powered-partly-by-biofuels

Biomass. (2016, May 20). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=Biomass&oldid=721248424

Zumwalt-class destroyer. (2016, May 18). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=Zumwalt-class_destroyer&oldid=720944689

Identifying How to Compete: Analyzing the Value Chain

Managers use value chain analysis to identify opportunities where information systems can be used to gain a competitive advantage (Porter, 1985, 2001; Shank & Govindarajan, 1993). Think of an organization as a big input/output process. At one end, supplies are purchased and brought into the organization. The organization integrates those supplies to create products and services that it markets, sells, and then distributes to customers. The organization also provides customer service after the sale of these products and services. Throughout this process, opportunities arise for employees to use information systems to add value to the product or service by acquiring supplies in a more effective manner, improving products, and selling more products. This set of activities that add value throughout the organization is known as the **value chain** within an organization.

Whereas the value chain model was initially created to focus on manufacturing, it can also be applied to service industries (sometimes with different activities being performed). For example, in a hotel, inbound logistics activities may include the receiving of supplies as well as handling reservations, and operations would include the day-to-day activities of checking guests in or out, cleaning rooms, preparing breakfast, and so on. Sales and marketing activities include promoting the hotel or attracting business meetings and conventions. Finally, customer service activities performed after the guest has left may include registering or resolving guest complaints. A typical hotel may, however, not perform any activities related to outbound logistics. Nevertheless, the supporting activities are likely to resemble those of other organizations. Other organizations may even lack both inbound and outbound logistics activities, and different activities may be classified differently. In the end, however, you should note that the value chain should serve as a tool to identify and analyze the different activities performed.

Value chain analysis is the process of analyzing an organization's activities to determine where value is added to products and/or services and what costs are incurred for doing so. In value chain analysis, you first draw the value chain for your organization by fleshing out each of the activities, functions, and processes where value is or should be added and where performance can be improved. Next, you determine the costs—and the factors that drive costs or cause them to fluctuate—within each of the areas in your value chain diagram. You then determine which activities need to be optimized so as to improve performance, cut costs, and ultimately gain or sustain competitive advantage.

The Role of Information Systems in Value Chain Analysis

Because information systems can automate and optimize many activities along the value chain, the use of information systems has become one of the primary ways that organizations improve their value chains. In Figure 2.14, we show a sample value chain and some ways that information systems can improve productivity within it. For example, many organizations use the

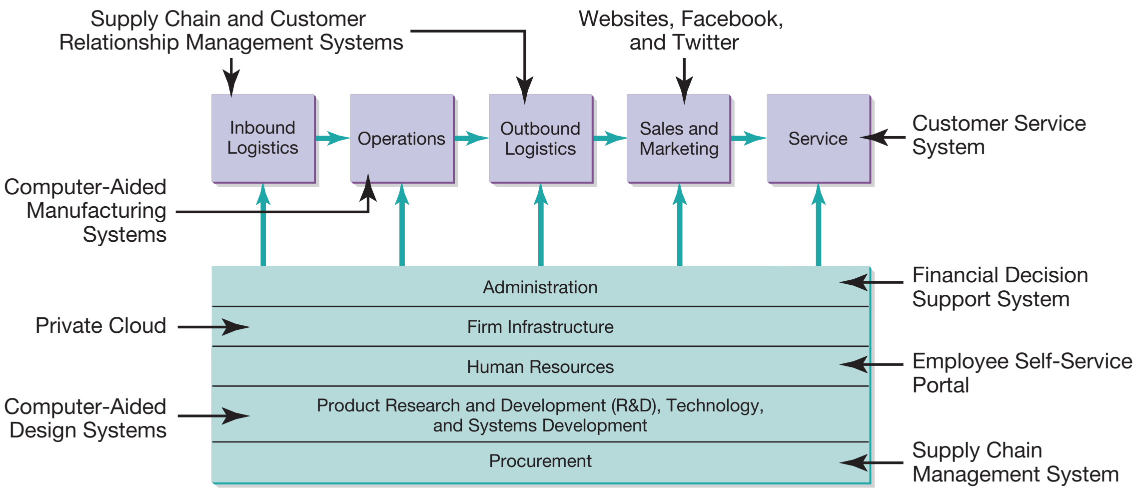


FIGURE 2.14

Information systems can improve an organization's value chain.

Internet to connect businesses with one another electronically so that they can exchange orders, invoices, and receipts online in real time. Likewise, organizations use various social media such as blogs, Twitter, or Facebook to connect with their customers.

The Technology/Strategy Fit

You might be asking, if any information system helps do things faster and better and helps save money, who cares whether it matches the company's strategy? Good question. If money grew on trees, you probably would build and use just about every information system you could imagine. Organizations could build or acquire many different valuable systems, but they are constrained by time and money to build or acquire only those that add the most value: those that help automate and learn as well as have strategic value. The old way for managers to think about information systems was that they were a necessary service, a necessary evil, and a necessary, distasteful expense that was to be minimized. Managers cannot afford to think this way anymore. Successful managers now think of information systems as a competitive asset to be nurtured and invested in and think of them as an enabler of opportunities and mechanism for supporting or executing their business model. In other words, organizations are trying to maximize **business/IT alignment**, and in most cases, they do not want systems that do not match the strategy, even if they offer automating and learning benefits. Further, while spending on information systems is rising, most companies are willing to spend money on projects only when they can see clear, significant value. Often, however, organizations have no choice in making some types of investments that may or may not coincide with their overall strategy. Such investments are called a **strategic necessity**—something the organization must do in order to survive.

Given this focus on the value that the system will add, an organization probably does not want a system that helps differentiate its products based on high quality when the organizational strategy is to be the overall industry low-cost leader. In other words, if a firm were pursuing a strategy for low-cost leadership, investments to help drive costs down would be valued over those that didn't. Throughout this book, we introduce various technologies, infrastructures, and services that can help to support an organization's competitive strategy.

We should also caution that merely choosing and implementing new or innovative information systems is not sufficient to gain or sustain competitive advantage. In any significant IS implementation, there must be commensurate, significant organizational change. This typically comes in the form of *business process management* and other similar methods of improving the functioning of the organization as opposed to merely dropping in an information system with no attempts at changing and improving the organization. We will talk more in Chapter 7, "Enhancing Business Processes Using Enterprise Information Systems," about the role of business process management for transforming organizational business processes. Further, an information system can be only as effective as the business model that it serves, and bad business models can't be overcome by good information systems. Next, we will discuss different business models in the digital world.

Business Models in the Digital World

We have examined how organizations can leverage technology investments to accomplish things faster, smarter, and more strategically. We also examined how to focus technology investments toward activities that provide competitive advantage and improve the performance of the organization's value chain. Taken together, organizations need to align their technology investments with their business model. A **business model** is a summary of a business's strategic direction that outlines how the objectives will be achieved; a business model specifies the **value proposition** as well as how a company will create, deliver, and capture value (Osterwalder & Pigneur, 2010) and identifies its customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partners, and cost structure. In other words, a business model reflects the following:

1. What does a company do?
2. How does a company uniquely do it?
3. In what way (or ways) does the company get paid for doing it?
4. What are the key resources and activities needed?
5. What are the costs involved?

WHO'S GOING MOBILE

Digital Nomads

The widespread availability of the Internet and the ever-increasing performance and capabilities of mobile technology have changed the way we work even while we're traveling. E-mail can be checked from the beach and documents edited from the airport. One side effect of these changes has been the opportunity to work in a location-independent way. If you can stay connected from wherever you are, why does it matter where you are when you work? This new approach has enabled the lifestyle of the "digital nomads." Digital nomads are people who live and work wherever they feel like, using the Internet and mobile technologies to connect with their customers or employers.

Popular locations for digital nomads share a few important criteria. The location must be an appealing place to live. As low cost of living and good weather are key drivers for many, digital nomads often choose places like Thailand, Indonesia, and Morocco. Those who seek more urban activities have located in cities like Bangkok, while beaches and resort towns are a draw for those looking to escape urban life. Next is good network connectivity. For digital nomads to be able to function effectively, they need to be able to connect to the Internet via Wi-Fi or cellular networks or otherwise in a reliable manner. Finally, community is important. The types of enterprises and business activities that are conducive to the digital nomad lifestyle often require collaboration. For example, entrepreneurial activities are more successful when you have access to like-minded individuals to share and develop ideas.

While the digital nomad lifestyle may seem like a dream come true, there are many challenges. For a digital nomad, it can be hard to earn as much money as a traditional employee, even with the same skill set—nomads often are challenged to maintain the kinds of relationships with their customers and employers that lead to lucrative contracts and more interesting assignments. There can also be a degree of resentment when customers and employers see pictures of nomads working in a hammock on the beach—whether or not this affects the quality of their work.

To be a successful digital nomad, it is not enough to just live location free through technology. The job you do must be conducive to the work style, and the skills you need will be different from those of a traditional employee. More emphasis is placed on building and retaining networks in order to keep the pipeline of opportunities full. However, with the right skill set, the right opportunities, and some careful planning, a digital nomad lifestyle may be right for you.

Based on:

Altringer, B. (2015, December 22). Globetrotting digital nomads: The future of work or too good to be true? *Forbes.* Retrieved May 29, 2016, from http://www.forbes.com/sites/forbesleadershipforum/2015/12/22/globetrotting-digital-nomads-the-future-of-work-or-too-good-to-be-true

How a company answers these questions dictates how and where information systems investments can be utilized to execute a competitive strategy and sustain an advantage over competitors. There are several components of a proper business model (Table 2.4). Each component plays a critical role in shaping all aspects of the business, including such factors as the expenses, revenues, operating strategies, corporate structure, and sales and marketing procedures. Generally speaking, anything that has to do with the day-to-day functioning of the organization is part of its business model, and information systems can be utilized to support and execute many aspects of the business model.

Revenue Models in the Digital World

Perhaps the most important ingredient for any organization is determining how to generate revenue. A **revenue model** describes how the firm will earn revenue, generate profits, and produce a superior return on invested capital (even nonprofit organizations need a revenue model). In addition to sales, transaction fees, and advertising-based business models common in the offline world, the Internet has enabled or enhanced other revenue models, such as **affiliate marketing** (see Table 2.5). Many companies selling products or services (such as Amazon.com) use the web as an economic medium to reach a large customer base; large numbers of customers allow these companies to turn over their inventory quickly, thus enabling the company to offer low prices while still making a profit. Other companies (such as Netflix.com) generate revenue using a subscription model where customers pay a monthly or annual fee for using the product or service. In addition, the *freemium* model has become a popular way of providing digital products or services in the digital world. This is discussed next.

TABLE 2.4 Components of a Business Model

Component	Description	Questions to Ask
Customer segments	The customers targeted with the product/service offering	Who will be our target customers? Who are the most important customers?
Value proposition	The utility that the product/service has to offer to customers	Why do customers need our product/service? What problems will our product/service solve? Why would customers choose our product/service over our competitors' products/services?
Channels	The ways in which the product/service offerings reach the target customers	How will our customers be reached? Which channels are best in terms of cost and convenience for the customers?
Customer relationships	The relationships formed with the target customers	What types of relationships do we build with our customers (e.g., one-off vs. long-term)? How do we maintain these relationships?
Revenue streams	The way a firm generates income	How do we generate income? What are we selling? What are customers willing to pay for?
Key resources	The most important assets needed to make the business model work	What key resources are needed to enable our value proposition, channels, customer relationships, and revenue streams?
Key activities	The most important activities needed to make the business model work	What key activities are needed to enable our value proposition, channels, customer relationships, and revenue streams?
Key partners	The network of partners and suppliers needed to make the business model work	Who are our key partners and suppliers? What resources do they offer, and what activities do they perform?
Cost structure	The costs incurred when operating the business model	What are the costs incurred when operating the business model? Which resources and activities are most expensive?

Source: Based on *Business Model Generation* by Alexander Osterwalder, Yves Pigneur, published by Wiley, 2010.

TABLE 2.5 Typical Revenue Models in the Digital World

Revenue Type	Description	Who Is Doing This?
Affiliate marketing	Paying businesses that bring or refer customers to another business. Revenue sharing is typically used.	Amazon's Associates program
Advertising	Free services are provided to customers and paid for by a third party.	Yahoo!, Google, Facebook, Twitter
Subscription	Users pay a monthly or yearly recurring fee for the use of the product/service.	Netflix, World of Warcraft, Spotify
Licensing	Users pay a fee for using protected intellectual property (e.g., software).	Symantec, Norton
Transaction fees/Brokerage	A commission is paid to the business for aiding in the transaction.	PayPal, eBay, Groupon, Scottrade, Airbnb, Uber
Traditional sales	A consumer buys a product/service from the website.	Amazon, Zappos, Nordstrom.com, iTunes
Freemium	Basic services are offered for free, but a premium is charged for special features.	Flickr, Skype, Dropbox.com

FREEMIUM. According to basic economics within a competitive marketplace, the price of something is set by its marginal cost—the cost of producing an additional unit of output. In recent years, the prices of computer processing, storage, and bandwidth—the fundamental building blocks for providing digital products or services—have been in a free fall, and cloud computing has turned many of these costs into variable costs. As the marginal costs of providing digital products of services continues to decrease, organizations are able to use a **freemium** ("free" + "premium") approach; using a freemium approach, an organization gives away limited versions of a product or service for free in order to build a large customer base and charges a premium for unrestricted versions (typically on a subscription basis). For example, the online photo-sharing application Flickr (owned by Yahoo!) allows users to store, share, organize, and tag a limited number of pictures for free, and users can upgrade to a paid "pro account," providing additional features, such as unlimited storage and advertisement-free browsing. Likewise, the cloud storage provider Dropbox offers free accounts with limited storage capacity and allows users to subscribe to accounts with larger storage space. Depending on the product or service offered, the restrictions of free versions can include limitations of features, bandwidth, storage, or number of users, or the product or service can be restricted to a certain class of users, such as educational users (see Figure 2.15).

Internet startups and app developers alike benefit from the ability to scale up quickly under the freemium approach; further, companies benefit from the paying subscribers as well as the free users, many of whom are likely to refer the product or service to their friends. However, a company choosing to use a freemium model has to carefully choose which features to offer for free. On the one hand, the free offerings have to be compelling enough to attract new users; on the other hand, if too many features are offered in the free versions, few people will be willing to pay for the more feature-rich versions. Often, a process of fine tuning and adjustments is needed to strike this balance; this is especially difficult if it involves reducing service levels of the free offering (as was the case when Microsoft reduced the free storage space of its OneDrive service from 15GB to 5GB in 2016).

The freemium business model has become extremely popular with mobile apps and, in particular, games. Mobile games such as Candy Crush Saga or Clash of Clans are free to download but offer players the option to make **in-app purchases**, allowing them to purchase access to extra features, content, or in-game currency. This allows the games to quickly build a huge user base in addition to generating continuous revenue streams. For example, in 2015, the free

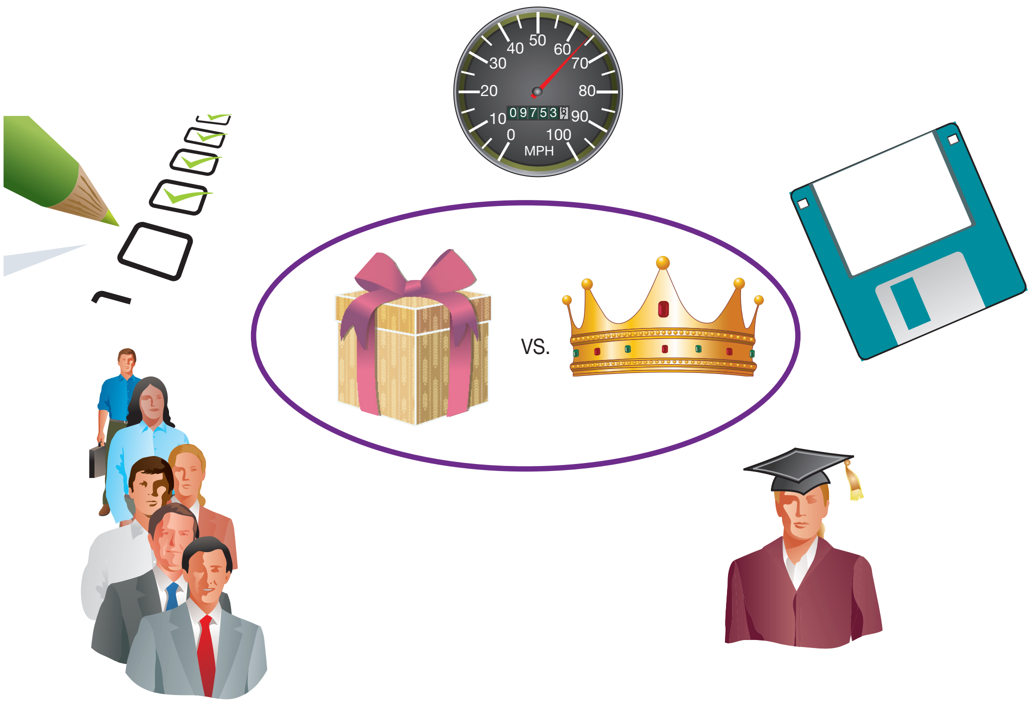


FIGURE 2.15

Under the freemium approach, typical restrictions of free versions include limitations of features, bandwidth, storage, type of user, or number of users.

WHEN THINGS GO WRONG

The Pains of Uber in China

Using a combination of social, mobile, and Big Data, the car hailing service Uber has built a successful business in many locations around the world by disrupting the local transportation industry. Entrenched, protected taxi monopolies have a hard time reacting and competing. What happens when the local transportation industry is willing to be just as disruptive? Many locales have attempted to protect their existing taxi systems legislatively or through the courts—Uber has been sued countless times. In China a competitor has taken a different tact—"out-disrupt" Uber.

Didi Kuaidi was formed by the merger of rival taxi-hailing services from Alibaba and Tencent—two of China's Internet giants. The service competed directly with Uber in the private car ride-sharing market but also went much further. Later renamed Didi Chuxing, the service let users select between a taxi, private car, shared car, shuttle van, or even bus. This gave Didi Chuxing enormous reach and market potential. In 2015, it arranged more than 1.4 billion rides—more than Uber has done worldwide since it was founded in 2009. In China's private car ride-sharing market, it was estimated that Uber had captured about a third while Didi Chuxing had the entire remaining two-thirds. However, as Uber first launched in China in 2014 and as of early 2016 only operated in the country's four largest cities, the question remained as to whether Uber would be able to recapture market share from Didi Chuxing as it expanded throughout the country.

At the same time, Didi Chuxing was not just sitting still and waiting for Uber to catch up. In addition to transportation services, Didi Chuxing planned to take advantage of the information it collected about users and usage, and even planned to start offering car loans to drivers and potentially even passengers. Further, Didi Chuxing let passengers book test drives of new cars from a variety of manufacturers—nearly 1.4 million test drives had taken place in less than a year. Lastly, Didi Chuxing was exploring the matchmaking business. The service let drivers and passengers select each other based on shared interests; started in partnership with LinkedIn, it allowed people to join their accounts across the two networks. Didi Chuxing has also invested in and forged partnerships with Uber's rivals in other markets like India and the United States. While Uber has been successful by following a strategy to disrupt traditional markets and power structures and to compete ruthlessly, it learned—as companies from Amazon to Google did before—that the regulatory environment in China often tends to favor local businesses. Facing an increasingly hostile regulatory environment, Uber was unable to compete with the powerful state-backed rival, and in mid-2016, decided to withdraw from the Chinese market, selling all its assets to its Chinese competitor in return for a minority stake in the company.

Based on:

Anonymous. (2016, January 30). More than mobility. *The Economist*. Retrieved May 29, 2016, from http://www.economist.com/news/business-and-finance/21689487-companys-ambitions-go-far-beyond-taxi-hailing-didi-kuaidi-dominating-uber-chinas

Kirby, W. C. (2016, August 2). The real reason Uber is giving up in China. *Harvard Business Review.* Retrieved August 9, 2016, from https://hbr.org/2016/08/the-real-reason-uber-is-giving-up-in-china

Naughton, J. (2016, August 7). Why Uber has been taken for a ride in China. *The Guardian*. Retrieved August 8, 2016, from https://www.theguardian.com/commentisfree/2016/aug/07/uber-china-free-trade-brexit

Uber (company). (2016, May 28). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=Uber_(company)&oldid=722506162

game Clash of Clans raked in more than US$1.3 billion, merely through in-app purchases. This, in turn, is beneficial for the players as well, as the game's developers depend on the revenue stream and are therefore incentivized to continuously update and upgrade the game experience.

Platform-Based Business Models and the Sharing Economy

Traditionally, many business models functioned like pipes, where products were produced and pushed to the customers (Choudary, 2013). The advent of the Internet, together with the megatrends mobile, social, and cloud computing, has enabled new business models, which are built around the concept of a platform. Rather than providing a product or service, a digital **platform** enables others—both other businesses and users—to co-create value (see Table 2.6). In essence, these business models are creating digital ecosystems where some users create value and other users consume. For example, users uploading content to Flickr or Wikipedia are producers of value that is consumed by others. Likewise, Uber and Airbnb are successful platforms that do not offer services themselves but depend on users to offer and consume services. As a result, the success of a platform is dependent on the network effect, and a platform only has value if users participate in the production or consumption; thus, any platform-based business model has to be

TABLE 2.6 Examples of Platform-Based Business Models

Value Created/Exchanged	Examples
Products	Amazon Marketplace, eBay
Services	Airbnb, Uber
Payments	Square, PayPal
Investments and funding	Kickstarter, Lending Club
Content	Wikipedia, Twitter, YouTube
Communication	WhatsApp, Skype
Collaboration	Dropbox
Social relationships	Facebook, LinkedIn

Source: Based on *What is a Platform?* by Alex Moazed, May 1, 2016, http://www.applicoinc.com/blog/what-is-a-platform-business-model/. Published by APPLICO INC.

attractive to both producers and consumers. Whereas platforms tend to be attractive as they often have negligible (or zero) marginal costs, they carefully have to think about how to monetize their services. For instance, Airbnb uses a transaction fee–based revenue model (charging both parties), whereas YouTube charges neither the producers nor the consumers but a third party (advertisers). Today, many pipe-based businesses include platform elements, such as reviews created by users. As we move further into the digital future, every business has to consider in how far its business model will include platform elements and how these will influence its business strategy.

Many of these platforms match producers and consumers directly without the need for traditional middlemen, a concept referred to as *disintermediation* (see Chapter 4, "Enabling Business-to-Consumer Electronic Commerce"). As increasingly, individuals are sharing not only content (such as opinions or media) but physical goods or services on dedicated platforms, many believe that we are moving toward a sharing economy. A **sharing economy** (sometimes referred to as **collaborative economy**) has been defined as "an economic system in which assets or services are shared between private individuals, either free or for a fee, typically by means of the Internet" (Oxford Dictionary, 2016). As ownership is shared, assets can often be used more effectively. For example, increasing population density makes individual car ownership increasingly infeasible but enables efficient car sharing. At the same time, shared ownership, facilitated by technological platforms, can help to utilize the car during (otherwise) idle times. In other words, it is not ownership that counts but being able to access the asset or resource. While initially, the concept of a sharing economy included social goals, such as waste reduction or increasing human interaction, this is now of lesser importance. Yet many companies within the sharing economy contribute to achieving greater social welfare. For example, research has shown that a vehicle used by a car-sharing platform such as car2go (a subsidiary of German automaker Daimler) can replace up to 13 privately owned vehicles, and for some, Uber replaces the need for owning a vehicle (see Figure 2.16). Likewise, platforms such as Craigslist or eBay encourage the selling of used goods, extending the usable life of many products.

Platform-based business models and the sharing economy are touted as offering many promises. In addition to benefits such as reduced car ownership or the reuse of otherwise-discarded goods, often-cited benefits include increasingly flexible work arrangements or people's ability to earn extra income by renting out their apartments to strangers using Airbnb or working as drivers for Uber. These business models, however, are not without criticism. For example, whereas the business models used by Uber or Airbnb disrupt traditional business models, often promising greater choices for end customers, they do so at a cost for humans and society. In this "**gig economy**," workers are not employed by the company, but are only hired for short-term, temporary jobs. In many cases, worker's rights—which people have fought for since the industrial revolution—are neglected, with workers having no protection against discrimination, no social security, little job security, and so on; likewise, income opportunities as well as social interactions

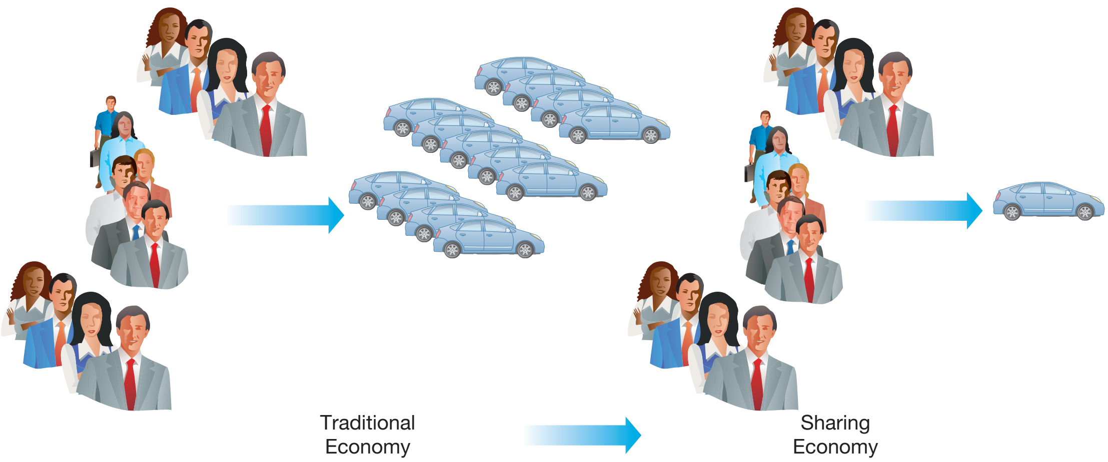


FIGURE 2.16

In the sharing economy, shared ownership reduces the need for individual ownership of cars and other goods.

with coworkers are often severely limited. Further, in their endeavor to disrupt traditional business models (such as hotels or limousine services), companies such as Uber and Airbnb try to gain a competitive advantage over traditional businesses by breaking (or at least bypassing) existing laws and regulations. While arguably, laws and regulations will (have to) adapt to new technologies in the short or long term, such behavior can often be regarded as unfair competition.

Service-Based Business Models

The Internet of Things, the rise in mobile devices, Big Data, and cloud computing have enabled another type of business models, centered around not selling products but providing these as services (sometimes referred to as **XaaS**, or "X as a service"). Many traditional manufacturers use pipe-based business models to produce goods which are then sold to the end users. Under a service-based business model, a manufacturer can offer equipment services, such as offering the product itself as a service or offering operations and optimization services, or information services, such as selling data or insights generated by the customer's usage of the product (see Figure 2.17). For example, manufacturers of jet engines, such as Rolls-Royce or GE, traditionally would sell engines to the owners of aircraft (such as airlines); however, as the bargaining power of buyers is high in the industry, the market for new engines is competitive, so much of the manufacturers' revenue typically comes from performing maintenance and selling spare parts. Under a service-based business model, in contrast, a manufacturer such as GE is being paid for guaranteeing continuous uptime, essentially

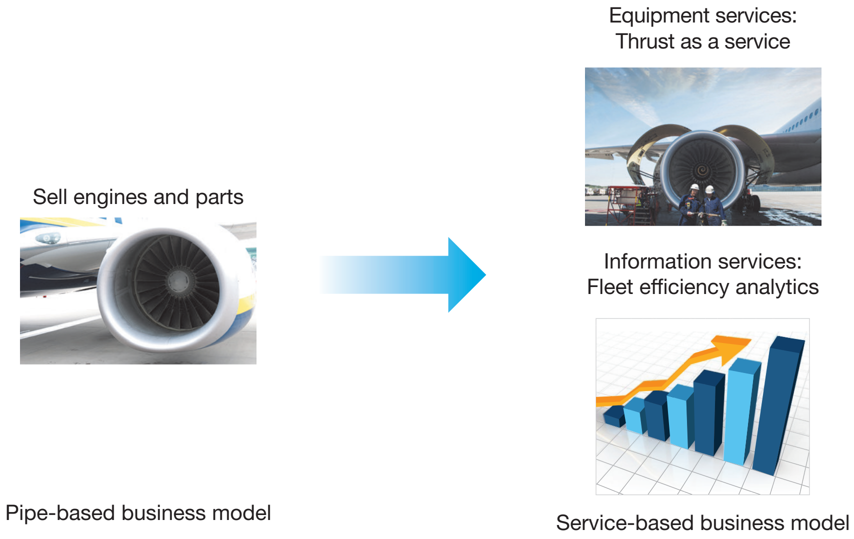


FIGURE 2.17

Under a service-based business model, a manufacturer can offer equipment services or information services.

Source: Sergioboccardo/Shutterstock; Christian42/Fotolia.

providing “thrust as a service.” The customer thus does not have to purchase the engine or spare parts but pays for hours of usage, transforming fixed costs into variable costs; the engine manufacturer only earns money for operating engines and thus has an incentive to improve the engine’s design and perform preventive maintenance. Obviously, such business models are only possible through rapid advances in Internet of Things technology; using a multitude of sensors integrated throughout the engines and connected to the Internet, GE can continuously monitor and analyze engine performance and use advanced analytics to predict potential engine failure and better schedule maintenance events. Similarly, Philips provides lighting as a service for 25 parking garages of the Washington Metropolitan Area Transit Authority; the transit authority needs no upfront capital for the lighting, and Philips installs and maintains the lighting and earns revenue through continuous energy-cost savings. These business models, however, require new thinking by the players involved. First of all, rather than focusing on minimizing manufacturing costs so as to increase profit margins, the manufacturers have to focus on life span and ease of maintenance/repair. Likewise, in order to maximize revenues, the manufacturers have to be able to monitor performance, predict outages, and schedule

ETHICAL DILEMMA

The Ethics of the Sharing Economy

The sharing economy is taking off. Two standouts have been Uber and Airbnb. Uber is a service that connects people in need of rides with drivers willing to give one. As of early 2016, Uber was available in more than 60 countries and 400 cities worldwide. Airbnb is a service that connects people looking for a place to stay with people who have a room or a house available to rent. As of early 2016, Airbnb had more than 1.5 million listings in 34,000 cities in 190 countries. As with any successful new business, many people are looking to duplicate successful business models and try to understand the secrets of success. Since both Uber and Airbnb have thrived on disrupting existing markets that are heavily regulated (i.e., taxi services and hotels), the question that comes to many people’s mind is: Are Uber and Airbnb breaking any laws or regulations to drive their success?

Taxi services are heavily regulated. To provide for rider safety, drivers must undergo extensive screening and background checks, and vehicles are regularly inspected. In addition, to control markets and limit the number of taxis in the street, the economics of taxi systems are often regulated at the city level. A medallion (taxi permit) is required to provide taxi services, and there are a limited number of them available. To own a medallion, a driver (or taxi company) must comply with all of the regulations and pay an often-substantial fee. To drive for Uber, no such fees or inspections are required—though the service has added background checks in certain jurisdictions. Likewise, hotels and other forms of lodging are regulated as well. In addition to the properties themselves being regulated for safety and security, many jurisdictions are interested in maintaining consistency in their zoning laws and ensuring the proper collection of tax revenue. Those renting out their apartment or house via Airbnb are not affected (or ignore) such regulations; further, as Airbnb hosts typically do not collect lodging (or occupancy) taxes from the guests, municipalities typically lose out on considerable tax revenues. Another criticism is the reduction of long-term housing associated with the unregulated renting of properties in residential neighborhoods.

Both Uber and Airbnb would argue that they are simply removing transactional friction from markets for services that are already permissible under existing laws. Others argue that Uber and Airbnb are simply shifting costs to others involved in the value chain for these services, such as drivers and homeowners. The challenge remains that the existing laws and regulatory frameworks provide for and protect existing economic stakeholders and interests. Whether new sharing economy entities like Uber and Airbnb are playing fair or not, these stakeholders will not take such challenges lying down. Expect more challenges and highly public disputes to come.

Questions

1. Should services like Uber and Airbnb have to follow the same rules and regulations as a taxi company or hotel? Why or why not? Explain.
2. Imagine creating a platform for individuals to connect and sell meals out of their home or apartment to paying customers in a way similar to Uber. What concerns could this raise?

Based on:

Airbnb. (2016, May 22). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=Airbnb&oldid=721592341

Millard, D. (2015, February 11). The sharing economy is not your friend. *Vice*. Retrieved May 29, 2016, from http://www.vice.com/read/the-case-against-Airbnb-and-uber

Uber (company). (2016, May 28). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=Uber_(company)&oldid=722506162

maintenance; all of this would not be possible without sensors connected to the Internet that provide continuous data streams and advanced Big Data analytics.

Making the transition from a product-oriented toward a service-based business model, however, is not without challenges. For example, whereas selling a product typically involves negotiating price and features, selling services involves not only developing new pricing models and implementing new business processes but also negotiating service level agreements with the customers (see Chapter 3, "Managing the Information Systems Infrastructure and Services"). Likewise, managing inventories and capacities is more challenging due to fluctuations in demand for services. Finally, the targeted customer segment for products is often different from that for services, which necessitates changes to marketing and communication with customers.

Valuing Innovations

Innovation is key for organizations attempting to gain or sustain a competitive advantage, be it through cost or differentiation. Companies that are leaders in their respective markets or have strong brands often tend to find it difficult to react appropriately to new trends, and Cisco's former CEO John Chambers predicted that almost half of today's leading businesses might not see the next decade (EY, 2016a). For organizations, **innovation** involves creating new products, processes, or services that return value to the organization (note that in contrast to merely inventing new products, services, or processes, innovation involves *realizing* the value). The most common form of innovation is incremental innovation, which involves enhancing or upgrading existing products, services, or processes. In contrast, **radical innovations** (sometimes called **disruptive innovations**) use a markedly new or different technology to access new customer segments and/or provide significantly greater benefits to existing customers and eventually marginalize or replace existing products or services (Chandy & Tellis, 1998) (see Table 2.7). When hearing *innovation*, people often only think about innovative products or services. Innovative products or services (even radical innovations), however, can easily be copied, and only focusing on these can be a dangerous path; in fact, many leading companies, ranging from Apple to Dyson, all too frequently have to engage in lawsuits to protect their innovations from copycats. Successful organizations thus go beyond product and service innovation and introduce other innovations such as new ways of earning revenue or entirely new business models. In their book *Ten Types of Innovation*, Keeley et al. (2013) outline how different types of innovations can help organizations gain or sustain competitive advantage (see Table 2.8).

Given that product performance innovations can often be easily copied, companies often combine multiple types of innovations to sustain competitive advantage. For example, Apple is typically known for its product innovations; yet, while the design and functionality of Apple's innovative products have been widely imitated, other companies find it difficult to copy Apple's product system innovations or customer engagement innovations. Likewise, computer manufacturer Dell combined profit model innovations (collecting money before building the product), process innovations (the built-to-order model), and channel innovations (selling computers online rather than in stores) as well as other types of innovation to challenge established computer manufacturers.

Most (if not all) of these innovations are enabled by or would not even be possible without information systems. For example, platform-based business models, such as used by Airbnb, would not be possible without the Internet; likewise, Uber's business model could not exist without mobile devices used by riders and drivers, and Uber would not be able to implement its dynamic pricing feature (called "surge pricing") without real-time analysis and prediction of traffic conditions and demand for services. For companies manufacturing physical products, process innovations enabled by robotics and the Industrial Internet of Things offer tremendous improvements in efficiency, product quality, agility, and flexibility, allowing companies to mass-produce customized products (see Chapter 4). Thus, an organization often must deploy new, state-of-the-art technologies to gain or sustain a competitive advantage. Although firms can choose to continually upgrade older systems rather than investing in new systems, these improvements can often at best give only a short-lived competitive edge.

To gain and sustain significant competitive advantage, firms must often deploy the latest technologies or redeploy and reinvest in existing technologies in clever, new ways. For example, architects and interior designers use **virtual reality (VR) headsets**—head-mounted devices

TABLE 2.7 Examples of Radical Innovations and Their Associated Displaced or Marginalized Technology

Radical Innovation	Displaced or Marginalized Technology
Digital photography	Chemical photography
Desktop publishing	Traditional publishing
Online stock brokerage	Full-service stock brokerage
Online retailing	Brick-and-mortar retailing
Free, downloadable greeting cards	Printed greeting cards
Distance education	Classroom education
Unmanned aircraft	Manned aircraft
Nurse practitioners	Medical doctors
Semiconductors	Vacuum tubes
Automobiles	Horses
Airplanes	Trains
Compact discs	Cassettes and records
MP3 players, music downloading, streaming	Compact discs and music stores
Smartphones	MP3 players, dedicated GPS navigation
Mobile telephony	Wire-line telephony
Tablets	Notebook computers
Xbox, PlayStation, smartphones	Desktop computers
3D printing	CNC milling
Camera drones	Helicopters for aerial filming/photography

enabling immersive three-dimensional experiences—such as Oculus Rift to allow customers to virtually explore planned buildings or offices before construction has started; likewise, Marriott used the Oculus Rift headset to "teleport" users to vacation destinations, and the tourism board of British Columbia produced 360-degree tours of the province. Virtual reality headsets are quickly becoming mainstream, with companies such as Samsung offering virtual reality cameras that allow capturing 360-degree videos that can be edited and viewed using Samsung's own "Gear 360" virtual reality headset. Similar to virtual reality, **augmented reality** uses information systems to enhance a person's perception of reality by providing relevant information about the user's surroundings; typically, special glasses or other devices are used to augment the user's view of the real-world environment with computer-generated content. An early application of augmented reality was Google Glass, eyeglasses with a tiny embedded screen, which augmented reality by displaying information about the wearer's surroundings, including weather information, public transportation schedules, reviews about a restaurant the wearer is looking at, and other useful information. Microsoft's HoloLens takes this concept a step further by enabling mixed reality, where the user's view of the real-world environment is augmented with 3D holographic content. While as of 2016, Google Glass was on hold, Microsoft's HoloLens was shipped to developers. No matter which products will eventually succeed in the marketplace, exciting new technologies are on the horizon.

But with the plethora of new information technologies and systems available, how can you possibly choose winners? Indeed, how can you even keep track of all the new breakthroughs,

TABLE 2.8 Ten Types of Innovation

Innovation	Description	Examples
Profit model innovation	Finding novel ways of generating revenues from offerings	Dropbox using a freemium approach; Microsoft offering Office 365 on a subscription basis; GE selling "thrust as a service"
Network innovation	Harnessing the capabilities and strengths of others	GlaxoSmithKline or Marriott using open innovation for new product or service ideas; Netflix running contests for improving movie recommendation algorithm; luxury hotels partnering with fashion designers
Structure innovations	Using the company's talent and assets in innovative ways	Southwest Airlines focusing on one aircraft type; Google allowing employees to use of 20 percent of their time for own projects
Process innovations	Changing primary processes used to produce product or service	Toyota pioneering lean production; Zara moving fashion from initial design to stores in 3 weeks
Product performance innovations	Creating novel products or improving existing products through differentiation	Dyson's Airblade hand dryers; Corning's "unbreakable" Gorilla Glass; Coke's customizable Coke bottles
Product system innovations	Creating bundles of complementary offerings	Microsoft bundling individual office programs into Office suite; Apple offering developer tools and app store to enable developers to create novel apps; Marriott letting users test drive GoPro HERO action cams
Service innovations	Supporting and enhancing value of offering	Zappos's WOW philosophy of delivering excellent customer service; Men's Wearhouse offering its customers to purchase free lifetime pressing
Channel innovations	Using innovative ways to connect offerings with customers	Niketown offering immersive experiences; Nespresso partnering with hotels and airlines
Brand innovations	Positioning the brand in innovative ways	Virgin family of brands; German discount grocer Aldi's Trader Joe's markets
Customer engagement innovations	Developing meaningful connections with customers	Swarm encouraging users to frequently "check in" to places; Apple tying customers to its ecosystem

Source: Based on *Ten Types of Innovation: The Discipline of Building Breakthroughs* by Larry Keeley, Helen Walters, Ryan Pikkel, Brian Quinn, published by John Wiley & Sons, 2013.

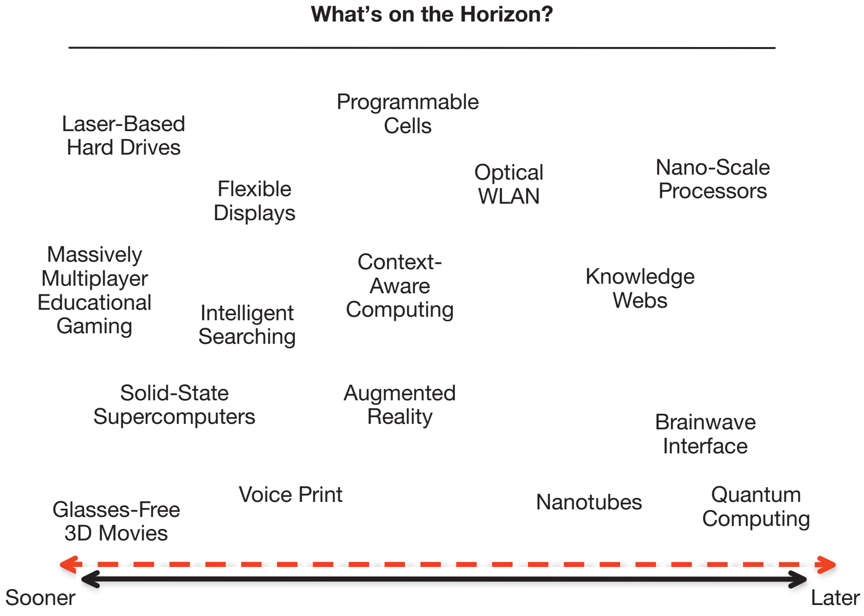
new products, new versions, and new ways of using technologies? For example, in Figure 2.18 we present a small subset of some new information technologies and systems, ranging from some that are here now and currently being used to some that are easily a decade away from being a reality. Which one is important for you? Which one will make or break your business? Does this list even include the ones that you need to be concerned about?

The Need for Constant IS Innovation

Sir John Maddox, a physicist and the editor of the influential scientific journal *Nature* for 22 years, was quoted in *Scientific American* in 1999 as saying, "The most important discoveries of the next 50 years are likely to be ones of which we cannot now even conceive." Think about that for a moment. Most of the important discoveries of the next 50 years are likely to be things that, at present, we have no clue about. To illustrate that point, think back to the state of the Internet back in 1999. Then the Internet was not on the radar screens of many business organizations. Those that had websites were mostly providing an electronic brochure to customers and weren't exploiting the technology to streamline business processes as is the norm today. Look now at how the Internet has transformed modern business. How could something so transformational not have been easier for businesses to imagine or predict a decade earlier? It is difficult to see these things coming. Next, we examine how you can improve your ability to spot and exploit new innovations.

FIGURE 2.18

Some enabling technologies on the horizon.



Successful Innovation Is Difficult

As we hinted at previously, there are limits to using emerging information systems to innovate and gain or sustain a competitive advantage. Information systems are often bought from or built by someone else. They are often either purchased from a vendor or developed by a consultant or outsourcing partner. In these situations, the information systems are usually not proprietary technologies owned by the organization. For example, although a soft-drink company can patent the formula of a cola or a pharmaceutical company can patent a new drug, an organization typically cannot patent its use of an information system, particularly if someone else developed it. The data in the system may be proprietary, but the information system typically is not.

INNOVATION IS OFTEN FLEETING. Given the pace of change in the digital world, advantages gained by innovations often have a limited life span. For example, even in situations where an organization has developed an innovative information system in-house, it usually did so with hardware, software, and networking components that others can also purchase. In other words, rivals can copy innovative information systems, so this form of competitive advantage can be short-lived. Indeed, if use of the new system causes one organization to gain a significant advantage over others, smart rivals are quick to duplicate or improve on that use of the system. Likewise, rivals can copy innovative products, services, or processes. One classic counterexample, however, is Amazon.com's patented "one-click" ordering process that has been successfully defended in the courts.

INNOVATION IS OFTEN RISKY. Choosing among innovative IS-related investments or potential product, service, or process innovations always entails risk. The classic example from consumer electronics is the choice of a videocassette recorder (VCR) in the early days of that technology and the competing Betamax (developed by Sony) and VHS (developed by JVC) formats. Most experts agreed that the Betamax had superior recording and playback quality, but VHS ultimately won the battle in the marketplace. People who made the "smart" choice at the time probably would have chosen a VCR with the Betamax format. Ultimately, however, that turned out to be an unfortunate choice. Recently, consumers again had to choose between two competing formats, namely, for high-definition (HD) DVD players, where the Blu-ray and HD DVD formats competed to become the industry standard. In this battle, Microsoft, Toshiba, and many others backed the HD DVD format, while Sony led the fight for Blu-ray (and even incorporated it into its PlayStation 3 gaming console). This time around, Sony (and the Blu-ray format) won the "format war," with the dissolution of the HD DVD Promotion Group in early 2008, effectively making Blu-ray the dominant format for HD video discs (Figure 2.19). Choosing among innovative IS-related investments is just as risky as choosing consumer electronics. In fact, for organizations, choosing among the plethora of available innovative technologies is far

FIGURE 2.19

Blu-ray has become the industry standard for high-definition DVD players.
Source: Matthew Jacques/Shutterstock.

riskier, given the size and often mission-critical nature of the investment. Choosing a suboptimal DVD player, although disappointing, is usually not devastating.

INNOVATION CHOICES ARE OFTEN DIFFICULT. Choosing new technologies in the IS area to develop innovative products, services, or processes is like trying to hit one of several equally attractive fast-moving targets. You can find examples of the difficulty of forecasting emerging technologies in the experiences that many organizations have had in forecasting the growth, use, and importance of the Internet. The 1994 Technology Forecast prepared by the major consulting firm Price Waterhouse (now PwC) mentioned the word *Internet* on only five pages of the 750-page document. The next year, more than 75 pages addressed the Internet. Only 3 years later, in the 1997 briefing, the Internet was a pervasive topic throughout. Back in 1994, it would have been difficult, perhaps even foolish, to forecast such pervasive, rapidly growing business use of the Internet today. Table 2.9 illustrates how many people and organizations have had difficulty making technology-related predictions.

Given the pace of research and development in the IS and components area, staying current has been nearly impossible. Probably one of the most famous metrics of computer evolution has been "Moore's law." Intel founder Gordon Moore predicted that the number of transistors that could be squeezed onto a silicon chip would double every 24 months (this number is now often reduced to 18 months), and this prediction has proven itself over the past 40 years (see Chapter 3). In fact, some computer hardware and software firms roll out new versions of their products every 3 months. Keeping up with this pace of change can be difficult for any organization.

Open Innovation

Given the difficulties associated with innovation, organizations increasingly realize that potential for innovation often exists outside of their boundaries and try to harness the creativity of external stakeholders. **Open innovation**, or the process of integrating external stakeholders into the innovation process, can thus prove very beneficial. For example, pharmaceutical giant Eli Lilly created a site called InnoCentive, where companies can post scientific problems and everybody can take a shot at solving the problem. Usually, a reward is paid to a successful solver. This way, an ad hoc research-and-development network is created, and companies have to rely less on a dedicated research-and-development department or on hiring specialists to solve a certain problem. At the same time, people can use their spare time and expertise to solve problems and earn rewards for their contributions. Other companies, such as P&G (Connect + Develop), Starbucks (My Starbucks Idea), Lego (Lego Ideas), Heineken (Innovators Brewhouse), and Marriott (Travel Brilliantly), successfully use open innovation to solicit ideas for novel products, services, or processes. Integrating external stakeholders into the innovation process, however, often involves making organizational data and knowledge accessible to the external stakeholders, so companies have to carefully balance the benefits and potential drawbacks of engaging in such initiatives.

TABLE 2.9 Some Predictions About Technology That Were Not Quite Correct

Year	Source	Quote
1876	Western Union, internal memo	"This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us."
1895	Lord Kelvin, president, British Royal Society	"Radio has no future. Heavier-than-air flying machines are impossible. X-rays will prove to be a hoax."
1899	C. H. Duell, commissioner, U.S. Office of Patents	"Everything that can be invented has been invented."
1927	H. M. Warner, Warner Brothers	"Who the hell wants to hear actors talk?"
1943	Thomas Watson, chairman, IBM	"I think there is a world market for maybe five computers."
1949	*Popular Mechanics*	"Where a calculator on the ENIAC is equipped with 18,000 vacuum tubes and weighs 30 tons, computers in the future may have only 1,000 vacuum tubes and weigh only 1.5 tons."
1957	Editor, business books, Prentice Hall	"I have traveled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won't last out the year."
1968	*BusinessWeek*	"With over 50 foreign cars already on sale here, the Japanese auto industry isn't likely to carve out a big slice of the U.S. market."
1977	Ken Olsen, president, Digital Equipment Corporation	"There is no reason anyone would want a computer in their home."
1989	Bill Gates, Microsoft	"We will never make a 32-bit operating system."
2004	Bill Gates, Microsoft	"Spam will be a thing of the past in two years' time."
2005	Sir Alan Sugar	"Next Christmas the iPod will be dead, finished, gone, kaput."
2007	Steve Ballmer, Microsoft	"There's no chance that the iPhone is going to get any significant market share."
2010	Steve Jobs, Apple	"This size is useless unless you include sandpaper so users can sand their fingers down to a quarter of their size." (speaking about 7-inch tablets)

Organizational Requirements for Innovation

Certain types of competitive environments require that organizations remain at the cutting edge in their use of information systems. For example, consider an organization that operates within an environment with strong competitive forces (Porter, 1979). The organization has competitive pressures coming from existing rival firms or from the threat of entry of new rivals. It is critical for these organizations to do things better, faster, and more cheaply than rivals. These organizations are driven to use information systems to develop innovative products, services, or processes.

These environmental characteristics alone, however, are not enough to determine whether an organization should deploy a particular information system. Before an organization can deploy any new system well, its processes, resources, and risk tolerance must be capable of adapting to and sustaining the development and implementation processes.

PROCESS REQUIREMENTS. To sustain competitive advantage through innovation, people in the organization must be willing to do whatever they can to bypass and eliminate internal bureaucracy, set aside political squabbles, and pull together for the common good. Can you imagine, for example, a firm trying to deploy a web-based order entry system that enables customers to access inventory information directly when people in that firm do not even share such information with each other?

RESOURCE REQUIREMENTS. Organizations focusing on innovation must also have the human capital necessary to implement innovative systems or to develop innovative products, services,

COMING ATTRACTIONS

The CITE Project

Smart technology is popping up in more and more places. Everything from our watches to our toasters to our cars can communicate on the Internet. However, not every smart tech idea will integrate well with the real world. How can manufacturers and innovators test their technologies prior to bringing them to market to avoid risking complete failure? The CITE Project may be the answer.

When an innovative technology is released into the real world, it is not always used the way the inventor originally envisioned. The so-called "law of unintended consequences" can yield some interesting side effects based on how people actually use technologies. Texting while driving, for example, has only recently been realized to be a substantial safety issue. New and innovative approaches are needed to mitigate these types of risks. In order to get a better handle on what some of these potential issues may be before technologies are widely deployed, the telecommunications and tech firm Pegasus Global Holdings is working with a variety of partners to build a complete city in the desert.

The Center for Innovation, Testing, and Evaluation (CITE) will be a full-scale city designed to represent a broad swath of environments from across the United States. There will be a city center with civic buildings and parks, office space, industrial parks, and a variety of residential areas. The goal is to be as realistic as possible, with the exception of actual residents. The plan is to build CITE in the desert of southern New Mexico, between the White Sands Missile Test Range (where the atomic bombs were tested) and the Mexico border.

CITE will allow new innovations to be tested at scale with minimal risk to the public. Everything from self-driving cars to smart homes to advanced thorium-based power supplies can be tried out in a controlled environment. This will give inventors the opportunity to see how their inventions actually behave in a real environment and make adjustments and improvements prior to bringing the technology to market. If successful, then maybe some of the pitfalls of widespread deployment of new technologies can be avoided. The challenge however, is that many of the unintended consequences of technologies are not realized until real people are allowed to use, misuse, and abuse them. Without actual residents and a real-world social context, critics doubt that CITE will be able to do more than serve as a glorified playground. As with any technology, though, the proof is in the doing—CITE could be operational as soon as 2018.

Based on:

Monks, K. (2015, October 6). CITE: The $1 billion city that nobody calls home. *CNN.* Retrieved May 29, 2016, from http://edition.cnn.com/2015/10/06/business/test-city/index.html

The Center, New Mexico. (2016, March 12). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=The_Center,_New_Mexico&oldid=709651961

or processes. The organization must have enough employees available with the proper systems knowledge, skills, time, and other resources to deploy these systems. Alternatively, the organization must have resources and able systems partners available to outsource the development of such systems if necessary.

RISK TOLERANCE REQUIREMENTS. The last characteristic of an organization focusing on innovation is that its members must have the appropriate tolerance for risk and uncertainty as well as the willingness to deploy and use new systems that may not be as proven and pervasive as more traditional technologies. If people within the organization desire low risk in their use of information systems, then gambling on cutting-edge systems will probably not be desirable or tolerable for them. Likewise, open innovation initiatives typically require sharing organizational knowledge with outside partners, and organizations trying to leverage outsiders in their innovation process have to be willing to accept the potential risks involved.

The Innovation Process

As you can see, using innovation to gain and sustain competitive advantage is difficult. For example, if you are using information systems to gain a competitive advantage in the area of operating efficiencies, it is likely that your rivals can just as easily adopt the same types of information systems and achieve the same gains. There are certainly ways to use information systems to create innovative products, services, or processes to gain a longer-lasting, sustainable competitive advantage; if you can use information systems to make your products or services unique or to cause your customers to invest so heavily in you that their switching costs are high (i.e., if switching to a competitor's product involves significant investment in terms of time and/or money for the customer), then you are better able to develop a competitive advantage that is sustainable over the long haul. For example, you might combine heavy investments in computer-aided design systems with very bright engineers in order to perfect your product and make it unique and something relatively difficult to copy. Alternatively, you might use a customer relationship management system to build an extensive database containing the entire history of your interaction with each of your customers and then use that system to provide very high-quality, intimate, rapid, and customized service that would convince customers that if they switched to a rival, it would take them years to build up that kind of relationship with the other firm.

ORGANIZING TO MAKE INNOVATION CHOICES. Given the need for constant innovation, how do organizations make decisions on which innovations to embrace and which to ignore? In the book *The Innovator's Solution*, Christensen and Raynor (2003) outline a process called the *disruptive growth engine*, which all organizations can follow to more effectively respond to radical innovations in their industry. This process has the following steps:

1. ***Start Early.*** To gain the greatest opportunities, become a leader in identifying, tracking, and adopting radical innovations by making these processes a formal part of the organization (budgets, personnel, and so on).
2. ***Display Executive Leadership.*** To gain credibility as well as to bridge sustaining and radical product development, visible and credible leadership is required.
3. ***Build a Team of Expert Innovators.*** To most effectively identify and evaluate potential radical innovations, build a competent team of expert innovators.
4. ***Educate the Organization.*** To see opportunities, those closest to customers and competitors (e.g., marketing, customer support, and engineering) need to understand how to identify radical innovations.

In addition to formalizing the identification of innovations within the organization, shifts in business processes and fundamental thinking about radical innovations are needed. Next, we examine how to implement the innovation identification process.

IMPLEMENTING THE INNOVATION PROCESS. Executives today who are serious about using information technology in innovative ways have made it a point to have their people be continually on the lookout for new radical innovations that will have a significant impact on their business. Wheeler (2002) has summarized this process nicely as the **disruptive innovation cycle** (Figure 2.20). The model essentially holds that the key to success for modern organizations is the

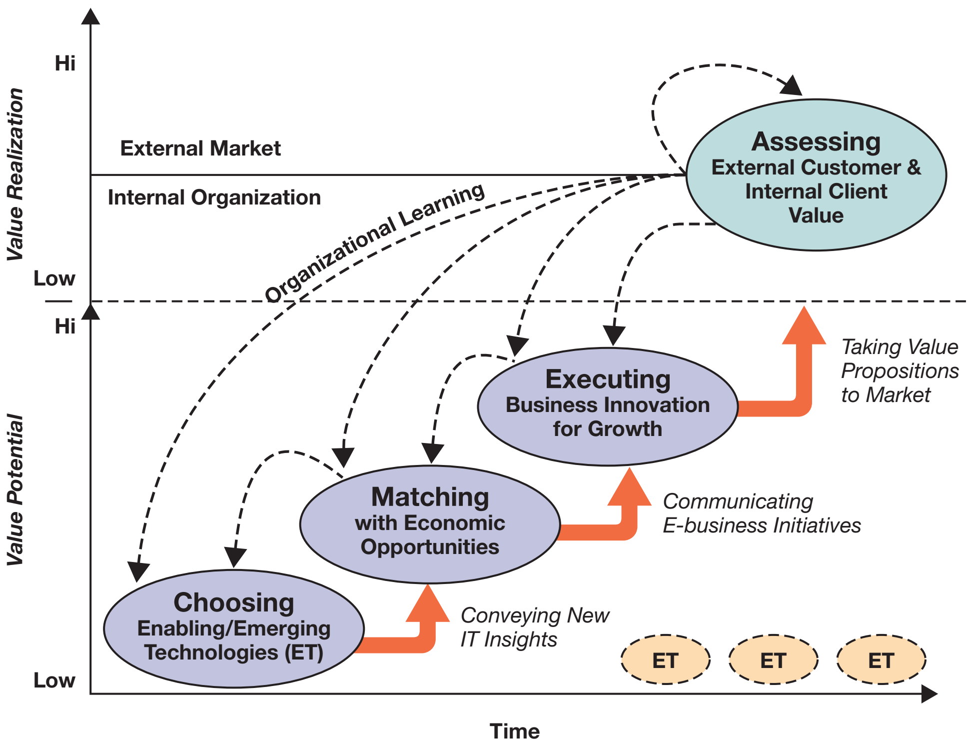


FIGURE 2.20

The disruptive innovation cycle.

Source: Based on *Information Systems Research*, Vol. 13, No. 2, pp. 125–146, 2002.

extent to which they use information technologies and systems in timely, innovative ways. The vertical dimension of the disruptive innovation cycle shows the extent to which an organization derives value from a particular information technology, and the horizontal dimension shows time. Next, we examine the cycle.

Choosing Enabling/Emerging Technologies The first bubble (lower-left) shows that successful organizations first create jobs, groups, and processes that are all devoted to scanning the environment for new emerging and **enabling technologies** (i.e., information technologies that enable a firm to accomplish a task or goal or to gain or sustain competitive advantage in some way) that appear to be relevant for the organization. For example, an organization might designate a small group within the IS department as the "Emerging Technologies" unit and charge the group with looking for new technologies that will have an impact on the business. As part of its job, this group will pore over current technology magazines, participate in Internet discussion forums on technology topics, go to technology conferences and conventions, and have strong, active relationships with technology researchers at universities and technology companies.

Matching Technologies to Opportunities Next, in the second bubble, the organization matches the most promising new technologies with current **economic opportunities**. For example, the Emerging Technologies group might have identified advances in 3D printing as a key enabling technology that now makes faster and cheaper prototyping feasible. In addition, managers within the marketing function of the firm have recognized that competitors have not released new models recently, and reducing product development cycle times can provide an opportunity to gain customers and market share.

Executing Business Innovation for Growth The third bubble represents the process of selecting—among myriad opportunities to take advantage of—those emerging technologies that have the biggest potential to address the current opportunities. The organization decides to acquire 3D printers that enable it to create prototypes much faster, helping the company to release new product models at shorter intervals, in order to attract new customers.

Assessing Value The fourth bubble represents the process of assessing the value of that use of technology, not only to customers but also to internal clients (sales representatives, marketing managers, the chief operating officer, and so on).

THINKING ABOUT INVESTMENTS IN RADICAL INNOVATIONS. The disruptive innovation cycle suggests three new ways to think about investments in radical innovations:

1. ***Put Technology Ahead of Strategy.*** This approach says that technology is so important to strategy and to success that you have to begin with technology. Notice that the first bubble involves understanding, identifying, and choosing technologies that are important. The first bubble does not begin with strategy, as a traditional approach to running a business organization would suggest. In fact, many would argue that given how important technology is today and how fast it changes, if you start with a strategy and then try to retrofit technology into your aging strategy, you are doomed. This approach argues that you begin by understanding technology and develop a strategy from there. This approach is admittedly very uncomfortable for people who think in traditional ways and/or who are not comfortable with technology. We believe, however, that for many modern organizations, thinking about technology in this way is key.
2. ***Put Technology Ahead of Marketing.*** The second way that this approach turns conventional wisdom on its head is that, like strategy, marketing also takes a backseat to technology. Think about it carefully, and you will see that marketing does not come into play until later in this model. A very traditional marketing-oriented approach would be to go first to your customers and find out from them what their needs are and what you ought to be doing with technology. The trouble with this approach is that, given the rapid evolution of technology, your customers are not likely to know about new technologies and their capabilities. In some sense, they are the last place you ought to be looking for ideas about new technologies and their impact on your business. Indeed, if they know about the new technology, then chances are your competitors already do too, meaning that this technology

SECURITY MATTERS

The Bangladesh SWIFT Theft

Information systems have made business faster and more efficient in almost any industry, from agriculture to banking. This has widely benefitted our society, but the flip side is that crime and theft can be faster and more efficient as well. Two banks in Southeast Asia recently learned the hard way that cybertheft can be massive and quick, with nearly US$81 million disappearing almost instantly and without a trace.

The Society for Worldwide Interbank Financial Telecommunication (SWIFT) is an organization that enables banks to rapidly clear financial transactions on a global basis. The society is owned by its members, who pay fees to provide for the technological infrastructure that enables quick and seamless financial transactions, such as clearing international money orders or settling very large transactions between governments and large financial services entities. The system has been in place since the 1970s and, as of September 2010, linked more than 9,000 financial institutions in 209 countries and territories, which were exchanging an average of more than 15 million messages per day.

In February 2016, attackers successfully penetrated the central banking system of Bangladesh and used the SWIFT system to initiate the transfer of nearly a billion dollars out of the country's accounts. US$81 million worth of these transactions cleared before a spelling error caught the attention of a recipient institution and the transfers were halted. The hackers not only gained access to the system and initiated the transfers, but they used malware to cover up their activity as well—as all transactions were logged to a hard-copy printer, the hackers intercepted the print jobs, effectively making the transactions invisible. This type of combined social-engineering and malware-based attack is very difficult to defend against and serves to illustrate the disparity in the level of sophistication between the attackers and the bank employees charged with protecting their systems. A few months later, the attackers struck again and moved an undisclosed amount of money in the Philippines.

One of the more disturbing aspects of these crimes is the fact that the SWIFT system itself was not compromised. However, attackers were able to exploit the weaknesses in security at a member organization bank and use that organization as a stepping-off point to the broader network. Once they were inside the system, they were assumed to be trusted actors executing legitimate transactions. SWIFT is investigating the implementation of additional network level security protocols and procedures but is simultaneously reminding member banks of the pressing need to secure their own houses as well. Still, the issues continue; in mid-2016, attackers had stolen large sums not only in Bangladesh but also from banks in Ecuador and the Ukraine.

Based on:

Corkery, M. (2016, May 12). Once again, thieves enter Swift financial network and steal. *The New York Times.* Retrieved May 29, 2016, from http://www.nytimes.com/2016/05/13/business/dealbook/swift-global-bank-network-attack.html

Gladstone, R. (2016, March 15). Bangladesh bank chief resigns after cyber theft of $81 million. *The New York Times.* Retrieved May 29, 2016, from http://www.nytimes.com/2016/03/16/world/asia/bangladesh-bank-chief-resigns-after-cyber-theft-of-81-million.html

Society for Worldwide Interbank Financial Telecommunication. (2016, May 27). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=Society_for_Worldwide_Interbank_Financial_Telecommunication&oldid=722327785

is not the one to rest your competitive advantage on. As Steve Jobs of Apple put it, "You can't just ask people what they want and then try to give that to them. By the time you get it built, they'll want something new."

3. ***Innovation Is Continuous.*** The third way that this approach is interesting—and potentially troubling—is that the process has to be ongoing. As shown along the time dimension at the bottom of the graph, the first bubble repeats over and over again as the Emerging Technologies group is constantly on the lookout for the "next new thing" that will revolutionize the business. The rate of information technology evolution is not likely to slow down, and innovative organizations truly cannot—and do not—ever rest.

Today, dealing with rapid change caused by radical innovations is a reality for most industries. If you are a leader in an industry, you must continually learn to embrace and exploit radical innovations, potentially *destroying* your existing core business while at the same time building a new business around the radical innovation. If you fail to do this, your competition may do it for you.

Startups and Crowdfunding

In recent years, we have witnessed the emergence of many highly successful innovative startups, with some having quickly developed into multibillion-dollar companies.

Startups—typically technology-based new ventures with high potential for scalability and growth—are often cofounded by entrepreneurs, developers, designers, or others with a promising idea. In the past, startups have been founded around services or platforms enabled by information systems. Advances in technologies such as 3D printing (see Chapter 1) have enabled hardware startups that build their business models around innovative physical objects, ranging from Coin's electronic credit card to the Square Reader developed by payment startup Square (which in early 2016 filed to go public). At the same time, 3D printing has the potential to disrupt traditional supply chains, as consumers will eventually be able to produce products in their own homes, opening up an even larger market for new, innovative ventures (EY, 2016b).

However, even with the ability to relatively quickly develop prototypes of innovative products, going from invention to developing product designs and manufacturing processes and then manufacturing enough stock to meet the planned initial demand requires not only a great idea for an excellent product but also knowledge about the business environment, connections with the business community, and often substantial financial resources. To obtain the needed support, many startups turn to so-called startup incubators, which provide various types of education and other resources. Relatedly, startup accelerators typically provide education, investment, and intense mentorship for cohorts of startups. On the other hand, angel investors can be a valuable source for funding (but often only provide limited education or mentorship). Recently, crowdfunding—though platforms such as Kickstarter or Indiegogo—has emerged as a novel form of obtaining project funding. **Crowdfunding** is the securing of business financing from individuals in the marketplace—the "crowd"—to fund an initiative (see Figure 2.21). Individuals who support a given initiative—called "backers"—pledge a certain amount of financial support to the project in return for certain benefits. In the case of Kickstarter, a funding campaign usually centers around a product—such as a smartphone case, a belt, an electronic gadget, or even a board game. Interested backers pledge money in support of the product, generally above a minimum

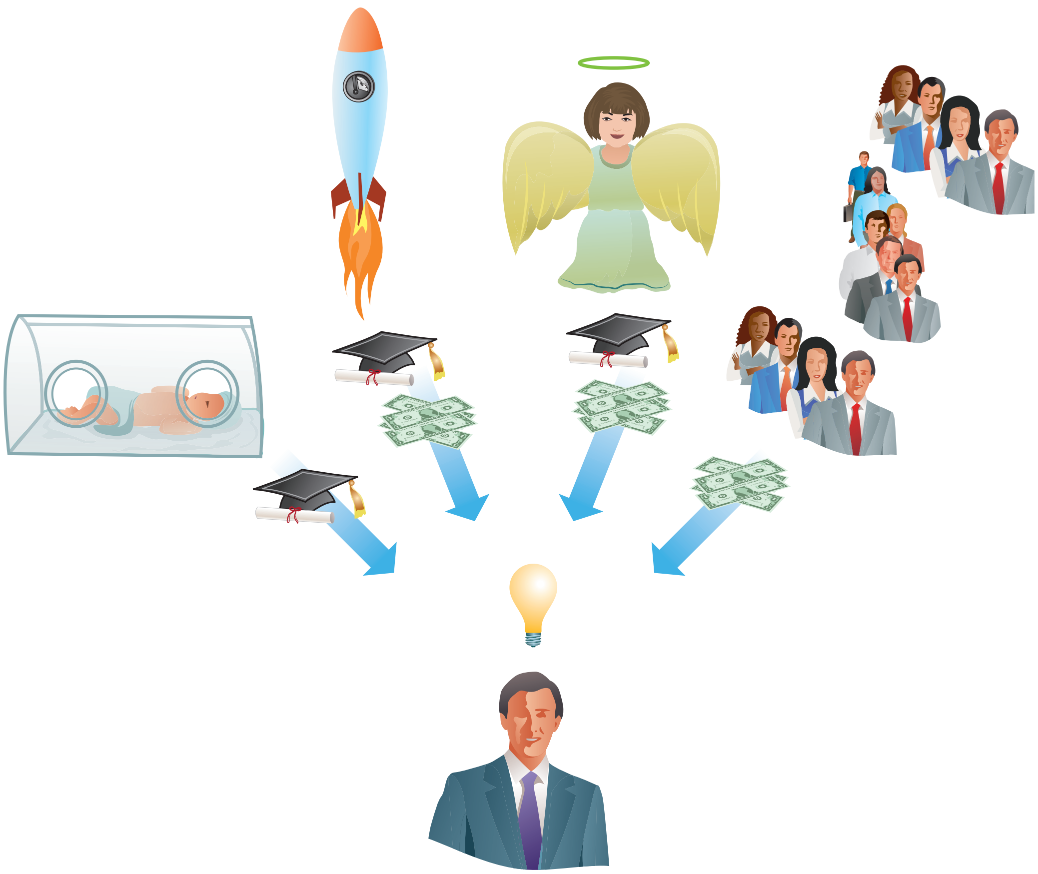


FIGURE 2.21
Inventors and startups can draw on many sources for support.

amount in return for one count of the item being backed. If (and only if) the campaign reaches its funding goal, the backers are charged the amount they pledged and the product goes into production. If too few backers are interested and the goal is not met, the campaign fails and no backers are charged any money. Kickstarter in particular has been very successful and has helped many campaigns get funded, totaling more than 135,000 projects with more than US$1 billion generated in pledges. Similarly, equity crowdfunding (sometimes called crowdinvesting) is the securing of financing from individuals, but the backers receive equity in return for their investment.

In this chapter, we examined how organizations can use information systems strategically, enabling them to gain or sustain competitive advantage over their rivals. As ongoing success depends on a sustained commitment to continuously learn and innovate, organizations must continuously search and apply the most effective business models.

INDUSTRY ANALYSIS

Education

For decades, the cost of higher education in the United States has steadily increased (an average increase of 16 percent every 5 years for the past four decades), and the average college graduate entered the workforce with about US$37,000 in student loans in 2016. Several emerging changes in the education industry hold the promise of bringing those costs down. Information systems are at the core of these exciting developments.

One way education is changing is through globalization. Universities increasingly partner with other universities around the world, encouraging collaboration among researchers, consistency in curriculum design, and cross-border movement of students, graduates, and faculty. Many countries outside of the United States and other Western countries are investing heavily in their education systems, and there are now many universities in less developed parts of the world that can compete with the best of the "old-school" Ivy League universities. The global economy has produced an equally global education system.

Along with the trend of globalization, many universities are extending their reach by implementing online courses or, in many cases, whole degrees that can be obtained via remote, self-directed courses delivered over the Internet. These programs are typically far less expensive to administer because once the materials are produced and refined, they can be used repeatedly by large groups of (paying) students. Some argue that such courses are less engaging and/or less effective, and there may be some truth to that. Regardless, universities continue to forge ahead in finding new ways to reach more students.

Another recent trend in education is the proliferation of so-called massively open online courses (MOOCs). These courses, which are freely available to the public, are able to effectively reach millions of students. Some very prestigious schools participate in providing these free courses, including Stanford, Wharton School of Business, UC Berkley, MIT, and Harvard. While the course content is provided free of charge, many of these institutions generate revenue by charging students for certifications or tutoring services.

Clearly, higher education is changing rapidly and in very significant ways, and technology has enabled each of these changes.

Questions

1. Are online courses better or worse as compared with traditional, face-to-face courses? Why?
2. In what ways could technology be used to improve on the deficiencies of online courses?

Based on:

Anonymous. (2016, May 2). African Universities urged to utilize online interactions. *Citi FM Online.* Retrieved May 29, 2016, from http://citifmonline.com/2016/05/02/african-universities-urged-utilize-online-interactions

Anonymous. (2016). A look at the shocking student loan debt statistics for 2016. *Student Loan Hero.* Retrieved May 29, 2016, from https://studentloanhero.com/student-loan-debt-statistics-2016

Friedman, J. (2016, May 12). 3 reasons to try out MOOCs before applying to college. *US News and World Report.* Retrieved May 29, 2016, from http://www.usnews.com/education/online-education/articles/2016-05-12/3-reasons-to-try-out-moocs-before-applying-to-college

Massive open online course. (2016, May 24). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=Massive_open_online_course&oldid=721913401

Key Points Review

1. ***Discuss how information systems can be used for automation, organizational learning, and strategic advantage.*** Information systems are used at different levels of an organization to support automating and organizational learning and to support strategy. To apply information systems strategically, you must understand the organization's competitive landscape as well as the value chain and be able to identify opportunities in which you can use information systems to make changes or improvements in the value chain to gain or sustain a competitive advantage.
2. ***Describe how information systems support business models used by companies operating in the digital world.*** Organizations utilize information systems investments as a central component for executing their business models and delivering their value proposition. Common revenue models include affiliate marketing, subscriptions, licensing, transactions fees, sales, and web advertising revenue. The freemium model for providing digital products or services has become a widely used strategy for quickly building a large user base and monetizing additional features provided. Fueled by information systems, many organizations are extremely successful by building platforms or offering their products as services.
3. ***Explain why and how companies are continually looking for innovative ways to use information systems for competitive advantage.*** In order to gain or sustain competitive advantage, organizations have to continuously innovate. As product innovations are often easily copied, organizations have to combine various types of innovation in their business models. Given that new technologies are not as stable as traditional ones, being at the technological cutting edge is typically quite difficult to execute. To best deploy new technologies, organizations must be ready for the business process changes that will ensue, have the resources necessary to deploy new technologies successfully, and be tolerant of the risk and problems involved in being at the cutting edge. Deploying emerging information systems is an ongoing process in which organizations should continuously scan the environment for emerging and enabling (and potentially disruptive) technologies, narrow down the list to those technologies that match with the challenges the firm faces or that create economic opportunities, choose a particular technology, implement it in a way that enables them to gain or sustain a competitive advantage, and assess the value of the technology.

Key Terms

MyMISLab™

Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

MyMISLab **2-1.** Compare and contrast the characteristics of the operational, managerial, and executive levels of an organization.

2-2. Compare and contrast automating and learning.

2-3. Describe competitive advantage and list six sources.

2-4. How do an organization's resources and capabilities result in a competitive advantage?

2-5. Compare and contrast pipe- and platform-based business models.

MyMISLab **2-6.** What is the freemium model, and how can a business successfully use this approach?

2-7. Why is successful application of innovative technologies and systems often difficult?

MyMISLab **2-8.** How can information systems help in combining multiple types of innovation?

2-9. Using past examples, explain what is meant by a radical innovation.

2-10. Describe the disruptive innovation cycle.

Self-Study Questions

2-11. ______________ is using technology as a way to help complete a task within an organization faster and, perhaps, more cheaply.
A. Automating
B. Learning
C. Strategizing
D. Processing

2-12. What are new technologies, products, or services that eventually surpass the existing dominant technology or product in a market called?
A. open innovation
B. radical innovation
C. incremental innovation
D. radical change

2-13. Which of the following is *not* improving the value chain?
A. improving procurement processes
B. increasing operating costs
C. minimizing marketing expenditures
D. streamlining production processes

2-14. A company is said to have ______________ when it has gained an edge over its rivals.
A. monopoly
B. profitability
C. competitive advantage
D. computer advantage

2-15. Each of the following was described in this chapter as a source of competitive advantage *except* for ______________.
A. delivering superior customer service
B. achieving lower cost than rivals
C. being the subject of a hostile takeover
D. having shorter lead times in developing and testing new products

2-16. ______________ involves creating new products, processes, or services that return value to the organization.
A. Startup culture
B. Creativity
C. Invention
D. Innovation

2-17. What is the process of choosing, matching, executing, and assessing innovative technologies called?
A. environmental scanning
B. disruptive innovation cycle
C. strategic planning
D. none of the above

2-18. The revenue model involving the referring of customers to another business is called ______________.
A. referral marketing
B. Internet marketing
C. affiliate marketing
D. ad marketing

2-19. At the ______________ level of the organization, functional managers (e.g., marketing managers, finance managers, manufacturing managers, and human resource managers) focus on monitoring and controlling operational-level activities and providing information to higher levels of the organization.
A. operational
B. managerial
C. organizational
D. executive

2-20. A supervisor's having to decide when to reorder supplies or how best to allocate personnel for the completion of a project is an example of a(n) ______________ decision.
A. structured
B. unstructured
C. automated
D. delegated

Answers are on page 84.

Problems and Exercises

2-21. Match the following terms with the appropriate definitions:

i. value chain analysis
ii. freemium
iii. managerial level
iv. value chain
v. disruptive innovation cycle
vi. sharing economy
vii. platform
viii. open innovation
ix. radical innovation
x. operational level

a. A business model that enables others—both other businesses and users—to co-create value, such that some users create value and other users consume
b. The process of analyzing an organization's activities to determine where value is added to products and/or services and the costs that are incurred for doing so
c. An economic system in which assets or services are shared between private individuals, either free or for a fee, typically by means of the Internet
d. The middle level of the organization, where functional managers focus on monitoring and controlling operational-level activities and providing information to higher levels of the organization
e. A model suggesting that the extent to which modern organizations use information technologies and systems in timely, innovative ways is the key to success
f. Giving away limited versions of a digital product or service for free in order to build a large customer base, and charging a premium for unrestricted versions
g. The set of primary and support activities in an organization where value is added to a product or service
h. An innovation that uses markedly new or different technology to provide significantly greater customer benefits, and eventually marginalizes or replaces existing products or services
i. The process of integrating external stakeholders into the innovation process
j. The bottom level of an organization, where the routine day-to-day interactions with customers occur

2-22. Using a business or organization that you are familiar with, contrast the operational, managerial, and executive levels by contrasting each level's typical activities, types of decisions, and information needs.

2-23. Using your own life, contrast several structured versus unstructured decisions that you regularly have to make.

2-24. Identify a company utilizing the distinct competitive strategies shown in Figure 2.11; provide evidence to support your selection.

2-25. Of the five competitive forces presented in the chapter (Porter's model), which is the most significant for an organization in terms of making IS investment decisions? Why? Which is the least significant? Why?

2-26. Using a company or organization that you are familiar with, map its various business processes into a value chain.

2-27. Using a business or organization that you are familiar with, analyze the organization's business model, including its customer segments, value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partners, and cost structure.

2-28. Go to Amazon.com's affiliate site. How does affiliate marketing at Amazon.com work? How do Amazon .com's business partners get paid? Who can sign up for this service?

2-29. Find and describe an example not discussed in this chapter that demonstrates the freemium revenue model.

2-30. Find and describe an example not discussed in this chapter that demonstrates the use of multiple types of innovation.

2-31. Find and describe an example not discussed in this chapter that demonstrates the transition from a product-based to a service-based business model.

2-32. Find and describe an example not discussed in this chapter that demonstrates the successful application of a platform-based business model.

2-33. Why shouldn't every organization deploy innovative information systems? What are some of the recommended characteristics of an organization that are necessary for that organization to successfully deploy innovative technologies?

2-34. Identify examples not discussed in the chapter of radical innovations that successfully displaced or marginalized an industry or technology.

2-35. What are the benefits of open innovation? For an organization, why may open innovation be problematic?

Application Exercises

Note: The existing data files referenced in these exercises are available on the book'swebsite: www.pearsonhighered.com/valacich.

Spreadsheet Application: Valuing Information Systems

2-36. The cost of maintaining information systems is high for Campus Travel. You have been assigned to evaluate the total cost of ownership (TCO) of a few systems that are currently in use by Campus Travel employees. Take a look at the TCO.csv file to obtain the list of systems that are in use and the costs associated with maintaining the software, hardware, and the associated personnel for each type of system. Calculate the following for your operations manager:

- The costs for server hardware by adding a new row to include web servers. This includes US$4,500 for the main campus and US$2,200 for the other campuses.
- The TCO for the entire information system used at Campus Travel. Hint: Sum all the values for all the systems together.
- The TCO for servers and network components of the information system.
- Make sure that you format the table, including using the currency format, in a professional manner.

Database Application: Building a System Usage Database

2-37. To understand the assets in Campus Travel, the IS manager has asked you to design a database that would be able to store all the assets. Your manager asks you to do the following:

- Create a new blank database called asset.mdb.
- Create a new table called "assets" in the asset database with the following fields:
  a. Item ID (Text field)
  b. Item Name (Text field)
  c. Description (Memo field)
  d. Category (hardware, software, other)
  e. Condition (new, good, fair, poor)
  f. Acquisition Date (Date field)
  g. Purchase Price (Currency field)
  h. Current Value (Currency field)

Team Work Exercise

Net Stats: Online Searching

The Google search engine has become so popular with Internet users that the word *Google* is often used as a verb ("I Googled the restaurant to see its reviews"), but there are other well-known search engines, such as Yahoo! and Microsoft's Bing. Table 2.10 shows the percentage of Internet surfers who used each search engine (i.e., the search engines' market share) in June 2016 as compared with June 2014.

Questions and Exercises

2-38. Search the web for the most up-to-date statistics about the search engine market.

2-39. As a team, interpret these numbers. What is striking/important about these statistics? How do the numbers compare to your own search behavior?

2-40. How have the numbers changed? Will there be other important players in the search engine market?

2-41. Using your spreadsheet software of choice, create a graph/figure that effectively visualizes the statistics/changes you consider most important.

TABLE 2.10 Top Search Engines by Market Share, June 2016 Compared with June 2014

Search Engine	June 2016 Market Share (%)	June 2014 Market Share (%)	Change (percentage points)
Google	77.6	73.4	3.2
Baidu	6.0	14.4	–8.4
Yahoo!	6.2	6.6	–0.4
Bing	8.7	4.9	3.8
Others	1.5	0.8	0.7

Source: Based on Top Search Engine Share Trend, published by Net Applications.com, 2015.

Answers to the Self-Study Questions

2-11. A, p. 53 **2-12.** B, p. 77 **2-13.** B, p. 60 **2-14.** C, p. 56 **2-15.** C, p. 60
2-16. D, p. 69 **2-17.** B, p. 69 **2-18.** C, p. 62 **2-19.** B, p. 51 **2-20.** A, p. 50

CASE 1 | Groupon

It comes as no surprise that the Internet has not only helped advance traditional business models but also enabled entirely new types of business models. The web is more flexible than real-life society in many ways, changing how we communicate with friends and family, changing how we work, and clearly changing the way we shop for products and services. This flexibility is a catalyst for the creation of a seemingly endless array of new types of businesses or the reinvention of tried-and-true business models of the past.

One example is the highly popular website Groupon, which prompts consumers to buy daily group deals in order to benefit from discounts from national and local businesses. Groupon's business model is to partner with established merchants looking to clear out seasonal stocks or excessive supply or to work with newer businesses looking to build a customer base. As the merchants sell higher volume, the cost per unit decreases (at least up to some point). This is where the "group" in Groupon comes in: A deal only goes through when a certain, predetermined number of Groupon subscribers signs up for it; once this number is reached, everyone who signed up for the deal enjoys the lower price. Groupon took the old-fashioned business model of using coupons to attract customers and married it with the network effects and economies of scale capabilities of the Internet to create a new and reasonably successful business model.

In 2016, Groupon had nearly 50 million active customers in 27 countries, operating in more than 500 cities worldwide; Groupon's annual revenue was about US$6.2 billion. Being an early player in the group-buying market and rapidly gaining market share, Groupon enjoyed a first-mover advantage and grew very quickly. In 2010, Groupon went public at a valuation of US$13 billion, trading up to nearly US$20 billion on the first day. Soon after, the stock value "tanked," and the company has been worth about half (or less) of its IPO value ever since. Today, Groupon's market value is about US$5.3 billion. So, from an investment standpoint, Groupon has clearly underperformed expectations.

There are a variety of reasons why Groupon has had mixed success. For many small businesses, Groupon has been a fantastic partner, and for others, a disaster. In particular, the buying frenzy that may result from coupon purchases is a tricky matter that should not be underestimated. Consider, for instance, the experience of an Oregon-based coffee shop called Posies Café, whose owner eventually lost more than US$8,000, thanks to unexpected increases in customer volume and the stress of hiring additional manpower, from a Groupon-enabled tidal wave of customers. Most small businesses are not capable of coping with a sudden flood of hundreds, or even thousands, of new customers. Think of the logistics of juggling overwhelming customer traffic and associated service quality issues. In addition, if a deal offers a 50 percent discount, Groupon takes about a 40 percent share of the deal's price (the numbers depend on factors such as size of the deal), leaving the merchant with 30 percent of the original price. Many businesses forget (or are not advised) to cap the number of deals, so that they end up having more business than they can handle and may not be able to limit the losses incurred. Thus, businesses that miscalculate the impact of a Groupon campaign usually end up either suffering huge losses or garnering a crushed reputation as service quality goes down the drain.

Aside from miscalculating the capacity of one's business to handle a rush of new clients, businesses often overestimate the long-term impact of a deal on the business. Many customers are looking for a one-time deal and never visit the business afterward. (How often would you repeat that helicopter trip if you had to pay full price, or how often do you need Lasik eye surgery?) Thus, businesses are advised to make the most out of the publicity brought about by Groupon's coupon campaign. Instead of relying solely on the one-time increase of buyers, which does not always generate profits, business owners should use the opportunity to sell additional products to customers. Likewise, service-oriented businesses should consider offering incentives for customers to come back by signing up for additional appointments. E-mail addresses and other personal information should be collected for future promotional needs. If Groupon is perceived more as an advertising strategy that requires careful management, business owners may, after all, achieve the ends of boosting their reputation and generating enhanced revenue.

Questions

2-42. How have information systems enabled new, interesting business models like that of Groupon?

2-43. What are the key components of Groupon's current business model?

2-44. How might Groupon leverage technology to strategically create a competitive advantage?

Based on:

Anonymous. (2016). 1Q16 fact sheet. *Groupon*. Retrieved May 29, 2016, from http://investor.groupon.com

Griffith, E. (2015, March 20). Counterpoint: Groupon is not a success. *Fortune.* Retrieved May 29, 2016, from http://fortune.com/2015/03/20/groupon-success

Groupon. (2016, May 18). In *Wikipedia, The Free Encyclopedia*. Retrieved May 29, 2016, from https://en.wikipedia.org/w/index.php?title=Groupon&oldid=720943890

Hall, J. (2011, November 22). Groupon demand almost finishes cupcake-maker. *The Telegraph*. Retrieved May 29, 2016, from http://www.telegraph.co.uk/finance/newsbysector/retailandconsumer/8904653/Groupon-demand-almost-finishes-cupcake-maker.html

Purewal, S. J. (2010, December 5). Groupon nightmares (and how to avoid them). *PCWorld*. Retrieved May 29, 2016, from http://www.pcworld.com/article/212328/how_to_avoid_groupon_nightmares.html

CASE 2 | Streaming Video

Remember the old brick-and-mortar movie rental services? You drove to the physical location, scanned shelves for your movie of choice (too frequently, it wasn't in), paid the clerk, and left. The flick was due back in 24 hours (or, at most, 3 to 5 days later), or you were billed a hefty late fee. In some cases, forgetful customers answered the door to find a police officer asking why they hadn't returned a rental movie.

Movie rental stores still exist but in quickly dwindling numbers. Many alternatives have spawned, beginning with Netflix, the first and now the world's largest online movie service. Though originally started as a mail-order DVD rental service, Netflix has rapidly embraced the streaming video market. As of December 2013, Netflix offered its 81 million subscribers in 190 countries tens of thousands of movie and television titles and, in 2015, accounted for 37 percent of all downstream web traffic during prime-time hours (the major streaming services combined accounted for a whopping 70 percent). Though Netflix continues to battle rising costs as movie and TV studios raise their licensing fees, the company continues to dominate in the streaming market.

Other competitors have entered the market as well. Amazon's Prime subscription service, in addition to providing discounts on fast shipping for all products, provides subscribers access to a vast library of movie and TV content. This content is available to users via Amazon's mobile devices, like the Kindle Fire, as well as the recently released Amazon FireTV, a US$99 set-top box that also supports gaming.

Apple and Google also compete in this space, though currently with a slightly different approach. iTunes has long been the leader in digital music distribution, and Apple moved seamlessly to movie and TV distribution as those became popular. The distinction from the Netflix and Amazon models is that iTunes provides a rental and purchasing marketplace, where customers can pay for temporary rights to a movie (rental) or may pay a higher price to purchase the movie for indefinite ownership. The Google Play store uses a similar rental/purchase model. The advantage of this model is that movie and TV studios are much more willing to participate in this type of distribution (which mirrors physical movie and TV distribution and the accompanying revenues). As a result, these marketplaces typically provide the latest, most popular movies. In contrast, a drawback of Netflix and Amazon's streaming services is their limited selection of popular or recent titles, as their streaming libraries are dependent on content deals they have made with individual studios.

One of the major advantages to these digital video distribution services is their ability to personalize a customer's experience to a degree previously not possible. These personalized services learn about a user's preferences according to the movies they frequently watch. From this data, the company creates a profile of each customer and a list of recommended movies. If, for example, a customer liked the movie *Prometheus*, he or she may also like the 1979 sci-fi classic *Alien*, and that movie will be included in a list of suggested movies. Customers can refine the recommendations by rating titles according to their preferences. These systems allow customers to tap large databases of movies, many of which they may not have been aware of at all.

Consider how fast things are changing. Just a few years ago, the only way to watch a movie other than paying to purchase it was to drive to a movie rental store like Blockbuster or Hollywood Video and pay to borrow a DVD for a few days. Today, that same entertainment can be obtained via any computer or mobile device or through an increasing number of "connected" TVs, Blu-ray players, or small video-streaming devices like the Amazon FireTV, AppleTV, or Google's Chromecast. These services and devices have completely disrupted the movie rental business. Hollywood Video, once a major competitor to Blockbuster Video with stores all over the U.S., declared bankruptcy in 2010 and closed all of its stores. Blockbuster Video slowly bled customers until it too declared bankruptcy in 2010. Some stores remained open for a few years, but as of June 2016, customers could find the Blockbuster name on a mere 19 locations.

Questions

2-45. In what ways has technology enabled the transformation and destruction of the traditional video rental industry?

2-46. Paid programming from cable companies still largely follows the model it has been following for the past few decades. How will technology and the public's appetite for on-demand, streaming video change the cable television industry in the coming years?

2-47. Discuss whether and how Netflix or Amazon can continue to grow their business and revenues in the streaming video market.

Based on:

Blockbuster LLC. (2016, June 26). In *Wikipedia, The Free Encyclopedia*. Retrieved June 26, 2016, from https://en.wikipedia.org/w/index.php?title=Blockbuster_LLC&oldid=727037281

Netflix. (2016, June 24). In *Wikipedia, The Free Encyclopedia*. Retrieved June 26, 2016, from https://en.wikipedia.org/w/index.php?title=Netflix&oldid=726823307

The Canadian Press. (2015, December 7). Netflix, YouTube video streaming dominate internet traffic in North America. *CBC news*. Retrieved June 26, 2016, from http://www.cbc.ca/news/technology/video-streaming-traffic-1.3354182

MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions.

2-48. List and describe five general types of organizational strategy.

2-49. What is a business model, and what are its primary components?

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3 Managing the Information Systems Infrastructure and Services

Preview

Just as any city depends on a functioning infrastructure, companies operating in the digital world are relying on a comprehensive information systems (IS) infrastructure to support their business processes and competitive strategy. Transactions are conducted with ever-increasing speed; likewise, with ever-increasing amounts of data to be captured, analyzed, and stored, companies have to thoroughly plan and manage their infrastructure needs in order to gain the greatest returns on their IS investments. When planning and managing their IS architectures, organizations must answer many important and difficult questions. For example, how will we utilize information systems to enable our competitive strategy? What technologies and systems best support our core business processes? Which vendors should we partner with, which technologies do we adopt, and which do we avoid? What hardware, software, or services do we buy, build, or have managed by an outside service provider? How can we use cloud computing to increase our agility? Clearly, effectively managing an organization's IS infrastructure is a complex but necessary activity in today's digital world.

This chapter focuses on helping managers understand the key components of a comprehensive IS infrastructure and why its careful management is necessary. With the increasing complexity of an organization's information needs and the increasing complexity of the systems needed to satisfy these requirements, the topic of infrastructure management is fundamental for managing in the digital world.

MANAGING IN THE DIGITAL WORLD:

From Google to Alphabet

Nearly everyone in the entire world knows a few global brands such as Apple, Coca-Cola, Samsung, and Toyota. Another powerful brand, Google, has become known around the world for its ubiquitous search engine (Figure 3.1). But Google is much more than a search engine. Google has very diverse interests, from driverless cars and other technologies to life sciences, investment capital, and space exploration through investments in SpaceX. Given this diversity, many things that Google was exploring didn't fall neatly under a search engine company, not to mention spending billions of dollars on many "blue ocean" R&D projects that were not always viewed favorably by investors. To make the point that Google is interested in far more than search engines and to help sharpen the focus of the various Google-owned companies, a holding company called Alphabet was created. This giant restructuring of the Google empire has placed 10 companies under the Alphabet umbrella (in early 2016) and allows Alphabet to have different types of companies, allowing investors the choice of investing in Alphabet or in one of the subsidiary companies that are publicly traded.

With this move to Alphabet, it has become much easier for investors to understand the Google business model and how each of the various companies are contributing to (or harming) Alphabet's bottom line. For example, Alphabet owns the robotics business Boston Dynamics, life sciences company Verily, and home

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

1. Describe how changes in businesses' competitive landscape influence changing IS infrastructure needs.
2. Describe the essential components of an organization's IS infrastructure.
3. Discuss managerial issues associated with managing an organization's IS infrastructure.
4. Describe cloud computing and other current trends that can help an organization address IS infrastructure–related challenges.

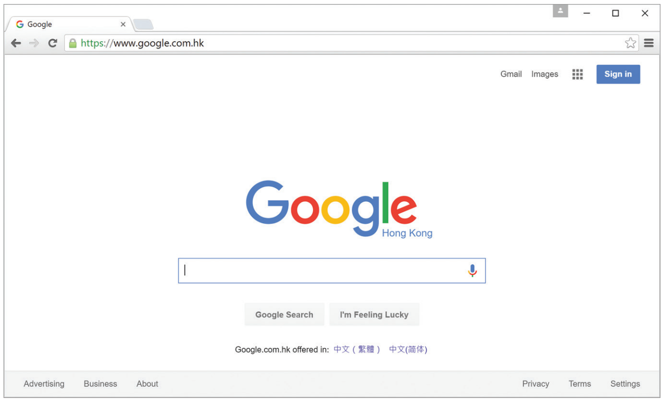

FIGURE 3.1

Google search page inside Google's Chrome browser.
Source: 2016 Google Inc. All rights reserved. Google and the Google Logo are registered trademarks of Google Inc.

automation company Nest Labs. With the restructuring, financial reporting shows where revenue is generated and where investments in new ideas are made. Investors are thrilled with this new transparency, and many feel that Alphabet will be more disciplined about where it will place investment bets as successes and failures will be more visible and tightly associated with a particular company.

Alphabet is now one of the biggest companies in the world. For most of us who use Gmail and Google Docs or watch countless YouTube videos, the shift to Alphabet won't even be noticeable. However, for those in the business and technology world, they better take notice! Google's founders Sergey Brin and Larry Page don't want to relax as simply the giants of online search; they have "always strived to do more, and to do important and meaningful things with the resources [they] have." Alphabet is not intended to be a big consumer brand; the intention is for the various Alphabet companies to be independent and develop their own brands and innovations. This way, the likelihood of finding the next new idea that can change the world is much higher.

Brin and Page believe that large companies get comfortable with their success and business model. Both want to continue to innovate and create inventions that can transform the world. For now, Google's search engine is bringing in most of the revenue and is highly profitable. But these tech pioneers are looking toward the future, aiming to take a long term view and "improving the lives of as many people as [they] can."

Clearly, Alphabet is about more than search engines, and its founders are about more than resting on prior accomplishments.

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

1. How does Google benefit from a well-functioning infrastructure?
2. What are the major components of Google's infrastructure?
3. What are the factors organizations should consider when building on infrastructure provided by Google?

Based on:

Anonymous. (n.d.). Our history in depth. Retrieved April 7, 2016, from http://www.google.com/about/company/history

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The IS Infrastructure

Most people expect a variety of basic municipal services, such as sanitation, security, transportation, provision of energy and water, and so on, to be provided by the city they live in. Any area where people live or work needs a supporting **infrastructure**, which entails the technical structures enabling the provision of services (Figure 3.2); many infrastructure components, such as power, telephone, water, and sewage lines, are "invisible" to the users, meaning that the users typically do not know (or even care) where, for example, their water comes from, as long as it flows when they open their faucets. Other, more visible, infrastructure components include streets, schools, hospitals, and parks. Both the area's inhabitants and businesses depend on the services provided by that infrastructure, and cities with a good infrastructure are considered more livable than cities with poorer infrastructure and are much more likely to attract businesses and residents.

For organizations, many decisions are based on the provision of such services, such as when choosing a site for a new manufacturing plant or company headquarters. Indeed, many municipalities attempt to attract new businesses and industries by setting up new commercial zones with a well-planned infrastructure. In some cases, specific infrastructure components are of special importance, such as access to freeways or rail tracks or sufficient availability of cheap energy. Just as an aluminum smelter needs access to rail tracks or an ample supply of energy, the data centers powering much of the digital world need connectivity to the Internet backbone and energy for powering and cooling the computers. With rising costs of energy, companies such as Google, Apple, and Facebook are not only looking for technological advances to increase the efficiency of their data centers but also trying to find geographical locations where energy efficiency can be optimized (Figure 3.3). One such example is search engine giant Google, which built a data center in an abandoned paper mill in Hamina, Finland, where the cool climate reduced the need for cooling. This location also provided the necessary connectivity and allowed for using seawater for cooling. Likewise, Apple and Facebook built data centers in the high desert in Oregon, where power is cheap and the cool climate significantly reduces the need for cooling.

For organizations operating globally, local differences in infrastructure pose additional challenges, particularly when operating in developing nations. For example, in many parts of the

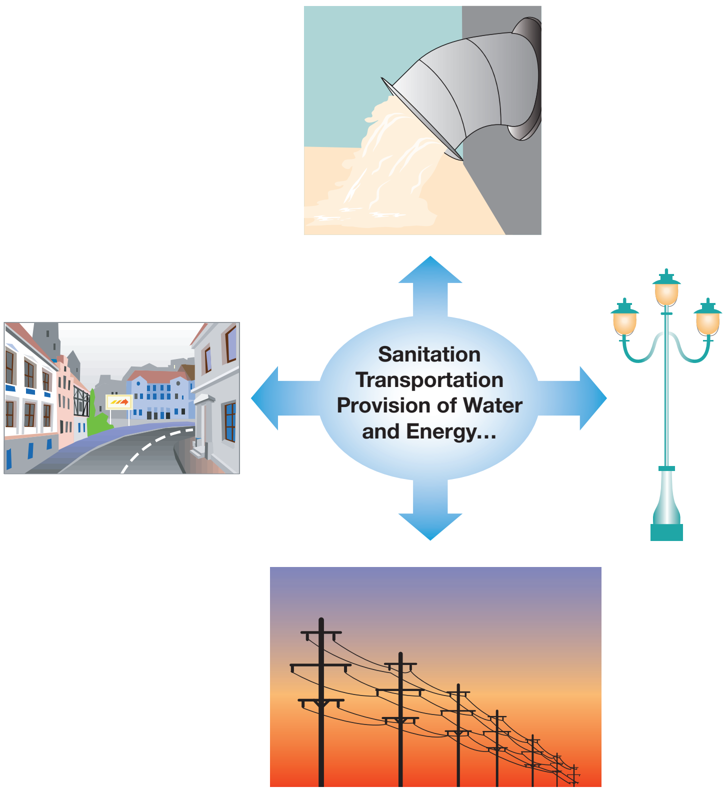

FIGURE 3.2

Infrastructure components of a city enable the provision of basic services.

Source: Edin Ramic/Shutterstock.

FIGURE 3.3

Google uses solar energy to power its main campus in Mountain View, California.

Source: Kimberly White/Thomson Reuters (Markets) LLC.

world, organizations cannot count on an uninterrupted supply of water or electricity. Consequently, many of the large call centers in India that support customers around the world for companies like Dell Computers or Citibank have installed massive power generators to minimize the effects of frequent power outages or have set up their own satellite links to be independent from the local, unreliable communications networks.

Just as people and companies rely on basic municipal services to function, businesses rely on an **information systems infrastructure** (also referred to as **digital infrastructure**) (consisting of hardware, system software, storage, networking, and data centers) to support their decision making, business processes, and competitive strategy. Earlier, we defined business processes as the activities organizations perform in order to reach their business goals, including core activities that transform inputs and produce outputs and supporting activities that enable the core activities to take place. To enable such processes, organizations rely on three basic capabilities supported by information systems: processing, storage, and transmission of data (Figure 3.4). Hence, almost all of an organization's business processes depend on the underlying IS infrastructure, albeit to different degrees.

Organizations nowadays are facing continuously changing business environments. Traditionally, companies were operating in relatively stable markets and could gain or sustain competitive advantage from relatively few innovations. Advances in information and communication technologies have leveled the playing field, allowing even small companies from all over the world to compete on a global scale. As new competitors can literally come out of nowhere, any competitive advantage will be increasingly short-lived, forcing organizations to keep innovating.

This suggests that digital infrastructures can have a profound influence on not only businesses but also individuals and society in at least three important ways. First, over time, new systems and capabilities are built on top of prior systems, acting to refine and extend the capabilities of prior generations of systems in ways much easier than physical infrastructure like roads and electrical grids, which are much more difficult to fundamentally change. This acts to accelerate innovation and change in ways never before possible. Second, again in contrast to other types of traditional infrastructure components, digital infrastructures are typically not controlled by a single business or government actor but are provided by companies such as Amazon, Google, and Switch. In other words, there is a competitive and market-based environment that acts to accelerate innovation and change. Third, digital infrastructures allow for platform-based business models that permeate almost every aspect of our daily lives, from having your Fitbit monitor your sleep and waking you in the morning, to making a Skype call with a friend in

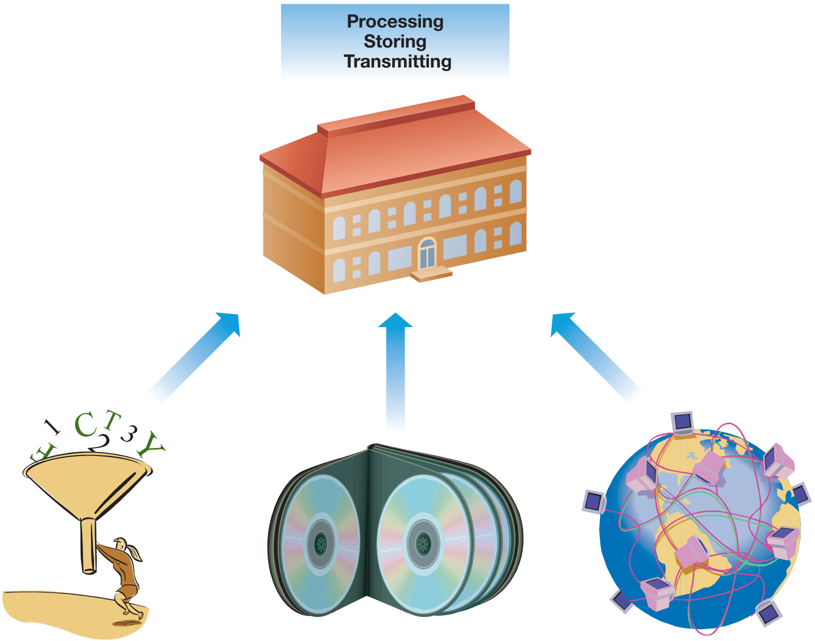

FIGURE 3.4

The information systems infrastructure enables processing, storing, and transmission of data.

WHO'S GOING MOBILE

Mobile Payments Are Transforming Developing Countries

In a relatively short period of time, mobile technologies have transformed the technology scene in many developing countries. These countries have historically had poor infrastructure for communications technologies such as telephone lines. With the comparatively low cost of cellular communications technologies, however, citizens of developing nations have rapidly adopted cell phones and, increasingly, smartphones. For many people in developing countries, these devices are the only point of connection to the Internet and worldwide communications. But these devices have not only enabled individual users to connect with the Internet, they have also transformed whole economies and societies.

In the United States and other Western countries, there is frequent talk of mobile payment systems using cell phones. Many payment platforms have been developed, but none has obtained wide enough adoption for the service to become ubiquitous. Slow adoption in Western countries is likely due to the widespread use of alternatives such as credit and debit cards and easy access to cash through banks and ATMs. These established methods are comfortable and relatively secure.

However, in the developing world, such established and secure infrastructure, for the most part, is nonexistent. As such, the developing world is embracing mobile payment. In fact, do you care to make a guess where the largest of such mobile payment platforms is located? M-Pesa, located in Kenya, has revolutionized mobile technology for millions. As in much of the developing world, widespread banking infrastructure does not exist in Kenya. So, when people need to pay for a meal or a cab ride, especially in rural locations, mobile payments have become mainstream. In Kenya, it is easier to pay for a cab ride with your mobile phone than it is just about anywhere else in the world. Nearly 60 percent of Kenyans with cell phones use them for mobile payment and banking, primarily through the M-Pesa system, and using mobile payments is rapidly spreading throughout the developing world, from Afghanistan to Zimbabwe.

Mobile phones are still on the rise in the developing world. But their use is transforming society in many developing countries. The ability to make and accept payments is fueling commerce, resulting in many positive developments and change.

Based on:

Anonymous. (2014, February 13). Emerging nations embrace Internet, mobile technology. *Pew Research*. Retrieved April 9, 2016, from http://www.pewglobal.org/2014/02/13/emerging-nations-embrace-internet-mobile-technology

Anonymous. (2015, May 5). Why are mobile payments so successful in developing countries? *BBVA Innovation Center*. Retrieved April 9, 2016, from http://www.centrodeinnovacionbbva.com/en/news/why-are-mobile-payments-so-successful-developing-countries

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Fingas, J. (2016, March 2). Apple leads the (tiny) mobile payment world. *Engadget*. Retrieved April 9, 2016, from http://www.engadget.com/2016/03/02/mobile-payment-market-share

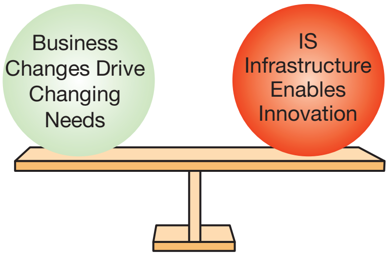


FIGURE 3.5

Business–IT alignment drives IS infrastructure changes to enable innovative business models and processes.

Europe, to working on your homework on the train, to Liking a post on Facebook in the evening. All day, everywhere, digital infrastructures are a key part of your life, whether you are a student, working full time, or retired. Given this pervasiveness, new digital ventures are leveraging these infrastructures to innovate and create value for customers. Likewise, with all this change and innovation, governments struggle to introduce policies that can enable adequate security and privacy without stifling innovation.

Facing this accelerating change enabled by digital infrastructures, organizations have to adapt or will sooner or later go out of business. Quickly adapting to a constantly changing competitive environment necessitates that businesses are increasingly flexible and agile. To achieve this flexibility and agility, organizations seek to align their organizational strategy and business processes with the right collection of systems and capabilities in the IS infrastructure. The formal definition of an organization's technologies, systems, and processes that support an organization's specific business processes and strategy is referred to as the **information systems architecture**. In other words, the IS infrastructure has a broad and flexible set of capabilities that can be utilized in a variety of ways. The IS architecture reflects the specific capabilities from this overarching set of capabilities to support the specific strategy and processes of an organization. As discussed in Chapter 2, "Gaining Competitive Advantage Through Information Systems," business–IT alignment is a continuous process of adjusting business goals and the IS architecture to achieve business objectives (Figure 3.5). To achieve alignment, changing business conditions drive changes in what IS infrastructure components and capabilities are utilized, resulting in a refinement of the organization's IS architecture. Likewise, changes and enhancements in the IS infrastructure enable innovative business models and processes and associated refinements to the IS architecture. In addition, any *lack* of availability, performance, or security (e.g., the news of an organization's website being attacked by hackers or collapsing under unanticipated customer demand) is often immediately visible to customers or other stakeholders, potentially leading to loss of business, trust, and goodwill. Thus, organizations' business processes need to be supported by the right applications and the right data, which in turn rely on a robust and evolving IS infrastructure (Figure 3.6). In sum, organizations rely on a complex, interrelated IS infrastructure to thrive in the ever-increasingly competitive digital world.

To get a better understanding of an IS infrastructure, we first provide a brief overview of how applications and databases support business processes and then discuss how hardware,

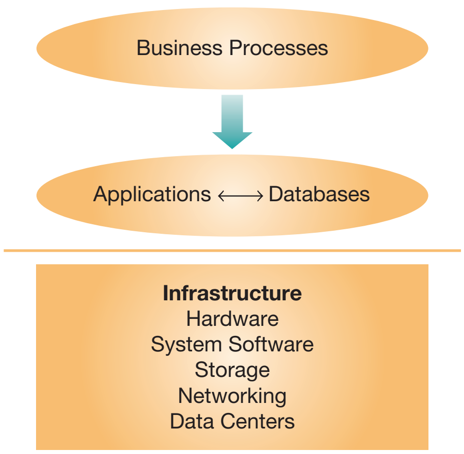


FIGURE 3.6

A robust and evolving IS infrastructure is needed to support an organization's strategy and business processes.

system software, storage, networking, and data centers interact to form an organization's IS infrastructure. Note that in this chapter, we will primarily focus on these components from a business perspective. For more technical details, please refer to the Technology Briefing.

Applications and Databases Supporting Business Processes

Data are probably among the most important assets an organization has, as data are essential for both executing business processes and gaining business intelligence. No matter what the business process is, data are used, processed, or generated along the way. For example, business processes associated with manufacturing products need data about inventory levels of raw materials, production capacities, and demand forecasts; likewise, back-office business processes associated with accounts receivable need data about customers, sales, receipts, and so on. In addition, increasing amounts of data are used for gaining business intelligence. Data once taken for granted or never collected at all are now used to make organizations more productive and competitive. Stock prices in the market, potential customers who meet a company's criteria for its products' target audiences, as well as the credit rating of wholesalers and customers are all types of data that organizations collect and analyze to turn into useful information. Yet just having access to data is not sufficient; it is through applications that the data can be used effectively. Next, we briefly describe the role of application software in supporting an organization's business processes.

APPLICATION SOFTWARE. Organizations are continuously looking for ways to streamline and automate business processes so as to generate more revenue or reduce costs and make the organization more profitable. **Application software** helps to automate business processes and enables processes that would otherwise not even be possible. Accountants have for centuries used thick books for maintaining the accounting records of a business; automating the associated tasks using accounting software applications not only has helped to make the tasks less effortful and reduce error rates but in addition allows quick analysis of accounting records so as to examine sales trends, delinquencies, profit margins, and the like. Similarly, automating inventory management functions using specialized inventory management software not only helps keep a more accurate and up-to-date inventory but can also generate a wealth of data that can be used to optimize inventory levels, taking into account the costs of keeping inventory and the potential costs of stockouts. E-commerce websites such as Amazon.com would not be possible without the applications needed for automatically processing transactions.

In addition to various types of application software for different business functions, other types of application software let users perform tasks such as writing business letters, managing stock portfolios, or manipulating forecasts to come up with the most efficient allocation of resources for a project. Application software also includes personal productivity software such as Microsoft Office; supply chain management systems to support the coordination of suppliers as well as the production and distribution of products or services; or customer relationship management (CRM) systems to help companies win and retain customers, gain marketing and customer insights, and focus on customer service (as discussed in Chapter 1, "Managing in the Digital World").

Many types of application software supporting business processes interact with databases, which allow them to efficiently retrieve and store the data needed for executing business processes and gaining business intelligence. Databases are discussed next.

DATABASES. **Databases**, which are collections of related data organized in a way that facilitates data searches, are vital to an organization's operations and often are vital to competitive advantage and success. In organizations, databases are performing various important functions. On the most fundamental level, databases are used to store data and to make the data accessible where and when needed. More specifically, the use of databases to store organizational data ranging from inventory to demand forecasts to customer data enables applications from across an organization to access the data needed. Typically, various business processes throughout an organization make use of the same data, and providing the associated applications with quick and easy access to the data can help streamline and optimize these processes. For example, if a salesperson has access to inventory levels, she can quickly give precise estimates of delivery times, which may help close the sale. Similarly, if business processes associated with inbound logistics or operations have access to order forecasts, this can help to streamline procurement and production processes, helping to avoid stockouts and minimize money tied up in excess inventory. Likewise, the use of databases enables the automation of various processes in the

ETHICAL DILEMMA

Putting People's Lives Online

Is that a man breaking into an apartment? There's obviously a house on fire. The lady in this picture looks exactly like my next-door neighbor, and those are obviously my clothes drying in my backyard. Search a random location on Google Maps, and you may find—via the Street View feature—the most unexpected candid shots of people walking on the street, waiting for a bus, or even hanging out in places they may not want others to know about. Without doubt, Google Maps can be tremendously useful; combining traditional maps, information from the web, and innovative technology, the application is a helpful assistant for planning trips, locating businesses, and so on. However, Google Maps has been under fire since the introduction of the Street View feature, with many questioning whether a strict line has been unnecessarily crossed in the invasion of public privacy.

The biggest argument behind the dilemma is the collective sense of intrusion that has stimulated concerns of losing one's privacy—parents are worried pictures of their children could possibly make them targets of child predators, and people visiting adult shops simply do not find it essential for the entire world to know where they went last Saturday afternoon. Although Google has so far attempted to ease public concern by blurring the faces of people, license plate numbers, and house numbers, it still is rather awkward to find, say, a good shot of your underclothes hanging on the clothesline and be informed about it by another person. The way Street View operates indeed creates a sense of insecurity; many critics erroneously believe that Street View resembles having a gigantic security camera capturing their every move without their consent or further, even without their being aware of it. Additionally, when collecting pictures for Street View, Google conceded that it violated privacy when it scooped up passwords, e-mail, and other personal information from unsuspecting computers as it drove through cities and neighborhoods.

The issues surrounding Google's Street View highlight an even broader issue: With ever more (often very personal) data being stored, shared, and exchanged in the cloud, companies such as Google, Facebook, and Apple effectively become the custodians of data that have the potential to ruin the lives of an untold number of people. Having access to vast amounts of data provides the potential of monetizing the data in some way.

Questions

1. What laws should govern how Facebook, Google, and other companies handle their customers' online data? What should be the penalties of misuse?
2. How can a company balance the responsibility that comes with having access to the data with the responsibility toward the company's shareholders to maximize profits?

Based on:

Anonymous. (2014, May 17). Cut that link. *The Economist*. Retrieved April 9, 2016, from http://www.economist.com/news/business/21602239-european-court-justice-forces-google-remove-links-some-personal-information-cut

Google Street View privacy concerns. (2016, March 25). In *Wikipedia, The Free Encyclopedia*. Retrieved April 10, 2016, from https://en.wikipedia.org/w/index.php?title=Google_Street_View_privacy_concerns&oldid=711939470

Scott, M. (2016, March 24). Google fined by French privacy regulator. *The New York Times*. Retrieved April 9, 2016, from http://www.nytimes.com/2016/03/25/technology/google-fined-by-french-privacy-regulator.html

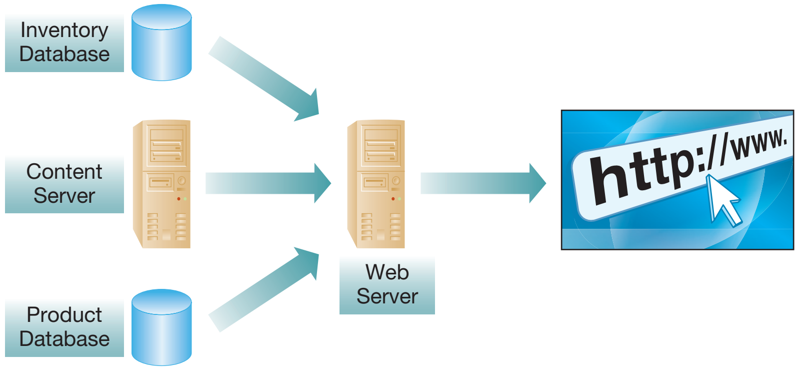
Streitfeld, D. (2013, March 12). Google concedes that drive-by prying violated privacy. *The New York Times*. Retrieved April 9, 2016, from http://www.nytimes.com/2013/03/13/technology/google-pays-fine-over-street-view-privacy-breach.html

organization. Well-managed databases can help to provide organization-wide access to the data needed for different business processes.

Additionally, database technology fuels electronic commerce, from helping to display available products for sale to providing customer service. For example, any product information you see on e-commerce sites such as Amazon.com is dynamically retrieved from databases; any changes to product information, pricing, or shipping estimates do not require changes to the product's web page itself but can be accomplished by simply changing the associated entry in the database. A customer viewing a product on Amazon.com receives a web page that is assembled by a web server using data coming from different databases (e.g., containing data about products, inventory, pricing, or customer reviews), a content server (e.g., for product images), and other sources (Figure 3.7); the actual transaction then involves product data, inventory data, customer data, payment data, confirmation e-mails, and so on. In order to harness the power of the data contained in the databases, organizations use **database management systems (DBMSs)**, which are a type of software that allows organizations to more easily store, retrieve, and analyze data.

FIGURE 3.7

Dynamic web pages are assembled using data from various databases.



Finally, databases support storing and analyzing Big Data from a variety of sources. Gaining insights from internal and external sources (such as social media) can provide valuable business intelligence for organizations.

How these data are collected, stored, and manipulated is a significant factor influencing the success of modern organizations. As databases have become a critical component for most organizations, they rely on a solid underlying IS infrastructure (note that sometimes, databases are considered part of the infrastructure; given their importance and role in an organization's business processes, we do not consider them infrastructure). In Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics," we talk more about the benefits of effectively and efficiently collecting, storing, and manipulating data stored in databases.

IS Infrastructure Components

Computing, storage, and networking technologies can create value by enabling efficiency, effectiveness, and agility. In recent times, fueled by globalization, e-commerce, and advances in technology, a well-functioning IS infrastructure has become increasingly important for organizations, leading to the need for making informed infrastructure decisions. In this section, we will introduce hardware, system software, storage, networking, and data centers and discuss how making the right choices about the IS infrastructure can contribute to business success.

Hardware

A fundamental component of the IS infrastructure is the hardware—that is, the computers that run the applications and databases necessary for processing transactions or analyzing business data. As organizations need to carry out hundreds or thousands of different activities belonging to various business processes, they need different types of computers to support these processes. The six general classes of computers are supercomputer, mainframe, server, workstation, personal computer, and mobile device (Table 3.1). A **supercomputer** is the most expensive and most powerful kind of computer. Typically, supercomputers are not used by business organizations; they are used primarily to assist in solving massive scientific problems. In contrast, large **mainframe** computers are used primarily as the main, central computing system for major corporations; optimized for high availability, resource utilization, and security, mainframes are typically used for mission-critical applications, such as transaction processing. A **server** is any computer on a network that makes access to files, printing, communications, and other services available to users of the network. Servers are used to provide services to users within large organizations or to web users. Servers are optimized for access by many concurrent users and therefore have more advanced microprocessors, more memory, and more disk storage than single-user computers; servers also boast high reliability and fast network connectivity. To support different business processes, organizations often have many different servers in different configurations. For example, whereas some web servers display the same static web pages for every visitor (as is the case with many informational websites), others are designed to dynamically create web pages based on user requests (e.g., Facebook displays content based on each individual user's network of friends); such servers have different requirements (e.g., in terms of processing power, network connectivity, or software) than e-mail servers, print servers, or other types of servers.

TABLE 3.1 Characteristics of Computers Currently Being Used in Organizations

Type of Computer	Number of Simultaneous Users	Physical Size	Typical Use	Random Access Memory	Typical Cost (in US$)
Supercomputer	One to many	Like an automobile to as large as multiple rooms	Scientific research	5,000+ GB	Up to $200 million
Mainframe	1,000+	Like a refrigerator	Transaction processing, enterprise-wide applications	Up to 3,000+ GB	Up to $10 million
Server	10,000+	Like a DVD player and mounted in a rack to fitting on a desktop	Providing websites or access to databases, applications, or files	Up to 512 GB	Up to $50,000
Workstation	Typically one	Fitting on a desktop to the size of a file cabinet	Engineering, medical, graphic design	Up to 512 GB	Up to $10,000
Personal computer	One	Fitting on a desktop	Personal productivity	512 MB to 32 GB	Up to $5,000
Mobile device	One	Handheld	Personal productivity	512 MB to 6 GB	Up to $750

In contrast to mainframes and servers, which are designed for multiple concurrent users, workstations and personal computers are typically used by one user at a time. **Workstations**, designed for medical, engineering, architectural, or animation and graphics design uses, are optimized for visualization and rendering of 3D models and typically have fast processors, large memory, and advanced video cards. **Personal computers (PCs)** and notebook computers are used for personal computing and small business computing. Finally, mobile devices—tablets and smartphones—have increasingly become part of an organization's information systems infrastructure. In contrast to general-purpose computers, **embedded systems** are optimized to perform a well-defined set of tasks, ranging from playing MP3 music files to controlling engine performance, traffic lights, or DVD players. Relatedly, programmable logic controllers (PLCs) are used to automate machines and can control everything from manufacturing processes to ski lifts. In addition to the processing components, IS hardware also encompasses input devices (such as computer mice, touch screens, or cameras) and output devices (such as monitors, printers, or speakers). With the advent of the Internet of Things (IoT), various sensors, controllers, and other single-purpose, nontraditional computing devices are used to provide valuable data as input to different processing technologies. For example, in one of the electronics factories of Siemens, a combination of sensors, PLCs, and manufacturing machines handles 75 percent of the entire production process (and, along the way, generates 50 million pieces of data per day); further, the use of Industrial Internet of Things devices such as sensors and intelligent product codes enables the products to tell the machines what should be done, enabling self-organizing production processes. Another key IoT technology helping to monitor product flows is **radio frequency identification (RFID)**, which is rapidly replacing the standard bar codes you find on almost every product. RFID uses electromagnetic energy to transmit data between a reader (transceiver) and a processing device, or RFID tag.

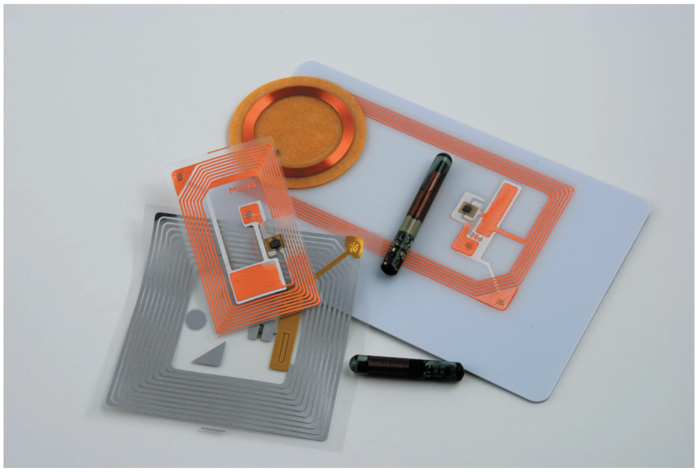


FIGURE 3.8

RFID tags can range in size from being a fraction of an inch up to several inches across.
Source: Albert Lozano-Nieto/Fotolia.

RFID tags can be used just about anywhere a unique identification system might be needed, such as on clothing, pets, cars, keys, missiles, or manufactured parts. RFID tags can range in size from being a fraction of an inch, which can be inserted beneath an animal's skin, up to several inches across and affixed to a product or shipping container (Figure 3.8). The tag can carry data as simple as the name of the owner of a pet or as complex as how a product is to be manufactured on the shop floor.

RFID systems offer advantages over standard bar code technologies in that RFID eliminates the need for line-of-sight reading. RFID also does not require time-consuming hand scanning, and RFID data is readable regardless of the entity's position or whether the tag is plainly visible. RFID tags can also contain more data than bar codes. Further, a company can program any data that it wants or needs onto an RFID tag, enabling a vast array of potential uses. Thus, it is possible to retrieve data about an entity's version, origin, location, maintenance history, and other important data and to manipulate that data on the tag. RFID scanning can also be done at greater distances than can bar code scanning. *Passive tags* are small and relatively inexpensive (starting from a few cents) and typically have a range up to several feet. *Active tags,* on the other hand, cost upward of US$5, include a battery, and can transmit hundreds of feet. Together with other IoT devices and Big Data, RFID systems have the potential to revolutionize production processes in countless industries (see Chapter 8, "Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management").

The application software used for various business processes cannot directly interact with these various types of hardware. Rather, the application software interacts with the system software, which, in turn, interacts with the computer hardware.

System Software

System software is the collection of programs that control the basic operations of computer hardware. The most prominent type of system software, the **operating system** (e.g., Windows, OS X, Ubuntu Linux), coordinates the interaction between hardware components (e.g., the CPU and the monitor), **peripherals** (e.g., printers), application software (e.g., office programs), and users, as shown in Figure 3.9. Operating systems are often written in assembly language, a very low-level computer programming language that allows the computer to operate quickly and efficiently. The operating system is designed to insulate you from this low-level language and make computer operations unobtrusive. Further, the operating system provides a common layer for different underlying devices so that applications only have to be developed for different operating systems rather than for each different computer model (Figure 3.10); **device drivers** allow the computer to communicate with various different hardware devices. The operating system performs all of the day-to-day operations that we often take for granted when using a computer, such as updating the system clock, printing documents, or saving data to a hard drive. Just as our brain and nervous system control our body's breathing, heartbeat, and senses without our conscious realization, the system software transparently controls the computer's basic operations. Mobile operating systems, such as Android, Windows 10 Mobile, or iOS, are optimized for mobile devices.

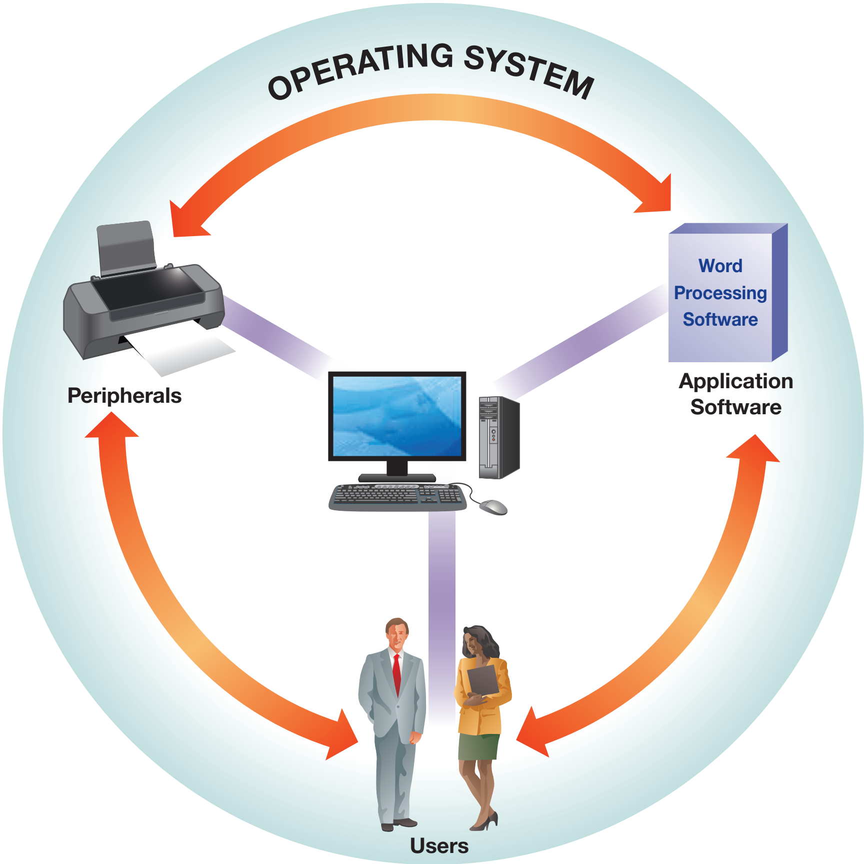


FIGURE 3.9

Operating systems coordinate the interaction between users, application software, hardware, and peripherals.

COMMON OPERATING SYSTEM FUNCTIONS. Many tasks are common to almost all computers. These include getting input from a keyboard or mouse, reading from and/or writing to a storage device (such as a hard disk drive), and presenting information to you via a monitor. Each of these tasks is performed by the operating system. For example, if you want to copy a word processing file from a flash drive onto your computer, the operating system makes this very easy for you, as all it takes is simply using the mouse to point at a graphic icon of the word processing file on the flash drive, then clicking and dragging it onto an icon of your hard disk. The operating system makes this process appear easy. However, underlying the icons and simple dragging operations is a complex set of coded instructions that tell the electronic components of the computer that you are transferring a set of bits and bytes located on the flash drive to a location on your internal hard disk. Imagine if you had to type sets of instructions every time

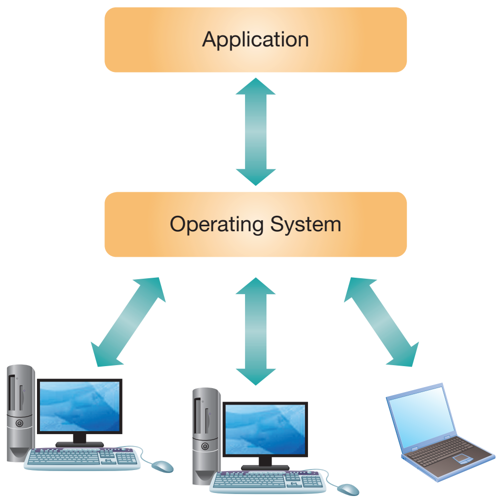


FIGURE 3.10

Operating systems provide a common layer for different underlying devices so that applications only have to be developed for different operating systems rather than for each different computer model.

you wanted to copy a file from one place to another. The operating system manages and executes these types of system operations so that you can spend your time on more important tasks.

Storage

In addition to processing and analyzing vast amounts of data, efficiently storing and retrieving data is key for organizational success. Further, governmental regulations such as the Sarbanes–Oxley Act mandate archiving business documents and relevant internal communication, including e-mail and instant messages. Hence, organizations are faced with the need to reliably process and store tremendous amounts of data, and this storage requirement is growing at an increasing rate. Earlier, we discussed the role of databases in supporting organization-wide business processes. To enable efficient storage and retrieval of the content of such databases (as well as digital content not stored in databases), organizations need to have a solid storage infrastructure. One can distinguish between three distinct types of data, based on their purpose, each with distinct requirements in terms of timeliness, searchability, access speed, and life span (Figure 3.11):

- Operational data—data used for managing business processes, such as for processing transactions or for data analysis
- Backup data—short-term copies of organizational data, used to recover from system-related disaster (Backup data are frequently overwritten with newer backups.)
- Archival data—long-term copies of organizational data, often used for compliance and reporting purposes

COMING ATTRACTIONS

Making Death Optional?

As medical science races forward with brain-controlled artificial limbs, nano-implants, and life-saving and extending treatments, it seems that almost anything is possible. Many companies, including Google, are working on ways to extend our lives by tens if not hundreds of years, but Humai, a small Los Angeles-based research company, wants to turn this idea on its head. Humai researchers are actually trying to extend the human lifetime indefinitely by being able to upload your consciousness onto computers that can control a robot. Humai will use artificial intelligences techniques to capture and store a person's conversational styles, behavior, and thought processes. Its plan is to take this data and fuse it with a brain from a deceased human, which will then control an artificial body. It sounds like a movie plot from nearby Hollywood, but this is not fiction. At this time, Humai believes that it may take up to 30 years to solve the various technical challenges.

To achieve this vision, Humai will need to solve many technical challenges. Between now and the time it is possible to complete the process, Humai will collect an extensive amount of data for years prior to a person's death. At a person's death, it will freeze the brain using cryonics technology until it is able to implant the brain into an artificial body. It believes that the embedded brain will be able to control the artificial body much like we control our own.

Humans have always been fascinated with living forever, from the myth of a "fountain of youth" that would restore youth to anyone who drinks or bathes in its waters to many popular movies including the classic *Dracula, Avatar*, and *Forever Young*. Many skeptics believe that Humai is not likely to succeed with its 30-year projection, but many prominent scientists believe that such advances are possible and may eventually be achieved someday. Do you want to live forever, even if it's in a body of a robot?

Based on:

Gershgorn, D., & Fecht, S. (2015, November 24). Humai wants to resurrect humans within 30 years. *Australian Popular Science.* Retrieved May 20, 2016, from http://www.popsci.com.au/science/medicine/humai-wants-to-resurrect-humans-within-30-years,412164

Humai. (n.d.). Retrieved May 20, 2016, from http://humaitech.com

Lambrechts, S. (2015, November 25). New startup could make death obsolete within 3 decades. *TechRadar.* Retrieved May 20, 2016, from http://www.techradar.com/news/world-of-tech/new-startup-could-make-death-obsolete-within-3-decades-1309696

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Woollaston, V. (2015, November 26). Bringing people back from the DEAD using Artificial Intelligence: Humai plans to wire brains of the deceased to "personality" chips. *The Daily Mail.* Retrieved May 20, 2016, from http://www.dailymail.co.uk/sciencetech/article-3335080/Bringing-people-DEAD-using-artificial-intelligence-Humai-plans-wire-brains-deceased-personality-chips.html

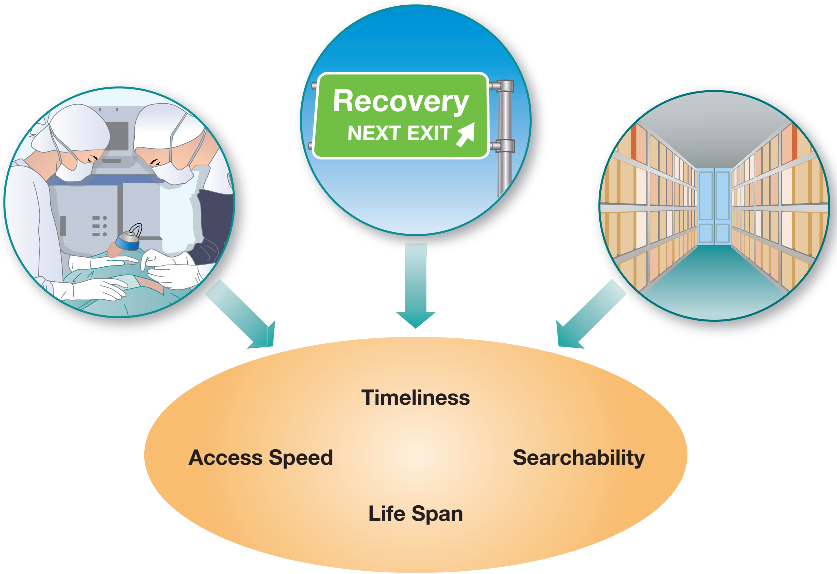


FIGURE 3.11

Operational, backup, and archival data have different requirements.

These different uses of organizational data call for different physical storage technologies. For example, operational data are typically stored in databases (e.g., data from transaction processing systems or customer data) or files (e.g., business documents, images, or company brochures) using disk-based storage media such as hard drives. Hard drives offer high access speeds and are thus preferred for data that are frequently accessed or where response time is of the essence (as in an e-commerce website); in addition, flash-based storage is increasingly used for situations where access speed is of crucial importance. To ensure continuous business operations in case disaster strikes, organizations periodically back up their data to a secure location; often, companies have completely redundant systems so as to be able to seamlessly continue business if the primary systems fail (see Chapter 10, "Securing Information Systems"). Storing backup data on hard drives enables quick recovery without slowing the company's operations. Data that are no longer used for operational purposes (such as old internal e-mails) are archived for long-term storage, typically on magnetic tapes. As data are stored sequentially on magnetic tapes, access speed can be very slow and data is not quickly searchable; however, magnetic tape has a shelf life of up to 30 years, is very low cost as compared to other storage media, and is removable, meaning that it is highly expandable and tapes can be easily stored in a secure, remote location (see the Technology Briefing for more on different storage technologies).

Networking

As you have seen, organizations depend on a variety of different applications, hardware, and storage technologies to support their business processes: Organizations have servers, mainframes, personal computers, storage devices, mobile devices, environmental control systems, and various other devices. Yet, taken alone, each individual piece of technology has little value; it is through connecting the different pieces that business value can be realized: For example, the best-performing database would be useless if it could not be accessed by those people or applications throughout the organization that depend on the data. Further, one of the reasons why information systems have become so powerful and important is the ability to interconnect, allowing internal and external constituents to communicate and collaborate with each other, and many innovative business models would not exist without the Internet. The infrastructure supporting this consists of a variety of components, such as the networking hardware and software that facilitate the interconnection of different computers, enabling collaboration within organizations, across organizations, and literally around the world.

HUMAN COMMUNICATION AND COMPUTER NETWORKING. Human communication involves the sharing of information and messages between senders and receivers. The sender of a message formulates the message in his brain and codes the message into a form that can be communicated to the receiver—through voice, for example. The message is then transmitted

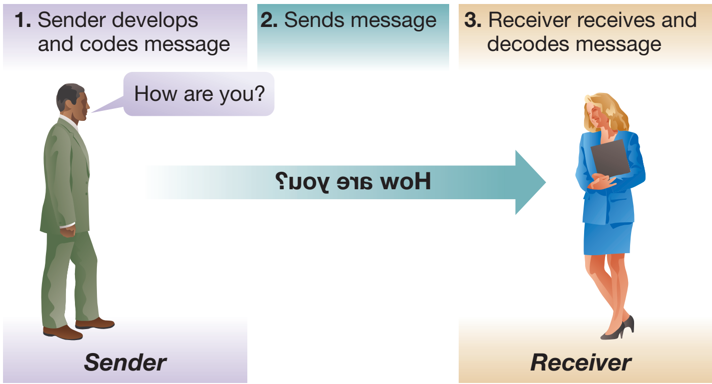


FIGURE 3.12

Communication requires senders, a message to share, and receivers.

along a communication pathway to the receiver. The receiver, using her ears and brain, then attempts to decode the message, as shown in Figure 3.12. This basic model of human communication helps us to understand telecommunications or computer networking. **Computer networking** is the sharing of data or services. The information source produces a message, which is encoded so that it can be transmitted via a communication channel; a receiver then decodes the message so that it can be understood by the destination. Thus, analogous to human communication, computer networks require three things:

- A sender (source) and a receiver (destination) that have something to share (a message)
- A pathway or transmission medium, such as a cable, to send the message
- Rules or protocols governing communication between senders and receivers

The easiest way to understand computer networking is through the human communication model. Suppose you are applying for a job in France after graduation. You need information about different employers. The first requirement for a network—information to share—has now been met. After contacting a few potential employers, a company sends you information about its hiring process (the encoded message) via e-mail. This is the second requirement: a means of transmitting the coded message. The Internet is the pathway or transmission medium used to send the message. **Transmission media** refers to the physical pathway—cable(s) and wireless—used to transmit data. At this point, you may run into some difficulties. If the potential employer has sent you information in French, you may not understand what he or she has written—that is, decode the message—if you don't speak French; if the message is not understood by the receiver, there is no communication. Although you have contacted the receiver, you and the receiver of your message must meet the third requirement for successful communication: You must establish a language of communication—the rules or protocols governing your communication. **Protocols** define the procedures that different computers follow when they transmit and receive data. You both might decide that one communication protocol will be that you communicate in English. This communication session is illustrated in Figure 3.13.

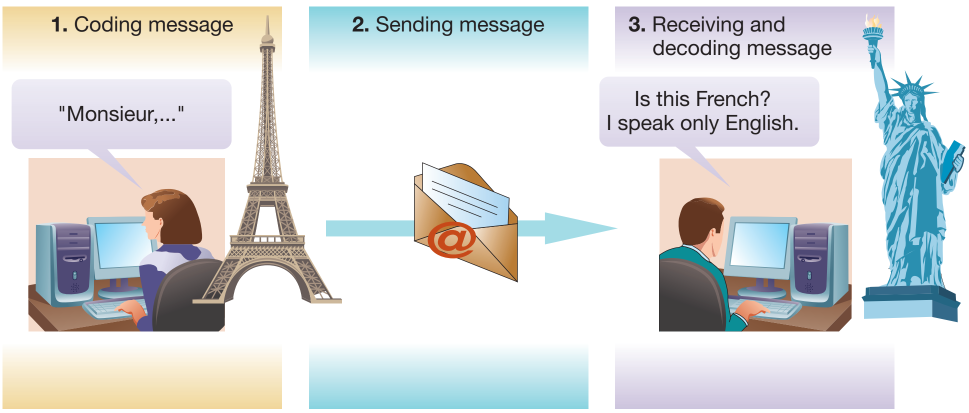


FIGURE 3.13

Coding, sending, and decoding a message.

COMPUTER NETWORKS. A fundamental difference between human and computer communication is that human communication consists of words, whereas computer communication consists of bits, the smallest unit of data used by computers. Virtually all types of content can be transmitted on a computer network—documents, art, music, or film—although each type has vastly different requirements for effective transmission. For example, a page of text is approximately 14 KB of data, whereas a publication-quality photograph could be larger than 200 MB of data. Similarly, to support different business processes, businesses operating in the digital world transmit vast amounts of data, ranging from customer data to sales data to design blueprints. To transmit such vast amounts of data in a timely manner from one location to another, adequate bandwidth is needed. **Bandwidth** is the transmission capacity of a computer or communications channel, measured in bits per second (bps) or multiples thereof, and represents how much binary data can be reliably transmitted over the medium in one second. To appreciate the importance of bandwidth for speed, consider how long it would take to download a 45-minute TV show (about 200 megabytes) from iTunes. It would take about six minutes at 1 megabit per second (Mbps) (regular cable or DSL connection) and two minutes at 15 Mbps (high-speed cable or DSL connection). In contrast, using an old-fashioned PC modem that transmits data at a rate of 56 kilobits per second (Kbps), it would take almost nine hours to download the same TV show. Hence, different types of information have different communication bandwidth requirements (see www.numion.com/Calculators/Time.html for a tool that helps you calculate download times). Typical local area networks have a bandwidth of 10 Mbps to 1 Gbps.

Telecommunications advances have enabled individual computer networks—constructed with different hardware and software—to connect together in what appears to be a single network. Networks are increasingly being used to dynamically exchange relevant, value-adding information and knowledge throughout global organizations and institutions. The following sections take a closer look at the fundamental building blocks of these complex networks and the services they provide.

Servers, Clients, and Peers Computers in a **network** typically have one of three distinct roles—servers, clients, and peers—as depicted in Figure 3.14. A server is any computer on the network that makes access to files, printing, communications, and other services available to users of the network. Servers only provide services. A **client** is any computer, such as a user's PC or laptop, on the network or any software application, such as Microsoft's Outlook e-mail client, that uses the services provided by the server. Clients only request services. A client usually has only one user, whereas many different users share the server. So-called **thin clients**—microcomputers with minimal memory, storage, and processing capabilities—use **desktop virtualization** to provide workers with a virtual desktop environment, helping to reduce costs for software licensing or maintenance and to comply with stringent privacy and data protection laws. A **peer** is any computer that may both request and provide services. Businesses typically use **client-server networks**, in which servers and clients have defined roles. With ubiquitous access to company local area networks (LANs) and the Internet, almost everyone works in a client-server environment today. In contrast, **peer-to-peer (P2P) networks** enable any computer

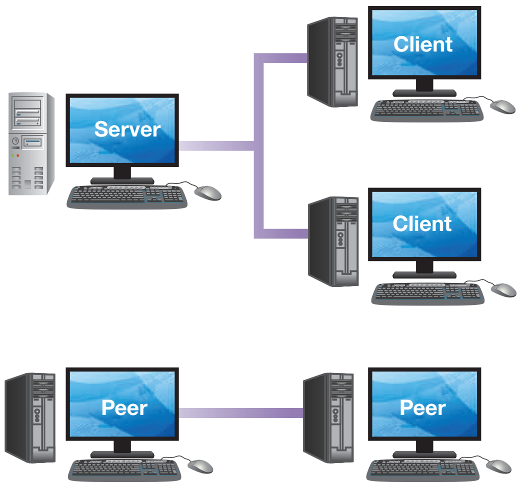


FIGURE 3.14

A server is a computer on the network that enables multiple computers (or "clients") to access data or services. A peer is a computer that may both request and provide services.

TABLE 3.2 Types of Networks

Type	Usage	Size
Personal area network (PAN)	Wireless communication between devices, using technologies such as Bluetooth	Under 10 meters
Local area network (LAN)	Sharing of data, software applications, or other resources between several users	Typically within a building
Wide area network (WAN)	Connect multiple LANs, often with distributed ownership and management	Large physical distance, from spanning multiple buildings or the area of a city to worldwide (Internet)

or device on the network to provide and request services; these networks can be found in small offices and homes. In P2P networks, all peers have equivalent capabilities and responsibilities; this is the network architecture behind the Internet telephony service Skype and popular file-sharing protocols such as BitTorrent, which allow peers to connect directly to the hard drives of other peers on the Internet that are utilizing the software.

Types of Networks Computing networks are commonly classified by size, distance covered, and structure. The most commonly used types are **personal area networks**, **local area networks**, and **wide area networks** (Table 3.2). These networks are typically used to connect devices within an organization or across organizational subunits. Wide area networks can range from spanning multiple buildings (sometimes called a **campus area network**) to covering the area of a city (sometimes called a **metropolitan area network**) to worldwide (the Internet). To enable the connection of mobile devices or to install a network where running cables is infeasible, organizations install **wireless local area networks (WLANs)** using high-frequency radio-wave technology; WLANs are also referred to as **Wi-Fi (wireless fidelity) networks**. The ease of installation has made WLANs popular for business and home use, and public WLANs can be found in many coffee shops, airports, or university campuses. For more on the different types of networks, see the Technology Briefing.

THE INTERNET. One global network that has enabled organizations and individuals to interconnect in a variety of ways is the **Internet**, a large worldwide collection of networks that use a common protocol to communicate with each other. The name *Internet* is derived from the concept of internetworking, which means connecting host computers and their networks together to form even larger networks.

WORLD WIDE WEB. One of the most powerful uses of the Internet is something that you probably use almost every day—the World Wide Web. The **World Wide Web** is a system of interlinked documents on the Internet, or a graphical user interface to the Internet that provides users with a simple, consistent interface to access a wide variety of content. A **web browser** is a software application that can be used to locate and display web pages, including text, graphics, and multimedia content.

A key feature of the web is **hypertext**. A hypertext document, otherwise known as a **web page**, contains not only content but also **hyperlinks**, which are references or links to other documents. The standard method of specifying the structure and content of web pages is called **Hypertext Markup Language (HTML)**. Specific content within each web page is enclosed within codes, or markup tags, that specify the structure and content of a document. These web pages are stored on **web servers**, which process user requests for pages using the **Hypertext Transfer Protocol (HTTP)**. Web servers typically host a collection of interlinked web pages (called a **website**) that are owned by the same organization or by an individual. Websites and specific web pages within those sites have a unique Internet address. A user who wants to access a web page enters the address, and the web server hosting the website retrieves the desired page

FIGURE 3.15

Dissecting a URL.

from its hard drive and delivers it to the user. In addition, web servers often employ scripting languages to assemble pages on the fly or retrieve data from databases and insert it into the page presented to the user (see the Technology Briefing). As data traveling between a server and a the user's computer can easily be intercepted and there are growing concerns about legitimate and illegitimate monitoring of web traffic, many organizations now routinely use the more secure HTTPS protocol for any data that are being transmitted over the web (a padlock icon in your browser's address bar signals that a secure protocol is being used).

Web Domain Names and Addresses A **Uniform Resource Locator (URL)** is used to identify and locate a particular web page. For example, www.google.com is the URL used to find the main Google web server. The URL has three distinct parts: the domain, the top-level domain, and the host name (Figure 3.15).

The **domain name** is a term that helps people recognize the company or person that the domain name represents. For example, Google's domain name is google.com. The prefix *google* lets you know that it is very likely that this domain name will lead you to the website of Google. Domain names also have a suffix that indicates which **top-level domain** they belong to. For example, the ".com" suffix is reserved for commercial organizations. Some other popular suffixes are listed here:

- .edu—educational institutions
- .org—organizations (typically nonprofit organizations)
- .gov—U.S. government entity
- .de—Germany (there are more than 240 two-letter country code top-level domains)

Domain names can be registered through many different companies (known as registrars) that compete with one another. Given the proliferation of domain names, more generic top-level domains (gTLDs) have been added, such as .aero for the air transport industry, .name for individuals, .coop for business industry cooperatives, and .museum for museums. In 2012, the ICANN (Internet Corporation for Assigned Names and Numbers—the organization that coordinates the domain name system) relaxed the strict rules for gTLDs so that regions, businesses, or other entities can apply for their own gTLD. For example, new gTLDs include .bike, .club, .tips, and .cab as well as many other gTLDs coming soon. The new gTLDs also allow for the use of non-Latin characters, such as in the Russian gTLD .онлайн (meaning "online").

The host name is the particular web server or group of web servers (if it is a larger website) that will respond to the request. In most cases, the "www" host name refers to the default website including the home page of the particular domain. Other host names can be used. For example, drive.google.com will take you to the group of web servers that are responsible for serving up Google's cloud-based storage for documents. Larger companies have several host names for their different functions. Some examples used by Google are the following:

- mail.google.com (Google's free e-mail service)
- photos.google.com (Google's application for organizing and editing photos)
- maps.google.com (Google's mapping application)

All the domain names and the host names are associated with one or more Internet protocol (IP) addresses. **IP addresses** serve to identify all the computers or devices on the Internet. The IP address serves as the destination address of that computer or device and enables the network to route messages to the proper destination. Traditionally, the format of an IP address (version 4) is a 32-bit numeric address written as four numbers separated by periods (the latest version, IPv6 uses 128-bit addresses, enabling more devices to be connected to the Internet). Each of the four numbers can be any number between 0 and 255. For example, 128.196.134.37 is an underlying IP address of www.arizona.edu, the University of Arizona's main web page.

IP addresses can also be used instead of URLs to navigate to particular web addresses. This practice is not done regularly, as IP addresses are far more difficult to remember than domain names, and an organization may assign its domain name to a server with a different IP address; for example, whereas the IP address behind google.com may change, the domain name stays the same.

In addition to specifying the address of the web server, URLs typically also include the path to the requested resource, such as a particular page located in a particular directory (e.g., http://mis.eller.arizona.edu/faculty/index.asp).

World Wide Web Architecture The web consists of a large number of interconnected web servers, which host the pages users access with their web browsers. The Internet uses the **Transmission Control Protocol/Internet Protocol (TCP/IP)** to facilitate the transmission of web pages and other information. Users can access web pages by entering the URL of the web page into their web browser. Once the user enters the URL into the address bar of the web browser, TCP/IP breaks the request into packets and routes them over the Internet to the web server where the requested web page is stored. When the packets reach their destination, TCP/IP reassembles them and passes the request to the web server. The web server understands that the user is requesting a web page (indicated by the "http://" prefix in the URL) and retrieves the web page, which is packetized by TCP/IP and transmitted over the Internet back to the user's computer. TCP/IP reassembles the packets at the destination and delivers the web page to the web browser. In turn, the web browser translates the HTML code contained in the web page, formats its visual appearance, and displays the results. If the web page contains a hyperlink, the user can click on it and the process repeats.

The Deep Web In addition to searchable content on the web, much content cannot be indexed by search engines such as Google. The term **deep web** refers to those parts of the web that cannot be indexed by conventional search engines. The common web (called "surface web") that you know and use every day—sites like YouTube, Google, Wikipedia, and news agencies—comprises as little as 1 percent of the total size of the web. Beyond this surface, the deep web is composed of tens of trillions of web pages that most people have never seen. The deep web consists of private areas requiring authentication, dynamic web pages created from connected databases, and static web pages that are not connected to other pages via hyperlinks. Some of this content is in public databases, such as data from the U.S. National Oceanic and Atmospheric Administration, NASA, or the Patent and Trademark Office. Search engines cannot traverse such pages because their contents are dynamically generated from databases and displayed on demand based on database queries. Other databases are private or behind a paywall, such as the government documents on LexisNexis and Westlaw or the academic journals on Elsevier. Organizations that maintain these databases charge users and institutions for access, and their contents are thus not freely available for search engine indexing. In addition, internal content behind corporate or university firewalls is not accessible to search engines. Not to be confused with the deep web, the term *dark web* is used to refer to those areas of the World Wide Web that are used for various nefarious purposes (such as trading drugs, stolen credit card information, or illegal porn) and that are typically only accessible using specialized browsers that anonymize the user and hide traces (see Case 2 at the end of the chapter).

INTRANETS AND EXTRANETS. As organizations have realized the advantage of using the Internet and web to communicate public information outside corporate boundaries, they can also leverage web-based technologies to support proprietary, internal communications through the implementation of an **intranet**. An intranet looks and acts just like a publicly accessible website and uses the same software, hardware, and networking technologies to transmit and display data. All intranet pages are behind the company's *firewall*, which secures proprietary data stored within the corporate local area network and/or wide area network so that the data can be viewed only by authorized users.

GREEN IT

Alphabet Renewables

Running the Alphabet (i.e., Google) empire requires a tremendous amount of electricity, not just in the United States but throughout the world. To reduce its carbon footprint, Alphabet is aggressively transitioning to renewable sources. The company has a widely publicized goal to use 100 percent clean energy by 2025. To reach this goal, Alphabet is signing long-term contracts with clean energy providers, investing in clean energy companies, and building its own "green" facilities. Alphabet has focused on renewable energy for a long time. In 2007, for example, Google had the largest corporate solar panel installation of its kind, generating 1.7 megawatts on its Mountain View, California, campus. It also operates a natural gas–powered generator at the local landfill, producing 990 kilowatts to provide for its electrical needs.

Alphabet is truly a global leader in renewable energy; long-term contracts with clean energy providers range from a 51-megawatt solar project by Duke Energy in North Carolina to a 76-megawatt wind generation project in Sweden and an 80-megawatt project in Chile. In addition to these contracts, it is also investing throughout the world to improve the clean energy infrastructure. For example, in early 2016, Alphabet announced a US$12 million investment in the Lake Turkana Wind Power Project in Kenya to build the largest wind generation project in Africa. This project is the largest single private investment project in the history of the country. In total, Alphabet has made 22 investments in clean energy infrastructure at a total of more than US$2 billion.

In late 2015, Alphabet had increased its renewable energy capacity to nearly 2 gigawatts. To put that another way, Google has enough clean energy to power a city twice the size of San Francisco. In addition, other tech giants such as Facebook, Amazon, Microsoft, and Apple are also embracing the move to renewable energy. And it is not just the tech companies; Alcoa, Bank of America, Coca-Cola, UPS, and Walmart, to name a few, are making strong commitments to renewable energy. While the move to renewable is good corporate responsibility, it is also good business. Developing a comprehensive plan that includes long-term contracts and investments will help to lock in prices, improve reliability throughout the world, and signal customers about the company's commitment to a clean energy and sustainability.

Based on:

Brueck, H. (2016, April 7). Google backs renewable energy in Asia. *Fortune.* Retrieved May 22, 2016, from http://fortune.com/2016/04/07/google-backs-renewable-energy-in-asia

Chow, L. (2015, December 3). Google announces "largest purchase of renewable energy ever." *Ecowatch.* Retrieved May 22, 2016, from http://ecowatch.com/2015/12/03/google-renewables-purchase

Lozanova, S. (2016, March). How Google became the world's largest corporate purchaser of renewable energy. *Triple Pundit.* Retrieved May 22, 2016, from http://www.triplepundit.com/2016/03/google-became-worlds-largest-corporate-purchaser-renewable-energy

Metz, C. (2015, December 3). Google buys enough clean energy to power two San Franciscos. *Wired.* Retrieved May 22, 2016, from http://www.wired.com/2015/12/google-buys-enough-clean-energy-to-power-two-san-franciscos

Sverdlik, Y. (2015, July 20). Cleaning up data center power is dirty work. *Data Center Knowledge.* Retrieved May 22, 2016, from http://www.datacenterknowledge.com/archives/2015/07/20/cleaning-data-center-power-dirty-work

In the simplest form of an intranet, communications take place only within the confines of organizational boundaries and do not travel across the Internet. Organizations can use intranets for disseminating corporate information, employee training, project management, collaboration, or enabling employee self-service for administering benefits, managing retirement plans, or other human resources–based applications through *employee portals*.

Increases in employees' mobility necessitate that an intranet be accessible from anywhere. Thus, most companies allow their employees to use *virtual private networks (VPNs)* to securely connect to the company's intranet while on the road or working from home (i.e., telecommuting). Figure 3.16 depicts a typical intranet system architecture (see Chapter 10 for more on firewalls and VPNs).

Similar to an intranet, an **extranet**, which can be regarded as a private part of the Internet that is cordoned off from ordinary users, enables two or more firms to use the Internet to do business together. Although the content is "on the web," only authorized users can access it after logging on to the company's extranet website. As an extranet uses the public (and normally insecure) Internet infrastructure to connect two or more business partners, it often uses VPNs to ensure the secured transmission of proprietary information between business partners (Figure 3.17). To access information on an extranet, authorized business partners access their

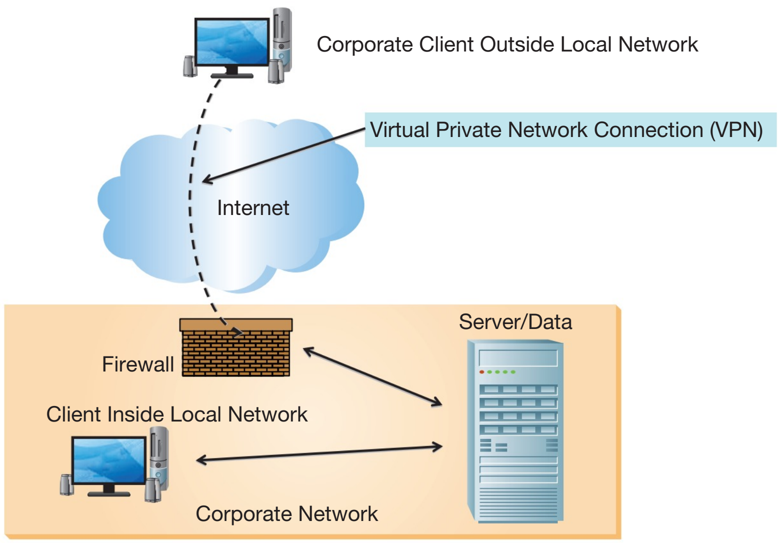


FIGURE 3.16
Typical intranet system architecture.

business partner's main extranet web page using their web browsers. Table 3.3 summarizes the similarities and differences between intranets, extranets, and the Internet.

Extranets benefit corporations in a number of ways. For example, extranets can dramatically improve the timeliness and accuracy of communications, reducing the potential for misunderstandings within the organization as well as with business partners and customers. In the business world, very little information is static; therefore, information must be continually updated and disseminated as it changes. Extranets facilitate this process by providing a cost-effective, global medium over which proprietary information can be distributed. Furthermore, they allow central management of documents, thus reducing the number of versions and the amount of out-of-date information that may be stored throughout the organization. While security is still considered to be better on proprietary networks, the Internet can be used as a relatively secure medium for business. Further, a company can use extranets to automate business transactions, reducing processing costs and achieving shortened cycle times. Extranets can also reduce errors by providing a single point of data entry from which the data can be updated on disparate corporate computing platforms without

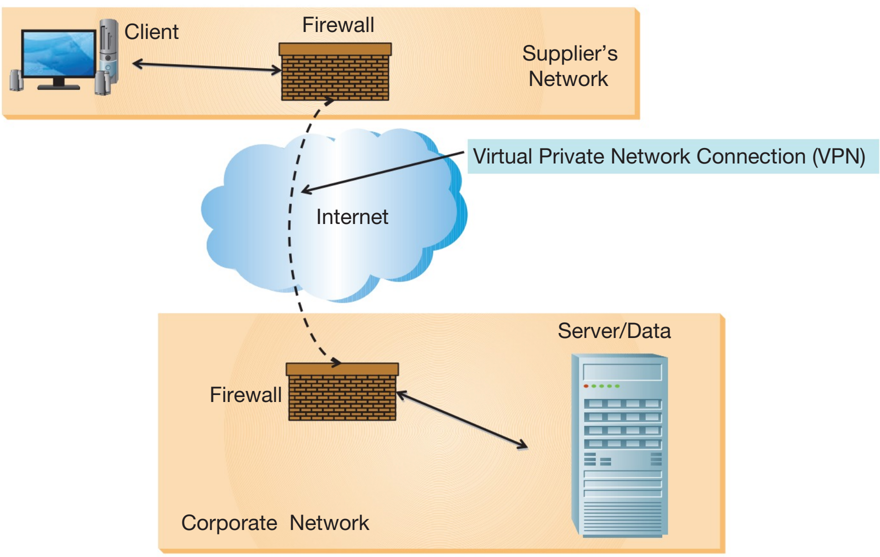


FIGURE 3.17
Typical extranet system architecture.

TABLE 3.3 Characteristics of the Internet, Intranet, and Extranet

	Focus	Type of Content	Users	Access
Internet	External communications	General, public content	Any user with an Internet connection	Public and not restricted
Intranet	Internal communications	Specific, corporate, and proprietary content	Authorized employees	Private and restricted
Extranet	External communications	Communications between business partners	Authorized business partners	Private and restricted

having to reenter the data. Management can then obtain real-time data to track and analyze business activities.

Data Centers

To satisfy the increasing requirements for processing and storing the ever-growing volume of data, large organizations need hundreds or even thousands of servers. Organizations such as UPS need tremendous amounts of computing power to route and track packages, online stores such as Zappos need to provide product information and track customer orders, and social networking game developers such as Riot Games need to track each and every action users take on the popular game League of Legends. As you can imagine, an organization's hardware and storage infrastructure can quickly grow quite large, and companies typically set aside dedicated space for their infrastructure components (such data centers can range in size from a single dedicated server room to buildings the size of a large warehouse). Storing and processing massive amounts of data requires lots of power as well as air-conditioning to keep the equipment running within the optimal temperature range (which helps to increase the life span of the equipment). Keeping this infrastructure in one location helps in managing, repairing, upgrading, and securing the equipment, and organizations go to great lengths in selecting locations that strike the optimal balance between protection from the elements (such as earthquakes or hurricanes) and proximity to the customers/users (to reduce latency).

Today, almost any business can be considered an e-business. Given that data are the lifeblood of almost all organizations, reliably accessing these data is a key concern. This is especially true for data-intensive organizations, ranging from e-commerce companies to logistics companies to government agencies. All such organizations are striving for the highest level of availability of their hardware, storage, and networking components, often reaching for "five-nines" (i.e., 99.999 percent availability, which translates into just over five minutes of downtime per year). To ensure this availability, there are not only specific demands for the individual components (e.g., being able to quickly swap hard drives or other parts in case of failure) but also for the data center overall (e.g., in terms of connectivity, floor space, provision of energy and cooling, and security). In addition, data centers need to be modular so as to be easily expandable in case of changing needs. The facilities for UPS in Atlanta, Georgia, and Mahwah, New Jersey, are prime examples of such high-availability facilities. To ensure uninterrupted service, the data centers are self-sufficient, and each can operate for up to 2 days on self-generated power. The power is needed not only for the computers but also for air-conditioning, as each facility needs air-conditioning capacity equaling that of more than 2,000 homes. In case power fails, the cooling is provided using more than 600,000 gallons of chilled water, and the UPS facilities even have backup wells in case the municipal water supply should fail. Other protective measures include raised floors (to protect from floods) and buildings designed to withstand winds of 200 miles per hour. Alternatively, organizations can rent space for their servers in collocation facilities, which are data centers managed by a third party that rents out space to multiple organizational customers (see Chapter 10 for more on securing data centers and collocation facilities).

Issues Associated with Managing the IS Infrastructure

Needless to say, for organizations, obtaining, operating, maintaining, and upgrading the information systems infrastructure can be a tremendous challenge, especially when these tasks are not part of their core business.

As you have undoubtedly noticed, computing technology has evolved rapidly and will most likely continue to evolve rapidly in the future. In general, because of the increasing pace of change with modern technologies, most organizations face accelerating obsolescence of their hardware and software investments as well as increasing storage and space constraints, demand fluctuations, and increasing energy costs (Figure 3.18). In the following section, we discuss how the interplay between the different infrastructure components both encourages and necessitates continuous upgrading of the infrastructure.

Rapid Obsolescence and Shorter IT Cycles

Over the past 75 years, information systems have gone through many radical changes. Rapid advances in both hardware and software capabilities have enabled or facilitated many business processes, and organizations are continuously faced with the need to upgrade the IS infrastructure so as to gain or maintain competitive advantage. In this section, we discuss the history of computing as well as the effects of rapid advances in technology.

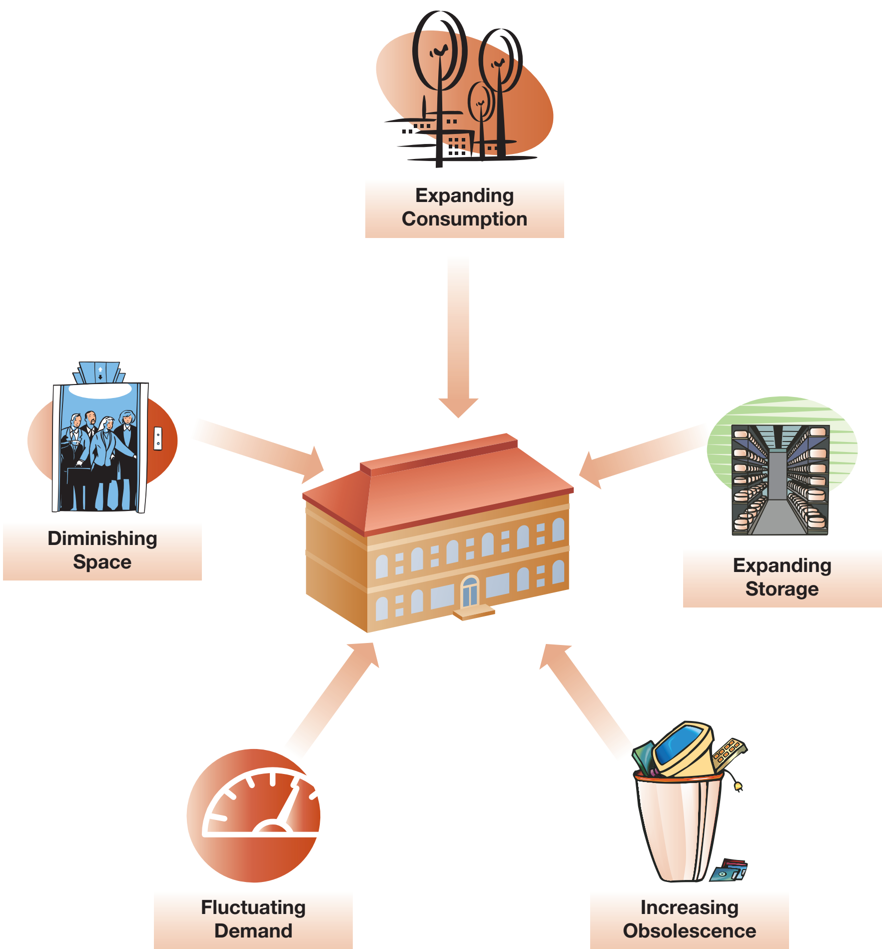


FIGURE 3.18

Information systems infrastructure challenges for modern organizations.

BRIEF HISTORY OF COMPUTING. When the Zuse Z1 Computer (a mechanical computer using program punch cards) was introduced in 1936, almost all business and government information systems consisted of file folders, filing cabinets, and document repositories. Huge rooms were dedicated to the storage of these records. Information was often difficult to find, and corporate knowledge and history were difficult to maintain. Only certain employees knew specific information. When these employees left the firm, so did all their knowledge about the organization. The computer provided the solution to the information storage and retrieval problems facing organizations up to the 1940s. Shifts in computing eras were facilitated by fundamental changes in the way computing technologies worked. Each of these fundamental changes is referred to as a distinct generation of computing. Table 3.4 highlights the technology that defined the six generations of computing.

MOORE'S LAW. In 1965, Intel cofounder Dr. Gordon Moore hypothesized that the number of transistors on a chip would double about every 2 years. When Moore made this bold prediction, he did not limit it to any specified period of time. This prediction became known as **Moore's law**. Interestingly, whereas the first CPU had 2,200 transistors, the newest models have broken the 5-billion-transistor mark, so Dr. Moore's prediction has been fairly accurate so far (see www.intel.com/technology/mooreslaw). The number of transistors that can be packed into a modern CPU and the speed at which processing and other activities occur are remarkable. For example,

TABLE 3.4 Six Generations of Computing

Generation	Time Period	Major Characteristic	Events
1	1946–1958	Vacuum tubes	• Mainframe era begins • ENIAC and UNIVAC were developed
2	1958–1964	Transistors	• Mainframe era expands • UNIVAC is updated with transistors
3	1964–1990s	Integrated circuits	• Mainframe era ends • Personal computer era begins • IBM 360 with general purpose operating system • Microprocessor revolution: Intel, Microsoft, Apple, IBM PC, MS-DOS
4	1990s–2000	Multimedia and low-cost PCs	• Personal computer era ends • Interpersonal computing era begins • High-speed microprocessors and networks • High-capacity storage • Low-cost, high-performance integrated video, audio, and data
5	2000–2010	Widespread Internet accessibility	• Interpersonal computing era ends • Internetworking era begins • Ubiquitous access to Internet with a broad variety of devices • Prices continue to drop; performance continues to expand
6	2010–present	Ubiquitous mobile connectivity	• Advent of powerful mobile devices and ubiquitous mobile connectivity • Big Data • Cloud computing • Internet of Things • Social networking

the Intel Core i7 Extreme CPU can complete hundreds of millions of operations every second. Given technological and economic limitations, today gains in computing power are increasingly being realized by adding more computing cores that can perform tasks in parallel. Further, advances in quantum computing promise a leap in computing power.

FASTER IT CYCLES AND CONSUMERIZATION. For organizations, this increase in capabilities is both a blessing and a curse. On the one hand, increases in processing power enable applications that were previously not possible; on the other hand, managers have to continuously think about when to upgrade the hardware components of the IS infrastructure. Beyond Moore's law, there are two other factors exacerbating this problem. First, IT cycles are becoming increasingly faster, with manufacturers releasing new devices at an ever-increasing pace. Whereas traditionally, IS managers would think in terms of 5 years, nowadays new versions of devices are released every 6–12 months. Second, with the increasing trend toward consumerization of IT, managers have to consider how to integrate their users' various mobile devices into the organization's IS infrastructure. We discuss mobile device management in Chapter 10.

SOFTWARE OBSOLESCENCE. In addition to constant increases in hardware capabilities, companies such as Microsoft are continuously developing new and improved software that uses this power to help people be more productive. New operating systems such as Windows 10 can use new processor architectures and offer a richer set of features than older operating systems such as Windows XP. However, these new operating systems often require new hardware, and older-generation application software may not be compatible with the new operating system (Figure 3.19). Further, new generations of application software promise better performance and more (or improved) features, enabling higher productivity. One example is Microsoft Office 2007 (and its most recent successor Office 2016); when developing Office 2007, Microsoft conducted many usability studies to improve the human–computer interface (see Chapter 9, "Developing and Acquiring Information Systems") so as to facilitate the execution of common tasks and, as a result, introduced the so-called "Ribbon" interface. Although people used to the "old" interface were initially reluctant to switch—because of the associated learning curve—many have now realized the benefits this new feature brings. Manufacturers of hardware and software often apply the concept of **planned obsolescence**, meaning that the product is designed to last only for a certain life span. For hardware, this can mean that certain components are not built to be serviceable, and the device has to be replaced once one of these components breaks down; similarly, older versions of software may not be able to open newer file formats, or a company may cease support for a product (mainstream support for the Windows XP operating system ended in 2009, and paid support as well as critical security updates ended in 2014), effectively forcing users to switch to newer versions. Hence, organizations are constantly faced with the decision of when and how to upgrade their current information systems infrastructure. Although such upgrades may increase productivity, often they do not but are still a large cost factor, both in terms of costs for hardware and software and in terms of the time and resources needed for upgrading tens, hundreds, or thousands of computers. Further, the

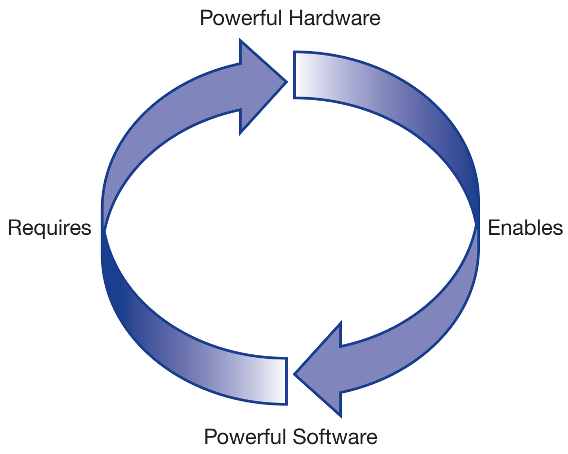


FIGURE 3.19

New hardware enables more powerful software; more powerful software often requires new hardware.

FIGURE 3.20

The rapid obsolescence of computer hardware carries a high price tag for the environment.
Source: Tonis Valing/Shutterstock.

rapid obsolescence of computer hardware carries a high price tag for the environment in terms of resources needed both to manufacture the new systems and to dispose of the old ones (Figure 3.20).

Big Data and Rapidly Increasing Storage Needs

Another issue facing organizations is the amount of data available and the amount of data needed to stay ahead of the competition. Today, organizations can collect and analyze vast amounts of data for *business intelligence* (see Chapter 6) and other purposes (such as compliance). For example, organizations can analyze each visitor's actions on the company's website in order to improve the site's performance. Similarly, organizations are increasingly trying to make use of Big Data, that is, trying to analyze structured and unstructured data from media reports, social media, customer support calls, and other sources. Obviously, capturing more data requires ever more storage space and ever more powerful computing hardware and database management systems for managing and analyzing the data. Further, Internet bandwidth grew tremendously during the dot-com bubble, allowing organizations to provide their customers with richer (and more bandwidth-hungry) content. At the same time, services such as YouTube and videos streamed by Netflix create a need for even more bandwidth. Hence, this is another example of a "vicious circle" where enhanced capabilities enable new applications, which in turn require a certain level of capabilities in terms of both data and communications infrastructure.

Demand Fluctuations

An additional challenge for many organizations is that the demands for computing resources are often fluctuating, leading to either having too few resources at some times or having too many idle resources most of the time (according to estimates, up to 70 percent of organizations' IS infrastructures are utilized at only 20 percent of their capacity). Companies engaged in (or supporting) business-to-consumer electronic commerce (such as Amazon.com or FedEx; see Chapter 4, "Enabling Business-to-Consumer Electronic Commerce"), for instance, face large spikes in demand during the pre-holiday season in December; consequently, increased capacity is needed to handle this demand. While it is relatively easy to hire temporary staff to handle an increase in orders, it is typically not that easy to make quick changes to the IS infrastructure based on changing needs. Just a few years ago, launching a startup involved purchasing lots of hardware and installing web servers in one's basement, with no real idea of how much demand would need to be met; fluctuation in demand for computing resources is especially difficult to cope with for new entrants who are not able to forecast demand and may not have the resources to quickly expand their IS infrastructure to meet increases in demand for their products or services.

For organizations with a growing customer (or user) base, the facilities infrastructure has to grow along with any increase in computing needs (as Google grew, it eventually had to move its equipment out of a friend's garage; now Google is said to have more than 30 major data centers). This can be especially problematic for fast-growing companies, as renting (let alone building) additional facilities is expensive and significant time is needed for locating the right facilities, contract negotiations, and setup of the hardware and software; further, long-term contracts limit the companies' flexibility to scale the infrastructure down in times of lower demand.

Increasing Energy Needs

Finally, the worldwide increase in demand for energy has become another concern for organizations. As computers process data, they consume electricity; further, various components (such as the CPU and the power supply) generate heat, and most computers have multiple fans to control the temperature. More powerful hardware needs more energy to enable the increase in computing power; at the same time, having more powerful hardware requires more energy for cooling. A typical desktop uses between 40 and 170 watts when idling and can use up to 300 watts or more under full load. A typical server rack (holding multiple servers) in a data center can easily consume 15–17 kilowatts, the equivalent of power needed for more than 10 homes. Although you may not feel the impact of your personal computer usage on your home energy bill, for organizations having hundreds or thousands of computers, rising energy costs are becoming a major issue. Further, power consumption and heat emissions continue to rise as hardware manufacturers pack more and more processing power into servers, often without providing much improvement in energy efficiency. Thus, power and cooling can be a significant cost factor for companies. Google has invested many resources into developing more efficient data centers. Google now uses modular data centers that use specially equipped shipping containers for housing servers so as to be able to maximize efficiency by optimizing airflow, cooling, and power transformation (we will talk more about another trend, "green computing," later in the chapter as well as throughout the book in the Green IT case).

Given these issues, organizations have been looking for ways to better manage their IS infrastructure so as to enhance flexibility and agility while reducing costs. In the following section, we will discuss cloud computing and how it can address some of these infrastructure-related challenges.

Cloud Computing

Managing the IS infrastructure can be a challenge for many organizations due to the evolution of hardware and software, the demand for more storage and networking bandwidth, and the rising costs of energy. Further, organizations need dedicated staff to support their infrastructure, which incurs further costs; often, managing the IS infrastructure is not among the organization's core competencies, so others may be better at managing the infrastructure for them.

In many organizations, the infrastructure has grown over the years, leading to a fragmented infrastructure that tends to be difficult to consolidate. However, efficiency, effectiveness, and agility are key for successfully competing in the digital world, and organizations require a flexible, scalable infrastructure for their applications and databases. As a result, over the past decades, there has been a shift away from thinking about developing and maintaining the IS infrastructure toward thinking about what *services* the infrastructure should deliver. For example, people and organizations just want to be able to use e-mail rather than having to think about purchasing an e-mail server and dealing with associated issues such as administration, maintenance, storage, energy consumption, and so on. In addition, organizations increasingly buy or rent, rather than build, applications (except for highly specialized systems that help gain or sustain competitive advantage, as is the case with Amazon.com or Dell) to support their business processes; in other words, organizations leave the building of applications to other parties and assume that these applications will work. Given this trend, a solid infrastructure is important, as the infrastructure

WHEN THINGS GO WRONG

Old and Dirty Energy Drives Global Internet Growth

The Internet has become central to nearly every aspect of the modern economy. While traditional web browsing, shopping, and sending e-mail on a desktop or notebook computer are still important and widely performed activities, the Internet is being increasingly utilized for entertainment where high-definition video can be viewed from every corner of world on a smartphone, a tablet, or even a watch. In the coming years, IoT gadgets and sensors will communicate with massive data centers through ubiquitous networks, and autonomous vehicles will take you to work or deliver your online purchases. Clearly, the reliance of society on the Internet, and all its related infrastructural components, is going to continue to rapidly increase throughout the world. In fact, the amount of data generated by all of this activity is growing at an estimated 20 percent a year. Additionally, as smartphones become mainstream in the developing world, nearly 80 percent of the world's adult population will be connected to the Internet by 2020. And, with IoT, the number of devices connected to the Internet will be roughly twice the global population by 2018 (more than 15 billion). In fact, Internet traffic from mobile devices increased 69 percent in 2014 alone. The biggest driver of data usage has been online video, where TV and movies accessed through streaming services like YouTube, Netflix and Hulu have become a method of mainstream information gathering and entertainment across the globe.

These increases in the number of users, the amount of data storage, and the desire for bandwidth-hungry applications like video suggest that energy consumption to drive the Internet will continue to increase rapidly over the next decades. Many of the largest tech companies are aggressively pursuing renewable and sustainable energy sources to power their facilities; much of the energy generated within the developing world, however, still comes from cheap energy sources like coal. In 2013, coal provided approximately 41 percent of the world's electricity needs. China, the world's leading emitter of greenhouse gases from coal, has been slow to move toward greener, and more expensive, energy sources. A recent Greenpeace report, *Clicking Clean: A Guide to Building the Green Internet*, reports that Apple is the most aggressive tech company in powering its data center operations with renewable energy, with other name brand companies like Facebook, Google, Amazon, and Microsoft also making great strides at reducing their dirty energy usage.

One of the challenges for transforming the world to clearer and more renewable energy is not only the relatively low price for coal but also the subsidies funneled into fossil fuel production, estimated to be near US$5 trillion worldwide each year. Energy activists like Elon Musk (the founder of Tesla Motors) are asking people to rise up against big fossil fuel companies. With environmental awareness fast on the rise, tech giants believe they can help lead such change. But as the world relies more on the Internet, we are also relying more on old and dirty energy sources.

Based on:

Buckley, C. (2015, November 3). China burns much more coal than reported, complicating climate talks. *The New York Times*. Retrieved May 22, 2016, from http://www.nytimes.com/2015/11/04/world/asia/china-burns-much-more-coal-than-reported-complicating-climate-talks.html

Greenpeace. (2015). Clicking clean: A guide to building the green Internet. *Greenpeace*. Retrieved May 22, 2016, from http://www.greenpeace.org/usa/wp-content/uploads/legacy/Global/usa/planet3/PDFs/2015ClickingClean.pdf

IEA. (n.d.). Coal. *International Energy Agency*. Retrieved May 22, 2016, from http://www.iea.org/aboutus/faqs/coal

Medlock, K. (2015, May 9). Elon Musk calls for a global revolt against dirty energy. *Inhabitat*. Retrieved May 22, 2016, from http://inhabitat.com/elon-musk-calls-for-a-global-revolt-against-dirty-energy

Zik, O., & Shapiro, A. (2016). Coal computing: how companies misunderstand their dirty data centers. *Lux Research*. Retrieved May 22, 2016, from http://web.luxresearchinc.com/how-dirty-is-your-cloud-download-the-complimentary-lux-research-white-paper

determines how quickly new systems can be implemented and how well they will function; turning over the responsibility for the lower levels of the infrastructure to other organizations allows a business to focus on developing and implementing those applications that help to gain or sustain competitive advantage. This becomes even more important as any lack of robustness or integration of an organization's infrastructure will be immediately noticed by customers or other stakeholders, potentially leading to loss of business, trust, or goodwill.

What Is Cloud Computing?

Technological advances such as increasing Internet bandwidth and advances in virtualization have given rise to cloud computing (the "cloud" is a metaphor for the Internet; see Figure 3.21). As defined by the National Institute of Standards and Technology (NIST), "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services)

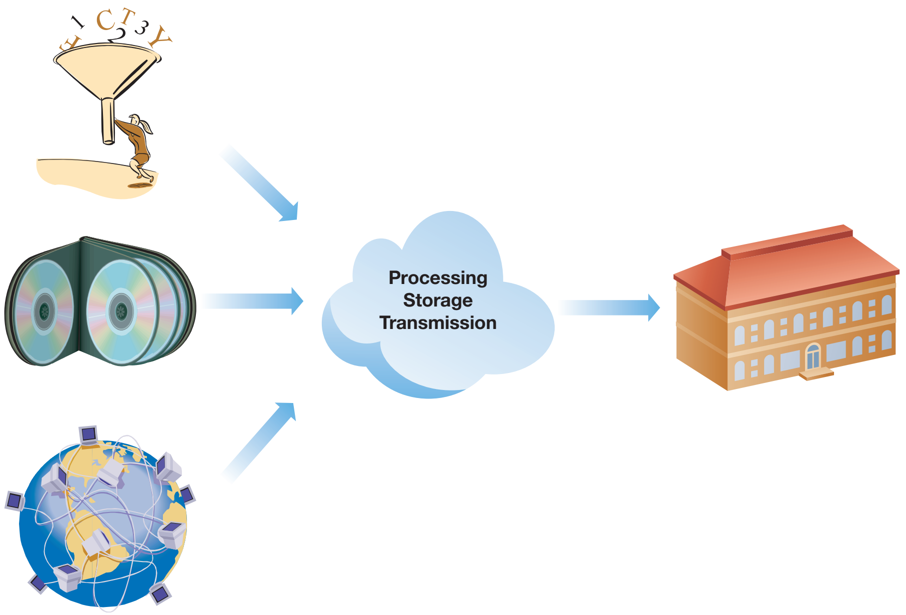


FIGURE 3.21

Processing, storage, and transmission of data taking place in the cloud.

that can be rapidly provisioned and released with minimal management effort or service provider interaction" (NIST, 2011). Using a **utility computing** model (i.e., organizations "renting" resources such as processing, data storage, or networking from an external provider on an as-needed basis, and paying only for what is actually used), cloud computing thus helps to transform IS infrastructure costs from a capital expenditure to an operational expenditure (Figure 3.22). One prime example of a cloud computing provider is Amazon Web Services; having built an immense infrastructure (in terms of both information technology and logistics) for supporting its online store, Amazon.com has decided to use these resources to generate additional revenue streams. For example, individuals and organizations can rent storage space on Amazon's Simple Storage Service (S3) or computing time on Amazon's Elastic Compute Cloud (EC2), all on an as-needed basis. The ability to create an entire infrastructure by combining Amazon's various services has facilitated many successful startup companies, such as the social scrapbooking site Pinterest and the community travel marketplace Airbnb. As

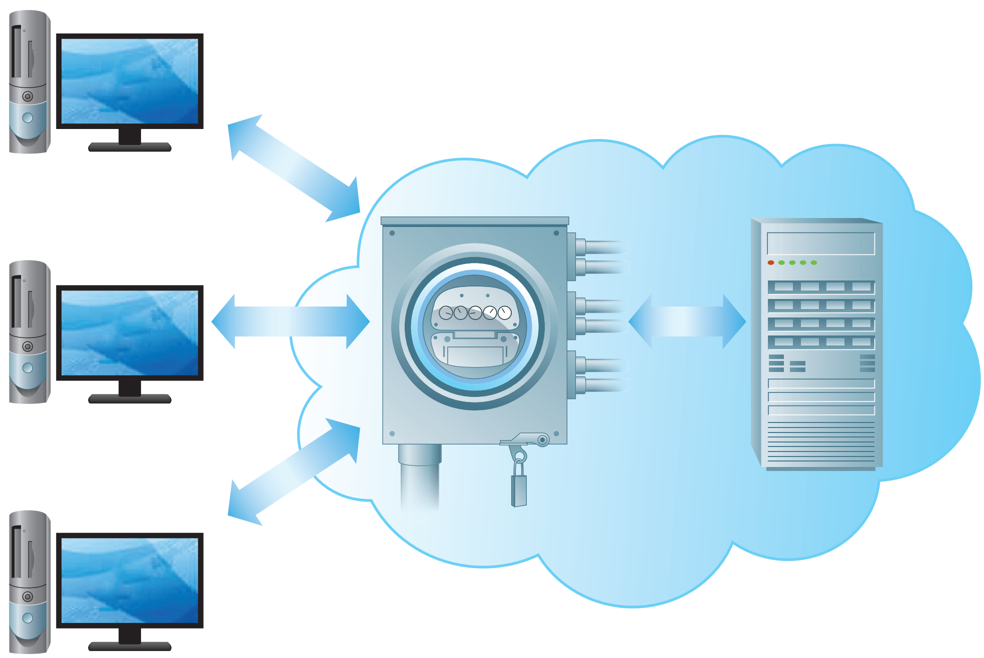


FIGURE 3.22

Cloud computing uses a utility computing model, allowing companies to pay for computing resources on an as-needed basis.

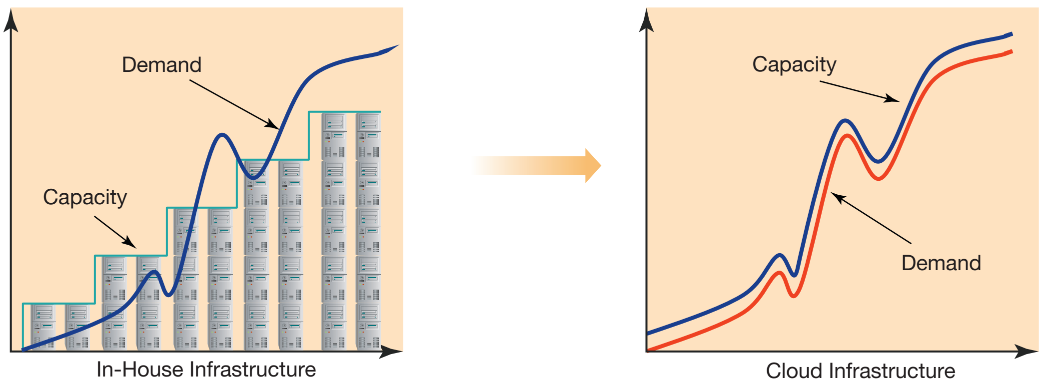


FIGURE 3.23

It is difficult to match demand using an in-house infrastructure; with a cloud infrastructure, resources can be added incrementally, on an as-needed basis.

Airbnb grew in popularity with travelers all over the globe, the company found itself being limited by challenges and constraints imposed by its original service provider. Moving to Amazon Web Services allowed Airbnb to quickly obtain 200 servers without needing to negotiate service contracts or commit to minimum usage. Flexibly scaling the infrastructure would have been close to impossible were Airbnb using its own data center because of both the time and the money needed to acquire this number of servers, and at the time, who knew whether Airbnb's business would actually take off? With a traditional in-house infrastructure, Airbnb would have had to add capacity in "chunks," leading to either having too many unused resources or not being able to satisfy its users' demand; using a cloud infrastructure, Airbnb can elastically scale the resources to be just above what is needed to keep the users satisfied (Figure 3.23).

CLOUD CHARACTERISTICS. The cloud computing model has several unique and essential characteristics that distinguish cloud computing from an in-house infrastructure and provide various benefits to users (NIST, 2011). These characteristics are discussed next.

On-Demand Self-Service To allow for most flexibility, users can access cloud resources in a buffet-style fashion on an as-needed basis without the need for lengthy negotiations with the service provider; in many cases, resources in the cloud are accessible by the customer with no need for human interaction with the provider. In the case of Amazon Web Services, a customer needs only a credit card (for billing purposes) and can set up server instances or expand storage space via a web-based control panel. For businesses whose needs may rapidly change, this allows for unprecedented flexibility, as it greatly facilitates scaling the infrastructure up or down as needed.

Rapid Elasticity Typically, servers and other elements of an IS infrastructure take several weeks to be delivered and days or weeks to be configured (as a company's IS personnel has to install and configure system software, databases, and application software, depending on the organization's needs); in contrast, in a cloud environment, computing resources can be scaled up or down almost instantaneously and often automatically, based on user needs. Hence, there is no need to purchase expensive equipment to prepare for an anticipated surge in demand (which ultimately may not materialize) during the holiday season. If, however, the surge in demand does materialize, businesses can access the required resources instantaneously at almost any quantity.

Broad Network Access As cloud services are accessed via the Internet, they are accessible from almost anywhere and from almost any web-enabled device. For organizations, this enables real-time management of business processes, as applications hosted in the cloud can be accessed whenever needed, from any location, be it from one's desktop or laptop or using an iPhone, iPad, or Android smartphone app. Thus, knowledge workers can swiftly respond to anything that may require their immediate attention without having to be physically in their office.

Resource Pooling Rather than renting out space or time to each customer on one specific, physical machine, cloud providers manage multiple distributed resources that are dynamically assigned to multiple customers based on their needs. Hence, the customer only rents a resource with no knowledge or control over how it is provided or where it is located. In some cases, however, service providers allow for specifying particular geographic areas of the resources; for example, a California company may want to rent resources located in California (close to its customers) so as to reduce response latency, or a European company may need to rent storage space on servers located in Europe so as to comply with data protection directives.

Measured Service **Measured service** is typically used in a utility computing model, where providers monitor usage and customers pay only for what they use. Different resources can have different types of metering. For example, customers could either be charged on an hourly basis for the use of server instances (the price typically depends on the instance's computing power, memory, and operating system), or be charged based on volume of data stored and/or transferred into or out of the cloud. For customers, the fixed costs associated with the IS infrastructure are thus transformed into variable costs, which are very easy to track and monitor.

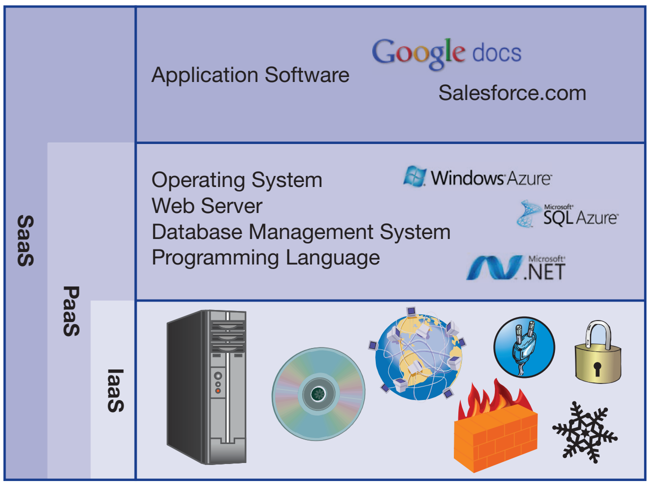
SERVICE MODELS. As can be seen from the previously mentioned examples, various services are provided in the cloud. Whereas some users require access only to certain software, others want to have more control and be able to run the software of their choice on a server in the cloud (Figure 3.24). Different cloud computing service models (NIST, 2011) are discussed next.

Infrastructure as a Service In the **infrastructure as a service (IaaS)** model, only the basic capabilities of processing, storage, and networking are provided. Hence, the customer has the most control over the resources. For example, using Amazon Web Services, customers can choose computing power, memory, operating system, and storage based on individual needs and requirements, thus being able to build (almost) their entire infrastructure in the cloud. Using such infrastructure, Netflix migrated its own IS infrastructure to Amazon Web Services to transcode movies into various formats, power its customer-focused website, and host other mission-critical applications. The IaaS model provides the customer with the greatest flexibility; on the other hand, while the infrastructure is provided, managing software licenses is still the responsibility of the customer, and setup costs are relatively high.

Platform as a Service In the **platform as a service (PaaS)** model, customers can run their own applications, which are typically designed using tools provided by the service provider. In this model, the user has control over the applications but has limited or no control over the underlying infrastructure. One example is Microsoft's Windows Azure, which acts as a cloud services operating system that customers can use to deploy custom applications. Using this platform, Outback Steakhouse launched a viral marketing campaign when it first introduced its Facebook Fan Page. To support the spikes in demand, Outback developed and deployed an e-mail marketing campaign using Windows Azure. As the underlying computing platform is provided, the customer does not have to worry about purchasing software licenses, for example, for the web servers' operating systems or for database management systems, and the service provider manages

FIGURE 3.24

Services by IaaS, PaaS, and SaaS providers.



the functioning and updating of the platform provided. A new trend is *serverless* computing. Designed to free users from having to set up virtual machines, serverless computing platforms such as Amazon's AWS Lambda allow for simply running small, specific functions, which can be integrated to develop applications. The service takes care of all management of the underlying platform, enabling continuous scaling, and the user is charged on the basis of usage time.

Software as a Service In the **software as a service (SaaS)** model, the customer uses only applications provided via a cloud infrastructure. Typically, such applications include web-based e-mail services (e.g., Google's Gmail) and web-based productivity suites (such as Zoho or Google Docs) but also advanced applications such as CRM systems, as provided by Salesforce.com (see Chapter 8). Typically, the customer cares only about the application, with no knowledge or control over the underlying infrastructure and typically has only limited ability to control or configure application-specific settings. Applications under the SaaS model are typically easiest to deploy because the customer does not have to worry about maintaining or updating the software, the underlying platform, or the hardware infrastructure.

TYPES OF CLOUDS. Cloud service providers such as Amazon.com offer what is referred to as a **public cloud**. Services in a public cloud can be used by any interested party on a pay-per-use basis; hence, they are often used for applications that need rapid **scalability** (i.e., the ability to adapt to increases or decreases in demand for processing or data storage) or in cases where there is insufficient capital or other resources to build or expand an IS infrastructure. In contrast, a **private cloud** (or internal cloud) is internal to an organization and can help the organization balance demand and supply of computing resources within the organization; similar to a public cloud, a private cloud provides self-service access to resources, allowing business users to provision resources on-demand using a utility computing model. A private cloud does not free an organization from the issues associated with managing the cloud infrastructure, but it does give the organization a high degree of customizability, flexibility, and control over its data and applications (Figure 3.25).

Managing the Cloud

Because of its various benefits, cloud computing has gained much popularity, especially among executives who try to harness the potential of scalability and increase the business' agility. However, there are also various issues management should consider when moving infrastructure to the public cloud. The first consideration is which applications, services, or data to move to the cloud. Typically, there is no single cloud computing provider that can meet all needs of an organization. Rather, organizations often have to partner with different service providers, selecting IaaS, PaaS, and SaaS models based on the business's needs and often combining public and

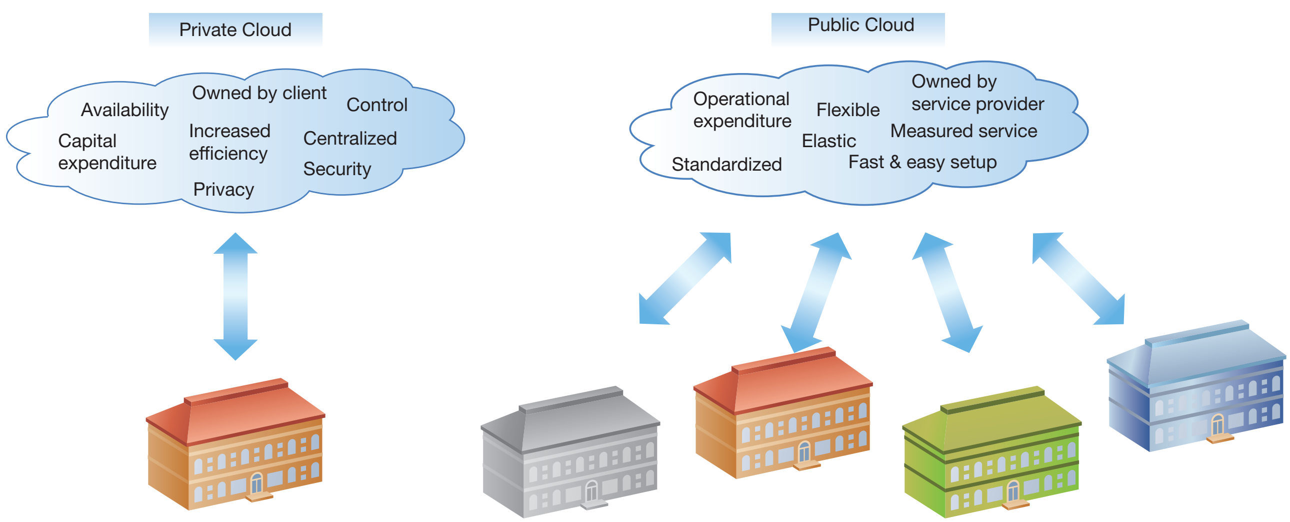


FIGURE 3.25

Public clouds versus private clouds.

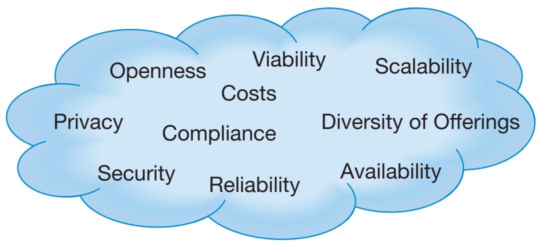


FIGURE 3.26

Organizations have to consider various issues when managing their cloud infrastructure.

private clouds; as there is not one solution that fits all, organizations have to carefully weigh the benefits and downsides of cloud computing. In addition, organizations must carefully consider which cloud services provider to choose. Some of the long-term, strategic issues that management should consider when evaluating different public cloud service providers include availability, reliability, scalability, viability, security, privacy, compliance, diversity of offerings, openness, and, not least, cost (Figure 3.26). These are discussed next (see also Hofmann & Woods, 2010).

AVAILABILITY/RELIABILITY. The availability of the service is a primary concern for most organizations. As shown by examples from Google, Amazon, and Microsoft, not even the largest public cloud computing providers are immune from problems, be it hardware failures, programming errors, or some network outage. Organizations thus have to evaluate which applications to move to the cloud and how to ensure the availability of cloud-based applications. In addition to examining what the promised uptime of the application/system is, what backups are made to the servers and storage, or whether sufficient bandwidth will be provided to access large amounts of data, organizations have to implement their own precautionary measures. As it is often too costly (e.g., in terms of lost business or goodwill) to be affected by negative events, organizations should plan ahead and replicate their cloud-based infrastructure in different locations. Related to this, an important criterion to consider is the provider's support policies. In case something does not work as promised, how will issues be resolved? One of the advantages of cloud computing is self-service, allowing clients to provision resources as needed. At the same time, this can be a potential downside, as there is not always the guarantee of having help available if needed. Thus, organizations must ensure that acceptable support capabilities and personnel are available, especially for mission-critical applications, to rapidly solve technical issues when they arise.

SCALABILITY. One of the biggest promises of cloud computing is scalability, such that organizations can scale up or down their infrastructure as needed. Yet not every provider will be able to meet every organization's demands. Thus, organizations have to carefully evaluate to what extent the provider will be able to meet current and future business needs in terms of data storage, transaction volumes, and so on.

VIABILITY. Another important issue is associated with the viability and stability of the provider in the long run. As an organization moves to a public cloud infrastructure, it puts much data and processing capabilities into the hands of an outside entity. If this outside entity happens to go out of business, this can have many repercussions for the organization, such as costs and efforts involved in setting up a new infrastructure, migrating applications, or transferring the data from the old provider to the new infrastructure.

SECURITY, PRIVACY, AND COMPLIANCE. In addition to concerns related to availability, reliability, scalability, and viability of the vendor, security, privacy, and compliance are critical aspects to consider when deciding which data and applications to move to the cloud and which provider to select. Especially when sensitive data are concerned, organizations have to question how secure the data will be from outside intruders, how the privacy of customer data will be protected, and whether the data storage complies with regulations such as the Sarbanes–Oxley Act and the Health Insurance Portability and Accountability Act (HIPAA) and standards such as the Payment Card Industry Data Security Standard. By definition, a public cloud infrastructure is shared among different companies with different applications running on the same hardware; as a result, it is impossible for organizations to know where exactly (physically) the data are located, and thus auditing who has access to the data is extremely difficult if not impossible.

Whereas using an in-house infrastructure, a company has complete control over its own data, this control is lost in a cloud infrastructure, and organizations have fewer legal rights if their data are stored in the cloud. Similarly, cloud computing providers may be asked to hand over sensitive data stored on their servers to law enforcement, leaving the organization with little control. Especially for industries heavily concerned with privacy and data protection, such as firms in the medical or legal fields, these issues are of critical importance. On the other hand, public cloud computing providers are certainly aware of these issues, and organizations have to weigh which applications or data to move to the cloud and which to keep in-house.

Issues such as availability, reliability, and security are normally covered in **service-level agreements (SLAs)**, which are contracts specifying the level of service provided in terms of performance (e.g., as measured by uptime), warranties, disaster recovery, and so on. A big caveat is that such service-level agreements do not *guarantee* the availability of resources; rather, they only promise certain service levels and provide for refunds or discounts if these promises are not met and can thus be regarded mostly as a vehicle for resolving conflicts in case of problems.

For businesses, this poses a serious dilemma, as such refunds and discounts normally only cover the costs paid for the service but can never offset the opportunity costs arising from lost business. On the other hand, when evaluating the benefits and drawbacks of moving the infrastructure to the public cloud, organizations also have to critically evaluate in how far they would be able to maintain certain uptime using an in-house infrastructure and at what costs; often, organizations realize that even though certain SLAs may not be met by the provider, the provider can still offer better uptime than a poorly managed in-house infrastructure. In evaluating their options, organizations often choose a hybrid approach, having certain mission-critical applications in-house while moving other, less demanding applications (in terms of uptime, etc.) to the public cloud.

DIVERSITY OF OFFERINGS. As discussed earlier, there are various providers of cloud computing services, ranging from IaaS to SaaS. As a larger number and diversity of providers is more difficult to manage, many organizations prefer to deal with fewer providers that can meet all needs. Thus, an important question to ask is which provider can offer the services needed both presently and in the future.

OPENNESS. A related question organizations face is the issue of interoperability. Most cloud providers use different infrastructures, different ways to store data, and so on. This, however, makes migrating data between providers extremely difficult and can lead a company to be locked in by a certain provider. In addition to different infrastructures and storage models, existing network bandwidth (and data transmission costs) poses an additional limitation to interoperability, as moving terabytes of data from one provider to another, even using very high-speed networks, can prove extremely time-consuming and expensive (as cloud computing providers often charge for transferring data into or out of their infrastructure).

COSTS. A final issue to consider when moving to a public cloud infrastructure is costs. The utility computing model used by cloud computing providers gives organizations control over the resources used and paid for—the organization only pays for the resources used and can scale the resources up or down when needed. Thus, this provides the organization with much transparency in the cost of the resources. Yet there is considerable disagreement over whether moving to the public cloud is cheaper than maintaining an in-house infrastructure. For example, the online game developer Zynga moved from a public cloud infrastructure to an in-house private cloud and decided to own, rather than rent, its infrastructure. Comparing the costs of owning versus renting is not an easy feat. Whereas it is easy to calculate the costs per month of a server in Amazon's EC2 cloud, many organizations do not know how much exactly it costs to run a comparable server in an in-house infrastructure, including the costs of the server itself, the fees for software licenses, the electricity, the data center, the staff, and so on. Thus, organizations have to carefully balance the benefits and costs of the flexibility and scalability the cloud offers, such as by using a cloud infrastructure only for periods of peak demand; needless to say, this adds another layer of complexity to the IT operations.

In sum, there are various issues to consider when moving to a cloud infrastructure, and each organization has to make various informed choices about how to harness the opportunities the cloud offers while minimizing potential drawbacks. In the next section, we will provide a brief discussion of various other applications enabled by the cloud.

Advanced Cloud Applications

Clearly, the cloud offers many ways for businesses to solve their IS infrastructure–related issues. In addition to the different cloud services models, the cloud has enabled other trends, such as using a *service-oriented architecture* for flexibly deploying new applications, *grid computing* to help solve large-scale computing problems, *content delivery networks* for increasing web application performance, and *IP convergence* for transmitting voice and video communication over the Internet. These applications are discussed next.

SERVICE-ORIENTED ARCHITECTURE. In order to achieve greater flexibility and agility, organizations have tried to move away from deploying large, monolithic applications in favor of a **service-oriented architecture (SOA)**. Using SOA, business processes are broken down into individual components (or **services**) that are designed to achieve the desired results for the service consumer (which can either be an application, another service, or a person). To illustrate this concept, think about the next oil change for your car. As you can't be expert in everything, it is probably more effective to have someone change the oil for you. You may take your car to the dealership, you may go to an independent garage or oil change service, or you may ask your friend to do it for you. For you, all that matters is that the service will be provided at the expected level of quality and cost, but you typically do not care if different service providers do things differently or use different tools.

By breaking down business processes into individual services, organizations can more swiftly react to changing business needs. For example, using an SOA approach, multiple services (such as "check inventory" or "order supplies") would be orchestrated to handle the individual tasks associated with processing customer orders and could be changed relatively easily if the business process changes.

To facilitate online collaboration with suppliers, business partners, and customers, SOA uses and reuses individual services as "building blocks" so that systems can be easily built and reconfigured as requirements change. To achieve these benefits, services have to follow three main principles:

- ***Reusability.*** A service should be usable in many different applications.
- ***Interoperability.*** A service should work with any other service.
- ***Componentization.*** A service should be simple and modular.

Following these principles, multiple applications can invoke the same services. For example, both an organization's point-of-sale system and e-commerce website could invoke the service "process credit card," and a digital dashboard could invoke the services "display products," "display inventory," and "display sales" (Figure 3.27). Hosting and deploying such services in the cloud can help in building applications using SOA. In addition, various services an organization may need are available in the cloud, eliminating the need to "reinvent the wheel." However, whereas an SOA approach appears to be appealing for many companies, it requires tremendous

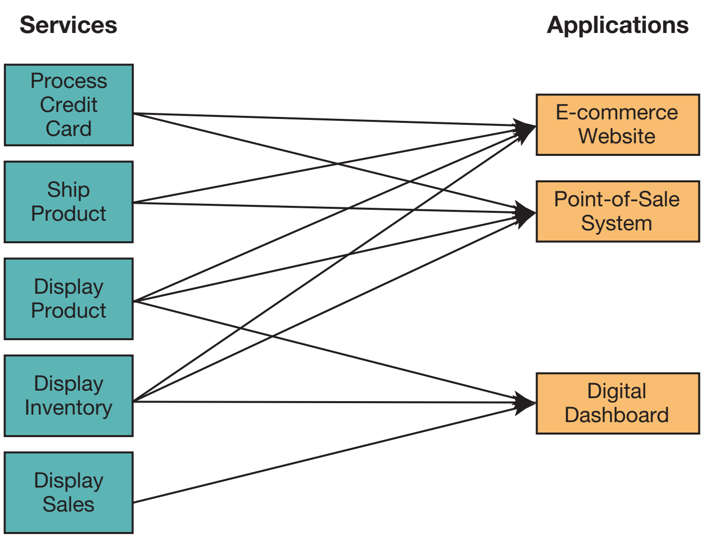


FIGURE 3.27

Using SOA, multiple applications can invoke multiple services.

FIGURE 3.28

The Titan supercomputer can perform more than 20,000 trillion calculations per second.

Source: Courtesy of Oak Ridge National Laboratory, U.S. Dept. of Energy.

effort and expertise to plan the architecture, select the right services from hundreds or thousands of available services, and orchestrate and deploy the services. Hence, while an SOA approach helps to increase flexibility, the integration of various services can be extremely complex and can be well beyond the means of small enterprises.

GRID COMPUTING. Businesses and public organizations heavily involved in research and development face an ever-increasing need for computing performance. For example, auto manufacturers, such as the GM German subsidiary Opel or Japanese Toyota, use large supercomputers to simulate automobile crashes and to evaluate design changes for vibrations and wind noise. Research facilities such as the Oak Ridge National Laboratory use supercomputers to model neutron transport in nuclear reactors or to study climate change scenarios (Figure 3.28), while others simulate earthquakes using supercomputers; such research sites have a tremendously complex hardware infrastructure.

Although today's supercomputers have tremendous computing power, some tasks are even beyond the capacity of a supercomputer. Indeed, some complex simulations can take a year or longer to calculate even on a supercomputer. Sometimes an organization or a research facility would have the need for a supercomputer but may not be able to afford one because of the extremely high cost. For example, the fastest supercomputers can cost more than US$200 million, and this does not represent the "total cost of ownership," which also includes all the other related costs for making the system operational (e.g., personnel, facilities, storage, software, and so on; see Chapter 9). Additionally, the organization may not be able to justify the costs because the supercomputer may be needed only occasionally to solve a few complex problems. In these situations, organizations either have had to rent time on a supercomputer or have decided simply not to solve the problem.

One way for overcoming cost or use limitations is to utilize **grid computing**. Grid computing refers to combining the computing power of a large number of smaller, independent, networked computers (often regular desktop PCs) into a cohesive system in order to solve problems that only supercomputers were previously capable of solving. Similar to cloud computing, grid computing makes use of distributed resources; however, in contrast to cloud computing, the resources in a grid are typically applied to a single large problem. To make grid computing work, large computing tasks are broken into small chunks, which can then be completed by individual computers (Figure 3.29).

However, as you can imagine, grid computing poses a number of demands in terms of the underlying network infrastructure or the software managing the distribution of the tasks. Further, the slowest computer often creates a bottleneck, thus slowing down the entire grid.

FIGURE 3.29

Grid computing: Computers located around the world work on parts of a large, complex problem.

SECURITY MATTERS

Car Hacking

The thought of riding down the highway in an automobile or bus and having the driver lose control because a malicious hacker has embedded malware into one of the vehicle's onboard computers is frightening. In many high-visibility demonstrations in a variety of magazines and news programs, hackers (or maybe it is better to call them researchers) have shown how they can break into many of these onboard systems.

Many potential onboard systems are vulnerable to hacking. Modern vehicles have a number of control units—essentially small computers—to operate and integrate a variety of systems, including the engine and transmission, airbags, steering and braking, remote keyless entry, and many others. Each of these systems is coupled together through a maze of networks. Modern vehicles also contain Bluetooth so the driver can connect a smartphone for hands-free mobile phone calls and even Wi-Fi hotspots to provide connectivity for gadgets, entertainment, and passengers. There is a tremendous amount of programming code in modern vehicles, and most of this code is from a broad range of vendors, making it virtually impossible for vehicle manufacturers to understand all potential vulnerabilities. Each of these systems has the potential to be exploited by hackers if design or security flaws are not identified.

A successful break-in typically isn't easy, however, often requiring several researchers several months to figure out. Because of this, some view this vulnerability as more hype than reality, suggesting that hacking into such onboard systems should not be viewed as being a huge safety or security concern. The truth is likely somewhere in the middle between hype and reality. While it may take a particular team a long time to figure out a particular hack into an onboard system, others can learn from these successful efforts to greatly shorten the learning curve. To address this, both technology and vehicle component vendors are working together to standardize approaches, share information, and make supply chains more secure to prevent tampering or counterfeit parts entering a vehicle. At the same time, manufacturers must also learn about vulnerabilities so that any security flaws can be quickly repaired.

Based on:

Greenberg, A. (2016, March 17). The FBI warns that car hacking is a real risk. *Wired*. Retrieved April 8, 2016, from http://www.wired.com/2016/03/fbi-warns-car-hacking-real-risk

Huddleston, Jr., T. (2015, September 15). This graphic shows all the ways your car can be hacked. *Fortune*. Retrieved April 8, 2016, from http://fortune.com/2015/09/15/intel-car-hacking

Intel. (n.d.). Automotive security best practices. *Intel*. Retrieved April 8, 2016, from http://www.intel.com/content/www/us/en/automotive/automotive-security-best-practices-white-paper.html

Pogue, D. (2016, February 22). Why car hacking is nearly impossible. *Scientific American*. Retrieved April 8, 2016, from http://www.scientificamerican.com/article/why-car-hacking-is-nearly-impossible

Vanian, J. (2016, January 26). Security experts say that hacking cars is easy. *Fortune*. Retrieved April 8, 2016, from http://fortune.com/2016/01/26/security-experts-hack-cars

A **dedicated grid**, consisting of a large number of homogeneous computers (and not relying on underutilized resources), can help overcome these problems. A dedicated grid is easier to set up and manage and, for many companies, much more cost effective than purchasing a supercomputer.

CONTENT DELIVERY NETWORKS. Another recent trend in IS hardware infrastructure management is the use of **content delivery networks** to increase performance of websites. Typically, the larger the geographical distance between a user and the web server hosting certain content, the longer it takes to transmit the content; this can be especially noticeable for content such as streaming media but also for other content presented on a web page. Content delivery networks help reduce this latency by providing a network of servers in various geographical locations, which store copies of particular websites. If a user in a particular geographic location requests a certain web page, the content delivery server closest to the user's location delivers the content, significantly speeding up the delivery of the content (Figure 3.30), a process that is normally unnoticed by the user. This process not only saves valuable resources such as bandwidth but also offers superior performance that would otherwise be too expensive for organizations to offer.

CONVERGENCE OF COMPUTING AND TELECOMMUNICATIONS. Today, much of an organization's communication and collaboration needs are supported by Internet technologies; for example, texting and e-mail have become the communications methods of choice for many people. However, for some topics, other forms of communication are more suited, so managers turn to the telephone, instant messaging, meetings, or videoconferences. The growing convergence of computing and telecommunications can help satisfy such diverse communication and collaboration needs. The computing industry is experiencing an ever-increasing convergence of functionality of various devices. Whereas just a few years ago a cell phone was just capable of making phone calls and people used personal digital assistants to support mobile computing needs, such devices are now converging such that the boundaries between devices are becoming increasingly blurred. Today, smartphones, such as the iPhone 7 or Samsung's Galaxy S7, offer a variety of different functionalities—formerly often available only on separate dedicated devices—to address differing needs of knowledge workers and consumers alike (e.g., phone, e-mail, web browser, navigation system, camera, music player, and so on).

In addition to a convergence of capabilities of devices, there is also increasing convergence within the underlying infrastructures. For example, in the past, the backbone networks for the

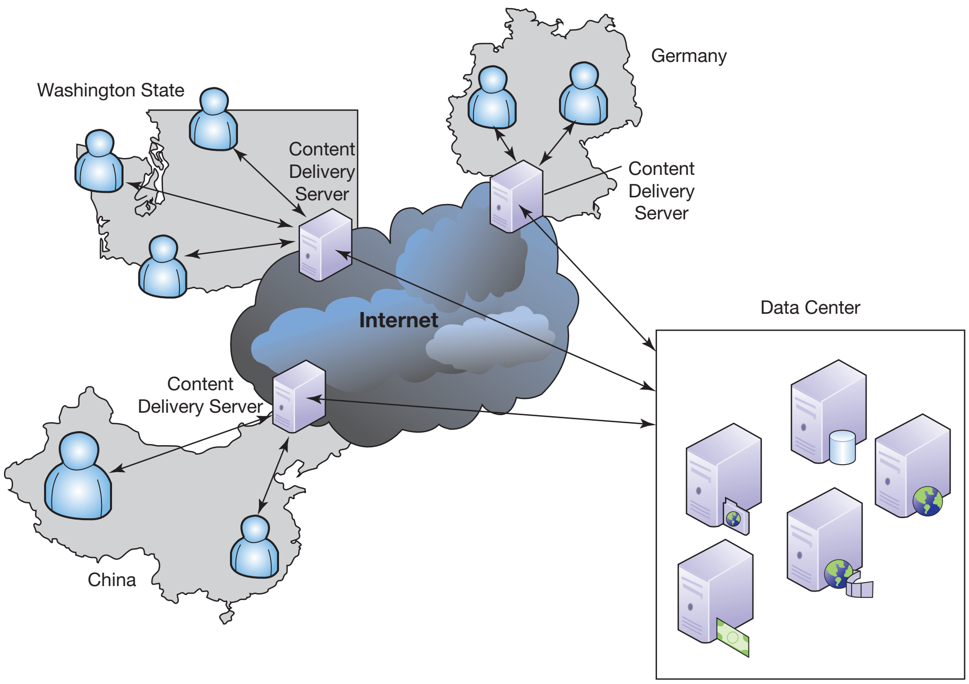


FIGURE 3.30

Content delivery networks store copies of content closer to the end user.

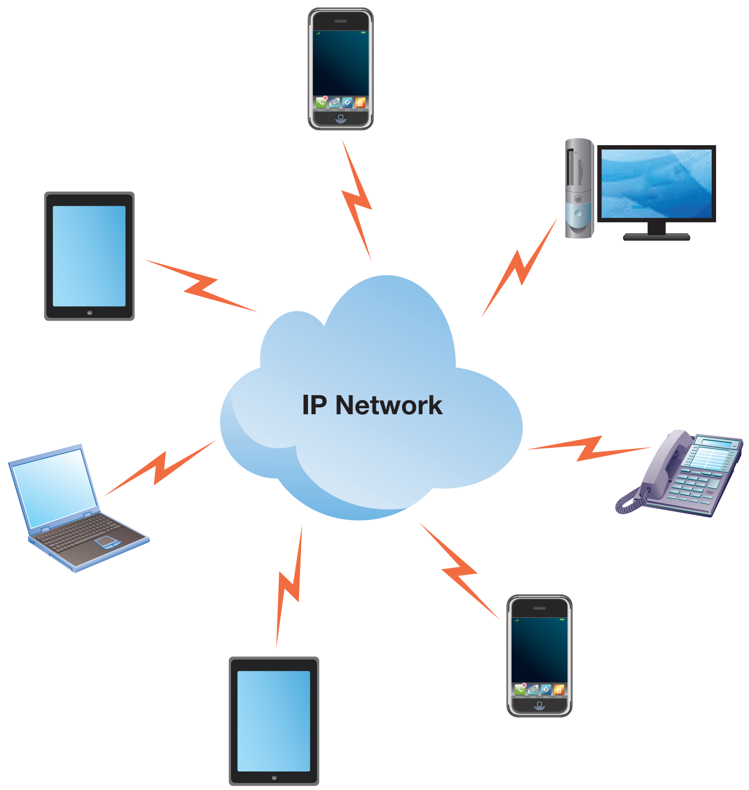


FIGURE 3.31

IP convergence allows various devices to communicate using IP technologies.

telephone and Internet were distinct. Today, increasingly, voice and data traffic share a common network infrastructure. **IP convergence**, or the use of the *Internet protocol (IP)* for transporting voice, video, fax, and data traffic, has allowed enterprises to make use of new forms of communication and collaboration (e.g., instant messaging and online whiteboard collaboration) as well as traditional forms of communication (such as phone and fax) at much lower costs (Figure 3.31). In the following sections, we discuss two uses of IP for communication: voice over IP and videoconferencing over IP.

Voice over IP **Voice over IP (VoIP)** (or IP telephony) refers to the use of Internet technologies for placing telephone calls. Whereas just a few years ago the quality of VoIP calls was substandard, recent technological advances now allow the quality of calls to equal or even surpass the quality of traditional calls over (wired) telephone lines. In addition to the quality, VoIP offers a number of other benefits; for example, users can receive calls from almost anywhere they connect to the Internet. In other words, knowledge workers are not bound to their desk to receive VoIP calls; instead, using IP routing, their telephone number "follows" them to wherever they connect to the Internet. For example, Christoph, who lives in Hong Kong, has VoIP telephone numbers in the United States and Germany so that friends and family members living in these countries can call him at local rates. Organizations can also benefit from tremendous cost savings, as often there is little cost incurred over and above the costs for a broadband Internet connection (e.g., VoIP software such as Skype allows users to make Skype-to-Skype calls for free).

Videoconferencing over IP In addition to voice communications, IP can also be used to transmit video data. Traditionally, videoconferences were held either via traditional phone lines, which were not made to handle the transfer of data needed for high-quality videoconferencing, or via dedicated digital lines, which was a very costly option. Similar to VoIP, the Internet also helped to significantly reduce costs and enhance the versatility of videoconferences by enabling **videoconferencing over IP**.

For some videoconferences, desktop videoconferencing equipment (consisting of a webcam, a microphone, speakers, and software such as Google Hangouts or Skype) may be

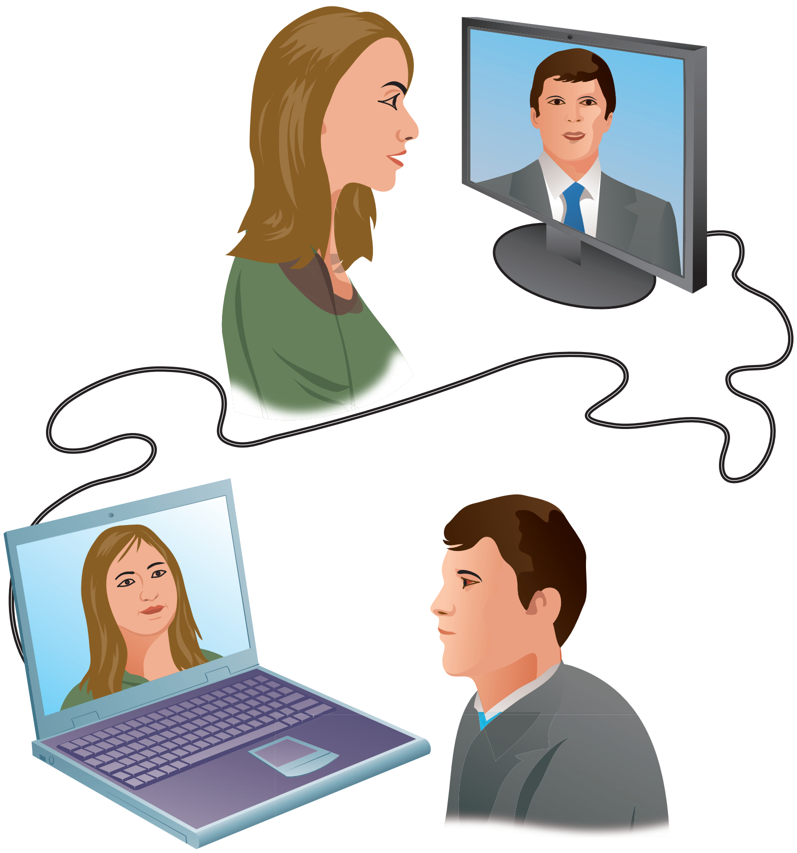


FIGURE 3.32

Desktop videoconferencing equipment helps organizations and individuals to reduce their telecommunications costs.

sufficient (Figure 3.32); for others, higher-end equipment may be needed. Such infrastructure can include specific videoconferencing hardware, or it can be a dedicated virtual meeting room featuring life-sized images allowing people from across the globe to meet as if they were sitting in the same room.We discuss videoconferencing in more detail in Chapter 5, "Enhancing Organizational Communication and Collaboration Using Social Media."

Green Computing

Fueled by the rapid advances of developing nations, the world has seen a tremendous increase in demand for and cost of energy. For organizations having hundreds or thousands of computers, rising energy costs are becoming a major issue. Further, organizations are being increasingly scrutinized for their contribution to societal issues such as climate change (see Chapter 1); more and more organizations are trying to portray a "greener" image when it comes to the use of energy and natural resources, as company executives have realized that they cannot afford the consequences of inaction on the company's reputation. As "green" efforts can save money on energy and water use, waste disposal, and carbon taxes and can be subsidized by grants, rebates, or free technical advice, they can also have positive impacts on a company's bottom line.

Green computing, or attempts to use computing resources more efficiently to reduce environmental impacts, as well as the use of information systems to reduce negative environmental impacts, can contribute to these efforts by helping to use computers more efficiently, doing the same (or more) with less. For example, organizations can save large amounts of money for power and cooling by using virtualization to replace hundreds of individual servers with just a few powerful mainframe computers. As studies have shown, computing resources in organizations are often very much underutilized, and using virtualization can help lower an organization's energy bill and carbon footprint. Similarly, cloud computing has been argued to contribute to reduced energy consumption, as the service provider's infrastructure is shared by many users.

Installing sophisticated power management software on individual desktops can save much energy that is wasted by leaving computers idling or on standby overnight. Further, discouraging employees from printing out e-mails or business documents can help to reduce the waste of paper—an average office worker prints more than a tree's worth of paper each year.

A related issue is the retiring of obsolete hardware. Today, companies cannot just send retired equipment to a landfill. Rather, companies as well as individuals have to evaluate how to best dispose of unwanted computers, monitors, and parts. Whereas the first step is to make the decision *when* to retire equipment, the next steps are equally important. Needless to say, it has to be ensured that old computers are wiped of all user data. Many third-party outsourcers ("IT asset disposition" vendors) offer services including wiping all computer hard drives and either refurbishing and selling usable equipment or dismantling the components to recycle valuable raw materials and properly dispose of hazardous waste.

INDUSTRY ANALYSIS

Movie Industry

Do you remember the original *Star Wars* movies or movies such as *King Kong* (1976) or *Godzilla* (1954)? Compare these to recent box office hits such as *Star Wars VII: The Force Awakens (2015*), *Deadpool (2016),* or animated movies such as *Finding Dory (2016).* With each new generation of movies, there is also a tremendous increase in computing power, enabling film studios such as Dreamworks and Universal Studios or special effects studios such as Weta Digital and Pixar to create animations and special effects of hitherto unimaginable quality using specialized powerful software and hardware for computer-generated imagery (CGI, also known as computer graphics).

As for major studios, rapidly evolving digital technology (specifically, recording hardware and sophisticated yet easy-to-use digital editing software) has opened vast opportunities for independent filmmakers who are producing studio-quality films without having to rely on expensive lighting, film development, and postproduction facilities. Thus, people who could never afford all the necessary equipment can now produce movies digitally. Further, digital cameras and projectors and advances in software have made the transition from celluloid to digital more attainable for filmmakers who until recently used traditional technology. And it is not just the little independent filmmakers embracing the digital trend. Today, most films made by large studios such a Paramount Studios and Warner Brothers are shot and edited using 100 percent digital formats. Another big innovation is the use of drones for recording the action. Drones are a very low-cost alternative to expensive helicopters and have the added benefit of being able to go places that humans or helicopters simply cannot due to size or safety constraints. This is a particular advantage for independently developed movies that don't have the budget of major blockbusters as well as for sports reporting.

The impact of technology on the movie industry does not stop with movie production. Many movie theaters across the world have shifted to digital projection technologies, reducing the need for duplicating and shipping large reels of film and reducing distribution costs by up to 90 percent while speeding up the time from the studio to the theater. Rather than on reels of film (that are susceptible to out-of-focus projection, scratches, or "pops"), the movies are stored on central servers, from which they are accessed and downloaded via the Internet by individual theaters. Theater owners can much more swiftly react to fluctuating demand and easily show movies on more than one screen in case of high demand. Clearly, the use of information systems has tremendously changed the movie industry.

Questions

1. Can digital technologies help movie theaters compete with the increasing trend toward more sophisticated home theaters? If so, how?
2. What are the ethical issues associated with special effects becoming more and more realistic with the help of digital technologies?
3. From the perspective of movie studios and theaters, list the pros and cons of using digital distribution technologies.

Based on:

Alexander, H., & Blakely, R. (2014, September 12). The triumph of digital will be the death of many movies. *New Republic*. Retrieved April 8, 2016, from https://newrepublic.com/article/119431/how-digital-cinema-took-over-35mm-film

Digital cinematography. (2016, March 4). In *Wikipedia, The Free Encyclopedia*. Retrieved April 8, 2016, from https://en.wikipedia.org/w/index.php?title=Digital_cinematography&oldid=708195035

Jardin, X. (2005, July 28). Hollywood plots end of film reels. *Wired*. Retrieved April 8, 2016, http://archive.wired.com/entertainment/music/news/2005/07/68332

Watercutter, A. (2015, March 6). Drones are about to change how directors make movies. *Wired.* Retrieved April 8, 2016, from http://www.wired.com/2015/03/drone-filmmaking

Key Points Review

1. ***Describe how changes in businesses' competitive landscape influence changing IS infrastructure needs.*** Organizations are facing continuously changing business environments, and quickly adapting to a constantly changing competitive environment necessitates that businesses are increasingly flexible and agile. Modern organizations use various applications and databases to support their business processes; these applications and databases rely on a solid underlying IS infrastructure consisting of hardware, system software, storage, networking, and data.
2. ***Describe the essential components of an organization's IS infrastructure.*** Organizations use various types of IS hardware to meet their diverse computing needs. The most prominent type of system software, the operating system, coordinates the interaction between hardware devices, peripherals, application software, and users. Further, organizations need to store massive amounts of data for operational, backup, and archival purposes. Networking is one of the reasons why information systems have become so powerful and important to modern organizations. Finally, organizations use data centers to house the different infrastructure components so as to ensure security and availability.
3. ***Discuss managerial issues associated with managing an organization's IS infrastructure.*** Radical advances in information technology have opened many opportunities for organizations but have also brought about challenges. Advances in hardware have enabled advances in software. Hardware and software obsolescence, faster IT cycles, and consumerization present issues such as when and how to upgrade the current infrastructure. Further, organizations' storage needs are growing at an ever-increasing pace, and organizations also have to deal with fluctuations in demand for computing power while often being unable to quickly scale the IS infrastructure accordingly. The increasing need for both computing power and storage fuels an increasing demand for energy, which can affect a company's image as well as its bottom line.
4. ***Describe cloud computing and other current trends that can help an organization address IS infrastructure–related challenges.*** Cloud computing uses a utility computing business model where customers can draw on a variety of computing resources that can be accessed on demand with minimal human interaction. Characteristics of cloud computing include on-demand self-service, rapid elasticity, broad network access, resource pooling, and measured service. Typical cloud computing service models are infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). When considering the move to a public cloud-based infrastructure, organizations have to weigh issues such as availability, reliability, scalability, viability, security, privacy, compliance, openness, diversity of offerings, and, not least, cost. Other applications in the cloud include SOA, grid computing, content delivery networks, voice over IP, and videoconferencing over IP. Finally, a recent trend is green computing, as companies realize potential cost savings and a positive effect on the company's image by implementing ways to reduce energy consumption and waste.

Key Terms

scalability 121
server 98
service 124
service-level agreement (SLA) 123
service-oriented architecture (SOA) 124
software as a service (SaaS) 121
supercomputer 98
system software 100
thin client 105
top-level domain 107
Transmission Control Protocol/Internet Protocol (TCP/IP) 108
transmission media 104
Uniform Resource Locator (URL) 107
utility computing 118
videoconferencing over IP 128
voice over IP (VoIP) 128
web browser 106
web page 106
web server 106
website 106
wide area network 106
Wi-Fi (wireless fidelity) network 106
wireless local area network (WLAN) 106
workstation 99
World Wide Web (www) 106

MyMISLab™

Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

3-1. How do applications support organizational business processes?

3-2. How do databases support organizational business processes?

3-3. Describe the key functions of system software.

3-4. For which purposes are data stored in organizations?

3-5. What are the distinguishing characteristics of different storage media?

MyMISLab **3-6.** How does computer networking work?

3-7. What are the major types of networks?

3-8. What is the World Wide Web, and what is its relationship to the Internet?

3-9. What are URLs, and why are they important to the World Wide Web?

MyMISLab **3-10.** What are the problems associated with software obsolescence?

MyMISLab **3-11.** Describe the characteristics of the cloud computing model.

3-12. Define grid computing and describe its advantages and disadvantages.

3-13. Describe what is meant by the term *IP convergence*.

3-14. Describe why green computing has become so important to modern organizations.

Self-Study Questions

3-15. All of the following are examples of infrastructure components except
A. hardware
B. system software
C. data centers
D. applications

3-16. Which of the following is *not* a consequence of lack of availability, performance, or security?
A. loss of managerial oversight
B. loss of business
C. loss of trust
D. loss of goodwill

3-17. Engineering drawings are typically prepared using ______________.
A. mainframes
B. servers
C. personal computers
D. workstations

3-18. Magnetic tape is typically used for ______________.
A. storing operational data
B. backing up critical data
C. maintaining customer records
D. archiving data

3-19. Which of the following is the protocol of the Internet?
A. URL
B. HTML
C. TCP/IP
D. ARPA

3-20. All of the following are correct domain suffixes except
A. .edu —educational institutions
B. .gov—U.S. government
C. .neo—network organizations
D. .com—commercial businesses

3-21. The ability to adapt to increases or decreases in demand for processing or storage is referred to as ______________.
A. adaptability
B. flexibility
C. scalability
D. agility

3-22. In cloud computing, services are typically offered using ______________.
A. private clouds
B. heterogeneous grids
C. a utility computing model
D. edge computing

3-23. For the most flexibility in the use of computing resources, companies choose a(n) ______________ provider.
A. utility computing
B. software as a service
C. platform as a service
D. infrastructure as a service

3-24. Large-scale computing problems can be solved using ______________ computing.
A. grid
B. utility
C. cloud
D. edge

Answers are on page 135.

Problems and Exercises

3-25. Match the following terms with the appropriate definitions:
i. Utility computing
ii. Service-level agreement
iii. System software
iv. Software as a service
v. Voice over IP
vi. Cloud computing
vii. Bandwidth
viii. Server
ix. Planned obsolescence
x. Scalability

a. The incorporation of a life span into the design of a product
b. The use of Internet technology for placing telephone calls
c. A cloud computing model in which the customer uses an application provided via a cloud infrastructure
d. A model for enabling convenient, on-demand network access to a shared pool of configurable computing resources
e. Any computer on a network that makes access to files, printing, communications, and other services available to users of the network
f. The transmission capacity of a computer or communications channel
g. A business model where computing resources are rented on an as-needed basis
h. Contracts specifying the level of service provided in terms of performance, warranties, disaster recovery, and so on
i. The collection of programs that control the basic operations of computer hardware
j. The ability to adapt to increases or decreases in demand for processing or data storage

3-26. Take a look at the website of an online retailer. Which pieces of content are likely assembled from data stored in databases?

3-27. Which applications are mission-critical for an online retailer? For a bank? Justify your assessment.

3-28. How do software programs affect your life? Give examples of software from areas other than desktop computers. Are the uses for software increasing over time?

3-29. Interview an IS professional about IS infrastructure. Which infrastructure components does this professional regard as most important? Why?

3-30. Using the web, find information about archiving your data. What options are available? What are the advantages and disadvantages of each option?

3-31. Scan the popular press and/or the web for clues concerning emerging technologies for computer networking. This may include new uses for current technologies or new technologies altogether. Discuss as a group the "hot" issues. Do you feel they will become a reality in the near future? Why or why not? Prepare a 10-minute presentation of your findings to be given to the class.

3-32. Do you have your own website with a specific domain name? How did you decide on the domain name? If you don't have your own domain, research the possibilities of obtaining one. Would your preferred name be available? Why might your preferred name not be available?

3-33. How does hardware and software obsolescence affect your life? Give examples of experiences with outdated hardware or software. How did you deal with these situations?

3-34. Using information on the web, find (or try to estimate) your computer's energy consumption. What are ways to reduce your computer's energy consumption?

3-35. Research the web for an example of a startup using a cloud infrastructure. What were the main reasons for choosing a cloud infrastructure? What alternatives did the startup have?

3-36. Are you using any services offered in the cloud? If so, what service model is offered by your provider? If not, what are your primary reasons for not using services offered in the cloud?

3-37. Interview an IS professional about cloud computing. Does this professional have a preference for public versus private clouds? Additionally, find out what data he or she would most likely entrust to a public cloud.

3-38. Research the web for service-level agreements of two different providers of cloud services and compare these based on availability, security, and privacy. How do the agreements differ? Are the agreements reasonable? Which provider would you select for your cloud infrastructure if you were to start a company?

3-39. Using a search engine, enter the key phrase "voice over IP providers." Who are the large vendors in this industry? What type of solutions do they offer to their clients? Does any vendor suit your communication needs?

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Tracking Frequent-Flier Mileage

3-40. You have recently landed a part-time job as a business analyst for Campus Travel. In your first meeting, the operations manager learned that you are taking an introductory MIS class. As the manager is not very proficient in using office software tools, he is doing all frequent-flier mileage in two separate Excel workbooks. One is the customer's contact information, and the second is the miles flown. Being familiar with the possibilities of spreadsheet applications, you suggest setting up one workbook to handle both functions. To complete this, you must do the following:

- Open the spreadsheet frequentflier2.csv. You will see a tab for customers and a tab labeled "miles flown."
- Use the vlookup function to enter the miles flown column by looking up the frequent-flier number. (Hint: If done correctly with absolute references, you should be able to enter the vlookup formula in the first cell in the "miles flown" column and copy it down for all the cells.)
- Use conditional formatting to highlight all frequent fliers who have less than 4,000 total miles.
- Finally, sort the frequent fliers by total miles in descending order.

Database Application: Building a Knowledge Database

3-41. Campus Travel seems to be growing quite rapidly. Now it has franchises in three different states, totaling 16 locations. As the company has grown tremendously over the past few years, it has become increasingly difficult to keep track of the areas of expertise of each travel consultant; often, consultants waste valuable time trying to find out who in the company possesses the knowledge about a particular region. Impressed with your skills, the general manager of Campus Travel has asked you to add, modify, and delete the following records from its employee database:

- Open employeedata.mdb.
- Select the "employee" tab.
- Add the following records:
  a. Eric Tang, Spokane Office, Expert in Southwest, Phone (509) 555-2311
  b. Janna Connell, Spokane Office, Expert in Delta, Phone (509) 555-1144
- Delete the following record:
  a. Carl Looney from the Pullman office
- Modify the following:
  a. Change Frank Herman from the Pullman office to the Spokane office
  b. Change Ramon Sanchez's home number to (208) 549-2544

Team Work Exercise

Net Stats: Internet Access Continues to Grow

Internet access in the United States and throughout the world is continuing to grow steadily. In early 2016, nearly 50 percent of the world's total population was accessing the Internet. In the United States, 88.5 percent of the population was accessing the Internet. Whereas many western European countries are in the mid-90 percent range and slowly move toward 100 percent penetration, Iceland is still ranked as the only country having 100 percent of its population online. At the other end of the spectrum, many small and very poor countries are still struggling to gain access. In countries such as Guinea, Somalia, and Eritrea, less than 2 percent of the population is online. In between the bottom and the top, access varies widely. In Asia, about 50 percent of the population has access, while less than 10 percent of those living in Africa have access.

Questions and Exercises

3-42. Search the web for the most up-to-date statistics.

3-43. As a team, interpret these numbers. What is striking/important about these statistics?

3-44. As a team, discuss how these numbers may look in 5 years and 10 years. What changes have to be made to the global networking infrastructure? What issues and opportunities do you see arising?

3-45. Using your spreadsheet software of choice, create a graph/figure that effectively visualizes the statistics/changes you consider most important.

Based on:

Akamai. (2015). The state of the Internet, Q4, 2015 report. *Akamai.com*. Retrieved April 7, 2016, from https://www.akamai.com/us/en/multimedia/documents/content/state-of-the-internet/q4-2015-state-of-the-internet-connectivity-report-us.pdf

Anonymous. (n.d.). Broadband technology fact sheet. *Pew Research*. Retrieved April 7, 2016, from http://www.pewinternet.org/fact-sheets/broadband-technology-fact-sheet

Internet Live Stats. (2016). Internet users. *Internet Live Stats*. Retrieved April 7, 2016, from http://www.internetlivestats.com

Answers to the Self-Study Questions

3-15. D, p. 93	**3-16.** A, p. 95	**3-17.** D, p. 99	**3-18.** D, p. 103	**3-19.** C, p. 108
3-20. C, p. 107	**3-21.** C, p. 121	**3-22.** C, p. 118	**3-23.** D, p. 120	**3-24.** A, p. 124

CASE 1 | A Catalyst for Innovation: Amazon Web Services

Amazon Web Services, or AWS, a subsidiary of Amazon.com, offers a suite of large-scale cloud computing services to organizations throughout the world. AWS allows organizations to more quickly and less expensively deploy massive amounts of computing capabilities as opposed to building and equipping a traditional data center with servers, networks, and related infrastructural components. AWS's best-known services are EC2, which stands for Amazon Elastic Computing Cloud, and S3, which stands for Amazon Simple Storage Service. Countless companies are using AWS to run major parts of their business, including Netflix, Spotify, Pinterest, Airbnb, Lyft, Yelp, and Gilt to name a few. In 2015, Gartner estimated that AWS customers were deploying ten times more infrastructure on AWS than the combined adoption of the next 14 providers. Estimates are that AWS has more than a million active customers in more than 190 countries, including nearly 2,000 government agencies, 5,000 education institutions, and more than 17,500 nonprofits. AWS is the 800-pound gorilla of cloud computing infrastructure companies. In early 2016, AWS had grown into a US$10 billion business with a 23 percent operating margin.

Many companies are leveraging the AWS global infrastructure to build their business. For example, Netflix delivers billions of hours of content globally by running on AWS. AWS enables Netflix to deploy thousands of servers and terabytes of storage throughout the world. Users can stream Netflix shows and movies anywhere in the world, supporting a range of devices from smart televisions to tablets and smartphones. Likewise, Airbnb is also leveraging AWS to rapidly expand its global marketplace that allows property owners and travelers to connect with each other for the purpose of renting unique vacation spaces. Owners and travelers can access Airbnb's system via their web browser or by using a smartphone app. Airbnb supports property rentals in nearly 25,000 cities in more than 190 countries. AWS has been a key part of Airbnb's global strategy. Another example is Lyft, a ridesharing company founded in 2012. Lyft's challenge was how to deploy mobile application support where riders could quickly and reliably find a driver to give them a ride. These and countless other companies, many of which you are likely familiar with, utilize AWS's cloud infrastructure to execute their value proposition for their customers.

As successful as AWS has been, Amazon is not content with simply dominating the cloud infrastructure business. While it is currently a US$10 billion business, some believe that AWS could ultimately be Amazon's biggest play. Recently, technology investor Chamath Palihapitiya, CEO of Social Capital LP, called AWS the "blue chip of technical infrastructure," predicting it will ultimately become a US$1.5 trillion business. He went on, "in order to understand the value of AWS, we think that Jeff [Bezos; Amazon's CEO] is going to completely disrupt this market. There are going to be unbelievable numbers of losers as AWS gets to scale … What [Bezos] did to retail, he will do to IT." Ten billion dollars is a long way from 1.5 trillion dollars, but AWS is growing fast. As AWS gets bigger, its economies of scale allow for undercutting the prices competitors charge their customers. Clearly, AWS has the potential to become the Walmart of IT services and further strengthen its position in numerous markets.

Amazon is becoming a central part of the global economy and society. While Amazon is one of many online retailers, it is growing rapidly and looks destined to eclipse Walmart as the world's largest retailer. In addition, with its AWS and S3 services, Amazon provides the IT backbone for countless successful companies and startups and is the world's dominant player in cloud service infrastructure. Amazon is also our bookstore and becoming our grocery store, Alexa answers our questions or plays our music, and Amazon is planning same-day product delivery with a fleet of drones. And all of this innovation runs on AWS.

Questions

3-46. Is Amazon too successful? If so, what should be done? If not, why not? Give specific examples to justify your position.

3-47. Why has Amazon been so successful in so many different areas? List specific examples of how it has generated and maintained competitive advantages. Is it unstoppable? In what areas has it been less successful?

3-48. If you had a startup tech company, would you use AWS? List advantages and disadvantage and explain your rationale.

Based on:

Amazon Web Services. (2016). Case studies and customer success stories, powered by the AWS cloud. *Amazon.com*. Retrieved May 23, 2016, from https://aws.amazon.com/solutions/case-studies

Amazon Web Services. (2016, May 11). In *Wikipedia, The Free Encyclopedia*. Retrieved May 23, 2016, from https://en.wikipedia.org/w/index.php?title=Amazon_Web_Services&oldid=719688469

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Soper, T. (2016, April 28). Amazon's cloud computing cash cow: AWS, now a $10B business, fuels record quarter for company. *GeekWire*. Retrieved May 23, 2016, from http://www.geekwire.com/2016/amazons-cloud-computing-cash-cow-aws-now-10b-business-fuels-record-quarter-company

CASE 2 | The Dark Web

Most people don't think too much about the web as long as they are able to visit their favorite websites. Popular websites like nytimes.com reside on what is called the *surface web*—meaning that they display content that a search engine like Bing or Google can find when you are searching the web. In addition to the surface web, there is a vast amount of non-indexed content that cannot be found with a normal search engine. This non-indexed content is collectively referred to as the *deep web*. The deep web is many times larger than the surface web. It has been suggested that the Internet can be visualized as a giant iceberg of information, with the content of the surface web being relatively smaller and visible and the deep web having a massive amount of content that is unseen by search engines and is typically more difficult to find and navigate.

The deep web contains a variety of content, both lawful and unlawful. Lawful content that resides on the deep web includes corporate and academic databases that cannot be found with a search engine but can be viewed with a normal browser. The deep web also houses content from mainstream websites, like Facebook posts that are only visible to a poster's friends or transaction data that you provide to Amazon when placing an order. All of this lawful content resides on the deep web, and much of it is only available to those authorized by the owner of the system to view or access it.

There is also a vast amount of unlawful content on the deep web, and this content is referred to as the *dark web*. Interest in the dark web has been on the rise following several high-profile data leaks that have been extensively discussed in the media. For example, after the hacking group called "The Impact Team" stole user data from the extramarital cheating website Ashley Madison, it posted this data on the dark web. Content on the dark web is arranged in a special way in order to provide anonymity to those who browse and share content. As such, you cannot access the dark web with a normal web browser. The most popular part of the dark web is called Tor. To access Tor, you need a special version of the Firefox browser. Tor, an acronym of The Onion Router, directs Internet traffic through a worldwide volunteer network of relays and virtual tunnels (rather than the usual direct connections to Internet sites)—each representing a layer of the onion. These relays allow users to conceal their location or usage from anyone conducting network surveillance or traffic analysis and are intended to protect the personal privacy of users. There are additional ways to further increase your anonymity on Tor by utilizing the Tails operating system, made famous by Edward Snowden, who used it to evade NSA watchdogs.

This high level of privacy within Tor allows people to conduct a wide range of confidential activities. Some use it for sensitive communications, including political dissent. But in the past decade, it's also become a hub for black markets that sell or distribute weapons, drugs, stolen credit cards, illegal pornography, pirated media, and more. You can even hire assassins. It is important to note, however, that Tor was initially created by researchers supported by the U.S. government's Defense Advanced Research Projects Agency, or DARPA, as a tool for fostering democracy in repressive regimes. So, while the dark web has many nefarious uses, it also has great value in many parts of the world where free expression is outlawed.

Because of the noted difficulties in searching and accessing the massive dark web, very little has been done to make it more accessible to the general public. Given the tremendous infrastructure resources required to search just the surface web, it is difficult to imagine the technologies, hardware, and software that would be required to allow the same search capabilities in the dark web. And given the nefarious nature of much of the dark web's content, perhaps society is better off making it difficult for most to navigate and utilize its content.

Questions

3-49. What infrastructure components are most important for providing the surface web to the public users of the Internet?

3-50. Should more effort be expended to enable wider access to the dark web? Why or why not?

3-51. What are the implications of the dark web for individuals? Companies? Governments?

Based on:

Ashley Madison data breach. (2016, May 19). In *Wikipedia, The Free Encyclopedia*. Retrieved May 23, 2016, from https://en.wikipedia.org/w/index.php?title=Ashley_Madison_data_breach&oldid=721001290

Dark web. (2016, May 22). In *Wikipedia, The Free Encyclopedia*. Retrieved May 22, 2016, from https://en.wikipedia.org/w/index.php?title=Dark_web&oldid=721467067

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Vilches, J. (2016, May 20). The dark web: What is it and how to access it. *TechSpot*. Retrieved May 22, 2016, from http://www.techspot.com/article/1177-dark-web

MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

3-52. Describe the difference between SaaS, PaaS, and IaaS.

3-53. Describe the different types of computers and their key distinguishing characteristics.

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4 Enabling Business-to-Consumer Electronic Commerce

Preview

This chapter focuses on electronic commerce (e-commerce, or EC), explaining how companies conduct business with customers over the Internet. The Internet and information technology (IT) megatrends, such as increases in mobile devices and social connectivity, have introduced unprecedented opportunities for the marketing of products and services, accompanied by features, functionality, and innovative methods to serve and support consumers. At the same time, conducting business transactions online has introduced various challenges. With e-commerce representing a growing proportion of overall retail sales, an understanding of e-commerce can be a powerful tool in your arsenal. People with e-commerce skills are in high demand in the marketplace; therefore, the more you know about e-commerce, the more valuable you will become.

MANAGING IN THE DIGITAL WORLD:

Taobao and the World of E-commerce

Most people in this world have heard of eBay and Amazon.com, two U.S.-based online retail sites where one can typically find any desired product. The online shopping fever has spread to China in the form of companies like Taobao and JD .com. Taobao, owned by Alibaba, was founded in 2003 and only 8 years later had 370 million registered users, more than the entire population of the United States. If you have tried any of Taobao's services, you know that it has various branches. There's Taobao Marketplace, China's eBay, which dominates the country's online consumer-to-consumer (C2C) e-commerce business with its 90 percent market share. Then there's Tmall.com, a separate site where renowned brands sell directly to consumers in a business-to-consumer (B2C) manner. In fact, Taobao has fostered such a holistic shopping experience that international names like Gap, Adidas, and Levi's, just to name a few, decided to launch their own official online retail storefronts in the virtual mall. By 2014, Taobao, Tmall.com, and Juhuasuan (another Alibaba site for "flash sales") had more than 231 million active buyers and 8 million sellers and took 11.3 billion orders a year. On the Chinese "Single's Day" alone, the Alibaba Group recorded US$9.3 billion in sales and shipped 278 million orders.

However, shoppers should beware. Taobao might be the talk of the town, but it is also known as a notorious

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

1. Describe different approaches to competing in cyberspace as well as different forms of electronic government and e-finance.
2. Describe business-to-consumer electronic commerce strategies.
3. Understand the keys to successful electronic commerce websites and explain the different forms of Internet marketing.
4. Describe mobile commerce, consumer-to-consumer electronic commerce, and consumer-to-business electronic commerce.
5. Describe how to conduct financial transactions and navigate the legal issues of electronic commerce.

market for piracy and counterfeit goods. You may want to try out JD.com instead (short for Jingdong Mall, formerly 360Buy) which has not made it to the list of notorious markets. The company is expanding fast, with an ambitious plan of solving logistics and delivery troubles that are a hallmark of the Chinese market, given the country's size and differences in population density (Figure 4.1). JD.com hopes to build a trucking fleet of close to 300 trucks and enter the logistics and distribution market, specifically to get rid of long-distance transport headaches. The greatest barrier to online shopping in China remains trust; within China, people fear being defrauded or receiving substandard products. Outside China, potential customers often face language barriers when attempting to communicate with the suppliers. While low-priced offers directly from Chinese suppliers may seem tempting, these factors can easily convince overseas consumers to turn to the more familiar Amazon.com or eBay.

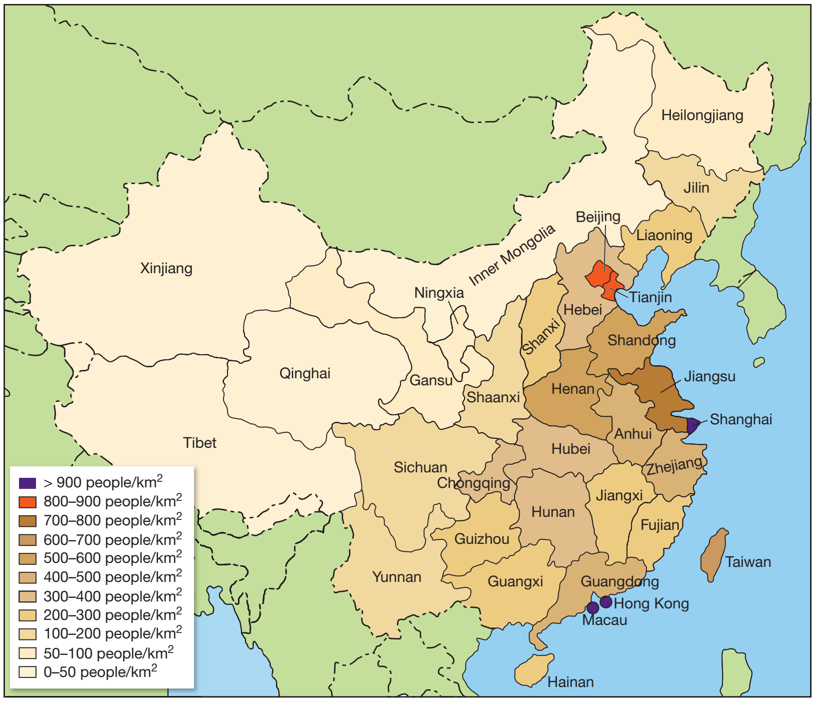

FIGURE 4.1

Companies serving the Chinese market face tremendous logistical challenges.

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

1. How have Taobao and JD.com evolved their e-commerce strategies to remain competitive in the global marketplace?
2. How does the proliferation of mobile devices change the competitive landscape for these companies?
3. How can these companies address issues related to trust and fraud?

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E-Commerce and E-Government

The Internet provides a set of interconnected networks for individuals and businesses to complete transactions electronically. **Electronic commerce (EC)** refers to the exchange of goods, services, and money[1] among firms, between firms and their customers, and between customers, supported by communication technologies and, in particular, the Internet. The Census Bureau of the Department of Commerce reported that while total U.S. annual retail sales in 2015 increased by 1.5 percent from 2014, online retail sales were up by nearly 15 percent and that EC accounted for 7.2 percent of total retail sales, resulting in sales of more than US$341.8 billion (Figure 4.2). Research firm eMarketer forecasts steady growth, anticipating global business-to-consumer e-commerce sales to exceed US$3.6 trillion by 2017. Considering all online markets, it is clear that online transactions have become a major segment of the global economy. With this much money at stake, it is little wonder that no other information systems (IS) issue has captured as much attention as has EC. Already during the Berlin airlift in 1948, the foundations for EC transactions between businesses were laid, as the Military Air Transport Service of the U.S. Air Force in Europe realized that the airlifted cargo was important but that *information* about the cargo—such as what exactly was contained in a shipment, where it was located, or when it was scheduled to arrive—was equally important and devised standard universal codes for transmitting these data via teletype (Seideman, 1996). The emergence of the Internet and web further facilitated EC and, in addition, paved the way for marketing and selling products and services to individual consumers. This has led to the creation of an electronic marketplace where a virtually limitless array of services, features, and functionality can be offered. As a result, a presence on the web has become a strategic necessity for most companies.

Types of Electronic Commerce

Contrary to popular belief, EC goes beyond consumers merely buying and selling products online. EC can involve the events leading up to the purchase of a product as well as customer service after the sale. Furthermore, EC is not limited to transactions between businesses and

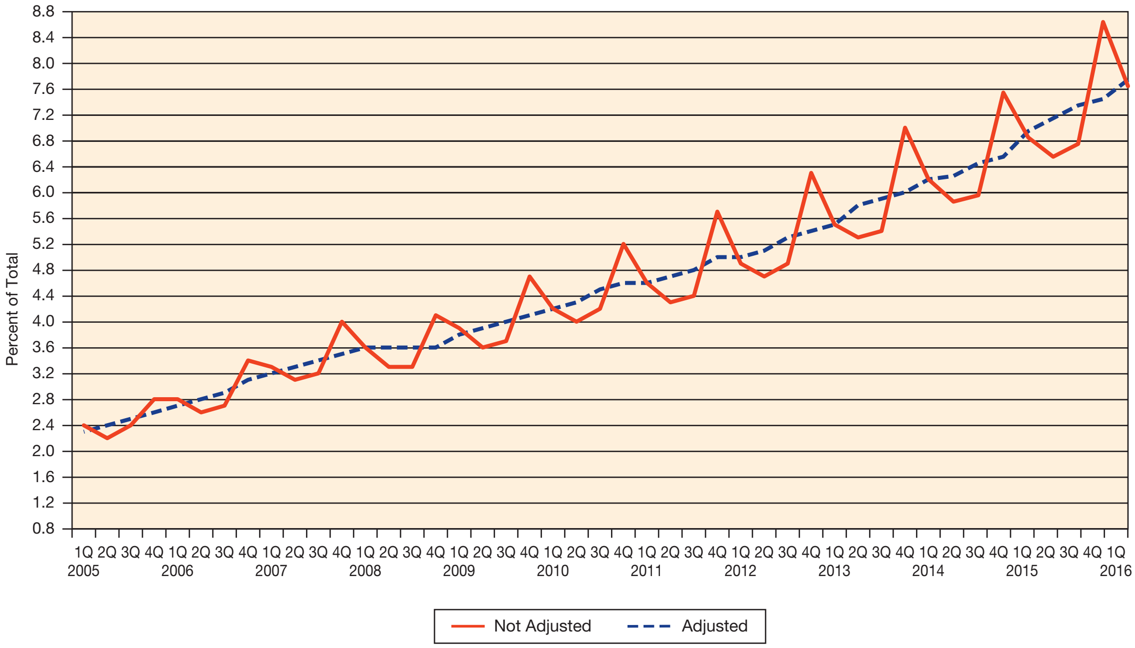

FIGURE 4.2

Online retailing continues to grow rapidly.

Source: U.S. Census Bureau News, U.S. Department of Commerce.

[1]EC can also include the distribution of digital products, such as software, e-books, music, movies, and digital images.

TABLE 4.1 Types of EC

Type of EC	Description	Example
Business-to-consumer (B2C)	Transactions between businesses and their customers	A person buys a book from Amazon.com.
Business-to-business (B2B)	Transactions among businesses	A manufacturer conducts business over the web with its suppliers.
Consumer-to-business (C2B)	Transactions between customers and businesses	A person offers his or her photography at shutterstock.com.
Consumer-to-consumer (C2C)	Transactions between people not necessarily working together	A person purchases some memorabilia from another person via eBay.

consumers, which is known as **business-to-consumer (B2C)** EC. EC is also used by organizations to conduct business with business partners such as suppliers and intermediaries. This form of EC, not involving the end consumer, is commonly referred to as **business-to-business (B2B)** EC. As many firms concentrate solely on B2B transactions, B2B EC is by far the largest form of EC in terms of revenues, with U.S manufacturers reporting e-commerce shipments totaling US$3.6 trillion in 2014 and wholesalers reporting e-commerce sales of US$2 trillion. Further, almost all companies focusing on the B2C arena, such as the clothing and home furnishing retailer Eddie Bauer, also engage in B2B EC. In the process of producing goods and services, a business typically sources its raw materials from a variety of specialized suppliers (in B2B transactions); after the production, the business sells each finished product to a distributor or wholesaler (in a B2B transaction) or directly to the end consumer (in a B2C transaction). We will discuss B2B EC in Chapter 8, "Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management."

Some forms of EC do not even involve business firms, as would be the case with transactions between consumers on an online auction site such as eBay; these forms of EC are referred to as **consumer-to-consumer (C2C)** EC. A related EC model is **consumer-to-business (C2B)** EC, where consumers offer products, labor, and services to companies, a complete reversal of the traditional B2C model. These basic types of EC are summarized in Table 4.1.

The five megatrends—social, cloud computing, the Internet of Things, mobile, and Big Data—have influenced various aspects of the digital world, and e-commerce is no exception. Fueled by the rise of social media, organizations are trying to leverage social networks to build lasting customer relationships, advertise products, or otherwise create value—a trend referred to as *social commerce*. Digital products and services are provided through the cloud (think iTunes, Dropbox, or Gmail). The Internet of Things enables companies to offer various innovative products and services that go beyond the initial purchase (such as the Nest thermostat that not only can be controlled from one's smartphone but also learns the user's schedules and habits, optimizing home energy use). The tremendous increase in the use of mobile devices has given rise to **mobile commerce (m-commerce)**—that is, any electronic transaction or information interaction conducted using a wireless, mobile device and mobile networks (wireless or switched public network) that leads to the transfer of real or perceived value in exchange for information, services, or goods (MobileInfo, 2016). Forrester Research estimates that U.S. B2C m-commerce sales will exceed US$142 billion in 2016, accounting for 38 percent of retail e-commerce sales; by 2020, 49 percent of retail e-commerce transactions will be made on mobile devices, for a forecast total of US$252 billion. In addition, B2B transactions are increasingly taking place on mobile platforms. Together, these megatrends generate a wealth of data, allowing companies to obtain an in-depth understanding of each individual customer so as to deliver individualized value propositions and build long-lasting customer relationships. Next, we examine the use of information systems for interactions with and between governments.

E-government

E-government is the use of information systems to provide citizens, organizations, and other governmental agencies with information about public services and to allow for interaction with

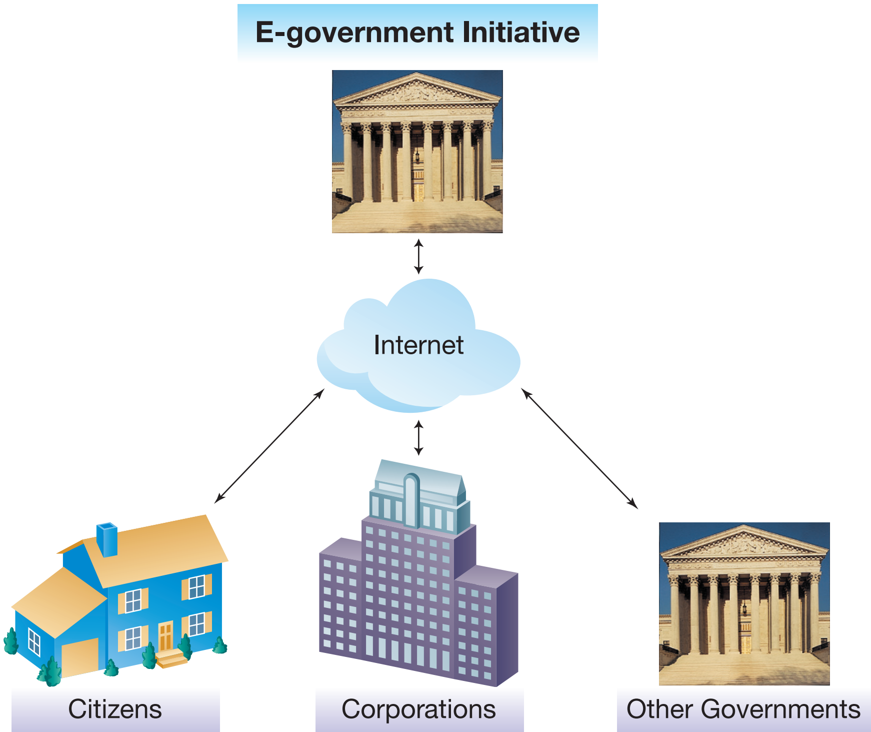

FIGURE 4.3

E-government initiatives include interaction with citizens, corporations, and other governments.

Source: Photographs in the Carol M. Highsmith Archive, Library of Congress, Prints and Photographs Division.

the government. Similar to the EC business models, e-government involves three distinct relationships (Figure 4.3).

GOVERNMENT-TO-CITIZENS. **Government-to-citizen (G2C)** EC allows for interactions between federal, state, and local governments and their constituents. The U.S. Internal Revenue Service's Internet tax filing, or *e-filing*, is one of the more recognizable G2C services, saving resources in terms of time and paper. Other services provided by governments include the online application for ID cards and municipal services, e-voting, or the provision of electronic access to public government data.

GOVERNMENT-TO-BUSINESS. **Government-to-business (G2B)** is similar to G2C, but this form of EC involves businesses' relationships with all levels of government. This includes e-procurement, or a government's streamlining its supply chain by purchasing materials directly from suppliers using proprietary Internet-enabled procurement systems. Also included in G2B initiatives are forward auctions that allow businesses to buy seized goods and surplus government equipment (these transactions can take place on a G2C level as well). Other G2B services include online applications for export licenses, verification of employees' Social Security numbers, and online tax filing.

GOVERNMENT-TO-GOVERNMENT. Finally, **government-to-government (G2G)** EC is used for electronic interactions that take place between countries or between different levels of government within a country. Since 2002, the U.S. government has provided comprehensive e-government tools that allow foreign entities to find government-wide information related to foreign trade or business topics. Other G2G transactions relate to the intergovernmental collaboration at the local, state, federal, and tribal levels.

E-finance

As we move further into the digital age, various products, services, and industries are being disrupted (see Chapter 2, "Gaining Competitive Advantage Through Information Systems"), and the financial industry is no exception. **E-finance** is the use of information systems to provide financial services and markets. Ubiquitous accessibility, the proliferation of mobile devices, advances in cloud computing, and Big Data analytics have brought about many radical changes for the financial services industry, and many foresee further radical changes in the near future. For example, financial companies can now operate on a global scale, and many services traditionally offered by banks can now be offered by other, nontraditional players. Likewise, *disintermediation* has enabled firms to provide many financial services directly to the end customers, and the Internet has enabled customers to easily compare prices for financial services. These changes have affected not only traditional banks but also brokerage firms, insurance companies, and other players in the financial market.

E-BANKING AND ONLINE BROKERAGE. One type of services frequently offered online is managing financial transactions. Whereas traditionally consumers had to visit their bank to conduct financial transactions, they can now manage credit card, checking, or savings accounts online using **online banking** or pay their bills using **electronic bill pay** services. Increasingly, financial service providers offer ways for their customers to use their mobile devices for conducting banking transactions. For example, many banks created **mobile banking** apps for checking account balances or initiating transactions. Large banks like Chase, Citibank, USAA, Capital One, and Charles Schwab offer mobile check deposit apps, allowing customers to deposit a check by simply taking a picture of the check with a smartphone's camera. E-finance has also had a large impact on payment services as well as the development of *cryptocurrencies*; we will discuss these later in the chapter.

In addition to online banking, **online brokerage** has seen steady growth over the past several years. For example, many people turn to sites such as MSN Money, Yahoo! Finance, or CNN Money to get the latest information about stock prices, firm performance, or mortgage rates, and use online brokerage firms to buy or sell stocks. Further, most large online brokerage services offer trading apps for various smartphone platforms. In addition, e-finance has brought about tremendous changes to financial markets. For example, many stock markets around the world now use electronic trading, such that stock traders from around the world can trade without having to be at the stock market's physical location. Further, electronic trading greatly increases trading speed and reduces transaction costs. Likewise, foreign exchange markets now operate electronically.

FINTECH. **Fintech** (financial technology) refers to technologies that support activities in the financial sector. Often, fintech is associated with companies (often startups) that use technologies in innovative ways to disrupt activities in the financial sector; many fintech startups focus on specific types of interactions, segments, or business processes. For example, successful fintech startups range from crowdfunding platforms such as Indiegogo or Kickstarter to mobile payment processors such as Square, peer-to-peer lenders such as Prosper and Lending Club, small-business lenders such as Behalf, or digital investment managers such as FutureAdvisor. Another fintech innovation is the use of artificial intelligence for providing investment advice or managing financial portfolios. However, many of the innovative services provided by fintech startups are not captured by traditional financial regulations. Therefore, many innovations in the fintech sector will necessitate changes in regulation of financial services and public policy, often on a global scale; likewise, for organizations and individuals alike, managing risks becomes paramount, especially when dealing with players who are not established in the market.

Business-To-Consumer E-Commerce

Technological forces are driving business, lowering barriers to entry and leveling the playing field, allowing small and large businesses from around the globe to sell products to a global customer base. For small companies, this opens up vast opportunities. Unlike in international sports tournaments such as the Ironman World Championship, where athletes first have to compete locally to qualify for the big event, online businesses can "participate in the world championships" (i.e., compete on a global scale) right from the start. Companies are exploiting the capabilities of the web to reach a wider customer base, offer a broader range of products, and develop closer relationships with customers by striving to meet their unique needs (Valacich, Parboteeah, & Wells, 2007).

While it is beneficial for many small companies to access a global marketplace, this also means that every company participating in a market faces increased competition, and companies must strategically position themselves. Before the Internet, retailers (except for catalog merchants) operated solely using traditional physical stores; today, this approach is referred to as **brick-and-mortar business strategy**. Companies following this strategy solely operate physical locations such as retail stores and do not offer their products or services online. The advent of the web has enabled companies to move beyond their physical location and engage in the online

COMING ATTRACTIONS

The AI Hedge Fund

For many years hedge funds and money managers have relied on statistical models to improve their trading strategies. Trained in a variety of mathematical disciplines, specialists called "quants" use historical data and other sources of information to develop sophisticated models. However, these models tend to be highly complex and can be challenging to update and adapt to changing market conditions. To speed up the process of developing and refining these models, several startup hedge funds are turning to techniques from artificial intelligence (AI).

The field of AI is vast and varied. Many different approaches have been developed in attempts to emulate the intelligence and capabilities of humans (see Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics"), with some being very successful and others less so. Recent innovations in the sub-discipline of machine learning have led to widespread practical application; in particular, improvements in genetic algorithms (where many approaches are tried out and only the best survive) and deep learning (where multiple layers of neural networks are trained simultaneously) have enabled applications such as improved image and voice recognition and processing—Siri, Cortana, and Alexa are but a few examples.

Typically, machine learning algorithms are able to bring together data from many sources and use historical outcome information to train and improve their models. Whereas humans can operate in a similar way, the difference is that the machines can consider hundreds of thousands, even millions, of possibilities, evaluate them automatically, and then choose the ones that generate the best outcomes. The settings that led to the better outcomes, called "parameters," can then be fed back into the models for another iteration of improvement. While the resulting models can be extremely complex, the question is how to design the models such that the parameters and outcomes are actually useful for making trading decisions. Critics doubt that in the long run, the new machine learning based funds will be any better at this than existing players. For example, David Harding, the billionaire founder and CEO of Winton Capital Management is generally skeptical of the hype over machine learning and AI. "If I squinted a little and looked at Winton, I'd say that's more or less what we've been doing for the past 30 years," he says. Even believers in AI-based trading foresee other issues. As AI-based trading is expected to level the playing field, in the long run, everyone is likely to have access to the same intelligence. Yet if everyone is having access to the same intelligence, how could anyone outperform the market?

Based on:

Knight, W. (2016, February 1). Will AI-powered hedge funds outsmart the market? *MIT Technology Review.* Retrieved June 27, 2016, from https://www.technologyreview.com/s/600695/will-ai-powered-hedge-funds-outsmart-the-market

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Wigglesworth, R. (2016, March 25). AI progress fails to convince all investors. *Financial Times.* Retrieved June 27, 2016, from http://www.ft.com/intl/cms/s/0/1c249b10-ed49-11e5-888e-2eadd5fbc4a4.html

sales of goods and services, or **e-tailing**. In the most extreme form of e-tailing, companies follow a **click-only business strategy** and only conduct business electronically in cyberspace. These firms (sometimes called **virtual companies**) have no physical store locations, allowing them to focus purely on EC. An example of a click-only company is the online retailer Amazon.com, which does not have a physical storefront in the classic sense. In e-business terminology, click-only companies are sometimes called "pure play companies," focusing on one very distinct way of doing business; other firms, such as the bookseller Barnes & Noble, choose to utilize the Internet to extend their traditional offline retail channels. These firms employ a **click-and-mortar business strategy** approach (also referred to as a **bricks-and-clicks business strategy**). The three general approaches are depicted in Figure 4.4.

THE CLICK-AND-MORTAR STRATEGY. The greatest impact of the web-based EC revolution has occurred in companies adopting the click-and-mortar approach. Click-and-mortars continue to operate their physical locations and have added an EC component to their business activities. With transactions occurring in both physical and virtual environments, it is imperative that click-and-mortars learn how to exploit commercial opportunities in both domains. Conducting physical and virtual operations presents special challenges for these firms, as business activities must be tailored to each of these different environments in order for the firms to compete effectively (e.g., differential pricing or shipping and inventory management can suddenly become huge concerns for companies selling physical products). Traditionally, a company would only offer its customers a single channel, be it the physical retail store, a catalog, or

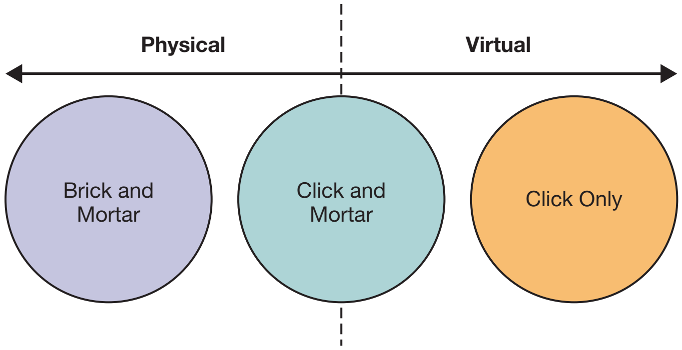


FIGURE 4.4

General approaches to conducting commerce.

an online store. As companies grew, many started using a multichannel approach, offering the customer different (independent) touchpoints, such as a retail store and a catalog (a concept referred to as **multichannel retailing**). Increasingly—and especially due to the proliferation of mobile devices—transactions take place *across* multiple environments, a concept referred to as **cross-channel retailing**. For example, in-store pickup refers to situations where a customer orders a product online and picks it up in a retail store; similarly, customers may evaluate products offline and purchase the products through the retailer's website. Finally, **omni-channel retailing** entails providing seamless, simultaneous interactions using different channels, such that a customer does not interact with a single channel but with the brand as a whole (see Figure 4.5). For example, a shopper in a retail store of electronics retailer Best Buy can scan a QR code to receive more information or product reviews, which are located on Best Buy's mobile site. Likewise, **sales beacons**—Bluetooth devices that can detect proximate smartphones and send messages—are likely to become a widely used way to send marketing messages or personalized coupons to the mobile phones of in-store shoppers.

No matter which approach click-and-mortars pursue, they face various challenges due to increasing IS complexity. Design and development of complex computing systems are required to support each aspect of the click-and-mortar approach, especially when attempting to offer seamless experiences across channels.

THE CLICK-ONLY STRATEGY. Click-only companies can often compete more effectively on price because they do not need to support the physical aspects of the click-and-mortar approach. Thus, these companies can reduce prices to rock-bottom levels (although a relatively small click-only firm may not sell enough products and/or may not order enough from suppliers to be able to

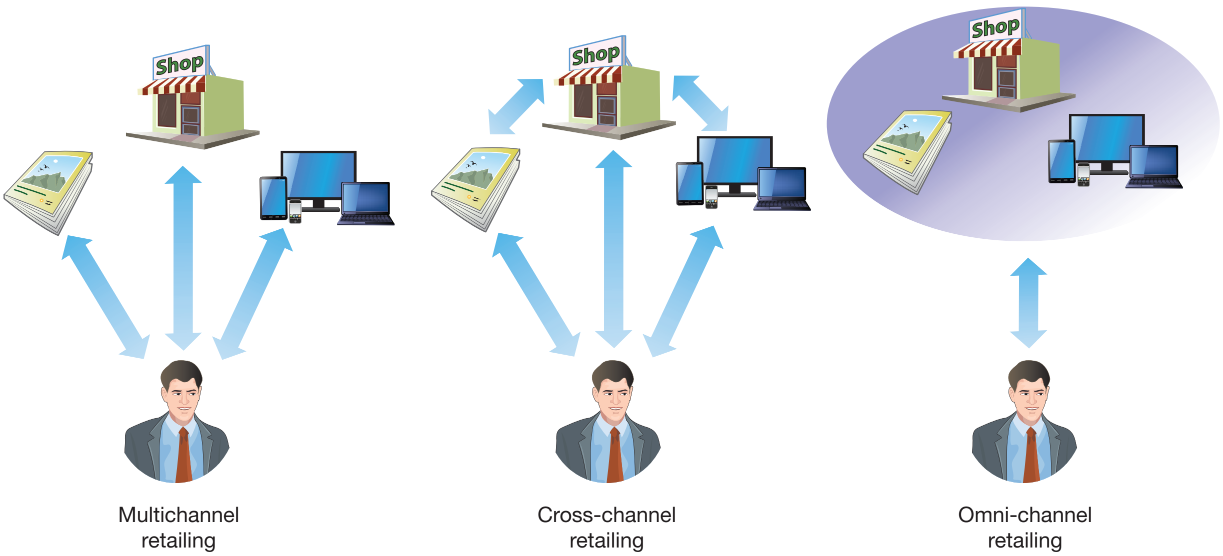


FIGURE 4.5

Supported by information systems, companies can interact with their customers using various touchpoints.

realize economies of scale and thus reduce prices). Click-only firms, such as Amazon.com or eBay, also tend to be highly adept with technology and can innovate very rapidly as new technologies become available. This can enable them to stay one step ahead of their competition. However, conducting business in cyberspace has some problematic aspects. For example, it is more difficult for a customer to return a product to a purely online company than simply to return it to a local department store. In addition, some consumers may not be comfortable making purchases online. Individuals may be leery about the security of giving credit card numbers to a virtual company. We will discuss these potential drawbacks later in this chapter.

E-tailing: Capabilities and Opportunities

Powerful web technologies have given rise to a global platform where firms from across the world can effectively compete for customers and gain access to new markets. Global customers do not have to rely on potentially outdated information from printed catalogs or account statements that arrive in the mail once a month but can access websites that are linked to corporate databases to provide real-time access to personalized information. Likewise, companies in the travel industry, such as airlines, can dynamically adjust fares based on availability, booking time, current and historical demand, forecast demand, and other factors to maximize revenues (a practice referred to as yield management) and disseminate the most current fares in real time on the company's website. Further, the web has opened new avenues for communication between companies and their customers; firms have augmented telephone-based ordering and customer support with web-based support, electronic mail, online text or video chat applications, and social media. In many cases, these are provided to allow customers to communicate with a customer service representative in real time through the corporate website. The web not only has facilitated the dissemination of information and facilitated communication with customers but often is used to facilitate all stages of a transaction, allowing companies to conduct business online without human assistance, greatly reducing transaction costs while enhancing operational efficiency. For example, once a customer places an order, the customer's address and payment information are stored in the company's customer database, the customer's credit card is automatically charged, the inventory is checked, and the order is routed to the fulfillment center, where the shipping label is automatically generated. Aside from picking and packing the actual product, most of the transaction requires little to no human interaction. For the business, this tremendously reduces the costs associated with the transactions by reducing the demand for phone representatives taking the order or back-office staff handling the orders. In addition, the Internet has enabled various new approaches to doing business. These are discussed next.

DISINTERMEDIATION. The web has disrupted many traditional business models by offering the ability to sell products directly to the end customers without the need for distributors or retailers. This phenomenon of cutting out the "middleman" and reaching customers more directly and efficiently is known as **disintermediation**. Disintermediation creates both opportunities and challenges. On the one hand, producers or service providers can offer products at lower prices (or reap greater profits) by bypassing traditional distribution and retail channels; on the other hand, they also have to take on those activities previously performed by these middlemen. For example, when airlines started selling tickets online and dealing directly with customers, they disintermediated travel agents. As a result, the airlines directly had to deal with upset travelers in case of delays or cancellations, while the travel agents had to find ways to make up for lost revenue, such as by charging booking fees when arranging a person's travel. In contrast, **reintermediation** refers to the design of business models that reintroduce middlemen in order to reduce the chaos brought on by disintermediation. For example, without middlemen like Travelocity.com, Orbitz.com, and other travel websites, a consumer would have to check all airline websites in order to find the flight with the best connection or lowest price.

THE LONG TAIL. Another opportunity enabled by the web is the ability to focus on the "long tails." Coined by Chris Anderson (2004, 2006), the concept of the **long tail** refers to catering to niche markets in addition to (or instead of) purely selling mainstream products. The distribution of consumers' needs and wants can be compared to a statistical normal distribution: The center of the distribution reflects the "mass market," characterized by relatively similar "mainstream"

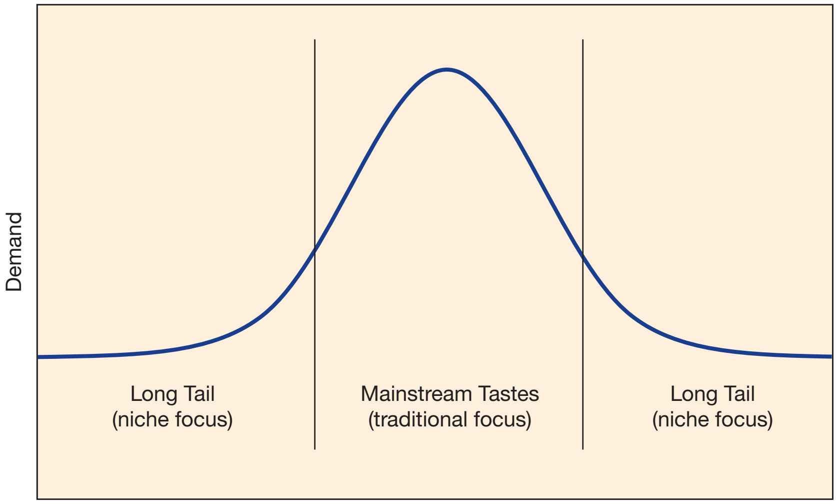


FIGURE 4.6

The long tails.

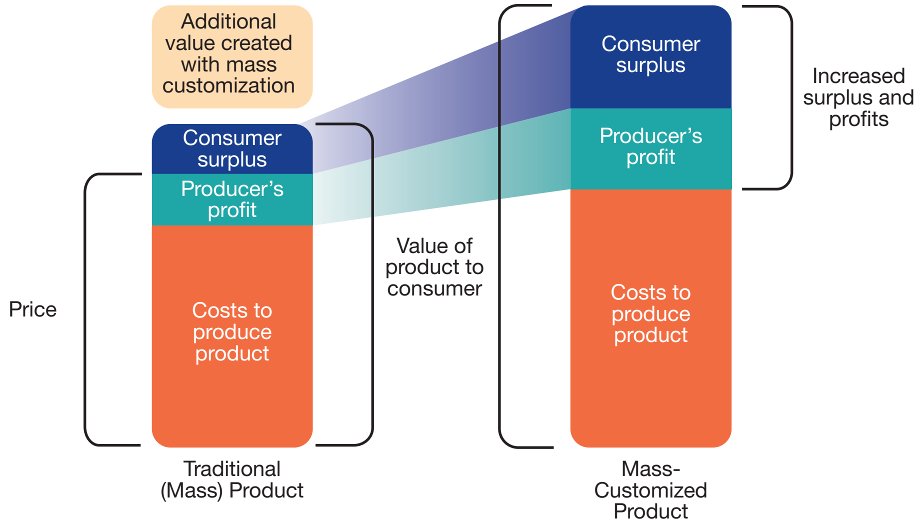
needs and wants shared by many people; the tails are the niche markets, catering to very diverse needs and wants (but comparatively few people share the same needs and wants) (Figure 4.6). Because of high storage and distribution costs, most traditional brick-and-mortar retailers and service providers are forced to limit their product offerings to serving the needs and wants of the mainstream customers in the center of the distribution. For example, large mainstream movie productions typically draw a huge audience and are shown in many movie theaters; in contrast, most independent movie productions are not shown at local cinemas, as they are unlikely to draw a large enough audience to cover the movie theater's costs to show the movie. Similarly, record stores carry only CDs of which a certain number of copies is likely to be sold each year to cover the costs for shelf space, sales personnel, and so on. Given the limited local reach of brick-and-mortar stores, this ultimately limits the stores' product selection.

In contrast, enabled by their extended reach, many e-tailers can focus on the long tails, that is, on products outside the mainstream tastes. For instance, whereas a local video rental store is unlikely to have a large selection of documentaries (because of a lack of local demand), Netflix can afford to have a very large selection of rather unpopular movies and still make a profit with it. Rather than renting a few "blockbusters" to many people, many (often outside the mainstream) titles are rented to a large number of people spread out on the long tails. Similarly, online bookseller Amazon.com can carry a tremendous selection of (often obscure) titles, as the costs for storage are far lower than those of its offline competitors. In fact, more than half of Amazon.com's book sales are titles that are *not* carried by the average physical bookstore, not even by megastores such as Barnes & Noble. In other words, focusing on those titles that are on the long tails of the distribution of consumers' wants can be a very successful strategy in the digital world.

MASS CUSTOMIZATION. Mass consumption, one of the hallmarks of modern economic activity, is based on the concept of mass production, which reduces costs by producing large numbers of identical goods. The Ford Model T is one of the earliest successful examples of mass production; all customers were offered the same model, which was produced on an assembly line (instead of being handcrafted, as other automobiles at that time); subsequently, mass production was adopted as the standard way of producing goods to be sold at affordable prices. Web technologies, combined with the ability to interact directly with the end customers, have allowed firms to focus on the long tails by tailoring their products and services specifically to each customer's particular needs on a large scale, a model referred to as **mass customization**. Linking online product configuration systems with just-in-time production allows companies to assemble each individual product based on a customer's specifications so that companies are able to provide individualized products while at the same time reaping the economies of scale provided by mass production. For instance, Dell Computer Corporation allows customers to customize their computers based on their specific performance needs. Likewise, customers can design personalized tennis shoes at Nike.com, customize their Mini at miniusa.com, or even

FIGURE 4.7

Mass customization generates additional value for customers and profits for producers.



have their personalized cookies baked at kekswerkstatt.de. While manufacturing a customized product tends to be more expensive than traditional mass production, the product's value for the customer increases, allowing the producer to charge a higher price, leading to higher profit margins (Figure 4.7).

GROUP BUYING. Another innovative business model enabled by the Internet is **group buying**. Companies such as Groupon or LivingSocial negotiate special volume discounts with local businesses and offer them to their members in the form of "daily deals"; if enough people agree to purchase the product or service, the customers typically get significant discounts over the original purchase price. The business offering the product or service uses these deals to either reduce unsold inventory or to get new customers "into the door"; yet local businesses face the danger of making significant losses on these deals, as the group purchasing site typically takes a hefty share of the deal's price (often about 50 percent), or they may not be able to cope with the sudden increase in demand (see Case 1 at the end of Chapter 2 for more on Groupon and its business model).

NEW REVENUE AND PRICING MODELS. As discussed in Chapter 2, the Internet has enabled or facilitated various revenue models, with companies earning revenues not only through traditional sales but also through subscription, licensing, or transaction fees. Further, organizations and individuals alike can generate revenues through web advertisement or affiliate marketing programs. Some companies selling products or services have come up with pricing models that transcend traditional **menu-driven pricing models**. Under a menu-driven pricing model, companies such as Amazon.com or Travelocity.com set the prices that consumers pay for products or services. In contrast, Priceline.com uses a **dynamic pricing model** to offer consumers discounts on airline tickets, hotel rooms, rental cars, and various other products and services. Customers specify the product they are looking for and how much they are willing to pay for it, and Priceline.com matches the customers' bids with offers from companies (who often use Priceline.com to get rid of excess inventory). After a user searches for a service and submits a bid on Priceline.com, the system routes the information to appropriate brand-name companies, such as United Airlines and Avis Rent a Car, which either accept or reject the customer's offer (Figure 4.8).

SOCIAL COMMERCE. Companies operating in the digital world have realized that people's purchasing decisions are increasingly influenced by social media. Using various social media, people explore products or engage with others about their purchasing experiences. Thus, organizations are trying to leverage social networks to advertise products, build lasting relationships, or otherwise create value. **Social commerce** is the use of social media to influence shopping behavior, from the pre-purchase evaluation stage to post-purchase experiences. One use of social media is to incorporate social functionality into a company's website, allowing customers to engage with the company or others through reviews or comments. For example,

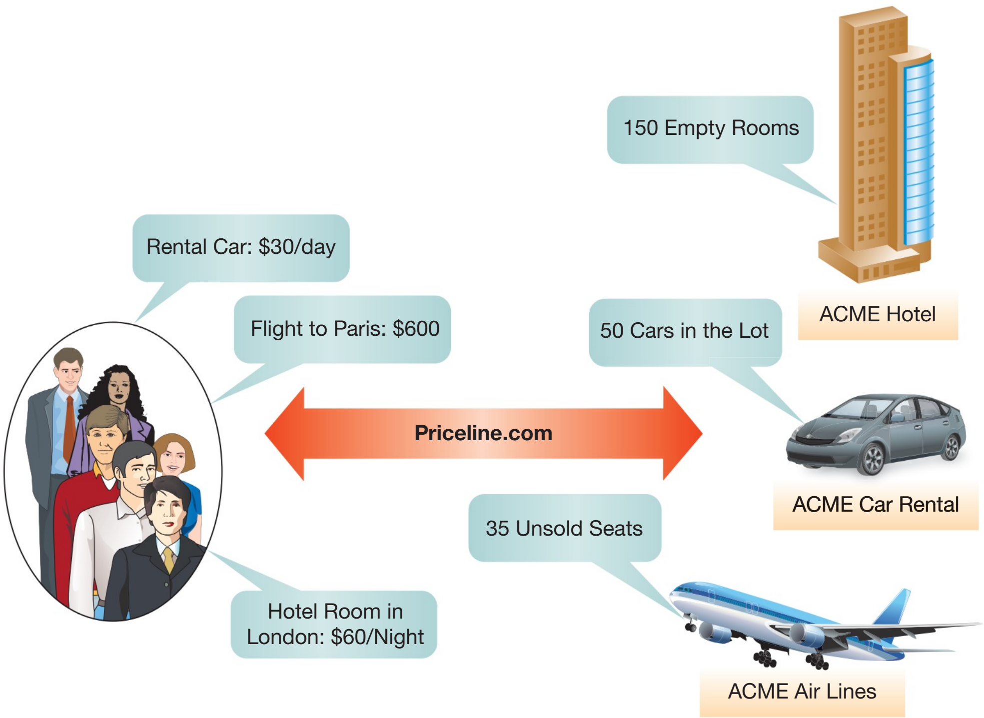


FIGURE 4.8

Priceline.com lets consumers name their own price for travel-related services.

Amazon.com presents recommendations based on what other shoppers with similar tastes have viewed or purchased and encourages shoppers to share their recent purchases on social networking sites. Likewise, online retailers incorporate social sharing functionality into their websites so that customers can share their purchases with their social networks, effectively promoting the products they purchased. Another use of social media is to use social networks such as Facebook, Twitter, or Instagram to advertise products, distribute content, or otherwise engage with current or prospective customers. Adding social elements to the online shopping experiences not only helps increase sales but also gives the organizations a wealth of data about their customers, their motivations, and their experiences (see Chapter 8 for a discussion of social media and managing customer relationships).

In addition, several business models are built around social interactions in the online world. Consumer-to-consumer marketplaces such as eBay or Etsy allow individuals to sell products to other individuals. Group-buying sites such as Groupon use the network effect to increase buying power and obtain deals and discounts. Shopping discovery sites such as Pinterest or Polyvore allow users to suggest novel and exciting products and let merchants sell these products on the site (or app). Social shopping site Wanelo features 30 million products from 550,000 stores, allowing users to follow brands, stores, or other users and share their wish lists, allowing them to discover new styles or products. Recently, online customers have created their own form of social commerce; with the aim of bypassing traditional retail channels, online users have formed buying co-ops on social networks such as Facebook in order to purchase goods at wholesale prices. Clearly, while social commerce has various facets, it is certain that social aspects will play an ever-increasing role in e-commerce interactions.

Benefits of E-tailing

For e-tailers and customers alike, e-tailing can provide many benefits over traditional brick-and-mortar retailing in terms of the marketing concepts of product, place, and price. These are discussed next.

PRODUCT. Websites can offer a virtually unlimited number and variety of products because e-tailing is not limited by physical store and shelf space restrictions. For instance, e-tailer Amazon.com offers millions of book titles on the web compared with a local brick-and-mortar–only book retailer, which can offer "only" a few thousand titles in a store because of the restricted physical space.

ETHICAL DILEMMA

The Ethics of Reputation Management

If you're trying to decide on which book to purchase, which movie to watch at the theater, which hotel to stay at, or which restaurant to go to for dinner, you are likely to use the power of the crowd—that is, you probably consult websites such as Amazon.com (books), Rottentomatoes.com (movies), Tripadvisor.com or Booking.com (hotels), or Yelp.com (restaurants) to read reviews from others. For consumers, online reviews can be a valuable decision aid. On the other hand, online reviews can make or break a business. For example, a restaurant receiving just a few negative reviews on Yelp.com during the pre-opening phase will be much less likely to attract diners in the future, and the restaurant may fail before it even started. For the restaurant owner, who has invested her life's savings, this would mean that she would have to declare bankruptcy; further, she may have to lay off the chef, the waitstaff, and the dishwasher, all of whom have families to feed. The owner is tempted to boost the reputation of the restaurant and thinks about composing a few reviews herself and publishing those under different pseudonyms. Alternatively, she is considering giving out free drinks or desserts to diners as an incentive for posting positive reviews.

Needless to say, websites that publish customer reviews want to provide unbiased reviews and often have (proprietary) mechanisms in place to minimize (or at least reduce) the potential of biased reviews. In addition, under rules of the U.S. Federal Trade Commission, paying someone to post reviews may actually be illegal. Yet you may have noticed extensive, raving reviews about a 500-page book posted just a day after the book was released or reviews that sound suspiciously like marketing copy.

The restaurant owner thus faces a dilemma. On the one hand, she may just ignore the negative reviews and hope that diners keep coming in spite of these reviews; however, this may result in having to lay off all her staff and close the restaurant if customers are kept away by the reviews. On the other hand, she may engage in "reputation management" and try to provide a more "balanced" picture of her restaurant on the review site.

Questions

1. What would you do? How about not providing any incentives but merely asking all satisfied customers to write reviews?
2. What would happen if the public found out about the owner's reputation management?
3. Imagine the owner knew that the initial negative reviews were posted by a competitor trying to drive her out of business. Would this change your assessment? If so, how?

Based on:

Roggio, A. (2012, January 31). Fake reviews, a despicable practice? *Practical eCommerce*. Retrieved April 25, 2016, from http://www.practicalecommerce.com/articles/3330-Fake-Reviews-a-Despicable-Practice-

Tijerina, A. (2011, February 11). The ethics of online reviews. *Drivingsales.com*. Retrieved April 25, 2016, from http://www.drivingsales.com/blogs/arnoldtijerina/2011/02/11/the-ethics-of-online-reviews

For online customers, comparison shopping is much easier on the web. In particular, numerous comparison shopping services that focus on aggregating content are available to consumers. Some companies fulfilling this niche are Google Shopping, Shopping.com, and PriceGrabber (focusing on a wide range of products); AllBookstores.com (books); and Booking.com (hotel rooms). By displaying information about prices, sellers' ratings, or shipping options, these comparison shopping sites can literally force sellers to focus on providing the best value in order to be successful. If sellers do not have the lowest price, they must be able to offer better quality, better service, or some other advantage. These comparison shopping sites generate revenue by charging a small commission on transactions, by charging usage fees to sellers, and/or through advertising on their site.

PLACE. As company storefronts can (virtually) exist on every computer that is connected to the web, e-tailers can compete more effectively for customers, giving e-tailers an advantage. Whereas traditional retailers are bound to physical store locations and open hours, e-tailers can conduct business anywhere at any time.

The ubiquity of the Internet has enabled companies to sell goods and services on a global scale. Consumers looking for a particular product are not limited to merchants from their own city or country; rather, they can search for the product where they are most likely to get it, where they may get the best quality, or where prices may be lowest. This has enabled customers to purchase goods from all over the world (such as various gadgets sold at www.dx.com). At the same time, this has created competition for domestic businesses, as often, overseas e-tailers can offer products much cheaper and may even offer free shipping (due to international postal agreements, as in the case of www.madeinchina.com).

PRICE. E-tailers can also compete on price effectively as they can turn their inventory more often because of the sheer volume of products and customers who purchase them. Companies can sell more products, reducing prices for consumers while at the same time enhancing profits for the company. Further, virtual companies have no need to rent expensive retail space or employ sales clerks, allowing them to further reduce prices.

Drawbacks of E-tailing

Despite all the hype associated with e-tailing, there are some downsides to this approach, in particular, issues associated with trust.

TRUST. One of the main factors keeping many consumers from purchasing goods and services online is trust. Especially for new online businesses, this tends to be challenging, as customers may be hesitant to purchase from companies they have never heard of. Often, trust becomes an issue due to the customer's inability to adequately experience the capabilities and characteristics of a product prior to purchase as well as due to uncertainties surrounding product delivery and returns.

Direct Product Experience For many products, customers desire not only information about product characteristics but also sensory information, such as taste, smell, and feel. When shopping for clothes at Lands' End, how can you be sure that you will like the feel of the material? Or what if you discover that the pair of size 9 EE hockey skates you just purchased online fits you like an 8 D? Likewise, products such as fragrances and foods can be difficult for consumers to assess via the web. Does the strawberry cheesecake offered online actually taste as good as it looks? How do you know if you will really like the smell of a perfume without actually sampling it? Finally, e-tailing eliminates the social aspects of the purchase. Although growing in popularity, e-tailers won't soon replace the local shopping mall because going to the mall with some friends or interacting with a knowledgeable salesperson cannot be replicated online. On the other hand, online shopping provides certain anonymity, allowing people to shop for products they may not feel comfortable buying in a physical retail store.

Product Delivery and Returns Except for digital products, such as music, games, or electronic magazines, e-tailing requires additional time for products to be delivered. If you have run out of ink for your printer and your research paper is due this afternoon, chances are that you will visit your local office supply store to purchase a new ink cartridge rather than ordering it online. The ink cartridge purchased electronically needs to be packaged and shipped, delaying use of the product until it is delivered. To combat these issues, large online retailers now offer 1-day delivery or, as is the case with Amazon.com's Prime Now, 2-hour delivery in select cities. Similarly, many click-and-mortar businesses offer in-store pickup and ship-from-store services to address issues associated with product delivery and to effectively compete with click-only companies. Other issues can also arise. The credit card information that you provided online may not be approved, or the shipper may try to deliver the package when you are not home. Finally, the customer may be unsure about product returns in case the product is not of the expected size or quality. When purchasing goods offline, people can easily return the product to the store; likewise, many click-and-mortar retailers offer in-store returns. However, when interacting with a click-only company, customers will have to carefully follow the merchant's instructions in order to receive a replacement or refund, leading to uncertainties for the customer. These issues become even more problematic when conducting transactions across national borders.

Electronic Commerce Websites and Internet Marketing

The basic rules of commerce are to offer valuable products and services at fair prices; a sound underlying business model is key for a successful business both online and offline. However, as is the case with effects of retail store layout and design on offline purchasing behavior, the design of an online retailer's website influences online purchasing behavior. In addition, to be successful, companies in the digital world have to market their products or services across a variety of online channels. These topics are discussed next.

Designing Websites to Meet Online Consumers' Needs

Successful companies design their websites to enhance their online customers' experience when interacting with the website. Valacich, Parboteeah, and Wells (2007) found that online consumers' needs can be categorized in terms of the site's **structural firmness** (characteristics that influence the website's security and performance), **functional convenience** (characteristics that make the interaction with the website easier or more convenient), and **representational delight** (characteristics that stimulate a consumer's senses). These are discussed next.

Structural Firmness For websites to be successful, structural firmness is a must. Online customers are unlikely to trust and revisit a website (let alone make a transaction) if the website does not function well (at least reasonably well). For example, the website should not have (or at least minimize) bad links, it should provide understandable error messages should something go wrong, and it should ensure privacy and security of the customers' data (EC websites often use trust seals to signal that privacy and security are ensured). Further, the website should be fast; if online customers have to wait for pages to load, they are not apt to stay at the site long or to return. In fact, studies suggest that the average length of time that a web surfer will wait for a web page to load is only a couple of seconds.

Functional Convenience The website must be easy to use. As with nearly all software, websites that are easy to use are more popular. If visitors have trouble finding things on a page or navigating through the website's links, they are unlikely to make a transaction or return to the site. Thus, websites should provide easy navigation for users to find their way (and back),

SECURITY MATTERS

Too Small to Be Hacked?

Stealing secret data is only valuable if someone is willing to pay for it, and one of the challenges facing cybercriminals is how to turn their exploits into hard currency. In recent years, many cybercriminals have turned to stealing data that can be easily converted into hard currency. Credit card numbers can be used directly to purchase merchandise or gift cards until the theft gets reported and the account canceled. Personal data can be used to steal someone's identity in order to apply for loans to get cash. However, as consumers, retailers, and banks get better at recognizing illicit activity and preventing data theft, it is getting more difficult for cybercriminals to monetize their activities. A recent trend has been taking data hostage.

Many small to medium-sized businesses lack the sophistication and resources to adequately protect their information systems. The data contained in these systems, however, are usually of limited value to others outside the business. So, instead of stealing the data, cybercriminals lock it up in such a way that it cannot be accessed. Usually, instead of transferring the data out, criminals simply encrypt the data in place. Without properly designed backup systems, many businesses are unable to access or recover their data. The cybercriminals then demand a ransom payment in order to restore access to the data. A small business's data may not be valuable to others, but the data are often extremely important to the operation of the business. Without extensive IT support or sophistication, the owners of the business may be willing to pay the ransom to regain access to their data, thus providing immediate income to the criminals. Unfortunately, paying off the criminals may or may not get the data back, and the vulnerabilities that led to the attack in the first place may still be in place.

To prevent becoming a victim in the first place, experts recommend paying for a third-party service to audit, enhance, and maintain system security. While a small business may not be able to afford a sophisticated staff and specialized technology to monitor and secure its information systems, there are many outsourcing providers that can provide the required expertise and capabilities for a reasonable fee. As with many types of risks, an ounce of prevention can be worth a pound of cure. Security audits and enhancements are only part of the equation, however. It is also important to ensure that proper backup and disaster recovery policies and procedures are in place and to test them regularly. Finally, users are a key part of the equation. Technology alone cannot protect a business if the system user is the weak link, so it is essential to train users to recognize phishing scams and not to perform risky actions like clicking on unknown links or executing unknown attachments that can contain malware.

Based on:

Gustke, C. (2016, January 13). No business too small to be hacked. *The New York Times*. Retrieved June 26, 2016, from http://www.nytimes.com/2016/01/14/business/smallbusiness/no-business-too-small-to-be-hacked.html

provide indications about where the users are on the site, and offer help features. Further, features such as one-click ordering, offering a variety of payment methods, or order tracking can increase the perceived functional convenience of a website.

Representational Delight Finally, the website must be aesthetically pleasing. People are more likely to visit, stay at, and return to a website that looks good, as the design of a website can signal other characteristics of an online business, such as professionalism (Wells, Valacich, & Hess, 2011). Thus, successful firms have web sites that are nice to look at and have a unique look and feel to separate their website from their competition. Aesthetics can include the use of color schemes, fonts, backgrounds, and high-quality images. Furthermore, websites should have a clear, concise, and consistent layout, taking care to avoid unnecessary clutter.

THE ONLINE CONSUMERS' HIERARCHY OF NEEDS. In a perfect world, an organization would strive to maximize all three sets of characteristics. In reality, businesses constantly have to make trade-offs between complexity, resource limitations, and other factors; thus, it is important to understand online consumers' *relative* needs. Valacich and colleagues' (2007) "online consumer's hierarchy of needs" suggests that overall, a site's structural firmness is most critical; once visitors' needs for structural firmness have been met, functional convenience is the next most important set of characteristics, followed by representational delight. In other words, if a website is only nice to look at but difficult to navigate or appears not secure, visitors are unlikely to stay or make a transaction.

Needless to say, a basic level of structural firmness, functional convenience, and representational delight should be provided by any website (in other words, online visitors have a "zone of intolerance"). Beyond this basic level, the importance of the different sets of characteristics depends on the objective of a particular page on a website (Figure 4.9). For example, for a very utilitarian web page, such as the login page of your online banking site, structural firmness should be emphasized to the user (though both functional convenience and representational delight should not be neglected). In contrast, for a relatively more hedonic web page, such as a page designed to engage a visitor into considering a new home loan, representational delight should be emphasized (again, not neglecting the other factors). Hybrid pages, offering both hedonic and utilitarian value, such as those within Amazon.com or eBay, should balance the different factors (though typically checkout pages on such sites emphasize aspects related to structural firmness).

SETTING UP YOUR ONLINE STORE. As numerous examples show, the web allows almost anyone to set up an online store. The first step in starting a B2C e-commerce business is to set up an online storefront that is easy to use, fast, reliable, and aesthetically pleasing. However, especially small companies often lack the resources to set up a professional e-commerce site. One solution for companies wanting to benefit from being associated with large, successful e-businesses is to turn to the e-commerce giants eBay and Amazon.com, which let others sell products on their sites on a large scale. In addition, online businesses can choose from various (often freely available) e-commerce solutions that offer numerous well-designed store templates. E-commerce solutions offered by commercial providers such as Intuit, GoDaddy, Shopify, or Yahoo! or open

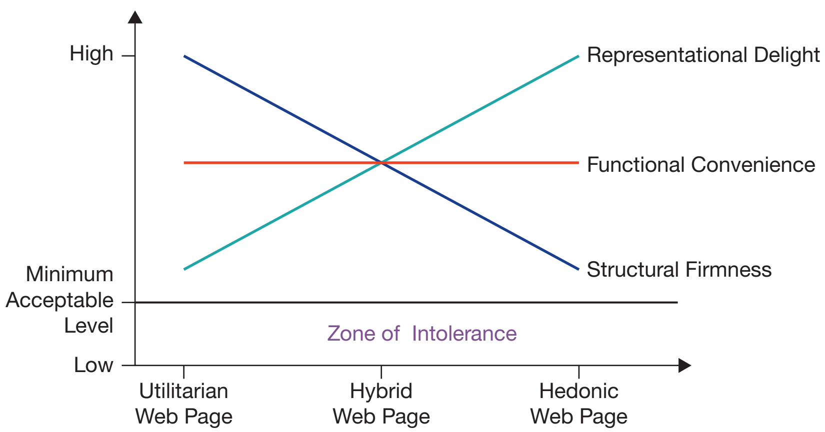


FIGURE 4.9

Different websites (pages) must focus on different design features.
Source: Based on Valacich et al. (2007).

source solutions such as osCommerce or PrestaShop offer various store templates, an integrated shopping cart, and so on; typically, such e-commerce solutions are customizable, giving businesses the option of integrating customer reviews, reward programs, or tracking information.

An additional challenge for fledgling online merchants is the effort involved in picking, packing, and shipping the orders. To address this problem, many smaller companies choose to outsource order fulfillment. For example, Fulfillment by Amazon "rents out" warehouse and information systems infrastructure to anyone wanting to run a successful online business, essentially offering fulfilment as a service, where all a company has to do is ship the products (in bulk) to Amazon's warehouses, where the products will be stored until an order is received. Employees from the fulfillment service then pick, pack, and ship the order, allowing the companies to concentrate on managing the online business, attracting new customers, and so on.

Internet Marketing

One fundamental mistake companies can make when taking a current business online or creating an online business is assuming that if you build it, they will come. As with an offline business, marketing is a critical activity in any online endeavor, and a website cannot be successful without customers. As companies must attract visitors to their site and away from the thousands of other sites they could be visiting, companies advertise their firm's web presence by including the website address on all company materials, from business cards and letterheads to advertising copy. Further, it is now common to see a company's URL listed at the end of its television commercials, and more and more companies integrate **QR codes** into their offline ads. QR codes are two-dimensional bar codes with a high storage capacity. In a consumer context, QR codes are typically used to point the consumer to a particular web page when he or she scans the bar code with a mobile device's camera (Figure 4.10). Alternatively, QR codes can trigger certain actions, such as initiating a phone call to a sales representative or sending a text message to a prespecified number.

Historically, companies' advertising budgets were mostly spent on noninteractive advertising campaigns, such as using billboards or newspaper, radio, or television ads. However, as it is becoming the norm to access the Internet multiple times a day from multiple devices and locations, companies are reallocating their advertising budgets; in 2014, organizations spent 24 percent of their advertising budget on Internet marketing; research firm Forrester estimates that by 2019, companies will spend 35 percent of their advertising budget on Internet marketing, including search marketing, display ads, e-mail marketing, social media, and mobile marketing (VanBoskirk, 2014). All of these are discussed next.

FIGURE 4.10

Scanning a QR code can trigger certain actions, such as opening a web page.
Source: Scanrail1/Shutterstock.

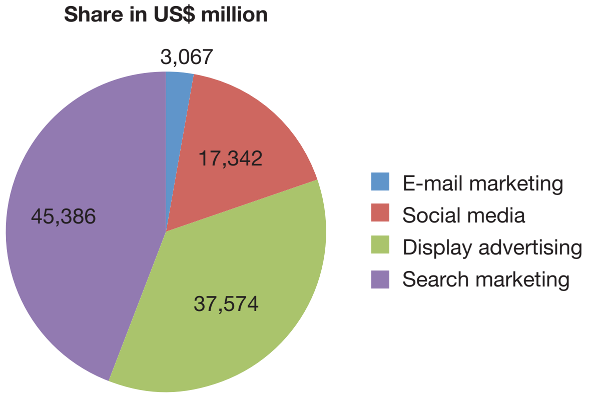


FIGURE 4.11

Search marketing is forecast to have the largest share of interactive marketing by 2019.
Source: Based on VanBoskirk, S. (2014, November 18). *US Digital Marketing Forecast, 2014 to 2019*. Cambridge, MA: Forrester Research.

SEARCH MARKETING. Whereas people would traditionally obtain information about products or companies from offline sources, many web surfers now just enter the name of a product into a search engine such as Google or Bing and then visit the resulting pages. Given this trend, it is not surprising that search marketing is now big business. Research firm Forrester reports that by 2019, companies in the United States will spend US$45.4 billion on search marketing (Figure 4.11). Included in search marketing are search engine optimization and paid search, both of which are discussed next.

Search Engine Optimization The results presented by search engines such as Google or Bing are typically separated into organic results (i.e., based on the page's content) and sponsored results. The organic results of a user's search are presented based on complex, proprietary formulas, and the ranking (position of the link to a particular page) in the search results is largely outside the control of the web page's owner (Figure 4.12). Given the incredible numbers of results that are returned for common searches such as "apparel," "sportswear," or "digital camera," most surfers visit only the first few links that are presented and rarely venture beyond the first page of the search results; thus, companies use **search engine optimization (SEO)** in an attempt to boost their ranking in the organic search engine results. Although the exact formulas for a web page's rank in the organic results of a search engine are kept as trade secrets, the major search engines give tips on how to optimize a page's ranking, including providing unique and valuable content, keeping the content updated, and including key words for which a user might query.

There are a multitude of companies promising to improve a page's ranking, but because search engines' algorithms are usually proprietary and are frequently changed and there can be literally hundreds of factors influencing a page's rank, the success of using such services is often limited. Further, search engines such as Google try to detect whether a page is using unethical

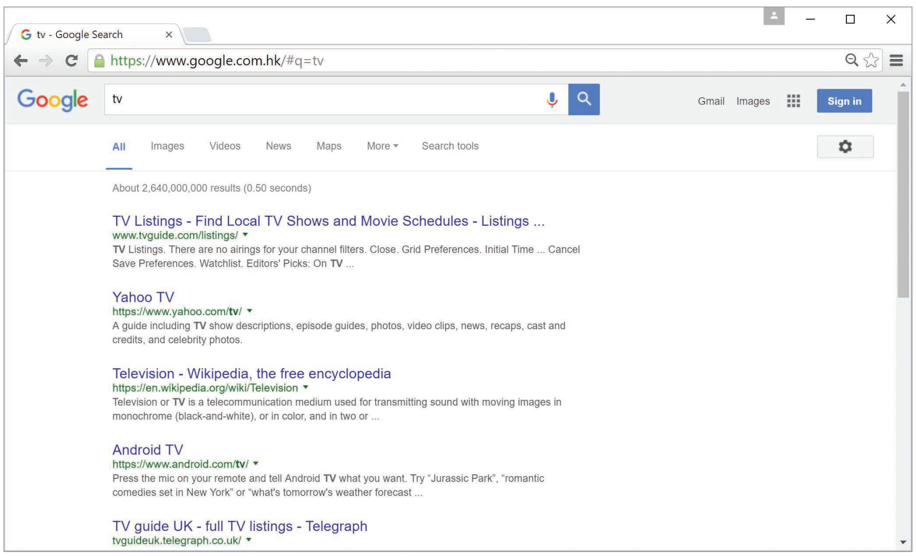
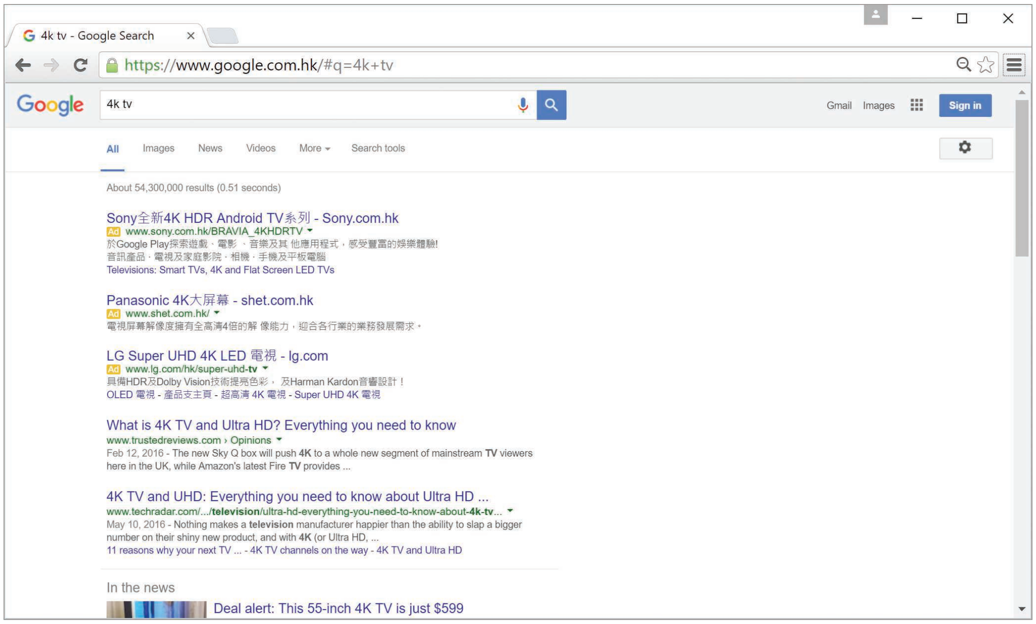


FIGURE 4.12

It is hard to influence the ranking of your company's page in the organic search results.
Source: 2016 Google Inc. All rights reserved. Google and the Google Logo are registered trademarks of Google Inc.

FIGURE 4.13

Companies pay per click for being included in the sponsored listings.



"tricks" (such as "hidden" key words) to improve its ranking and ban sites using such tricks from the listing altogether. Nevertheless, even slight modifications to a page can have a large impact on the page's ranking in search results, and investments in SEO are often worthwhile, especially in times of tight marketing budgets.

Paid Search A way to ensure that your company's page appears on the first page users see when searching for a specific term is using **search advertising** (or **sponsored search**). For example, using Google's "AdWords," a company can bid for being listed in the sponsored search results for the term "4K TV" (Figure 4.13). In order to present the most relevant ads to its users, Google then determines the relevance of the ad and the content of the linked page to the search term, and, depending on the amount of the bid, the company's web page is listed in the sponsored results; Google is paid on a pay-per-click basis (see the following discussion of pricing models). As you can imagine, this can quickly become very expensive for advertisers, especially when the sponsored link is associated with a popular search term, and the advertiser has to bid against many competitors. On the other hand, a system such as Google's AdWords ensures high-quality leads, as the ads are presented only to users actually searching for a specific key word (in contrast to traditional ads, which are presented to anyone). As programs such as AdWords can be tweaked in myriad ways (such as by key words, negative key words, region, time of day, and so on), many companies turn to professional consultants who help to optimize sponsored search campaigns. Alternatively, some search engines offer to elevate a page's position in the organic results after paying a fee (**paid inclusion**). Many search engines that pride themselves on offering unbiased results (such as Google), however, do not offer paid inclusion. Overall, Forrester Research estimates that spending on paid search will increase from US$25.2 billion to US$41.3 billion between 2014 and 2019.

DISPLAY ADS. In the early days of the web, display advertising was the prevalent form of online advertising. Similar to traditional newspaper ads, companies would advertise their presence on other popular websites, such as nytimes.com, using static banner ads, video ads, or interactive banner ads, which allow users to interact with the advertisement. A recent trend in display advertising has been contextual advertising, where the ads placed on a page are in some way related to the content of that page. If, for example, you are reading tournament results from a PGA golf event at a popular sports website such as espn.com, you will also likely see an advertisement to buy new golf equipment or to visit a golf resort. A variety of interactive features, rich media ads, and the ability to place ads in online videos as well as the ability to accurately measure an ad's impact contribute to display advertising's increasing popularity.

E-MAIL MARKETING. E-mail marketing has been, and continues to be, a very popular aspect of advertisers' overall interactive marketing mix (VanBoskirk, 2014). Given the low cost of less than US$1 per 1,000 e-mails, advertisers are increasingly trying to move away from direct-mail advertising and replace it with e-mail advertising. In addition to low cost, the effectiveness of e-mail advertising campaigns can be measured directly (such as by including special links or images in the e-mail that allow the sender to track which e-mails the recipients have opened or reacted to). Further, e-mail marketing saves tremendous amounts of paper over traditional direct mail advertising, allowing a company to build a positive green image.

SOCIAL MEDIA MARKETING. One continuing trend in Internet marketing is harnessing the power of social media, such as Facebook or Twitter. More and more people rely on social media to stay in contact with their friends or business associates, so including such sites in the interactive marketing mix is a natural move for companies. In addition to placing display ads on such sites, companies increasingly use social networking sites for interactive communication with their customers. For example, the Coca-Cola Company has created a page on Facebook, allowing it to interact with its more than 97 million "fans" (i.e., Facebook users who "like" the page) in various ways; Coke's fans can download free virtual goodies, can upload pictures related to everything Coke, or can use interactive apps. By creating this page (which is free for Coke, except for the time needed to set it up, monitor, and maintain it), Coke can build strong relationships with a large group of its target customers. Similarly, people can follow Coke on Twitter or visit Coke's channel on the video-sharing site YouTube. A recent trend for companies is establishing "social media listening centers" to feel the pulse of public opinion across a variety of social media.We discuss social media marketing in more detail in Chapter 5, "Enhancing Organizational Communication and Collaboration Using Social Media."

MOBILE MARKETING. Finally, mobile marketing is forecast to skyrocket between 2014 and 2019 (VanBoskirk, 2014). Increasing use of smartphones and tablets has provided marketers with yet another channel for highly targeted advertising (such as based on a user's location). This is true especially for tablets (with their relatively large screens), which allow for various innovative interactive ad formats. Further placing ads into mobile phone apps allows app developers to offer apps for lower prices (or free, under the freemium model; see Chapter 2) and provides marketers with another opportunity to reach their target audience through their favorite channels. Finally, the growth in mobile commerce further contributes to the growth of mobile marketing, as companies are trying to reach their customers wherever, whenever.

PAYMENT MODELS IN INTERNET MARKETING. In offline advertising, an ad's exposure can only be guessed and pricing is typically fixed. For example, the cost for renting an outdoor billboard is determined by the size of the billboard, the location, or the estimated number of cars passing by that billboard in a certain time period; likewise, the price for a newspaper ad is determined by the ad's size, the paper's circulation, and so on. On the web, in contrast, it is possible to determine exactly how many people have been exposed to or clicked on an ad. Thus, one common pricing model for online advertising is the **impression based model**; under this model, pricing is based on the number of times the page containing an ad is displayed, typically expressed in cost per thousand impressions (i.e., cost per mille, or CPM). Depending on advertising volume and the popularity of the site where the ad is placed, costs can range from US$8 to US$40 per thousand impressions. However, research firms estimate that between 30 and 60 percent of website visits may be generated by nonhuman traffic; further, many web surfers do not even look at the online ads and web browsers such as Firefox offer the option to block certain ads. Thus, the trend in web advertising is moving toward performance-based pricing models, where the return on investment is more direct, such as **pay-per-click models**. Under this type of pricing model, the firm running the advertisement pays only when a web surfer actually clicks on the advertisement; the cost per click is typically between US$0.01 and US$0.50 per click, depending on the site, its viewers, and so on. One drawback, however, of pay-per-click models is the possibility of abuse by repeatedly clicking on a link to inflate revenue to the host or increase the costs for the advertiser; this is known as **click fraud**. Click fraud has become increasingly problematic, and companies such as Google are constantly monitoring clicks to detect potentially fraudulent activity.

ASSESSING PERFORMANCE OF INTERNET MARKETING. One major benefit of Internet marketing is the ability to target specific recipients based on location, time of day, page content surrounding an ad, or the viewer's demographics, "likes," or interests (e.g., on a social network such as Facebook), making Internet marketing campaigns very effective; further, in contrast

WHEN THINGS GO WRONG

Buying Likes

We've all seen them in our social network feeds: "Like this page for a chance to win a cash prize" or "Share this link to help John Doe get a backstage pass to the concert!" Social media sites like Facebook are a great platform for businesses to generate buzz and, with a well-executed marketing campaign, get noticed by millions of users. Many businesses entice users to "like" their business page for some reward—a discount or chance to win a prize—and in turn, the users who "like" the business spread the word to each of their network connections automatically. Users of Twitter and Instagram can also promote topics or businesses using hashtags (keywords denoted with a "#" symbol; see Chapter 5). These campaigns can be very effective. For example, in 2015, Starbucks hosted a photo contest in which participants who posted a photograph with a red Starbucks cup could win US$500. To be eligible to win, the contestants had to post the picture on Instagram along with the hashtag #RedCupContest. This simple campaign resulted in more than 40,000 entries competing for one of five prizes.

Sometimes, however, these campaigns and contests can be deeply biased by automated "likes" and submissions, giving unfair advantage to users who try to game the system. There are many services that offer "like buying" and other forms of electronic voting fraud. One such company, based in Chennai, India, employs dozens of people whose job is to use a multitude of social media accounts to "like," follow, vote for, or otherwise promote whatever campaign their clients hire them to promote. Some of these companies use special software to spoof and rapidly change their IP address, preventing filtering from contest sponsors who try to prevent multiple votes from the same IP address or who limit valid entries to only those within a specified geographical region.

Social media platforms try to suppress this type of devious behavior, but, as with many such practices, it turns into a cat-and-mouse game with both the social networks and the fraudsters constantly finding new ways to outsmart the other. Do a search for "vote buying services" online and see who is currently ahead.

Based on:

Permenter, C. (2013, June 6). Buying likes and rigging votes: Facebook's seedy underworld. *The Daily Dot*. Retrieved June 27, 2016, from http://www.dailydot.com/business/facebook-buy-votes-rig-contests-likes

Young, H. (2015, December 14). The 30 most brilliant social media campaigns of 2015. *Salesforce.com.* Retrieved June 27, 2016, from https://www.salesforce.com/blog/2015/12/2015-most-brilliant-social-media-campaigns.html

to traditional marketing campaigns, it is easy to assess viewer's reactions to an ad. Given that Google and Facebook know (or are able to infer) various characteristics of their users (and Google manages ads across a variety of partner websites ranging from AOL to the *Washington Post*), it comes as no surprise that these two companies reap 85 cents of each new online advertising dollar spent by companies, according to analysts. How is the success of Internet marketing campaigns measured? The performance of Internet marketing can be assessed by metrics such as **click-through rate**, reflecting the number of surfers who click on an ad (i.e., clicks) divided by the number of times it was displayed (i.e., impressions), or **conversion rate**, reflecting the percentage of visitors who actually perform the marketer's desired action (such as making a purchase, signing up for a newsletter, watching a video, and so on). Targeting a well-defined audience with an ad campaign can help to attract high-quality leads, ultimately resulting in higher conversion rates. In addition, tracking visitors' behavior on a website can provide a host of useful information. For example, a firm can track the path that visitors take through the many pages of its website and record the length of the visits, page views, common entry pages, a page's bounce rate and exit rate, and even the user's region, browser, or Internet service provider, among other statistics. **Exit rate** is defined as the percentage of visitors who leave the website (i.e., terminate the session) after viewing that page; in other words, it reflects the percentage of users for whom a particular page is the last page they view before moving on to a different site or closing their browser window. In contrast, **bounce rate** is defined as the percentage of single-page visits; in other words, it reflects the percentage of users for whom a particular page is the only page visited on the website during a session. As the different metrics can be affected by the page itself as well as by the quality of the traffic being attracted, the company can use this information to improve its website or attempt to attract higher-quality traffic. If the exit rate for a particular page is abnormally high, the company can try to find out why this occurs and redesign the page to entice the users to stay. Similarly, pages that go unused can be eliminated from the site, reducing maintenance and upkeep. This process of analyzing web surfers' behavior in order to improve website performance (and, ultimately, maximize sales) is known as **web analytics** (for more on this topic, see Case 1 at the end of this chapter and Chapter 6).

Mobile Commerce, Consumer-To-Consumer EC, and Consumer-To-Business EC

Fueled by the megatrends, mobile commerce has seen tremendous growth in the past few years. As defined earlier in the chapter, m-commerce is any electronic transaction or information interaction conducted using a wireless, mobile device and mobile networks (wireless or switched public network) that leads to the transfer of real or perceived value in exchange for information, services, or goods (MobileInfo, 2016).

Powerful mobile devices such as Apple's iPhone and iPad or Samsung's Galaxy, supporting high-speed data transfer and "always-on" connectivity, provide a wide variety of services and capabilities in addition to voice communication, such as multimedia data transfer, video streaming, video telephony, a sheer unlimited number of useful apps, and full Internet access, allowing consumers to access information or make transactions on the go. Mobile payment systems such as Apple Pay further facilitate mobile commerce. Indeed, research firm Forrester expects 270 million U.S. shoppers to use mobile devices by 2020 (up from 244 million in 2015; Lindner, 2016). In other regions of the world, mobile commerce has an even larger impact, with almost 50 percent of all e-commerce transactions in China having taken place on a mobile device in 2015 (a number that is forecast to reach 71 percent by 2019; eMarketer, 2015a).

The increasing use of tablets is seen as another major driver of mobile commerce. Although providing for mobility, tablets are often used in people's living rooms as "couch computers"; thus, tablets allow people to shop from the comfort of their homes without being tied to a desk and a computer screen (Figure 4.14). In addition, tablets provide larger screen sizes, allowing for better product presentation. An analysis of 16.2 billion transactions from 150 online retailers showed that tablet users tend to spend significantly more per order than shoppers using smartphones or personal computers (Adobe, 2012); given that tablet users tend to have above-average incomes, tablets may be the perfect channel for selling products or services online.

LOCATION-BASED M-COMMERCE. Another key driver for m-commerce is **location-based services**, which are highly personalized mobile services based on a user's location. Location-based services are implemented via the cellular network, Bluetooth and Wi-Fi networks, and global positioning system (GPS) functionality, now built into most modern smartphones. Location-based services allow the service provider to offer information or services tailored to the users' needs, depending on their location. For example, search engines can provide specific information about attractions or restaurants located in the user's vicinity, retail stores

FIGURE 4.14

Tablets are often used as "couch computers."

Source: Diego Cervo/Shutterstock.

TABLE 4.2 GPS-Enabled Location-Based Services

Service	Example
Location	Determining the basic geographic position of the cell phone
Mapping	Capturing specific locations to be viewed on the phone
Navigation	The ability to give route directions from one point to another
Tracking	The ability to see another person's location

can enhance store locators with navigation instructions, or users can receive real-time traffic or public transport information (Table 4.2).

INFORMATION ON THE GO. In the digital world, people have become increasingly used to having tremendous amounts of information available. Mobile devices have taken this to the next level, in that people now have the information available whenever, wherever (Figure 4.15). For instance, when deciding on whether to visit a particular restaurant, people can get further information or customer reviews from sites such as Yelp using their mobile devices; similarly, when standing in a retail store, customers can easily retrieve a host of information and reviews about particular products. For customers, this capability can help tremendously when making purchase decisions; for companies operating in the offline world, this has turned into a mixed blessing. On the one hand, they can augment the offline shopping experience by being able to provide much more information than they would typically be able to, which can open up many opportunities for cross-channel and multichannel retailing and can allow bricks-and-clicks retailers to compete with their click-only counterparts. On the other hand, the rise in smartphone

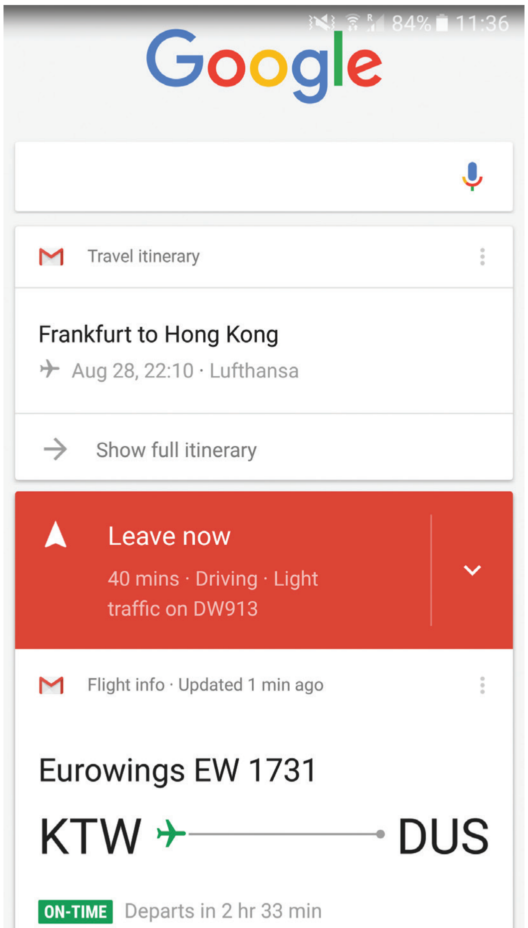


FIGURE 4.15

Using mobile devices, information is always at your fingertips.

Source: 2016 Google Inc. All rights reserved. Google and the Google Logo are registered trademarks of Google Inc.

use has led to **showrooming**—that is, shoppers coming into a store to evaluate the look and feel of a product to then purchase it online or at a competitor's store. Obviously, click-only companies benefit from this practice; online retailer Amazon.com even offers an app that lets the user scan a product's bar code with the smartphone's camera and then displays the product information and price offered by Amazon.com.

In addition to providing information on the go, service providers offer mobile tickets or even mobile boarding passes; typically a QR code is sent to the smartphone of the user, who then just has to present the code to a QR code reader to verify the ticket or boarding pass. This adds convenience for the user, who does not have to keep track of paper tickets, physical boarding passes, and the like, and the service provider can offer additional information and services, such as automatic notifications of delays or gate changes for passengers.

PRODUCT AND CONTENT SALES. Mobile users increasingly use their mobile devices to purchase products or content on the go. In an attempt to harness this trend, many online retailers design mobile versions of their websites so as to facilitate the shopping process on mobile devices. With the increasing popularity of mobile commerce, companies have to strategically decide whether to go beyond mobile versions of their websites and create dedicated mobile apps, which can offer many features that cannot be provided on mobile websites. However, mobile apps are typically costly to develop as they have to be tailored to different platforms (e.g., Apple's iOS versus Android) and device form factors (such as different screen sizes of smartphones and tablets) (Figure 4.16). In any case, firms operating in the digital world should accommodate for unique aspects of mobile interactions (e.g., interactions are often short and fragmented or users face frequent distractions). According to research firm EPiServer, mobile users regard user reviews, direct customer support, adaptation to different screen sizes, location-based functions, and wish list functions as the most important features of mobile retail sites (eMarketer, 2016).

Especially among commuters, accessing content from mobile devices is extremely popular. Content providers ranging from newspapers to TV stations are now offering various ways to access their content from mobile devices. The increasing field of mobile content is obviously an important part of many companies' mobile marketing mix, as it allows reaching people in more places and provides for extremely targeted marketing efforts (such as based on a user's location).

C2C EC

C2C commerce has been with us since the start of commerce itself. Whether it was bartering, auctions, or tendering, commerce has always included C2C economics. Electronically facilitated interactions create unique opportunities (such as a large pool of potential buyers) and unique problems (such as the potential of being defrauded; see Table 4.3). This section discusses

FIGURE 4.16

Businesses have to decide whether to build apps for different platforms and form factors.

Source: Scanrail/Fotolia.

TABLE 4.3 Opportunities and Threats of C2C EC

Opportunities	Threats
Consumers can buy and sell to broader markets	No quality control
Eliminates the middleman that increases the final price of products and services	Higher risk of fraud
Always available for consumers, 24/7/365	Harder to use traditional payment methods (checks, cash, ATM cards)
Market demand is an efficient mechanism for setting prices in the electronic environment	
Increases the numbers of buyers and sellers who can find each other	

e-auctions and *online classifieds*, two of the most popular mechanisms consumers use to buy, sell, and trade with other consumers.

E-AUCTIONS. **E-auctions** provide a place where sellers can post goods and services for sale and buyers can bid on these items. Relatedly, bartering typically takes place on a one-on-one basis, but websites such as swap.com bring together many people listing items to swap.

The largest e-auction site, as you probably know, is eBay (www.ebay.com). eBay's revenue model is based on small fees that are associated with posting items, but these small fees quickly add up, so that in 2015 eBay's net revenues exceeded US$8.5 billion. Whereas eBay is hugely popular, there continue to be cases of fraud. According to the Internet Crime Complaint Center (2016), e-auctions are marred with fraud, with e-auction fraud being among the top five most common crime types filed with the center. In particular, non-shipment of goods and counterfeit items tend to be the biggest problems; with the proliferation of fake goods ranging from handbags to brake pads, air bags, and chain saws, purchasing and using counterfeit goods can not only lead to legal complications but can potentially have dangerous or even deadly consequences. Needless to say, online auction sites warn users to exercise caution when purchasing goods; in addition, e-auction providers such as eBay offer swift conflict resolution mechanisms to preserve people's trust in the marketplace and use sophisticated business intelligence applications (see Chapter 6) to detect and minimize e-auction fraud, attempting to make C2C EC a safer shopping experience.

ONLINE CLASSIFIEDS. Another type of C2C e-commerce is online classifieds. Although online classifieds sites such as craigslist.com are enabled by web capabilities, no transactions take place online. Yet online classifieds have flourished in recent years, enabling people to sell anything from flowers to furniture. A related concept that has gained popularity is "freecycling," that is, giving away goods for free to anyone who is willing to pick them up.

PLATFORM-BASED C2C BUSINESS MODELS. As discussed in Chapter 2, digital platforms enable users to co-create value, and fueled by the megatrends social and mobile, many platforms focus on enabling C2C interactions. For example, ride-sharing platforms such as Uber, Linq, and Juno allow everyday people to use their own vehicles to provide an alternative to traditional cabs. Likewise, Airbnb allows people to rent their apartments to others, C2C marketplaces such as Etsy allow individuals to sell vintage or handmade products to other consumers, and the mobile photo-sharing service Instagram enables people to easily set up online storefronts.

C2B EC

Just as the web has enabled small businesses to participate in global EC, it has also enabled consumers to sell goods or services to businesses, reversing the more typical B2C model. Consumer-to-business (C2B) EC has seen a few implementations. One prime example is microstock photo sites such as Shutterstock, which sell pictures, videos, or artwork to publishers, newspapers, web designers, or advertising agencies. Up until a few years ago, clearinghouses such as Getty Images were the primary source for stock photography used by advertisers, book publishers such as Pearson Prentice Hall, or publishers of newspapers or magazines; however, the images purchased from these clearinghouses tended to be expensive, as the clearinghouses sourced the pictures from professional photographers. In contrast, Shutterstock sources much of

FIGURE 4.17

Amateur and professional photographers can sell their creations through microstock photo sites such as shutterstock.com.

its content not from professionals but from amateur photographers (Figure 4.17). Today, high-quality digital cameras can be had for far less than US$1,000, and with the right editing software, amateur photographers can create images that almost match those of professional photographers. Amateur photographers can upload their pictures to microstock photo sites, where interested parties can license and download the images for US$1 to US$5 per image, which is a fraction of the price of a regular stock photo. Given that overhead costs are almost negligible, the microstock photo sites can make a profit while still sharing part of the revenue with the pictures' creators. Similarly, companies use crowdsourcing on micro-task marketplaces such as Amazon's Mechanical Turk (see Chapter 5) in order to have small, well-defined tasks (such as tagging pictures or describing products) completed by a scalable ad hoc workforce of everyday people. However, it can be argued that consumers who regularly engage in C2B transactions and make parts of their living with such transactions can be considered businesses; hence, the line between C2B and B2B transactions is somewhat blurry.

Securing Payments and Navigating Legal Issues in EC

Within a short period of time, radical developments in technology and systems have brought EC from a fringe economic activity to one of the most prevalent in today's global economy. This innovation has not slowed down and has opened some promising new areas within EC. This section outlines web-based financial transactions and legal issues related to engaging in EC.

Securing Payments in the Digital World

One of the most crucial aspects of B2C EC, C2C EC, and m-commerce is ensuring that online transactions are secure. Although the transfer of money is a critical factor in online shopping, online banking, and online investing, security researchers and software companies are lamenting that people are often reluctant to change their habits when surfing the web and carelessly reveal sensitive information to unknown or fraudulent sites. In fact, more than 17.6 million consumers in the United States (or 7 percent of U.S. adults) became victims of *identity theft* in 2014 (see Chapter 10). Security concerns and other factors (such as impatience, lengthy checkout procedures, or comparison shopping) lead shoppers to frequently abandon their shopping carts and to not follow through with a purchase—reports show that more than half of the online shopping carts are abandoned. Traditionally, paying for goods and services was limited to using credit and debit cards, but using these methods can open up many security issues. To address these issues, there are now different ways of exchanging funds when buying and selling goods or services online. Issues related to different forms of online payment are discussed next.

PAYMENT SERVICES. Concerns for security have led to the inception of independent payment services such as PayPal (owned by eBay), Apple Pay, Square, or Google Wallet. These services allow online customers to purchase goods online without having to reveal much private information to the actual sellers. Rather than paying a seller by providing credit card information, an online shopper can simply pay by using his or her account with the payment service. Thus, the customer has to provide the (sensitive) payment information only to the payment service, which keeps this information secure (along with other information such as e-mail address or purchase

GREEN IT

Green Online Shopping

Have you ever spent endless hours in different stores looking for a particular item? Unless the different stores are located in the same mall (or in the same general vicinity), driving between the stores requires using fossil fuels and contributes to increased pollution and road traffic. When shopping online, in contrast, you can easily search for products at different stores and compare prices, availability, shipping options, and so on, so you only need energy to power the device you use for your online "shopping trip."

Unfortunately, calculating the environmental impact of online shopping versus shopping in a brick-and-mortar store is not always easy. Products purchased online are typically delivered by companies such as UPS or DHL; as the delivery vans travel optimized routes and deliver packages destined for hundreds of other people, they potentially save hundreds of trips taken to a store. Likewise, stores do not have to print out and handle paper receipts and other paperwork, lowering the need for chopping down trees. On the other hand, incredible amounts of cardboard boxes are needed to prevent damage to the items in transit.

A study conducted by Carnegie Mellon's Green Design Institute estimated that purchasing a thumb drive from online retailer Buy.com (where the products are shipped directly from the distributor to the customer) can result in 35 percent savings in energy consumption and carbon dioxide emissions, compared with the same product purchased in a physical retail store. According to the researchers, the primary drivers for energy consumption for online purchases were packaging and delivery to the customers, whereas the largest driver of energy consumption for traditional retailing was the customer's drive to and from the retail store, accounting for 65 percent of the total emissions produced.

Recent research conducted at the University of Delaware, however, suggests that online shopping might not be that green after all, due to an increase in fine particulate matter emissions (PM2.5) produced by the delivery vehicles. Further, the comparison is not always easy, as offline shoppers often bundle their purchases (such as by going to big box stores or shopping malls), online shopping may actually stimulate additional consumption (and thus need for transporting items), and delivery vehicles are often only a quarter full (as estimated by London's transport authority).

The effects of increased particulate emissions and road traffic can especially be felt in large cities such as London, which expects delivery van traffic to increase by 20 percent until 2030—with this increase being entirely due to online shopping. As a result, cities are encouraging alternative energy to power these vans. For example, the city of London is providing subsidies to Gnewt Cargo, a company operating an all-electric delivery fleet, and the Norwegian Postal Service has purchased hundreds of electric delivery vans. While this is not going to reduce congestion, it can at least help make online shopping a little greener.

Based on:

DeWeert, S. (2016, February 17). How green is online shopping? *The Guardian*. Retrieved June 27, 2016, from https://www.theguardian.com/environment/2016/feb/17/how-green-is-online-shopping

Shankleman, J. (2016, May 9). As pollution from online shopping grows, London funds a solution. *Bloomberg*. Retrieved June 27, 2016, from http://www.bloomberg.com/news/articles/2016-05-09/as-pollution-from-online-shopping-grows-london-funds-a-solution

Swaney, C. & Ordiz, E. (2009, March 3). Carnegie Mellon study finds shopping online results in less environmental impact. *Carnegie Mellon University*. Retrieved June 27, 2016, from https://www.cmu.edu/news/archive/2009/March/march3_onlineshopping.shtml

history) and does not share it with the online merchant. Google linked its payment service to the search results so that Internet users looking for a specific product can immediately see whether a merchant offers this payment option; this is intended to ease the online shopping experience for consumers, thus reducing the number of people abandoning their shopping carts. Another payment service, PayPal, goes a step further by allowing anyone with an e-mail address to send and receive money. In other words, using this service, you can send money to your friends or family members, or you can receive money for anything you're selling. This easy way to transfer money has been instrumental in the success of eBay, where anyone can sell or buy goods from other eBay users. With the increase in mobile interactions, mobile payment services such as Apple Pay or Square are seeing an increase in popularity. Such services greatly facilitate making in-store payments and offer an alternative to carrying cash or credit cards (e.g., by allowing the user to pay for a cup of coffee using a smartphone). A recent development of mobile payment services is to allow for peer-to-peer payments, such that a group of friends could easily split the bill for a meal at a restaurant. For example, the hugely successful Chinese messaging platform WeChat not only allows making online and offline payments but also allows for peer-to-peer transactions.

CRYPTOCURRENCIES. One radical innovation in the area of making and receiving payments is cryptocurrencies. **Cryptocurrencies** (the most widely used being Bitcoin) are virtual currencies that are not issued by any central bank and use encryption technologies to secure transactions and to generate new units of the currency. Often described as being primarily used for illicit purposes (such as dealing with drugs or weapons), these cryptocurrencies have various useful legitimate applications. Most of us are comfortable with providing credit card information to a reputable online retailer such as Amazon.com or NewEgg.com. Likewise, many of us have purchased things from other individuals or small companies using a payment service like PayPal. Credit card companies and payment services like PayPal act as trusted middlemen and provide consumers a safety net, giving them the confidence that their purchase will produce the desired good or service and ensuring that their personal financial information remains confidential. These services, however, come at a fairly significant cost. Credit card companies charge vendors between 1 and 3 percent of the purchase amount of every transaction, a cost that is typically passed on to the consumer in the form of higher prices. Payment services such as PayPal also charge fees, which can be as high as several percentage points of the total price.

In contrast, the technology underlying Bitcoin requires no trusted middleman, reducing the transaction costs to negligible amounts. Thus, Bitcoin is very useful for everything from micropayments to international transfers. In fact, many major online companies (including Dell, Expedia, and Overstock.com) as well as offline retailers now provide ways for customers to pay with Bitcoin. In addition to extremely low transaction fees, Bitcoin transactions are anonymous, akin to cash payments. How does Bitcoin work?

Bitcoin was launched around the year 2008 by an anonymous developer pseudo-named Satoshi Nakamoto. Bitcoin is transferred as payment within a completely decentralized

WHO'S GOING MOBILE

Mobile Payments

The advent of the credit card and electronic funds transfer (EFT) mechanisms have paved the way for cashless societies. Indeed, in the United States, only 7 percent of all transactions are made in cash, and in Sweden, the number is only 3 percent. Yet, even though the number of cash transactions seems to be on the decline, there are still various scenarios in which using EFT or credit cards is cumbersome or downright impossible. For example, many offline retailers resist accepting credit cards for small purchases, mainly due to the high costs involved, and many small amounts (such as paying at the parking meter) cannot be paid using credit cards. Similarly, the friend who covered the bill for dinner is unlikely to accept credit cards, and paying for online purchases on your mobile phone (e.g., for movie tickets) is very cumbersome.

With increasing mobility in the digital world, the smartphone appears to be a natural payment companion: Just like a wallet, most people carry their phone with them at all times. To harness this opportunity, companies have devised various innovative ways to use a smartphone as a payment device. For example, near-field communication (NFC) allows for simply waving an NFC-enabled phone in front of a reading device; the payment amount is typically billed to a linked credit card. Similarly, the American coffee giant Starbucks developed an app that lets users pay for their coffee by having the barista scan a bar code generated by the app, and PayPal developed an app that allows for sending money to friends or for ordering products by simply scanning a QR code. Other novel payment systems use people's selfies or voice recognition to authorize payments. Payment provider Visa is even piloting a chip that enables the use of a car for making payments; built into the vehicle, the chip can communicate with gas pumps or parking meters and charge the payment amounts to a linked credit card account.

Mobile payment appears to be here to stay. However, it is not without problems. For example, critics cite the lack of accessibility for older generations as well as costs involved for the merchants and, last but not least, privacy concerns: Unlike cash transactions, mobile transactions are always stored somewhere, which may put people's privacy at risk when making purchases or even donations. On the other hand, mobile payments offer a host of opportunities for retailers, enabling them to build ever closer relationships with their customers.

Based on:

Cave, A. (2012, April 10). Is mobile the way we'll all be paying? *Telegraph.co.uk*. Retrieved June 27, 2016, from http://www.telegraph.co.uk/finance/festival-of-business/9195540/Is-mobile-the-way-well-all-be-paying.html

Collins, K. (2016, March 2). Paying with your face and car is the new paying with your phone. *CNet*. Retrieved June 27, 2016, from http://www.cnet.com/news/paying-with-your-face-and-car-is-the-new-paying-with-your-phone

peer-to-peer payment network—the payment processing is handled by thousands of computers around the world, each running the open source Bitcoin software. When someone pays for something using Bitcoin, the transaction is broadcast within the Bitcoin network, and is stored on a secure, public ledger that is accessible to any computer that wants to verify it. The authenticity of each transaction is ensured by digital signatures corresponding to the sending address of the payer and payee, and encryption ensures that the data about the parties involved in the transactions remain anonymous. The public ledger is constantly verified and maintained by the Bitcoin network and is thus "open for business" 24 hours a day, 7 days a week, and is not subject to any national holidays. In the Bitcoin network, this public ledger takes the form of a **blockchain**, an indelible, decentralized public ledger to which transactions are added in blocks, serving as proof of all transactions ever made (Figure 4.18). As the ledger is decentralized (i.e., distributed over a large number of computers), any changes made require consensus by the majority of nodes, making the blockchain highly resilient against tampering, and entries, once made, cannot be deleted. While blockchain technology is most widely known as the technology underlying Bitcoin, organizations from IBM to Wells Fargo are exploring possible ways of using blockchain technology for any other types of transactions that require trust, accountability, and transparency.

MANAGING RISK IN B2C TRANSACTIONS. When making an online purchase using a credit or debit card, an online customer has to transmit much personal information to a (sometimes unknown) merchant, and many Internet users (sometimes rightfully) fear being defrauded by an untrustworthy seller or falling victim to some other form of computer crime (see Table 4.4 for guidelines on how to conduct safe transactions on the Internet; see also Chapter 10). For online

FIGURE 4.18

In the Bitcoin network, transactions are stored on a public ledger in form of a blockchain.

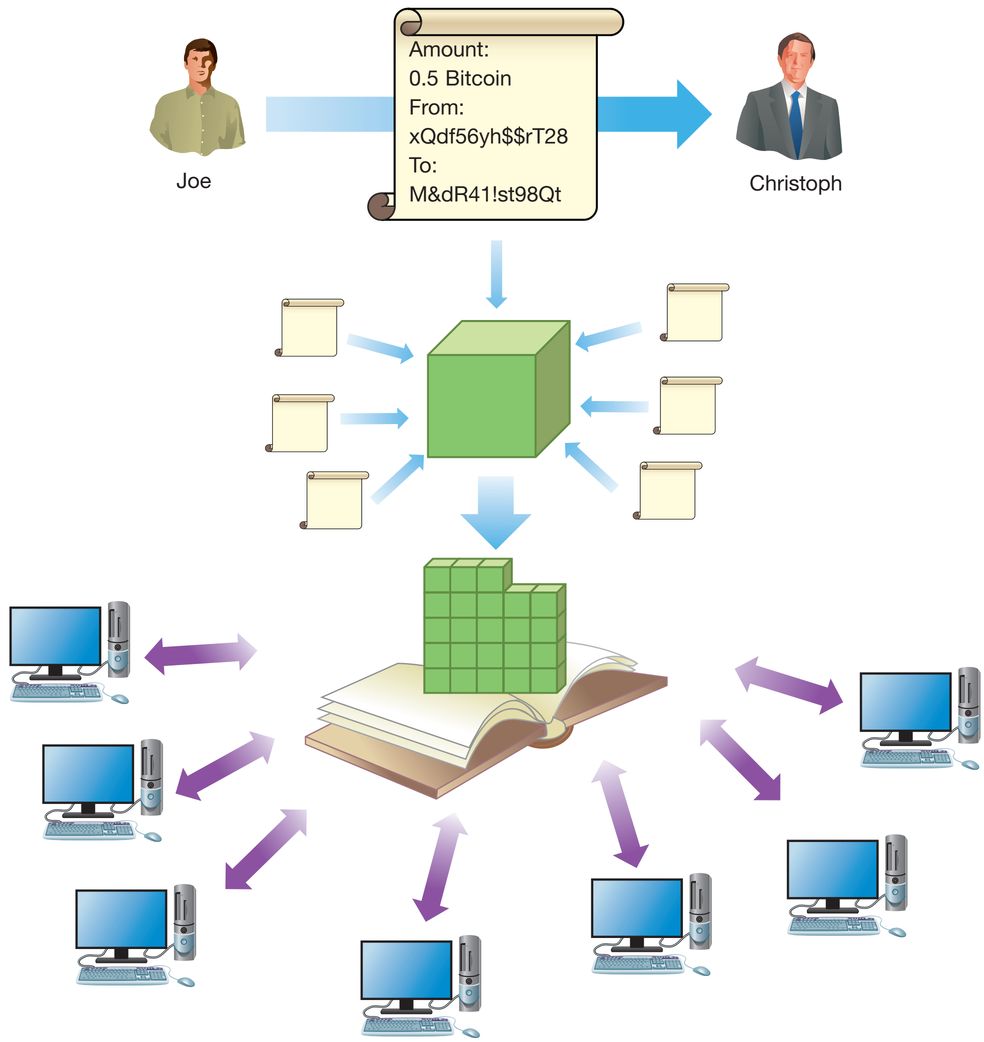


TABLE 4.4 Ways to Protect Yourself When Shopping Online

Tip	Example
Use a secure browser	Make sure that your browser has the latest encryption capabilities; also, always look for the padlock icon in your browser's status bar before transmitting sensitive information
Check the site's privacy policy	Make sure that the company you're about to do business with does not share any information you would prefer not to be shared
Read and understand the refund and shipping policies	Make sure that you can return unwanted/defective products for a refund
Keep your personal information private	Make sure that you don't give out sensitive information, such as your Social Security number, unless you know what the other entity is going to do with it
Give payment information only to businesses you know and trust	Make sure that you don't provide your payment information to fly-by-night operations
Keep records of your online transactions and check your e-mail	Make sure that you don't miss important notifications about your purchases
Review your monthly credit card and bank statements	Make sure to check for any erroneous or unauthorized transactions

Source: Based on Privacy Rights Clearinghouse (2016).

merchants, the risk of people using fraudulent credit card data may be equally high. As in offline transactions, online consumers at times dispute transactions for various reasons. In such cases, the merchant is financially responsible for the transactions, and credit card issuers typically charge back transactions that are disputed by cardholders. For the merchants, such chargebacks normally result in the loss of the transaction amount, loss of the merchandise, processing costs, and chargeback fees; in addition, the merchant's bank may charge higher fees or even close the merchant account if the chargeback rate is excessively high. Thus, minimizing chargebacks is of prime concern for online merchants. Some of the reasons for chargebacks, such as unclear store policies, product descriptions, shipping terms, or transaction currencies, can be minimized through good web store design; other reasons, such as stolen credit cards, require different safeguards (Visa, 2008).

Any credit card transactions must be authorized by the issuer of the credit card (typically the bank). However, this authorization merely ensures that the credit card was not reported as lost or stolen but does not ensure that the person making the transaction is the actual cardholder. In such card-not-present transactions, there is no imprint of the physical card and no cardholder signature, so online merchants have to be especially careful when deciding whether to make a transaction. While online customers demand a quick checkout process, leaving the merchant with little time to authenticate whether the customer is indeed the cardholder, the transaction date is the date the merchandise is shipped; thus, online merchants typically have one or several days to verify the identity of the cardholder (except for digital products or services). One mechanism used to authorize card-not-present transactions is the so-called **card security code**, a three-digit code located on the back of the card; this code is not stored in the card's magnetic stripe and is thus only known to a person who is in the possession of the physical card (note that credit card company rules prohibit merchants from storing the code). To further minimize risk, online merchants often use automated fraud-screening services that provide the merchants with a risk score based on a number of variables such as match between shipping address, billing address, and phone number; the time of the order and the customer's time zone; transaction volume; and the customer's IP address and its geographic location. Based on the risk score, merchants can then decide whether to let the transaction go through. For such screening services to be most

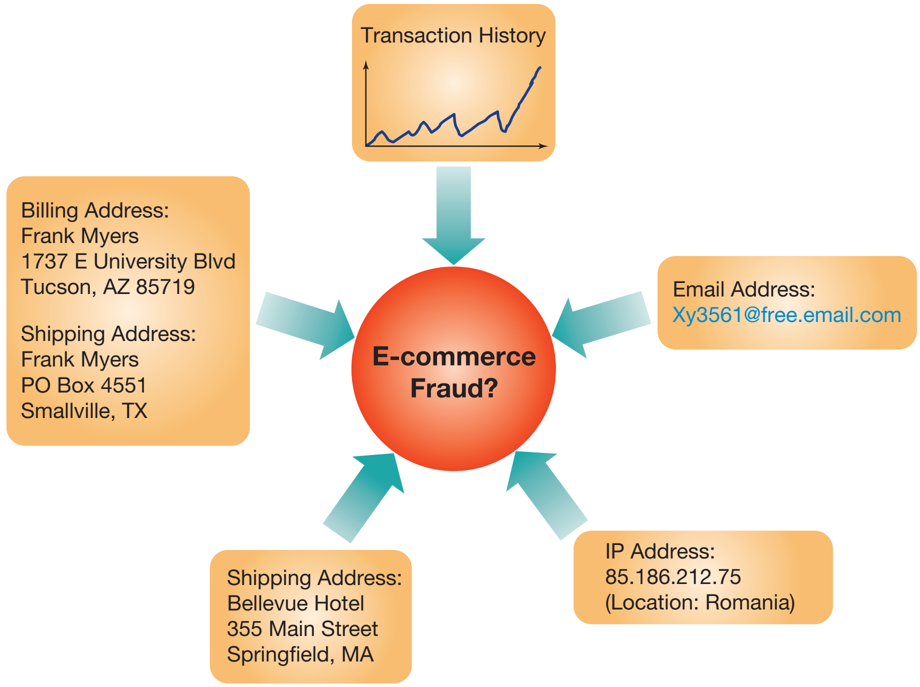


FIGURE 4.19

Various indicators can signal potential e-commerce fraud.

effective, the merchant should collect as much data as possible during the checkout process, which may lead some customers to abandon their shopping carts. In addition, online merchants can assess orders based on various fraud indicators (Figure 4.19); Visa recommends looking for fraud indicators such as:

- ***E-mail addresses.*** Legitimate e-mail addresses often contain some parts of the customer's name; in contrast, fraudsters often set up e-mail addresses consisting of meaningless character combinations with free e-mail providers.
- ***Shipping and billing addresses.*** Fraudsters often have the merchandise shipped to foreign, high-risk countries. Thus, merchants may require billing and shipping addresses to be the same. In addition, as many fraudsters come from foreign countries, misspellings of common words or street names may serve as a potential fraud indicator.
- ***Transaction patterns.*** Fraudulent transactions often show very distinct patterns. For example, the orders may be larger than normal, may consist of multiple items of the same type, or may consist largely of big-ticket items. Similarly, fraudulent transactions often consist of multiple orders using the same credit card in a short period or multiple orders using different cards shipped to the same address. Further, fraudsters often use overnight shipping so as to reduce the merchant's time for verification checks and to be able to quickly resell the merchandise.

Being alert for such fraud indicators can help an online merchant to reduce the risk of fraudulent transactions. Often, it is prudent to either call the customer for verification of the order (though this may be problematic for privacy reasons) or outright reject the transaction.

Legal Issues in EC

Although EC is now a viable and well-established business practice, there are issues that have changed the landscape for businesses and consumers and continue to do so. Two of the most important issues for EC businesses are taxation of online purchases and the protection of intellectual property, especially as it pertains to digital products, both of which are outlined next.

TAXATION. Although this issue is a relatively old one, it remains controversial within the American legal system. With EC global transactions increasing at an exponential rate, many governments are concerned that sales made via electronic sales channels have to be taxed in order to make up for the lost revenue in traditional sales methods. As people shop less in

TABLE 4.5 Arguments For and Against Taxation of EC Transactions

For	Against
Increases tax income of local, state, and federal governments	Slows EC growth and opportunity
Removes unfair advantage for e-tailers over brick-and-mortar stores	Creates additional compliance burden for e-tailers
Increases accountability for e-tailers	E-tailers located in one state would subsidize other states or jurisdictions
	Drives EC businesses to other countries

local retail stores, many cities, states, and even countries are now seeing a decrease in their sales tax income because of EC. Table 4.5 highlights issues associated with taxation of EC transactions.

According to tax laws such as the **Internet Tax Freedom Act**, sales on the Internet are treated the same way as mail-order sales, and a company is required to collect sales tax only from customers residing in a state where the business had substantial presence. In other words, only if an EC business had office facilities or a shipping warehouse in a certain state (say, California), it would have to collect sales tax on sales to customers from that state (in that case, California). Many EC businesses thus strategically selected their home bases to offer “tax-free shopping” to most customers. For example, Amazon.com tended to be very selective in where it located shipping facilities and warehouses to offer favorable tax conditions for most customers while still being able to offer fast delivery. Walmart.com, on the other hand, collects taxes on all of its U.S. EC transactions, as it is physically present in every U.S. state. Note that even if the EC business does not *collect* sales tax on goods or services you may have purchased, you are still liable for *paying* “use tax” (usually equal to your state’s sales tax) on those goods and services. Currently, Amazon has negotiated tax agreements with various states, and the U.S. legislature has proposed the Marketplace Fairness Act to simplify taxation issues surrounding e-commerce and to allow states to require e-tailers to collect sales tax even if the e-tailer has no physical presence. No matter whether (or when) this act is passed, taxation will remain a difficult issue.

On an international level, taxation is even more difficult. A U.S. customer ordering an item from China may be liable for paying use tax in his or her home state; likewise, a customer outside the U.S. ordering from a U.S. seller would not have to pay U.S. sales tax but may be liable for paying tax (and/or import duty) in his or her home country on the shipment’s arrival. For digital products (such as software or music downloads), the movement of the product is difficult to track, and the tax revenue is easily lost. Obviously, e-businesses actively doing business in other countries have to comply with the various different tax laws in different countries.

OTHER LEGAL CONSIDERATIONS. In addition to taxation, companies selling goods or services on the web face a myriad of other issues. For example, companies should ensure they have explicit, enforceable terms of contract, terms of sale, and/or terms of website use; such terms may also cover questions surrounding the liability for content and its accuracy. Further, ownership of content and trademarks can be a virtual minefield. When posting content on one’s site, one has to ensure not to infringe on others’ copyrights or trademarks (e.g., by posting product photographs without permission or even by having trademarked names in one’s domain name). Likewise, care has to be taken if third parties develop content for one’s site: Who will own the copyright for that material? However, online businesses should not only ensure not to infringe on others’ intellectual property but also make sure to protect their own intellectual property, such as by displaying copyright notices and the like. Finally, it is important to clearly state the jurisdiction and ensure to comply with the laws and regulations of that jurisdiction.

DIGITAL RIGHTS MANAGEMENT. With consumers increasingly using EC as a viable alternative to traditional commerce, the entertainment industry has no choice but to embrace the Internet as a distribution medium. Yet digital media are easily copied and shared by many people, as

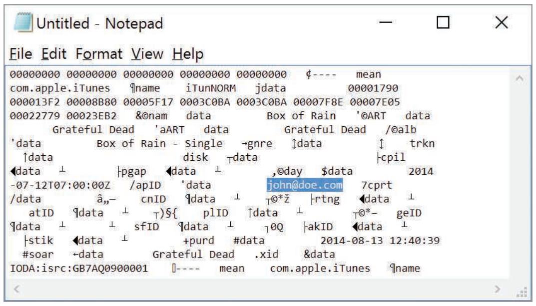


FIGURE 4.20

Digital watermarks are used to trace illegal copies of digital media to the original purchaser.
Source: Notepad 2016, Windows 10, Microsoft Corporation.

the entertainment industry has painfully learned after the introduction of the compact disc. Hence, the entertainment industry has turned to **digital rights management (DRM)**, which is a technological solution that allows publishers to control their digital media (music, movies, and so on) to discourage, limit, or prevent illegal copying and distribution. DRM restrictions include which devices will play the media, how many devices the media will play on, and even how many times the media can be played.

To prevent illegal sharing of DRM-free content, it is often watermarked so that any illegal copy can be traced to the original purchaser (e.g., content purchased on iTunes contains the e-mail address used for the purchase) (Figure 4.20). A **digital watermark** is an electronic version of physical watermarks placed on paper currency to prevent counterfeiting.

The entertainment industry argues that DRM allows copyright holders to minimize sales losses by preventing unauthorized duplication, but critics refer to DRM as "digital restriction management," stating that publishers are arbitrary on how they enforce DRM. Further, critics argue that DRM enables publishers to infringe on existing consumer rights and to stifle innovation; for example, restrictions and limitations such as limiting the number of times a game can be activated or limiting on which devices media can be accessed cause much inconvenience to users (such as when purchasing a new computer) and can thus breed piracy. Finally, critics argue that examples such as Amazon.com or Apple's iTunes show that businesses can be very successful with DRM-free content (CNet Australia, 2012).

NET NEUTRALITY. The Internet was designed as an open network, which means that every website, every application, and every type of data (e.g., a game, Skype call, or YouTube video) is treated the same. Because of this openness, virtually anyone or any business, well known or unknown, can access and be found on the web. For example, unknown bloggers can compete with large news providers like CNN for readers. Many believe that this openness has been the primary catalyst for countless innovations and some of today's most successful companies, like eBay and Google. Without this openness, many fear that startups and entrepreneurs will be muscled out of the marketplace by big corporations that have the money to control what people are able to see or do on the web.

In general, **net neutrality** is the principle that all Internet data should be treated the same. Proponents of net neutrality believe that the Internet should forward all data packets on a first-come, first-served basis, allowing anyone to freely communicate with any application or content without interference from a third party. Proponents are worried that without strong laws to protect the Internet, governments, providers, and large corporations will be able to block Internet applications and content and even block out competitors.

Many large corporations and telecommunications providers, however, would like to change the way information is accessed and prioritized on the web. Large telecommunication providers would like to charge different rates to access different websites, to have adequate speed to run certain applications, or even to have permission to plug in certain types of devices. Yet this would give larger and more established companies tremendous power over smaller and startup firms, and without legal protection, consumers could find that a network operator has blocked the website of a competitor or slowed the delivery of content from companies unwilling to pay additional fees.

Many believe that retaining net neutrality is critical to preserve current freedoms. It guarantees a level playing field for all websites and Internet technologies. Without net neutrality, many of the next generation of innovations may be shut out.

While electronic commerce has now existed for several decades, it continues to evolve and mature. Each year, innovative strategies continue to emerge in virtually all sectors of business and government. Technologies evolve as well as how and where people conduct electronic commerce, from desktops, to laptops, to tablets, and to smartphones at home and while on the road. New capabilities often create unforeseen issues that require new laws and regulations. The best prediction about the future is that change will continue in this rapidly evolving space.

INDUSTRY ANALYSIS

Retailing

You may make many purchases online in order to benefit from greater convenience or lower prices, but you will likely set foot in a brick-and-mortar retail store at least occasionally, and you may have noticed some changes brought by technology. A few decades ago, large retail chains started introducing computerized point-of-sale inventory systems consisting of checkout computers and an inventory control system. A simple bar code scan captures a sale, and the item is automatically deducted from the store's inventory, allowing real-time tracking of purchases so that the retailer knows when to reorder merchandise or restock shelves. In addition to a speedier checkout process, such systems help to reduce stockouts, increasing customer satisfaction. In many grocery stores, this system has been taken a step further, allowing the customers to conduct the checkout process themselves, saving time and labor costs. In Switzerland, grocery retailer Migros introduced a system that allows customers to scan items as they are placed into the shopping cart. At the checkout counter, all the customer has to do is swipe a credit card.

In the near future, many items may be equipped with radio frequency identification (RFID) tags (see Chapter 8), eliminating the need to scan each individual item, so that the total price for a cart full of merchandise can be calculated within a second, saving even more time and adding convenience for the customer. Imagine the time you'll save when all you have to do is pass with your cart through an RFID reader and swipe your credit card.

Payment systems are also changing. A new "Pay by Fingerprint" system allows customers to complete a purchase by placing a finger onto a fingerprint scanner without the need to sign a sales slip or enter a personal identification number (PIN); this makes the checkout process extremely convenient and secure. Another innovative way to pay for a purchase is via mobile phone. Using a technology called near-field communication (NFC; similar to Bluetooth), the customer's mobile phone communicates with the retailer's payment terminal, and the payment amount is automatically debited from the customer's bank account. NFC-based payment systems have already begun to be implemented; major smartphone manufacturers such as Samsung, Nokia, Motorola, and HTC actively support this new technology by integrating it into new handsets.

Further, many brick-and-mortar retailers have had to respond to the phenomenon of showrooming, in which, as discussed earlier, customers examine products in person at a store and then leave to order the same product online for less. Retailers invest billions to build and maintain their storefronts, and online retailers can often undercut physical stores' prices; when a customer takes advantage of this, the brick-and-mortar retailer cannot recoup the cost of the storefront. Some retailers like Best Buy and Target are embracing this trend, however, by encouraging consumers to browse their shelves and compare prices online. By providing perks such as superior, personal customer service and instituting price-matching policies, these retailers prevent loss of customers due to price while benefiting by selling additional products. Other new and exciting in-store technologies include smart fitting rooms that use augmented reality technology to show how an item would look when worn or suggest complementary items. Finally, retail stores are increasingly using Bluetooth-enabled sales beacons to provide customers with real-time promotional offers.

As you can see, information systems have had a huge impact on retailing, and many more changes are yet to hit the shelves.

Questions

1. How can technology help brick-and-mortar retailers compete against e-tailers?
2. Privacy advocates criticize the use of RFID, as it allows better tracking of purchasing habits. How can brick-and-mortar retailers alleviate these concerns?
3. As you have read, part of the "human element" in retailing is being replaced by technology. How can brick-and-mortar stores avoid becoming too "sterile" when using information systems to compete against e-tailers?

Based on:

Davies, S. (2015, December 17). The smart fitting room is the future of retail. *TechCo.* Retrieved June 27, 2016, from http://tech.co/smart-fitting-room-future-retail-2015-12

Fitzgerald, D. (2013, November 3). Fear of "showrooming" fades. *The Wall Street Journal*. Retrieved June 26, 2016, from http://online.wsj.com/news/articles/SB10001424052702303661404579175690690126298

Nsubuga, J. (2016, February 27). Supermarkets of the future could have no staff. *Metro.co.uk.* Retrieved June 27, 2016, from http://metro.co.uk/2016/02/27/supermarkets-of-the-future-could-have-no-staff-5721663

Key Points Review

1. ***Describe different approaches to competing in cyberspace as well as different forms of electronic government and e-finance.*** EC is the online exchange of goods, services, and money between firms and between firms and their customers. Companies and individuals are engaging in business-to-business, business-to-consumer, consumer-to-consumer, or consumer-to-business e-commerce. In addition, e-government is a government's use of IS to provide a variety of services to citizens (government-to-citizens), businesses (government-to-business), and other governmental agencies (either within a country or between countries; government-to-government). The Internet has also enabled conducting financial transactions via online banking or online brokerage and has provided the basis for various innovative fintech services.
2. ***Describe business-to-consumer electronic commerce strategies.*** Companies must strategically position themselves to compete in the EC environment and choose between operating as brick-and-mortar companies, click-and-mortar (or bricks-and-clicks) companies, or click-only (or virtual) companies. Capabilities of the web have enabled new business models based on mass customization, disintermediation, or group buying as well as social commerce. E-tailers can benefit from being able to offer a wider variety of goods to more people at lower prices. On the other hand, a major drawback is customers' lack of trust.
3. ***Understand the keys to successful electronic commerce websites and explain the different forms of Internet marketing.*** Successful B2C companies have a website that meets online customers' needs. A company should also advertise its web presence. Popular ways to advertise products or services on the web are search marketing, display ads, e-mail marketing, social media, and mobile marketing. Advertisers pay for search marketing or display ads on the basis of either the number of impressions or pay-per-click. Various metrics and web analytics can provide valuable information about the effectiveness of Internet marketing campaigns and performance of websites.
4. ***Describe mobile commerce, consumer-to-consumer electronic commerce, and consumer-to-business electronic commerce.*** M-commerce is rapidly expanding with the continued evolution of faster cellular networks, more powerful handheld devices, and more sophisticated applications. Location-based services, based on GPS technology, are a key driver, enabling even more innovative m-commerce applications. As mobile consumers not only use their devices to obtain timely information on the go but also increasingly purchase products or content in mobile settings, businesses have to consider the specific settings and devices of their target customers. Further, the Internet has fueled the development of a variety of ways people can trade goods, socialize, or voice their thoughts and opinions. Specifically, e-auctions allow private people to sell goods to large markets. One emerging topic in EC is C2B EC, where individuals offer products or services to businesses.
5. ***Describe how to conduct financial transactions and navigate the legal issues of electronic commerce.*** The ability to pay for products or services is key for any form of electronic commerce. Yet securing payments in the digital world is still of concern, both for customers and for merchants, who have to minimize their risk arising from potentially fraudulent credit card transactions; as a result, many (especially smaller) retailers use online payment services; for some applications, cryptocurrencies have become an alternative form of payment. Finally, taxation, legal issues surrounding website content, contracts, and transactions, as well as protecting intellectual property and net neutrality continue to be major issues and impediments to EC.

Key Terms

long tail 146
mass customization 147
mobile commerce (m-commerce) 141
menu-driven pricing model 148
mobile banking 143
multichannel retailing 145
net neutrality 170
omni-channel retailing 145
online banking 143
online brokerage 143
paid inclusion 156
pay-per-click model 157
QR code 154
reintermediation 146
representational delight 152
sales beacon 145
search advertising 156
search engine optimization (SEO) 155
showrooming 161
social commerce 148
sponsored search 156
structural firmness 152
virtual company 144
web analytics 159

MyMISLab™ Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

4-1. What is EC, and what different approaches to competing in cyberspace do companies use?
4-2. What are the primary forms of e-government? Provide examples for each.
4-3. Compare and contrast the click-only and the bricks-and clicks approaches to conducting business online.
4-4. Describe the effects of disintermediation.
MyMISLab **4-5.** Describe social commerce and explain how companies can leverage consumers' social networks.
4-6. Describe the benefits and drawbacks of e-tailing.
MyMISLab **4-7.** What is the online consumer's hierarchy of needs, and why is it important for e-tailers?
MyMISLab **4-8.** Describe the differences between SEO, search marketing, and sponsored search.
4-9. Describe m-commerce and explain how it is different from regular EC.
4-10. What is showrooming, and how has it affected offline retailers?
4-11. Compare and contrast online banking and online brokerage.
4-12. How does taxation pose a threat to EC?
4-13. How does net neutrality pose a threat to EC?

Self-Study Questions

4-14. EC is the exchange of ______________ among firms, between firms and their customers, and between customers, supported by communication technologies and, in particular, the Internet.
A. goods
B. services
C. money
D. all of the above

4-15. ______________ are those companies that operate in the traditional, physical markets and do not conduct business electronically in cyberspace.
A. Brick-and-mortars
B. Click-onlys
C. Both A and B
D. Dot-coms

4-16. The ability to sell products directly to the end customers, without the need for distributors or retailers, is called ______________.
A. disintermediation
B. disintegration
C. reintegration
D. reintermediation

4-17. Business models based on catering to niche markets in addition to (or instead of) purely selling mainstream products are said to center on the ______________.
A. far ends
B. long ends
C. niches
D. long tails

4-18. ______________ reflects the percentage of users for whom a particular page is the only page visited on the website.
A. Bounce rate
B. Exit rate
C. Click-through rate
D. Conversion rate

4-19. Offering the customer different (independent) touch-points, such as a retail store and a catalogue is referred to as ______________.
A. mixed-channel retailing
B. cross-channel retailing
C. omni-channel retailing
D. multichannel retailing

4-20. Trying to "outsmart" a search engine to improve a page's ranking is known as ______________.
A. rank enhancement
B. SEO
C. search engine hacking
D. Google fooling

4-21. In order to minimize fraud, e-tailers look for anomalies in ______________.
A. e-mail addresses provided
B. shipping and billing addresses
C. transaction patterns
D. all of the above

4-22. According to the Internet Tax Freedom Act, e-tailers ______________.
A. have to collect sales tax from all customers regardless of their location
B. have to collect sales tax based on the place of the customer's residence
C. have to collect sales tax based on the prevalent tax rate at the e-tailer's headquarters
D. have to collect sales tax only from customers residing in a state where the business has substantial presence

Answers are on page 176.

Problems and Exercises

4-23. Match the following terms with the appropriate definitions:

i. Click-through rate
ii. Reintermediation
iii. web analytics
iv. Paid inclusion
v. Conversion rate
vi. Long tails
vii. Click fraud
viii. Search engine optimization
ix. E-government
x. Group buying

a. Special volume discounts negotiated with local businesses and offered to people in the form of "daily deals"
b. The design of business models that reintroduce middlemen in order to reduce the chaos brought on by disintermediation
c. The large parts of consumer demand that are outside the relatively small number of mainstream tastes
d. The percentage of visitors who actually perform the marketer's desired action
e. The number of surfers who click on an ad divided by the number of times it was displayed
f. The use of information systems to provide citizens, organizations, and other governmental agencies with information about and access to public services
g. Methods used to improve a site's ranking
h. The analysis of web surfers' behavior in order to improve a site's performance
i. The practice of paying a fee to be included in a search engine's listing
j. The abuse of pay-per-click advertising models by repeatedly clicking on a link to inflate revenue to the host or increase the costs for the advertiser

4-24. Visit www.firstgov.gov. What kind of services do you see that would help you? What services would you use? What areas are missing?

4-25. Visit Alaska Airlines's website (www.alaskaair.com) for real-time pricing and test the custom messenger bag builder at www.timbuk2.com. How have Internet technologies improved over the years?

4-26. Search the web for a company that is purely web-based. Next, find the website of a company that is a hybrid (i.e., the company has a traditional brick-and-mortar business plus a presence on the web). What are the pros and cons of dealing with each type of company?

4-27. Search the web for a click-and-mortar company that is using multichannel retailing and a company that is using cross-channel or omni-channel retailing. How do the customer interactions with those companies differ? Which company would you rather purchase from? Why?

4-28. What is it about a company's website that draws you to it, keeps you there on the site longer, and keeps you coming back for more? If you could summarize these answers into a set of criteria for websites, what would those criteria be?

4-29. Visit the following services for comparison shopping: BestBookBuys (www.bestwebbuys.com/books), Bizrate (www.bizrate.com), and mySimon (www.mysimon.com). These companies focus on aggregating content for consumers. What are the advantages of these websites? What does the existence of such sites mean for the online merchants?

4-30. Compare three different search engines. What tips do they provide to improve a page's rankings? How much does it cost to advertise a page on their results pages? If you were a company, could you think of any situation where you would pay almost any amount to have the first listing on the first results page?

4-31. Describe your experiences in online shopping. How did you pay for your purchases? What information did you have to reveal to the merchant? Did you feel comfortable giving out that information?

4-32. Have you ever used a mobile, wireless device such as a smartphone for online shopping? If so, what did you like or dislike about it? In what ways could your shopping experience be made better? If you have not used a mobile device for shopping, what prevented you from doing so? What would have to happen before you would begin using a mobile device for shopping?

4-33. When you shop online, is sales tax a criterion for you? Do you try to purchase goods where you do not have to pay sales tax? If you would have to pay sales tax for everything you buy online, would that change your online shopping behavior?

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Analyzing Server Traffic

4-34. Campus Travel has recently found that its Internet connections between offices are becoming slow, especially during certain periods of the day. Since all the online traffic is maintained by another company, an increase in bandwidth requires a formal approval from the general manager. The IS manager has proposed to increase the bandwidth of the company's network; in a few days, he has to present the business case for this proposal at the weekly meeting of the department heads. You are asked to prepare graphs for the presentation to support the IS manager's business case. In the file ServerLogs.csv, you will find information about the network traffic for a 1-week period. Prepare the following graphs:

- Total bandwidth used for each day (line graph)
- Bandwidth used per day, by time period (line graph)
- Average bandwidth used in each two-hour period (line graph)

Format the graphs in a professional manner and place each graph on a separate page. (Hint: If you are using Microsoft Excel's Chart Wizard, select "Place chart: As New Sheet.")

Database Application: Tracking Network Hardware

4-35. As Campus Travel is new to EC, the management suggests following a stepwise approach for using the Internet to conduct business. Before using the Internet for conducting transactions, the managers recommend setting up a site that provides information to customers. Part of this informational site is an agency locator that shows the services each agency has. You have been asked to create a new database. This includes creating relationships between entities. To create this new database, do the following:

- Create a database called "agency."
- Create a table called "agencies" and include fields for agency ID, street address, city, state, ZIP code, phone number, number of service agents, and working hours.
- Create a table called "services" that includes service ID, name (i.e., type of service), and description.
- Create a third table called "agency_services" that includes the agency ID field from the agencies table and the service ID field from the services table.
- Once these tables are created, go to the relationship view and connect the agencies (one side) and agency_services (many side) tables and the services (one side) and agency_services (many side) tables using two one-to-many relationships (i.e., each agency can offer many services; each service can be offered by many agencies).

Team Work Exercise

Net Stats: Who Is Subsidizing Web Content?

When you subscribe to cable television, you typically have to decide between different packages, each offering various channels focusing on sports, movies, cartoons, and so on. In addition, you have the option of subscribing to other channels that interest you. Hence, the charges on your monthly cable bill are for your subscribed services. In contrast, the charges on your Internet bill are for connecting to the Internet rather than for the content on the web. Hence, content providers on the Internet are typically dependent on other ways to generate revenue. Companies such as CNN, the *Washington Post*, Google, or Yahoo!, which provide content for free, subsidize their expenses by advertising revenue. One of the most common forms of advertising on the web is display ads, which have moved from simple static images to rich, interactive advertisements. Although the cost per thousand views may be only between US$8 and US$40, display ads are big business.

Which sites do people visit most often? Research firm comScore regularly provides rankings of the web's most popular "web properties," based on the number of unique monthly visitors. The top five properties in August 2016 were:

- Google Sites: 240.7 million unique visitors
- Yahoo Sites: 213.2 million unique visitors
- Facebook: 206.3 million unique visitors
- Microsoft Sites: 188.8 million unique visitors
- Amazon Sites: 186.3 million unique visitors

Questions and Exercises

4-36. Search the web for the most up-to-date statistics.

4-37. As a team, interpret these numbers. What is striking/important about these statistics?

4-38. How have the numbers changed? Which industries seem to be most interested in online advertising? Why?

4-39. Using your spreadsheet software of choice, create a graph/figure that effectively visualizes the statistics/changes you consider most important.

Based on:

ComScore (2016, August). Latest rankings. *comScore*. Retrieved September 22, 2016, from https://www.comscore.com/Insights/Rankings?country=US

Wojcicki, S. (2010, March 15). The future of display advertising. *Google Blog*. Retrieved June 27, 2016, from http://googleblog.blogspot.com/2010/03/future-of-display-advertising.html

Answers to the Self-Study Questions

4-14. D, p. 140	**4-15.** A, p. 147	**4-16.** A, p. 146	**4-17.** D, p. 146	**4-18.** A, p. 146
4-19. D, p. 145	**4-20.** B, p. 155	**4-21.** D, p. 168	**4-22.** D, p. 169	

CASE 1 | Web Analytics

In the 1990s, Josh James enrolled in an information systems class as part of his business management and entrepreneurship degree program. Being not particularly excited about the topic, Josh sat near the back of the room. During the first class period, Josh noticed a student near the front of the class who was easily answering all of the questions, and he decided he wanted to get to know him. His name was John Pestana, and they quickly became friends. John—a technology whiz with a knack for spinning web code—suggested that he and Josh start building websites for companies, and a partnership was born. As their student-run business grew amid the dot-com craze of the late 1990s, their clients began to ask about whether their fancy new websites were drawing any more web traffic. The two young entrepreneurs immediately recognized a compelling business opportunity, and they soon founded Omniture, a web analytics company that quickly grew to dominate the web analytics market. With innovative analytics tools, Omniture attracted many large companies, including Walmart, Comcast, NBC Universal, and Hyatt. In 2006, Omniture went public and was the number-two performing technology initial public offering (IPO) that year. Three years later, Omniture was acquired by technology giant Adobe Systems for US$1.8 billion. Adobe continues to develop the web analytics tools, which have since been integrated into the company's suite of online marketing solutions, the Adobe Marketing Cloud.

Web analytics is the measurement, collection, analysis, and reporting of web traffic data with the goal of understanding and optimizing web usage. The key features of most web analytics tools are enabled by a small bit of programming code that is embedded in each of the pages of a website. As a user navigates from page to page, various pieces of information about the user are collected. These include metadata such as the type of browser (Safari versus Chrome versus Internet Explorer), the type of device (mobile versus desktop), or the viewable resolution of the user's screen; browsing data such as how long the user stays on each page or where the user clicks; and navigation path data, such as which page the user came from or how many total pages the user has viewed within the website. The data are collected anonymously and aggregated for later analysis. For popular sites like Walmart.com or Amazon.com, web analytics software can collect millions of points of data within a relatively short amount of time.

Many companies employ entire teams whose sole purpose is to analyze web analytics data. These analytics data can be a gold mine of valuable information that a company can use to inform strategic decisions regarding its website. Consider the value of such information to a major online retailer like Zappos.com. Using analytics data, Zappos's analysts could study the browsing behaviors of thousands of different users to identify potential improvements to their website. They might find that users get stuck on a certain type of page and identify changes to the menu structure to improve the navigation. They may find that many users add items to their cart but exit the site without completing their order when they are prompted to create a user account. This discovery could lead them to move the account creation process to a different point in the checkout flow or perhaps even make account creation optional. These are only a few of the nearly infinite potential discoveries that web analytics data can help discover.

Given the large mass of web analytics data collected by a site like Walmart.com, there is a high potential for information overload. Thus, a key feature of successful web analytics solutions is the ability for business users to filter data in helpful ways, allowing them to drill down into items of interest. Another way in which analytics platforms reduce information overload is through the use of easy-to-interpret graphical representations of the data. These range from simple bar charts and line graphs to shaded geographical maps and complex charts depicting users' flow through a navigational structure. These and many other information summarization methods make the vast amount of web analytic data digestible so that business leaders can make informed, strategic decisions.

Web analytics is a prime example of business analytics in the digital age. For companies that conduct the majority of their business online, and in particular for retailers, entertainment hubs, and news providers, web analytics data provide invaluable insight into the behavior of their customers. Those companies that learn to effectively leverage those data can make significant changes that directly affect their bottom line.

Questions

4-40. Why do you think Omniture services were so popular, given the time period in which the company was founded?

4-41. Think of an online service (not retail) that you use frequently. How could this company use web analytics data to improve its website and positively affect its business?

4-42. Do you think that capturing usage data for performing web analytics is an invasion of privacy? Why or why not?

Based on:

Anonymous. (n.d.). Adobe Marketing Cloud. *Adobe*. Retrieved June 27, 2016, from http://www.adobe.com/marketing-cloud.html

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CASE 2 | Rocket Internet—Cloning Business Models

As many successful online businesses have painfully experienced, innovative business models in the digital world can be easily copied. Being early players in a new market and focusing on rapidly gaining market share, many companies enjoy a first-mover advantage but, due to their success, are cloned by numerous other "impersonators" around the globe: The daily deal website Groupon has a variety of clones all over the world; Uber has been cloned in China but has also attracted me-too companies in various other countries; Online clothing retailers such as Zappos or Asos have been cloned numerous times. Cloning successful business models can be less risky than coming up with and launching an innovative business idea, and often, developers of clones manage to sell the clones to the original companies later on; for example, in 2010, Groupon decided to buy up its "clones" to reclaim its identity and, most important, fast-track its expansion into foreign markets in Europe and Asia.

Rocket Internet, one of Europe's biggest Internet companies, has gained notoriety for cloning business models. Founded by the brothers Marc, Alexander, and Oliver Samwer, Rocket Internet's mission is "to become the world's largest Internet platform outside the United States and China." To achieve this mission, Rocket Internet's focus is on building companies rather than innovating; in other words, Rocket Internet looks for innovative and successful Internet-based business models and replicates those in other (often emerging or pre-emerging) markets, striving to grow the clone as quickly as possible with the aim of later selling the clone. To achieve rapid growth of a clone and gain a first-mover advantage in the clone's region, Rocket Internet attempts to increase the clone's reach, offers a wider variety of products or services, or tries to price competitors out of the market; typically, this approach requires investing significant funds not only into building the clone but also in marketing (using not only Internet marketing, such as Google AdWords campaigns, but often also traditional television ads). Using this strategy has proven to be very successful; for example, CityDeal (a Groupon clone) was sold to Groupon for US$170 million less than half a year after the clone was launched. Rocket Internet has successfully cloned a number of innovative online business models, ranging from Airbnb (Wimdu) to Uber (EasyTaxi) to grubHub (foodpanda) to Zappos (Zalando, one of Europe's largest fashion retailers). Although Rocket Internet is often accused of "stealing" business ideas, business models cannot be patented, and so there is little danger of facing legal consequences for infringing on other's intellectual property.

While cloning successful Internet-based business models seems easy, this is not necessarily the case. Often, the originals are focused on growing their business in their respective home markets. Other markets, however, typically require different approaches to operations, marketing, and so on. Being extremely effective at adapting business models and tailoring them to local market conditions has been key to the success of Rocket Internet. This is even more astonishing given that Rocket Internet now operates in more than 100 countries, and Rocket Internet has built tremendous knowledge about which factors (such as cultural, geographic, legal, and so on) are important for what types of business models. Interestingly, while many of the business models copied by Rocket Internet were developed in the United States, none of Rocket Internet's clones operates in this market, which Rocket Internet considers oversaturated. Likewise, Rocket Internet has only limited reach in China, facing similar restrictions and protectionist policies as many other Western Internet businesses.

In spite of its impressive growth, Rocket Internet is also facing challenges. Using proprietary technologies and processes, Rocket Internet tries to launch a business within less than 100 days, after which it decides whether to continue pursuing the business model. In this process, Rocket Internet learned that cloning business ideas that heavily rely on communities and the network effect (such as Airbnb) is infeasible within a short time frame, given the need for building a community and customer trust. Further, although many of Rocket Internet's businesses have achieved phenomenal growth, many have yet to make a profit, and Rocket Internet has been accused of being intransparent about the valuation of companies in its portfolio. However, as long as innovators continue to come up with new business ideas, there's a good chance of these ideas being cloned, be it by Rocket Internet or by other companies.

Questions

4-43. Rocket Internet has been accused of killing innovation. Is the practice of copying business models and selling them back to the original ethical? Why or why not?

4-44. What types of business models are easiest to clone? What types are hardest to clone? Why? Give a specific example of each.

4-45. Think about an innovative business model you could "clone" and launch in a particular market. Which factors (such as cultural, geographic, legal, and so on) would be most important to adapt for this market? Which factors would be least important? Why?

Based on:

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MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

4-46. Describe mass customization and explain how companies can reap higher profits despite higher production costs for manufacturing customized products.

4-47. How can online retailers minimize the risk associated with credit card transactions?

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5 Enhancing Organizational Communication and Collaboration Using Social Media

Preview

This chapter focuses on social media and how social media can enhance organizational communication and collaboration. Most likely, you are actively using various social media applications such as Facebook, Instagram, or Wikipedia, and you may ask, "Why do we need to have a chapter on this?" Social media introduce unprecedented ways to connect to friends, share knowledge with your colleagues, or collaborate with a team of engineers 5,000 miles away, and many of today's companies cannot afford to miss this trend. Most young people entering the workforce have grown accustomed to using Facebook or Twitter for their communication needs (and some even regard e-mail as an outmoded communication medium); if a company doesn't allow the use of these tools, some employees may leave and work for another company. Additionally, you may have noticed your parents' generation joining sites such as Facebook, as the masses are more and more taking those tools for granted.

With social media providing a vastly expanded set of capabilities for individuals and businesses, an understanding of how they can be applied can be very helpful. Being able to understand and apply these emerging capabilities and strategies that are associated with social media is a highly valued skill.

MANAGING IN THE DIGITAL WORLD:

Facebook

Managing our lives in the modern, digital world seems to be far more complex than it was in the past. The same is true for companies. Interactions with customers were limited to one-way communication using TV ads, billboards, posters, or radio broadcasts. In return, people showed affinity to a particular brand by displaying bumper stickers, wearing T-shirts, or refusing to even try alternative brands. All in all, no real interaction could be recorded between customers and brands.

Things have changed since then. In mid-2016, Facebook reported impressive usage statistics (Figure 5.1). Each month, more than 1.65 billion users access the site, and more than 1.5 billion of those users access the service via a mobile device. On average, Facebook users upload more than 300 million photos per day, and five new profiles are created every second.

Many companies have also joined Facebook, creating pages to extend their reach and promote new products. In addition, celebrities, musicians, public figures, movies, and almost any other product or service you can think of now appears to have a Facebook page. Facebook has become another get-together space for people who have acquaintances, friends, or beliefs in common. Businesses use it to build and track customer loyalty, and connections are made even tighter with the help of "like" buttons that seem to be on almost every site on

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

1. Explain organizations' needs for communication and collaboration.
2. Explain social media and evolving web capabilities.
3. Describe various social media applications, and explain their role in enhancing communication, collaboration, cooperation, and connection.
4. Describe how companies can manage enterprise-oriented social media applications and deal with potential pitfalls associated with social media.

FIGURE 5.1

Facebook is the most popular social network, with more than 1.65 billion monthly active users.
Source: Thomas Pajot/Fotolia.

the web. Facebook has changed the scope of social interactions, as consumer preferences, collective tastes, and future demands are now more easily analyzed and predicted through the number of "likes" or the comments left by consumers responding to photos regarding the latest smartphone or that new movie premiering next Thursday. Through this social media platform, companies can interact with customers like never before.

In early 2016, most objective measures of Facebook's tremendous success appear to continue. Over the past year, daily active users were more than 1 billion, up 16 percent, with quarterly revenue up 52 percent, exceeding US$5.3 billion. Of the more than US$5 billion in quarterly advertising revenue, about 82 percent was generated through ads delivered on mobile devices. In early 2016, Facebook's market value was greater than US$350 billion, making it the sixth most valuable company in America. Analysts predict that Facebook could grow more than 30 percent annually for the next few years. That growth rate is twice the rate that is forecasted for Google and nearly triple of what Apple is expected to grow. If this growth occurs, analysts believe that Facebook could be the first US$1 trillion-dollar company.

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

1. How can Facebook be used to address organizations' needs for communication and collaboration?
2. What are the social media and evolving web capabilities used by Facebook?
3. Facebook started as a "pure" social networking site. What other social media applications are now integrated into Facebook, and how do they help enhance communication, collaboration, cooperation, and connection?

Based on:
Anonymous. (2016, April 27). Facebook reports first quarter 2016 results. Retrieved June 22, 2016, from https://investor.fb.com/investor-news/press-release-details/2016/Facebook-Reports-First-Quarter-2016-Results-and-Announces-Proposal-for-New-Class-of-Stock

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The Need for Communication and Collaboration

Just as you communicate with your friends when planning a vacation or organizing a party, or collaborate with your teammates on a class project, organizations rely on effective communication and **collaboration** (i.e., two or more people working together to achieve a common goal), both within and outside organizational boundaries. Most organizational business processes require communication and collaboration between employees of different departments as well as with outside business partners (such as suppliers), customers, and other external stakeholders. Many organizations operate on a national or global scale and rely on effective and efficient communication between various locations or subsidiaries, and even small, local companies need to communicate with suppliers or promote their products or services to customers. Further, globalization has enabled companies to source raw materials, parts, or components on a global scale or manufacture products wherever they can find the lowest cost, best quality, or most qualified workforce. In all of these scenarios, effective and efficient communication is essential to convey specifications, coordinate production or delivery schedules, and so on. Similarly, salespeople rely on efficient communication with the customers and with other departments within the organization. With the increased global reach of organizations, the needs for *internal* communication have also changed tremendously.

Virtual Teams

To be competitive, organizations constantly need to bring together the right combinations of people who have the appropriate set of knowledge, skills, information, and authority to solve problems quickly and easily. Traditionally, organizations have used task forces, which are temporary work groups with a finite task and life cycle, to solve problems that cannot be solved well by existing work groups. Unfortunately, traditional task forces, like traditional organizational structures, cannot always solve problems quickly, as structure and logistical problems often get in the way of people trying to get things done. Thus, organizations are increasingly trying to harness the expertise of highly specialized team members, regardless of their location. With various collaboration and communication tools enabled by the Internet, collaborators on projects or teams do not have to be colocated; rather, businesses increasingly form **virtual teams**, composed of members from different geographic areas and assembled as needed to collaborate on a certain project (Figure 5.2). Membership on these virtual teams is fluid, with teams forming and disbanding as needed, with team size fluctuating as necessary, and with team members coming and going as they are needed.

Employees may, at times, find themselves on multiple teams, and the life of a team may be very short. In addition, team members must have easy, flexible access to other team members, meeting contexts, and information. Resembling highly dynamic task forces, virtual teams are commonly used for tasks such as developing systems and software; for example, the programmers are located in India, the project managers are in the United States, and the testers are in Europe. However, systems development is not the only place you will find virtual teams. For instance, the healthcare industry has embraced the idea of using technology to create superior care for patients by creating virtual teams that may include dieticians, physicians, surgeons, pharmacists, and social workers from different cities, all of whom can coordinate care of a patient using various web technologies so as to provide the best healthcare professionals regardless of where the patient resides.

If you have ever worked on a team project for your class (and you probably have), you have noticed that there are many different communication needs, such as discussing issues, sharing documents, and making decisions. Just as there are many things to discuss within your team project, there are also many ways that you can communicate and collaborate, and different time horizons. One key distinction is between the need for **synchronous** (i.e., at the same time) and **asynchronous** (i.e., not coordinated in time) communication. For example, chatting online or making a telephone call are examples of synchronous communication, whereas texting or sending e-mails are examples of asynchronous communication. Likewise, meetings of virtual teams typically take the form of **virtual meetings** using online environments; such meetings can be held synchronously, like a teleconference, or asynchronously, using technologies such as online discussion boards. If time is of the essence, such as when attempting to meet deadlines or resolve urgent customer problems, synchronous media may be best suited, as delays can create process

FIGURE 5.2

Members of highly specialized virtual teams are often not colocated.
Source: Toria/Shutterstock.

inefficiencies or dissatisfied customers and can thus be costly for the organization. Thus, over the years, different tools have emerged to support various communication and collaboration needs (Table 5.1).

Groupware

Enabled by computer networking (and later the Internet), **groupware**—a class of software that enables people to work together more effectively—became a widely used way for collaboration within teams or organizations. Since the appearance of the first mainstream groupware product—Lotus Notes—in 1989, groupware has become ubiquitous in all types of organizations, with many (often free) tools allowing anyone with a connected device to utilize the benefits of groupware. Groupware and other collaboration technologies are often distinguished along two dimensions:

1. Whether the system supports synchronous or asynchronous collaboration and communication
2. Whether the system supports groups working together face-to-face or distributed

TABLE 5.1 Categories of Collaboration Tools

Category	Description	Instances	Examples
Electronic communication tools	Tools allowing users to convey verbal and written information and send files, documents, or other content	Fax, e-mail, voice mail, blogs, wikis, static websites	MS Outlook, Blogger, Wikipedia
Electronic conferencing tools	Tools allowing information sharing and rich interactions between users	Internet forums, instant messaging, application sharing, videoconferencing	Apple FaceTime, Skype, Google Hangouts, WebEx
Collaboration management tools	Tools used to facilitate virtual or collocated meetings and manage group activities	Electronic calendars, knowledge management systems, intranets, online document systems	Google Docs, MS Office Online, MS SharePoint

Using these two dimensions, groupware systems can be categorized as being able to support four modes of group interaction, as shown in Figure 5.3.

Depending on the purpose, organizations draw on different types of asynchronous groupware tools, such as e-mail, mailing lists, workflow automation systems, intranets (see upcoming discussion), group calendars, or collaborative writing tools. One widely used tool for group communication is **discussion forums** (also known as discussion boards or online forums), which emulate traditional bulletin boards and allow for threaded discussions between participants. Typically, discussion forums are dedicated to specific topics, and users can start new threads (Figure 5.4). Depending on the owner or host of the forum, the discussion forum may be moderated so that new postings appear only after they have been vetted by a moderator; further, some discussion forums may only allow posts from registered users, whereas others allow anyone to contribute. As the purpose of such forums is to enable discussion and/or solve problems, many discussion forums now incorporate collaboration features such as the ability to mark answers as helpful or correct.

Like asynchronous groupware, there are also many forms of synchronous groupware available to support a wide variety of activities, including shared whiteboards, online chat, electronic meeting systems, and, of course, video communication systems (discussed in the following section). An **electronic meeting system** is a sophisticated software tool used to help group members solve problems and make decisions through interactive structured processes such as electronic idea generation, idea evaluation, and voting (Figure 5.5). These structured processes help groups stay on track and avoid costly diversions that regularly occur in meetings. EMSs have traditionally been housed within a dedicated meeting facility; increasingly, web-based implementations support team members around the globe. Many groupware systems used by organizations combine a variety of tools supporting both synchronous and asynchronous communication and collaboration.

Videoconferencing

In the 1960s, at Disneyland and other theme parks and special events, the picturephone was first being demonstrated to large audiences. It took another 30 years to take off, but today, organizations are routinely conducting videoconferences to replace traditional meetings, using either desktop videoconferencing or dedicated videoconferencing systems.

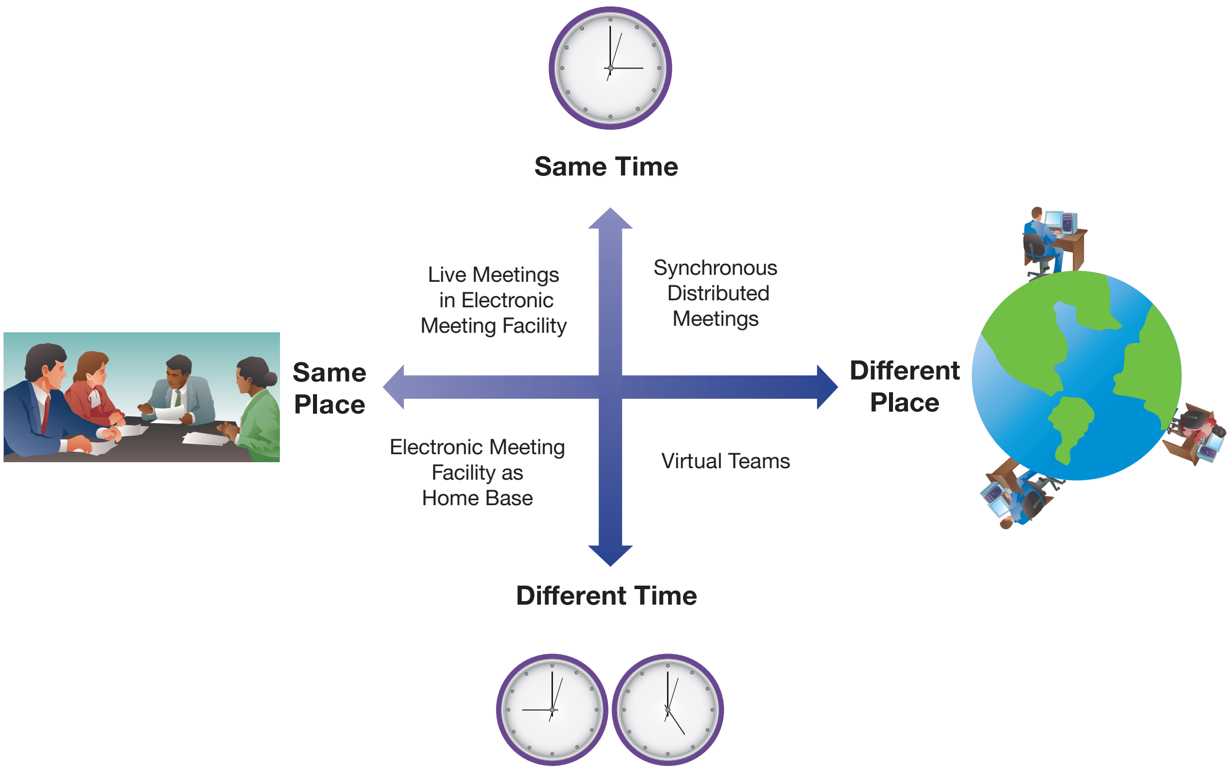


FIGURE 5.3

Groupware supports various modes of group interaction.

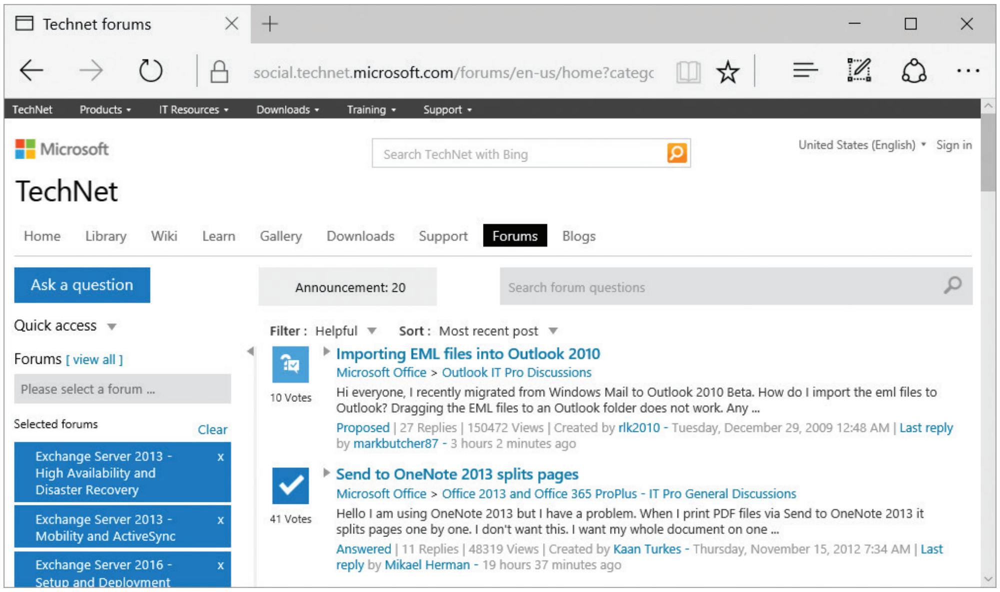


FIGURE 5.4

Microsoft offers discussion forums for questions and feedback related to its various products and services.

Source: TechNet 2016, Windows 10, Microsoft Corporation.

Desktop videoconferencing has been enabled by the growing power of processors powering personal computers and faster Internet connections. For desktop videoconferencing, all that is needed is a **webcam** (i.e., a small video camera that is connected directly to a PC or integrated in a laptop PC's monitor), a speaker telephone or a separate microphone and speakers/headphones, videoconferencing software (e.g., Skype, Google+, or Apple FaceTime), and a high-speed Internet connection. Similarly, people can now use various apps on their mobile devices, enabling them to make video calls on the go.

Dedicated videoconferencing systems are typically located within organizational conference rooms, facilitating meetings with customers or project team members across town or around the world. These systems can be highly realistic—as if you are almost colocated with your colleagues—but high-end systems can be extremely expensive, ranging from a few thousand dollars up to US$500,000. No matter what type of videoconferencing system is utilized by an organization, this collaboration technology has come a long way from the demonstration at Disneyland in the 1960s and has become mainstream in most modern organizations.

FIGURE 5.5

An electronic meeting system utilizes networked computers and sophisticated software to support various group tasks.

Source: Konstantinos Kokkinis/Shutterstock.

GREEN IT

Green IT Fueling Renewable Energy

Everyone is excited about the potential for renewable energy to replace non-renewable sources such as coal, petroleum, and nuclear. Renewable energy is generated from natural processes that are continuously replenished, such as sunlight, rain, tides, and geothermal heat. For individuals and organizations, key considerations are reducing energy bills and reducing carbon footprint; reducing the carbon footprint is especially important for organizations attempting to portray a positive image by engaging in socially responsible behavior. Continuous improvements in various energy technologies are rapidly improving the efficiency and reducing the costs of renewable sources. Likewise, IoT sensors allow for analyzing energy needs and performance to optimize the balance between energy consumption and performance needs for a variety of devices. With such progress, many individuals and companies are going green by buying electric cars, installing solar panels and wind turbines, and so on.

Recently, the U.S. military has also started to embrace renewable energy sources. As the Department of Defense, which includes all branches of the military, is the largest consumer of energy in the United States, contributing to about 2 percent of the nation's total energy consumption, this can have significant impacts on reducing CO_2 emissions. While increasing its use of cleaner fuels is a good environmental outcome, this is not a motivating factor for the U.S. military. According to one source, "We're concerned about climate change… but the first mission is bombs on target." Thus, its primary motivation centers around energy security, both on bases and when deployed throughout the world. For instance, by using solar technology when deployed in the Middle East, it reduced the diesel generator loads by 60 percent. However, using alternative energy sources and still being able to provide energy where needed, when needed, requires continuously monitoring and analyzing energy consumption. Senior leaders believe that solar and other renewable sources, coupled with analytic capabilities provided by information systems, will provide the military with greater energy options and improve the resilience of the operations both domestically and when deployed. And there will also be the added benefit of a greener and cleaner military.

Based on:

Hepler, L. (2016, June 22). Energy meets security: Can the military scale clean power? *GreenBiz*. Retrieved July 1, 2016 from https://www.greenbiz.com/article/energy-meets-security-can-military-scale-clean-power

Kaenel, C. (2016, March 16). Energy security drives U.S. military to renewables. *Scientific American*. Retrieved July 1, 2016, from http://www.scientificamerican.com/article/energy-security-drives-u-s-military-to-renewables

Intranets and Employee Portals

Internet technologies have given rise to another widely used tool for communicating and collaborating within organizational boundaries. Specifically, many large organizations have intranet-based employee portals. As discussed in Chapter 3, "Managing the Information Systems Infrastructure and Services," an intranet is a private network using web technologies, used to facilitate the secured transmission of proprietary information within an organization. An intranet looks and acts just like a publicly accessible website, but the intranet pages are behind the company's firewall, so only authorized users can access the content using their web browser. Modern intranets allow for dynamically creating customized intranet pages for each employee depending on job functions or even geographical location. Whereas all pages have the same look and feel and draw on the same underlying data, each employee can access only the data needed to perform his or her job function (following the principles of least permissions and least privileges; see Chapter 10, "Securing Information Systems"). For example, if an employee from human resources logs on to the employee portal, he or she would see only content that pertains to his or her job, such as payroll information or hiring statistics.

All intranet pages are behind the company's firewall, and in the simplest form of an intranet, communications take place only within the confines of organizational boundaries and do not travel across the Internet. However, increases in employees' mobility necessitate that an intranet be accessible from anywhere. Thus, most companies allow their employees to use virtual private networks (VPNs) to connect to the company's intranet while on the road or working from home (i.e., telecommuting). Once connected via a VPN, users can access resources as if they were located within the organization and connected to the organization's network. Figure 5.6 depicts a typical intranet system architecture (see Chapter 10 for more on firewalls and VPNs).

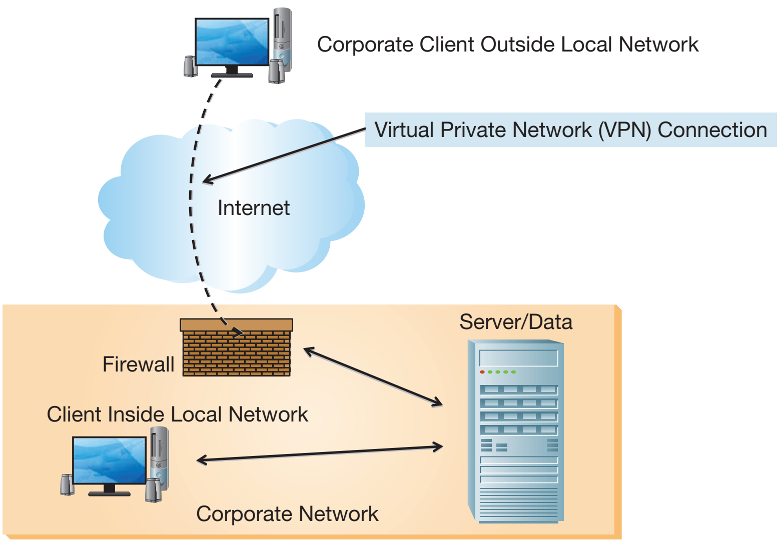


FIGURE 5.6

Typical intranet system architecture.

REAL-TIME ACCESS TO INFORMATION. A major benefit of corporate intranets is the ability to increase the efficiency and effectiveness of collaboration by providing real-time access to information. Unlike paper-based documents, which need to be continually updated and distributed to employees when changes occur, intranets make it less complicated to manage, update, distribute, and access corporate information. For instance, Boeing disseminates corporate news by distributing multimedia content over the company's intranet, allowing employees to view digital copies of company news releases as they occur, from the convenience of their desktops.

With intranet-based solutions such as those deployed at Boeing, up-to-date, accurate information can be easily accessed on a company-wide basis from a single source that is both efficient and user friendly. Companies can become more flexible with resources required to create, maintain, and distribute corporate documents, while in the process employees become more knowledgeable and current about the information that is important to them.

ENTERPRISE SEARCH. Another component supporting employee productivity by providing real-time access to information is the integration of enterprise search functionality. As more and more content is accessible via a company's intranet, relevant information becomes increasingly difficult to locate, especially if the information is in different languages and located on different servers or databases, as is the case in many large global organizations such as Nestlé. Hence, the requirements for enterprise search engines are very different from those of Internet search engines such as Google or Bing. Enterprise search engines such as Microsoft's Enterprise Search or the Google Search Appliance are designed to retrieve content from various internal data sources, including documents, databases, or applications linked to the company's intranet. Such capabilities allow organizations to easily share millions of documents located throughout the organization. Thus, providing enterprise search functionality can enhance productivity and be an important factor contributing to users' satisfaction with the company's intranet.

COLLABORATION. One of the most common problems occurring in large corporations relates to the coordination of and collaboration on business activities in a timely fashion across divisions or functional areas. For instance, Boeing uses its intranet to facilitate collaborative efforts, such as in the process of designing new aircraft components. In this process, three-dimensional digital models of aircraft designs frequently need to be shared between aerospace engineers. Using Boeing's intranet, an engineer can share a drawing with another engineer at a remote location; the second engineer revises the drawing as necessary and uploads the updated drawing to a shared folder on the intranet. The Boeing intranet provides the company with the capability of reducing product development cycle times as well as the ability to stay abreast of current project, corporate, and market conditions. Likewise, intranets are being used to poll staff about current issues or by employees to communicate with each other and executives in secure nonpublic forums.

To further enable collaboration and communication, many intranet solutions now incorporate social components. In contrast to traditional intranets, where typically only select users with editorial privileges can create and update content, these intranets—sometimes referred to as **social intranets**—allow every user to create and update content and to easily connect with other content creators (see our discussion of social software below). Further, intranet solutions such as Jive are integrated with various other collaboration tools, ranging from Gmail to Dropbox, Skype, or customer relationship management software such as Salesforce.com (see Chapter 8, "Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management").

EMPLOYEE PORTALS. In addition to being used for communication and collaboration, organizational intranets are widely used to provide **employee portals** that enable **employee self-service** for administering benefits, managing retirement plans, or other human resources–based applications. For example, for large companies, processing human resources–related forms can be a large cost factor. Depending on the complexity of the form, processing a paper-based form can cost US$20 to US$30, according to benefits administration solutions provider Workscape, Inc. Whereas interactive voice response–based telephone applications can cut these costs to US$2 to US$4, using intranet-based employee self-service applications can reduce this further, to a few cents per form. Considering that an employee, on average, conducts 15 human resources–related transactions per year, the savings can be significant. Using the intranet, form templates can be centrally managed, and modifications can be made instantaneously as conditions change; thus, employees can submit the appropriate form electronically with the assurance that they have used the correct version. Further, using online forms can help to significantly reduce error rates, as the entries can be checked for accuracy at the time of data entry, thus preventing the user from inputting incorrect or illogical entries. Using employee portals, employees become self-reliant, reducing time spent dealing with employment-related issues and allowing them to focus on their work responsibilities.

The Evolving Web

The traditional collaboration tools previously introduced are based on Internet technologies. However, up until a few years ago, the web was regarded as a one-way medium (sometimes referred to as "web 1.0"), with a relatively strict distinction between content creators and content consumers. Some entities would create content (say, a website), and others would consume this content. However, changes in technology have enabled new uses of the web; dynamic web applications, often referred to as **web 2.0** applications, allow people to collaborate and share content online, shifting the users' role from passive consumers of content to content creators (Figure 5.7). In contrast to the TV network ABC's site, where content is provided by ABC, the web 2.0 application YouTube depends on **user-generated content**, content that is created and uploaded by other users; similarly, whereas *Encyclopaedia Britannica* invests large sums in professionally researched articles, the articles in the online encyclopedia

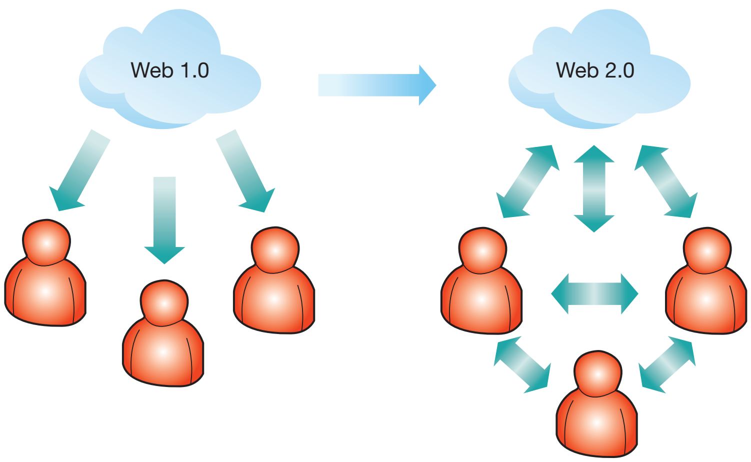


FIGURE 5.7

Web 2.0 applications shift a web user's role from a passive consumer of content to its creator.

COMING ATTRACTIONS

Dissolvable Electronics

The pharmaceutical industry is fighting a constant battle against various bacteria that can quickly evolve to become resistant to antibiotic treatments. Drug researchers can spend months or years developing a new treatment, only to have that treatment lose effectiveness when the bacteria it was designed to kill become resistant. New antibiotics must then be developed, and these cunning bacteria keep pharmaceutical companies on their toes. It is not known whether researchers will be able to stay ahead of the bacteria indefinitely and keep the population healthy. But some researchers are developing alternative ways of killing bacteria using methods that are not susceptible to the mutations of bacteria.

Researchers at the University of Illinois are developing specialized electronic devices capable of performing short-term therapeutic tasks without active treatment from a medical professional. The key characteristic of these devices is their ability to disappear—to dissolve after a time and be absorbed by the person they were helping to heal. For example, after a surgery in which a large incision is made, a key risk for recovering patients is that of bacterial infection. A dissolvable electronic device could be embedded in the incision and emit just enough heat to kill bacteria. After the risk of infection has passed, the device, which is made of "biocompatible" materials, would then dissolve and be absorbed or excreted through the normal biological processes of the body.

Researchers have been working with an array of natural materials to test how well they perform in electronic devices and whether they might cause side effects or other damage when implanted. A variety of biodegradable materials, including DNA, proteins, and metals, have been tested. One test utilized egg proteins and found that the device's performance matched that of a non-degradable device, worked for more than 3 months in dry conditions, and lasted from 2 to 10 hours when operating in wet conditions. In this experiment, the rest of the chip took about 3 days to dissolve.

So, while this technology is not yet ready for deployment, the researchers have successfully demonstrated that it is possible to create dissolvable electronic circuits. Perhaps the technology will soon develop into something that will help the human race further reduce disease and sickness that still afflicts many around the world.

Based on:

ACS. (2016, April 27). Toward dissolvable electronics for implants and sensors. *American Chemical Society*. Retrieved June 28, 2016, from https://www.acs.org/content/acs/en/pressroom/presspacs/2016/acs-presspac-april-27-2016/toward-dissolvable-electronics-for-implants-and-sensors.html

Drake, N. (2013, May 24). New wireless electronics could heal wounds and then dissolve. *Wired*. Retrieved June 28, 2016, from http://www.wired.com/2013/05/remote-controlled-dissolvable-electronics

Zyga, L. (2015, January 15). Water-soluble silicon leads to dissolvable electronics. *Phys.org*. Retrieved June 28, 2016, from http://phys.org/news/2015-01-water-soluble-silicon-dissolvable-electronics.html

Wikipedia are jointly written and edited by the online community (owing to societal changes and competition from Wikipedia, *Encyclopaedia Britannica* decided to stop producing printed encyclopedias in 2012, instead focusing on its online offerings). In addition to these applications, many organizations have successfully incorporated web 2.0 concepts into their business models. For example, Amazon.com adds value to its site by incorporating product reviews from its customers. This way, it gives customers a channel to voice their thoughts; at the same time, a larger number of reviews can help other customers make better decisions, thus attracting more visitors to Amazon.com's site. Likewise, platform-based business models (such as pursued by Airbnb, Uber, or YouTube; see Chapter 2, "Gaining Competitive Advantage Through Information Systems") are based on web 2.0 concepts. In the following sections, we will discuss technological and societal changes that both enable and necessitate changes in the way many organizations do business.

Evolving Web Capabilities

Many successful web 2.0 applications rely on the network effect. The network effect (as defined in Chapter 1, "Managing in the Digital World") refers to the notion that the value of a network (or tool or application based on a network) increases with the number of other users. In other words, if a network has few users, it has little or no value. Many successful websites or service providers (such as Google) try to provide value to users by making parts of their functionality or data (such as map data) available for other websites to use and thus enable creating unique and dynamic applications, or *mashups*, quickly and easily.

The idea of mashups came from popular music where many songs are produced by mixing two or more existing songs together; in web 2.0 terminology, a **mashup** is a new application (or website) that uses data from one or more service providers. For example, a mashup could combine map data, photos, reference information, hotel prices, and weather information to provide a comprehensive overview of travel destinations. Rather than having to collect or generate all of this information single-handedly, the creator of the mashup could simply draw on services provided by Google Maps, Flickr, Wikipedia, Expedia, and AccuWeather (Figure 5.8). The online itinerary planner Sygic integrates data from OpenStreetMap, hotel booking services, and other services to let users plan their next holiday. Likewise, users and companies can create mobile apps by combining various services and data sources. The local search app AroundMe uses data from services such as Booking.com, Opentable.com, or Foursquare to display information, reviews, or driving directions about businesses, restaurants, or medical facilities near a given location. Other websites and mobile apps use data from airlines, radio stations, recommendation services, or any other sources of useful information.

Many organizations have recognized the power and benefits of allowing other sites and apps to incorporate their services and data into mashups. Why are companies doing this? By providing access to useful services and data, organizations extend their reach and build and strengthen customer relationships, providing a base for revenue-generating services (e.g., Google offers mapping services for free for low-volume usage but offers the services as a paid version for high-volume commercial usage, such as integration in a hotel booking site).

Evolving Social Interaction

Many successful web 2.0 applications embody core web 2.0 values such as collaboration and social sharing; these can be classified as **social media** (or **social software**), allowing people to communicate, interact, and collaborate in various ways. With web 2.0 coming of age, people's behaviors as well as societies have undergone rapid changes. For example, many people have changed the ways they search for information. Whereas in the past people turned to paper encyclopedias as sources of unbiased information, people now turn to websites such as Wikipedia or ask their friends and acquaintances on social networks such as Facebook for personalized information. Similarly, there has been a marked shift in the way people view privacy and share information; although criticized by privacy advocates, people are sharing more personal information online than ever before. Repeatedly, you can read about people posting the most private information without thinking about the consequences; as Facebook and other social websites have become pervasive in many people's lives, you have information about your friend's recent drinking escapades leading to a driving under the influence (DUI) arrest, your coworker's breaking up with his girlfriend, and other things you may or may not want to know, all at your fingertips. Clearly, social software has strongly influenced the lives of many people, and social media have now reached a point where almost everything is interconnected. Further, ongoing conversations on social media generate vast amounts of Big Data, which can used not only by the social media companies themselves but also by organizations using social media to connect with their stakeholders. Table 5.2 highlights the shift in perspectives from the web 1.0 to the web 2.0 era.

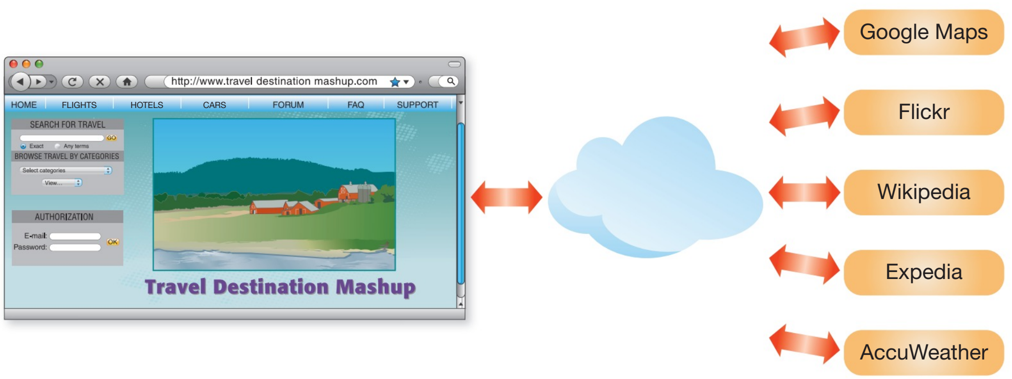


FIGURE 5.8

A mashup is a new application (or website) that uses data from one or more service providers.

TABLE 5.2 Shifting Perspectives from Web 1.0 to Web 2.0

Web 1.0	Web 2.0
Me	Me and you
Consume content	Consume and create content
Connect ideas	Connect ideas and people
Search	Receive and give recommendations to friends and others
Find	Share
Techies rule	Users rule
Organizations	Individuals

Source: Based on Sessums (2009).

The Evolving Workspace

The "millennials," or "Generation Y," who grew up being tied to social software such as Myspace (once the world's largest social network site, which now primarily focuses on music), YouTube, or Facebook, are joining the workforce and have much different expectations for their workplace than prior generations, and some fundamental shifts are taking place in employer–employee relationships (see Accenture, 2016). For example, employees are now looking for a portfolio career rather than a cradle-to-grave job, tend to view themselves as citizens rather than employees, and "loan their talent" to the employer rather than being a "human resource." Accenture feels that this new generation of "born digital" workers have new expectations about how work should be organized and performed. For instance, companies no longer just serve customers, compete with rivals, or are limited to industry boundaries. Today, successful companies collaborate with customers, partner with rivals, and evolve their business as needed. Thus, to be successful, companies must create a corporate culture that is embracing the trends of the digital world. For instance, millennials bring with them many new and valuable skills but also attitudes that may be difficult to integrate with more traditional business environments. A great example of this relates to the use of social networking in the office. If a business bans the use of social networking sites at work, many millennials will easily find creative workarounds to circumvent such policies or simply find a job that is embracing the trends of the digital world. Many believe that embracing social media and other changes is not only necessary to attract and retain top talent, it is also good for business (CIPHR, 2016). Viewing social media as a way to enhance company culture, improve customer relationships, and recruit future customers and employees provides many benefits. It also provides companies with deeper insight into what their competition is doing and what matters to their customers, all of which can aid in planning for the future.

Future Web Capabilities

Web technologies and collaboration are ever-evolving topics, and many developments have yet to be fully realized. This section briefly forecasts future capabilities of the web, in particular, focusing on efforts to create the semantic web and characteristics of web 3.0.

THE SEMANTIC WEB. Since the web opened up for public use, the number of web pages and sites has grown exponentially. Although this increase in web pages should mean that we have ever more information at our fingertips, it also means that the information is increasingly harder to find. What if the information on the web was organized in a way that users could more easily find information or relevant content? Traditionally, web pages were designed to be understood by people but not by computers, and search engines were examining pages for the existence of key terms; for example, when searching for "what eats penguins," a search engine would return web pages that might have this information, but more likely various pages just having the words or key terms "what" and "eats" and "penguins," as search engines were not sophisticated enough to be able to find, understand, and integrate content presented on web pages. The **semantic web**, originally envisioned by Tim Berners-Lee, one of the inventors of the World Wide Web, is a set of design principles that will allow computers to better index web pages, topics, and subjects. When web pages are designed using semantic principles, computers will be able to understand the meaning of the content, and search engines will be able to give richer and more accurate answers. The major search engines encourage webmasters to integrate so-called microdata into their pages' HTML markup to help search engines understand the *meaning* of content on the pages; for example, the markup of a business' address can be enhanced by using microdata to specify the meaning of the different parts of an address. In 2012, Google has started making strides toward implementing concepts related to the semantic web in its "knowledge graph." When searching for terms in Google, the search engine now attempts to understand what the user may mean; for example, when searching for "kings," the search engine not only provides a list of pages containing the keyword "kings" but also displays a box containing links to search results specific to the *Los Angeles Kings*, the *Sacramento Kings*, and the NBC TV series *Kings*. Similarly, when searching for "Los Angeles Kings," Google returns not only a list of web pages but also a summary of relevant information about the hockey team, culled from various web sources. Although the semantic web is largely unrealized (and may never be fully realized due to issues surrounding complexity, feasibility, or privacy concerns), Google's efforts show that computers are getting ever closer to understanding the meaning of content on the web.

WEB 3.0. In many ways, web 2.0 has already replaced web 1.0, and the question is "What will replace web 2.0?" For some, web 2.0 is just a short transitional period before the next wave of Internet technologies, which is predicted to last until 2020. There are several ideas on what this next wave, sometimes termed web 3.0, will entail. Some, such as *Forbes* contributor Eric Jackson, envision the next wave of the web to be centered around mobility, almost announcing the demise of the web as we know it. Others see web 3.0 as the "contextual web," where the immense amounts of content available to users will be filtered by contextual factors such as time, location, social activities, and so on. You may have already seen some of these emerging technologies in practice, especially regarding the context of a user's location, and we may only know what web 3.0 really is when we see it; it may even forever remain a buzzword. Nevertheless, we can see exciting new developments on the horizon, and the coming trends will likely involve true integration of devices and connectivity to create powerful, socially aware Internet applications. Stay tuned to see what the future holds.

Social Media and the Enterprise

Having realized the opportunities brought about by web 2.0 applications, many business organizations are continuously looking for ways to use social media to support their existing business processes; many organizations have built successful business models entirely based on core web 2.0 values such as social sharing or collaboration (see Chapter 4, "Enabling Business-to-Consumer Electronic Commerce," for a discussion on social commerce). In addition, the use of social media within a company's boundaries or between a company and its customers or stakeholders can help in sharing organizational knowledge, making businesses more innovative and productive, and helping them to effectively connect with their customers and the wider public.

You were likely familiar with many of the social media applications mentioned throughout the previous chapters, but there may have been some that you were not aware of. You are probably more comfortable with or find more value using some tools over others. Similarly, organizations are increasingly trying to find the right tools for their different needs. In the following sections, we will discuss how different social media applications enable or support communication, cooperation, collaboration, or connection; needless to say, many of these applications cannot be neatly categorized, fitting into more than one category.

Enhancing Communication Using Social Media

A prime application of social media in the enterprise is facilitating and enhancing the communication within an organization as well as between an organization and its stakeholders. For organizations, social media have opened up a vast array of opportunities for presenting themselves to their (potential) customers; at the same time, these applications have opened up literally thousands of channels for people to voice their opinions about an organization. In this section, we introduce various social media tools used for communication.

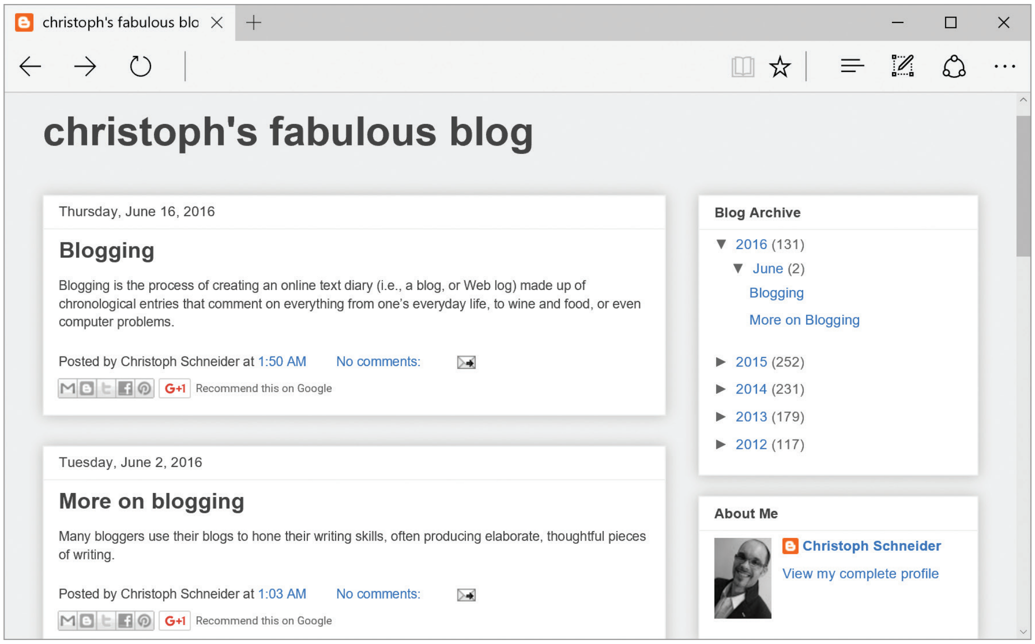


FIGURE 5.9

Blogging is the process of creating an online text diary (i.e., a blog, or web log) made up of chronological entries.

BLOGS. Blogging originally started out as a way for novices to express themselves using very simple web pages. Blogging is the process of keeping an online text diary (i.e., a **blog**, or web log) made up of chronological entries that comment on everything from one's everyday life to wine and food or even computer problems (Figure 5.9). Rather than trying to produce physical books to sell or use as gifts, bloggers (i.e., the people maintaining blogs) blog about their lives or voice their opinions (although feedback is often encouraged through associated threaded discussions). Many bloggers use their blogs to hone their writing skills, often producing elaborate, thoughtful pieces of writing. Others write blogs with the aim of attracting large audiences so as to monetize their efforts using online advertising or affiliate marketing programs.

However, blogs are not without controversy. Nicholas Carr, noted technology journalist (and active blogger himself), classifies blogging as the **"amateurization" of journalism**. Often the value of blogging is the ability to bring breaking news to the public in the fastest possible way. By doing so, some bloggers cut journalistic corners, rendering some of the posts on the blogs less than accurate, and blogs have been criticized for frequently providing the biased opinions of the writers, particularly because many of the authors' sources cannot be or have not been verified.

Nevertheless, bloggers have massively influenced the way in which people gather and consume information and have become important voices that can sway public opinion. In fact, turning to free information from blogs and other online sources, many readers have canceled newspaper subscriptions. In turn, diminishing readership in traditional newspapers has enticed advertisers to begin to withdraw from this traditional medium, leading to budget cuts and layoffs at reputable newspapers such as the *San Francisco Chronicle,* the *New York Times,* the *Washington Times,* and many others. Unfortunately—and ironically—this may erode the very sources that many bloggers base their information on.

In addition to blogs created by and/or for individual readers, blogs are being used by small, medium-sized, and large organizations for connecting with their employees or customers. For example, IBM's business-oriented social software suite IBM Connections includes blogs, helping people to voice ideas and obtain feedback from others. Similarly, companies such as Google maintain official company blogs (e.g., http://googleblog.blogspot.com) to inform their stakeholders about news, rumors, or current thoughts. In contrast to press releases or other official public relations statements, blogs provide an avenue for companies to present themselves in a more approachable way.

MICROBLOGGING. **Microblogging**, similar to blogging, enables people to voice their thoughts; however, in contrast to blogs, which often contain lengthy posts, microblogging services are designed for broadcasting relatively short "status updates," which are distributed in (near) real time. In contrast to social networks, where users can choose who can or cannot receive their status updates, typically, anyone can follow another person's microblog. A popular microblogging service is Twitter, which allows users to post short (up to 140 characters of text) "tweets" that are delivered to the author's followers or subscribers (Figure 5.10). The recipient can "retweet" (i.e., re-broadcast) interesting tweets to his or her followers. With many people broadcasting everything they find interesting and the high speed of message transmission, Twitter has become a source for breaking news. In China, where Twitter is blocked, the most popular microblogging service is Sina Weibo, which is widely used not only by individuals and companies but also by various levels of government to portray a positive image or monitor public sentiments. Many social networking sites (discussed later) also have microblogging functionality built in; for example, users can update their status on Facebook, letting their friends know about their current thoughts and allowing them to post replies.

Many organizations have used this trend and created accounts on Twitter. For example, Coca-Cola has an official Twitter account it uses to post news or interact with its (as of mid-2016) more than 3.2 million followers; Coca-Cola follows more than 66,000 Twitter accounts and actively replies to and retweets Twitter messages. This way, Coca-Cola signals that it cares about its followers, trying to increase its customers' brand loyalty. When posting a tweet, users can tag words or phrases with a "#"—called a **hashtag** (e.g., #NBAFinals, #ThursdayThoughts, or #WearOrange)—to indicate the topic and relate the tweet to other tweets about the same topic. A word phrase or topic that is tagged at a greater rate than others is said to be **trending**. A topic becomes trending because of a concerted effort by users or because of an event (e.g., a new winner of the Super Bowl or a missing aircraft) that prompts people to tweet about the topic. Microblogging, however, is not limited to text content. Apps such as Vine allow users to easily share short video clips, taken with the smartphone's camera. Likewise, Tumblr allows users to go beyond the 140-character limit and share any kind of digital content, including text, music, and videos; by combining features of blogs, microblogs, and social networking sites, Tumblr allows companies to communicate and connect with their customers. For example, in May 2014, AMC premiered a full-episode sneak preview of its new TV series *Halt and Catch Fire* on Tumblr.

INSTANT MESSAGING. In contrast to asynchronous discussion forums, blogs, and status updates, **instant messaging** (or online chat) enables real-time written conversations. Using instant messaging, multiple participants can have conversations and enjoy immediate feedback from their conversation partners. Some social networking sites such as Facebook have integrated instant messaging functionality. In addition, the increase in smartphone usage has merged instant messaging with cell phone–based text messaging; cloud-based messaging services such as WhatsApp allow for group chats, free text messages or voice calls (even internationally), and even the exchange of multimedia content, using the smartphone users' data plan or Wi-Fi connection. Other popular instant message services include Viber, Line, or WeChat (hugely popular in China). Some instant messaging apps such as Snapchat or Telegram allow users to set a time limit specifying for how long the recipient can view the message before it is automatically deleted. Many organizations have adopted web-based instant messaging for internal communications and also use live chat for sales and customer support functions. In addition to offering live chat with human customer service agents, companies increasingly use automated *chatbots* (discussed in Chapter 6) to initiate conversations and gather preliminary information from the customer in order to route him or her to the relevant human customer service representative.

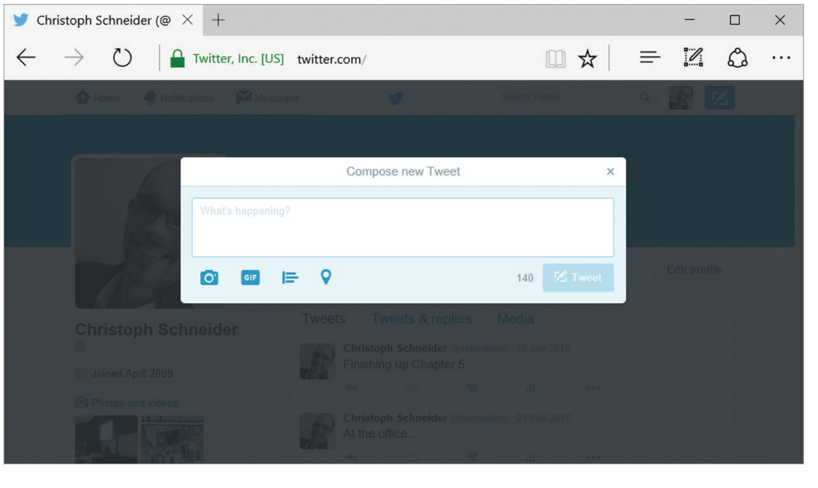


FIGURE 5.10

Twitter allows posting short "tweets" that are delivered to the author's followers or subscribers via mobile phone or Twitter applications.

Source: Screenshot of Twitter. Copyright ©, by Twitter.

Enhancing Cooperation with Social Media

In addition to communication, companies and individuals can benefit from social media applications that enable cooperation. Cooperation between individuals or organizations creates win-win situations such that one participant's success improves the chances of success of other participants. As with other social media applications, social media applications facilitating such cooperation rely on the network effect to provide the greatest benefits for users.

MEDIA SHARING. One example of cooperative social media applications making use of the network effect is the sharing of user-generated content such as pictures, videos, audio, or even presentations. Sharing media has become immensely popular on the web, using applications such as Flickr or Instagram (images), Vimeo or YouTube (videos), or SlideShare (presentations); using sites such as Pandora, users can even create their favorite music stream and share it with others who may have similar interests. Typically, the shared content is hosted on media-sharing sites; however, the content can also be embedded into other sites, creating a win-win situation for the content creator and the site embedding the content. For example, embedding an interesting and relevant YouTube video into a blog post helps to increase the attractiveness of the blog while at the same time increasing the viewership of the video, thus creating positive returns for both parties.

Similarly, webcasting is increasingly used for media sharing. Webcasting (or podcasting) is the distribution of digital media content, such as audio or video files for on-demand playback on digital media players. The increase in mobile devices such as smartphones and tablets has contributed to the tremendous growth of **webcasts** (or **podcasts**), as the consumption can be time shifted and place shifted; in other words, webcasts allow media content to be consumed at one's convenience, whenever or wherever. The term *podcasting*, derived from combining the terms *broadcasting* and *iPod*, is a misnomer, as podcasts can be played on a variety of devices in addition to Apple's iPods. As with blogging, webcasting has grown substantially, with traditional media organizations now webcasting everything from shows on National Public Radio to Fox's *Family Guy* to the *Oprah Winfrey Show*. In addition to media organizations and independent webcasters, the educational sector uses webcasts for providing students access to lectures, lab demonstrations, or sports events; this allows students to review lectures or prepare for class during their morning and evening commutes. In 2007, Apple launched iTunes U, which combines various course management tools; iTunes U is used by major U.S. universities, such as Stanford, Berkeley, and the Massachusetts Institute of Technology, with many universities offering free content ranging from lectures to faculty presentations (Figure 5.11). As webcasts can be enriched by allowing for interactive Q&A sessions or by embedding PowerPoint presentations, organizations increasingly use webcasts to provide access to shareholder meetings, online training, road shows, or other events.

To receive the most current content, users can subscribe to blogs, webcasts, videos, and news stories through Apple's iTunes, or via **RSS** (*Really Simple Syndication* or *Rich Site Summary*) feeds. Content publishers provide RSS feeds to notify users of updates to the content. Rather than users actively having to check multiple sources for updated content, RSS readers automatically check the feeds for updates and provide a synopsis of a document or the full text.

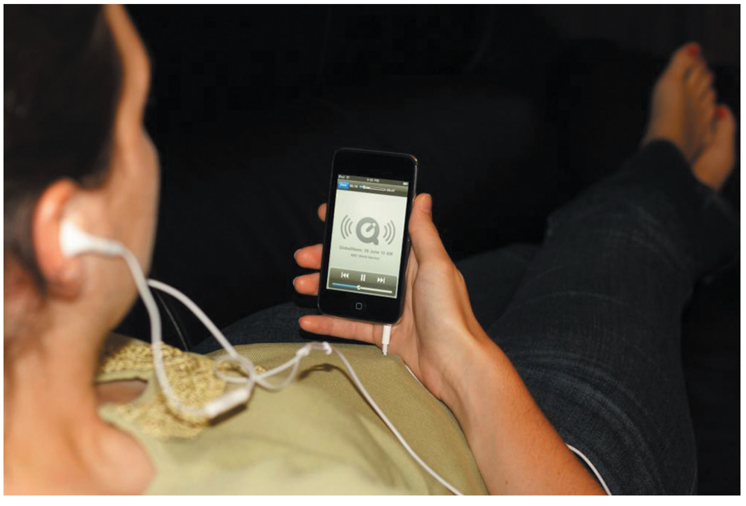


FIGURE 5.11

A student listens to a podcast on iTunes U.

Source: Courtesy of Christoph Schneider.

Recently, various apps, such as Periscope and Facebook, have enabled the possibility of sharing live video. Using Facebook Live, the White House broadcasts live videos from press conferences or president's speeches, and companies use live video to broadcast everything from hot topics to interviews or public performances. Broadcasting live videos via social media can enable various forms of direct interactions with the audience, such as by enabling the content creator to directly engage with the audience by responding to questions or comments during the broadcast. Yet, for the social media apps, monitoring content broadcast via live video is highly problematic: How can the spread of objectionable or illegal content be avoided? A case in point is the live broadcast of a double murder in Paris, France, in June 2016; the killer, a self-proclaimed follower of ISIS, used Facebook Live to broadcast himself murdering a police commander and the commander's wife. Given the rapid pace at which such content is generated, continuously monitoring and stopping (or deleting) such broadcasts is virtually impossible for service providers.

TAGGING. One problem with user-generated content is its variety; status updates, photos, videos, and other content are typically not easy to categorize or find. **Metadata**—which can be simply thought of as data about data—describe data in terms of who, where, when, why, and so on, and can be useful for categorizing content and making it easier to find. For example, metadata about a Word document include the author, the time the document was created, and when it was last saved; metadata about a digital photo include date and time, focal length, shutter speed, aperture value, and so on; metadata about a phone call include call time, duration, location of participants, phone numbers, or the phones' unique identifiers (Figure 5.12).

Whereas certain metadata about documents or media files are captured automatically (e.g., when saving a document in a word processor or when taking a picture with a digital camera), there are various other useful pieces of information that are not automatically captured, such as keywords about a document or the names of people in a picture. Thus, *manually* adding **tags**, or metadata, to digital media or other content is an important aspect of many social media applications. Tags are commonly added to pictures and videos on websites such as Flickr, a picture- and video-hosting website that allows users to upload their content. Likewise, hashtags, popularized by social media applications such as Twitter, Tumblr, and Instagram, are used to add metadata to messages posted on these services, allowing users to search for content related to a certain topic. A way to visualize user-generated tags or content on a site is through **tag clouds** (Figure 5.13). The size of a word in a tag cloud represents its importance or frequency, making it easy to spot the most important or frequent words or tags.

GEOTAGGING. Another type of metadata about media such as photos, videos, or even blogs or tweets is of geospatial nature; knowing where exactly a photo was taken and in what direction the camera was pointing, or knowing the location of a person sending out a breaking news update on Twitter can be extremely valuable. Such geospatial metadata (such as latitude, longitude, or altitude) added to digital media is referred to as **geotags**. Once the geographical coordinates of

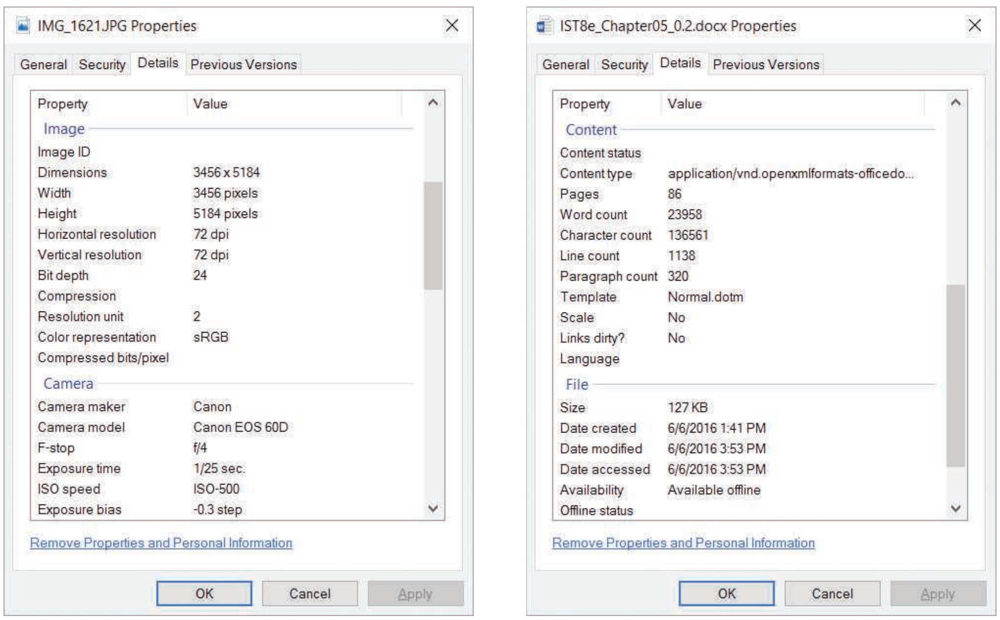


FIGURE 5.12

Metadata about a photo and a Word document.

Source: Windows 10, Microsoft Corporation.

FIGURE 5.13

A tag cloud representing words and concepts that are key to social media.
Source: Vlue/Shutterstock.

an item are known, it can easily be visualized on a map. For example, Google Maps can display various types of geotagged content, such as photos, webcams, Twitter posts, or Wikipedia articles about places or landmarks. Thus, Google can offer a map experience containing pictures of attractions, reviews, and things to do without having to take a single picture or write a single review itself. Geotags are often automatically generated, for example, when taking images with a smartphone; yet this may lead to privacy or security concerns, for example, when sharing images online. A case in point is the arrest of John McAfee, the creator of the antivirus software, who was sought by authorities in Belize in connection with a murder. McAfee went into hiding and, in 2012, met with a team of journalists in Guatemala; one of the journalists posted a picture with him online but forgot to remove the location metadata, revealing McAfee's hideout to the Guatemalan authorities, who arrested him for illegally entering the country. After a week in a Guatemalan prison, McAfee was deported to the United States.

SOCIAL BOOKMARKING. As other social media applications, social bookmarking relies on the network effect. For many web surfers, key challenges are finding information and then finding it *again* at a later time; hence, people often keep long lists of bookmarks to sites they find interesting or visit frequently. Although this is useful for individuals, users may miss a plethora of other, related, and potentially interesting websites. **Social bookmarking** helps to address this by allowing users to share interesting content and to create categorization systems (referred to as **folksonomies**). As more people participate in social bookmarking, the value for each user grows as the bookmarks become more complete and more relevant to each user. Widely used public social bookmarking tools include reddit and StumbleUpon. Likewise, Pinterest allows users to "pin" content they find interesting, and media websites such as CNN.com provide sharing links so as to increase the reach of their content. For organizations, social bookmarking can be extremely valuable for knowledge management and harnessing the collective intelligence of employees. Using enterprise-oriented social bookmarking tools, it is easy to map "islands" of knowledge within an organization, thus helping to easily find experts on a given topic.

SOCIAL CATALOGING. Similar to social bookmarking, **social cataloging** is the creation of a categorization system by users. Contributors build up catalogs regarding specific topics such as academic citations, wireless networks, books and music, and so on. For example, users can create virtual bookshelves with the social cataloging application goodreads, organize their collections, write reviews, and then share this bookshelf with others on the web. Similarly, students and researchers can use free tools such as Mendeley or Zotero (Figure 5.14) to manage their citations, thus facilitating the creation of reference lists for research papers. Organizations are typically dealing with tremendous amounts of information, ranging from supplier information to frequent customer complaints, and can use social cataloging for structuring this information and making it more accessible and useful.

SECURITY MATTERS

Terrorism Is Winning the Social Media Battle

Terrorism is the use of violence or threat of violence in order to purport a political, religious, or ideological change. Terrorists aim to provoke irrational fear among large numbers of people in order to influence policymakers and thus advance their goals. To be successful, terrorists need to gain publicity about their cause. Historically, terrorists have learned to use media to their advantage and rely on media to spread their message and further their goals. For example, in the 1960s and 1970s, there was a rash of commercial airliners hijacked. Often, these hijackings would be broadcast live on TV, and many believed that this exposure actually increased the number of hijackings. At that time, there was very little security or passenger screening at airports. To stop the hijackings, the government mandated screening of passengers and luggage.

Over the past many decades, terrorists have continued to refine their ability to leverage the available media to reach as many people as possible. In order to garner publicity toward their cause, terrorist organizations resort to acts of violence and aggression that deliberately target civilians. While terrorism has not been effective at taking down governments and capturing political power, it has been very successful at gaining increasing attention and spreading fear. Today, due to the convenience, affordability, and broad reach of social media platforms such as YouTube, Facebook, and Twitter, terrorist groups are increasingly using social media to further their goals and spread their message. New technologies have not only made it astonishingly easy to produce high-quality propaganda images and videos, they have also made it far easier to disseminate this propaganda. Cheap portable cameras and easy-to-use editing software allow for the rapid production of content. Digital distribution on social media sites allows content to be distributed globally or broadcast in real time at little cost or effort. With smartphones connected to the Internet, content can be viewed by millions around the world.

Terrorist organizations like the Islamic State, often referred to as ISIS, have created a variety of relatively well-edited videos to serve a dual purpose, inspiring one group of people to join their cause while disgusting and frightening the others. Numerous videos of executions have been released, including those of Western aid workers, journalists, alleged spies, suspected homosexuals, and anyone else the terrorists believe to be their enemy. Various types of dramatic murders have been displayed, including decapitations, shootings, and even burning victims alive.

While attempts have been made by various governments and agencies to thwart the use of social media by terrorist organizations, these attempts have (mostly) not been successful. As the future continues to unfold, we can be sure that violent extremists will continue to evolve their use of the latest media and platforms in an attempt to further their cause.

Based on:

Burke, J. (2016, February 25). How the changing media is changing terrorism. *The Guardian*. Retrieved June 28, 2016, from https://www.theguardian.com/world/2016/feb/25/how-changing-media-changing-terrorism

Gates, S. (2015). Social media, recruitment, allegiance and the Islamic State. *Perspectives on Terrorism*. Retrieved June 28, 2016, from http://www.terrorismanalysts.com/pt/index.php/pot/article/view/446/html

Koerner, B. I. (2016, April). Why ICIS is winning the social media war. *Wired*. Retrieved June 28, 2016, from https://www.wired.com/2016/03/isis-winning-social-media-war-heres-beat.

Terrorism and social media. (2016, June 17). In *Wikipedia, The Free Encyclopedia*. Retrieved June 28, 2016, from https://en.wikipedia.org/w/index.php?title=Terrorism_and_social_media&oldid=725707095

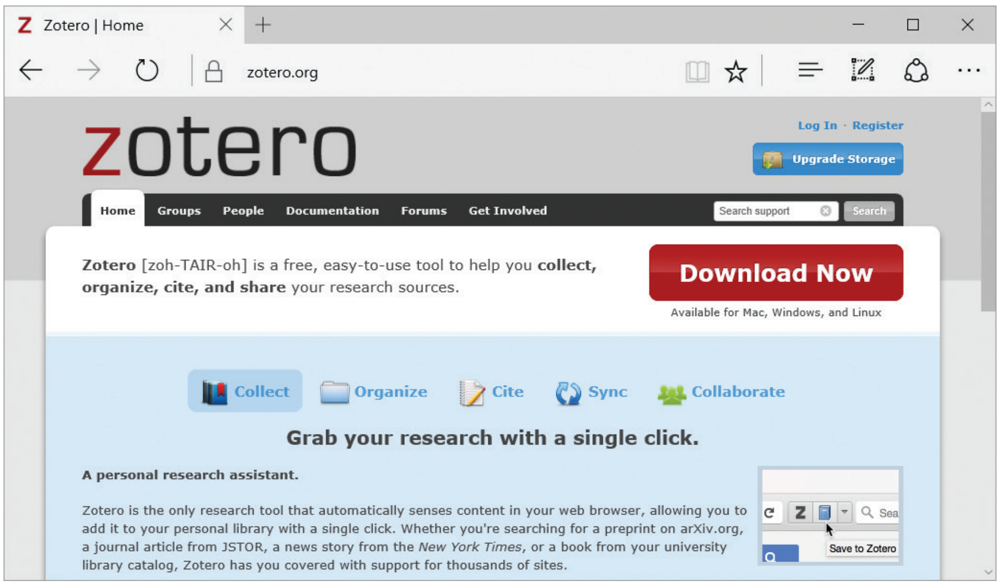


FIGURE 5.14

Zotero helps in organizing citations and research resources.

Source: Courtesy of Center for History and New Media, George Mason University. Copyright ©, by Zotero.

Enhancing Collaboration with Social Media

Traditional office technologies, such as telephones or e-mail, are very useful to organizations; yet such technologies are not well suited to support rich, rapid, multi-person team collaboration. For example, the telephone is best suited for person-to-person communication; e-mail is a useful technology for teams, but it does not provide the structure needed for effective multi-person, interactive problem solving. Modern organizations need technologies that enable team members to interact through a set of media either at the same place and time or at different times and in different locations, with structure to aid in interactive problem solving and access to real-time information. The Internet, cloud computing, and the increase in the use of mobile devices have enabled various social media applications that provide many capabilities that have forever transformed the way individuals and teams can work together. These are described next.

CLOUD-BASED COLLABORATION TOOLS. One key trend that has greatly facilitated collaboration is the rise of cloud computing. Traditionally, sharing and collaborating on documents were cumbersome; users typically had to e-mail documents back and forth or had to worry about having the latest version of the software installed. **Cloud-based collaboration tools** have greatly facilitated collaboration; for example, cloud-based collaboration tools allow for easy access and easy transfer of documents or other files from one person to another; using services such as Dropbox, documents are not only stored on a user's computer but also synced to other computers or devices via a copy of the document stored in the cloud. This way, a user can access a file from multiple devices, always having the latest version at his or her fingertips, or collaborators can work on documents without needing to e-mail documents. Similarly, tools such as Evernote, Wunderlist, or Microsoft OneNote allow for synchronizing and sharing of notes, task lists, and the like. Cloud-based productivity suites take this concept a step further by not only storing the files in the cloud but also enabling the access of office productivity tools from any computer (or even mobile device) with a web browser and Internet connectivity. While this frees the user from having to locally install productivity software, using cloud-based collaboration tools requires a live Internet connection to work on shared documents, and thus users may not be able to work when traveling or when having Internet connectivity problems. Table 5.3 outlines various benefits and risks of cloud-based collaboration tools.

Organizations and individuals can choose from different options for using cloud-based collaboration tools. On one end of the spectrum, companies offer single-purpose tools for everything from creating presentations to managing projects. On the other end of the spectrum, cloud-based collaboration tools such as Google Apps or Microsoft Office 365 integrate everything from document sharing to videoconferencing, thereby mirroring (or even surpassing) the capabilities of traditional offline office suites (Table 5.4).

TABLE 5.3 Benefits and Risks of Cloud-Based Collaboration Tools

Domain	Benefit	Risk
Information technology	Reduced costs and risks when using preexisting, easily deployed, and low-cost web-based tools (versus in-house developed tools).	Loss of control regarding data and service quality (data and tools will likely reside on the provider's server).
Organization	Tools are easy to use, facilitating widespread adoption throughout an organization.	Little or no documentation, training, or support for system complexities or problems.
Competition	More efficient and effective than e-mail, FTP, or legacy collaboration tools, potentially speeding up product development cycles and enabling quick responses to competitors' actions.	Security and compliance policies are often difficult to enforce, which may increase the possibility of exposing sensitive corporate data; increased threat of industrial espionage.
Upgrade cycles	No need to purchase software upgrades.	Tools and features in the collaboration environment can change without notice, potentially causing problems with users and corporate IT strategy.

TABLE 5.4 Web-Based Collaboration Tools

Type	Names
Spreadsheets	Google Drive, Zoho Sheet, Microsoft Excel Online
Word processors	ThinkFree, Zoho Writer, Google Drive, Microsoft Word Online
Presentation	Google Drive, Zoho Show, Microsoft PowerPoint Online, Prezi
Office suites	Zoho, Google Apps, Microsoft Office Online
Project management	Trac, Redmine, eGroupWare, Collabtive
Notes/task management	Evernote, Wunderlist, Microsoft OneNote Online
Cloud storage/sharing	Dropbox, Google Drive, Microsoft OneDrive, SugarSync, iCloud

CONTENT MANAGEMENT SYSTEMS. A **content management system (CMS)** allows users to publish, edit, version track, and retrieve digital content, such as documents, images, audio files, videos, or anything else that can be digitized. For example, organizations use open source content management systems such as WordPress, Joomla, or Drupal to create blogs or websites (see also upcoming discussion of open source software); Carnival Cruise Lines uses WordPress for publishing company news; the French automaker Peugeot uses Joomla for its company website; and the University of Minnesota uses Drupal. Whereas traditionally, webmasters would have the task of adding, modifying, or deleting content on a company's website, content management systems provide easy-to-use interfaces that allow the *creators* of content to make necessary changes; thus, a member of the marketing team may edit a product's description without having to ask the IS department to make the changes. Typically, such content management systems facilitate the creation and management of web content by allowing the assignment of different roles to different users; these roles are associated with different permissions, such that some users can create and edit content, others can edit but not create, and yet others can only view content contained in the system. Many open source content management systems can even be used for building e-commerce sites by incorporating functionality such as inventory management or shopping cart functionality. Yet content management systems, also known by several other names, including digital asset management systems, document management systems, and enterprise content systems, can be used for collaboration beyond the creation and management of websites. For example, Microsoft SharePoint is a document management platform that can be used to host intranet sites, extranet sites, or public websites that enable shared workspaces and integrate other collaborative applications such as document sharing, *wikis* (see upcoming discussion), and blogs. SharePoint also includes workflow functionality such as to-do lists, discussion boards, and messaging alerts (Figure 5.15). Because SharePoint has been designed to be easily customizable, it has been installed in a variety of businesses, which can personalize the collaborative SharePoint websites to meet their needs.

Learning Management Systems Similar to content management systems used for communication and collaboration, learning management systems such as Blackboard, Sakai, and Moodle have facilitated business processes in educational settings. Typically, learning management systems enable uploading and viewing content, administering exams, and self-service functions such as registering for courses or viewing grades. Increasingly, learning management systems offer additional tools for enabling team collaboration, class discussions, and the like.

COLLECTIVE INTELLIGENCE. One major benefit of social software is the ability to harness the "wisdom of crowds," or collective intelligence (Surowiecki, 2004). The concept of **collective intelligence** is based on the notion that distributed groups of people with a divergent range of information and expertise can outperform the capabilities of individual experts. For organizations, making effective use of the collective intelligence of their employees, customers, and other stakeholders can prove extremely valuable. Based on the concept of collective intelligence, **peer production** is the creation of goods or services by self-organizing communities. In peer production, the creation of the goods or services is dependent on the incremental contributions of the participants such that anyone can help in producing or improving the final outcome. Prime examples of peer production are open source projects and wikis.

WHO'S GOING MOBILE

Going SoLoMo: Yelp

If you're looking for a good restaurant, tailor, or pest control service in town, it is difficult to know which of the many options will provide the best service. Luckily, there's Yelp. You've probably heard of Yelp, the review and rating platform where you can find valuable information on local businesses provided by previous customers. The company began in 2004 as a way for friends to exchange local service recommendations via e-mail. The service quickly evolved to include social networking services and has expanded its operations to many countries around the world. Yelp has also been a pioneer in developing mobile, location-based services. Boasting 135 million monthly visitors and 95 million reviews (as of 2016), Yelp tends to come up as an example whenever people talk about the intersection of social, local, and mobile services (sometimes called **SoLoMo** for short).

Yelp has embraced the rising trends in mobile device usage. Shortly after the iOS app store launched the mobile app craze in 2008, Yelp released its first app for the iPhone. Apps for other platforms followed. With Apple's release of iOS 6 in September 2012, Yelp's rating and review content was integrated into the mapping and directions app of the iOS operating system. By November 2013, Yelp reported that 45 percent of its traffic came from mobile devices. Part of the reason for Yelp's mobile success is the fact that a smartphone with a Yelp app installed is "location-aware," meaning that users can use the phone's global positioning system (GPS) capabilities to find Yelp reviews of locations in the area. This is very useful if you are in an unfamiliar area and would like to go eat somewhere with positive reviews. You can simply search for restaurants and choose from among the highest-rated restaurants within walking distance.

Yelp has leveraged its dominating mobile presence to its advantage. The company began allowing local businesses to advertise to local users, and the advertising technique has proven quite powerful. If you open the Yelp app and are searching for restaurants, Yelp can be pretty confident that you're hungry and about to make a purchase. A cleverly placed ad offering a discount from a local pizza place may be just the thing that convinces you to buy a pizza instead of the Big Mac offered next door. Yelp is still seeing strong growth, with revenues of US$550 million in 2015, representing a year-on-year growth of 46 percent between 2014 and 2015. With about 35 percent of Yelp's overall revenue coming from local advertising, Yelp has some critics, who feel that Yelp is manipulating reviews and blocking overly negative reviews in order to increase ad spending by businesses. Still, while smartphone users increasingly use their devices to find information about local business, Yelp is well positioned to continue its SoLoMo leadership.

Based on:

Anonymous. (2016, February 8). Yelp announces fourth quarter and full year 2015 financial results. *PR Newswire*. Retrieved June 28, 2016, from http://www.prnewswire.com/news-releases/yelp-announces-fourth-quarter-and-full-year-2015-financial-results-300216659.html

Holloway, D. (2015, November 19). Americans to spend $40 billion at local businesses this holiday season. *YelpBlog*. Retrieved June 28, 2016, from https://www.yelpblog.com/2015/11/americans-to-spend-40-billion-at-local-businesses-this-holiday-season

Yelp. (2016, June 25). In *Wikipedia, The Free Encyclopedia*. Retrieved June 28, 2016, from https://en.wikipedia.org/w/index.php?title=Yelp&oldid=726935600

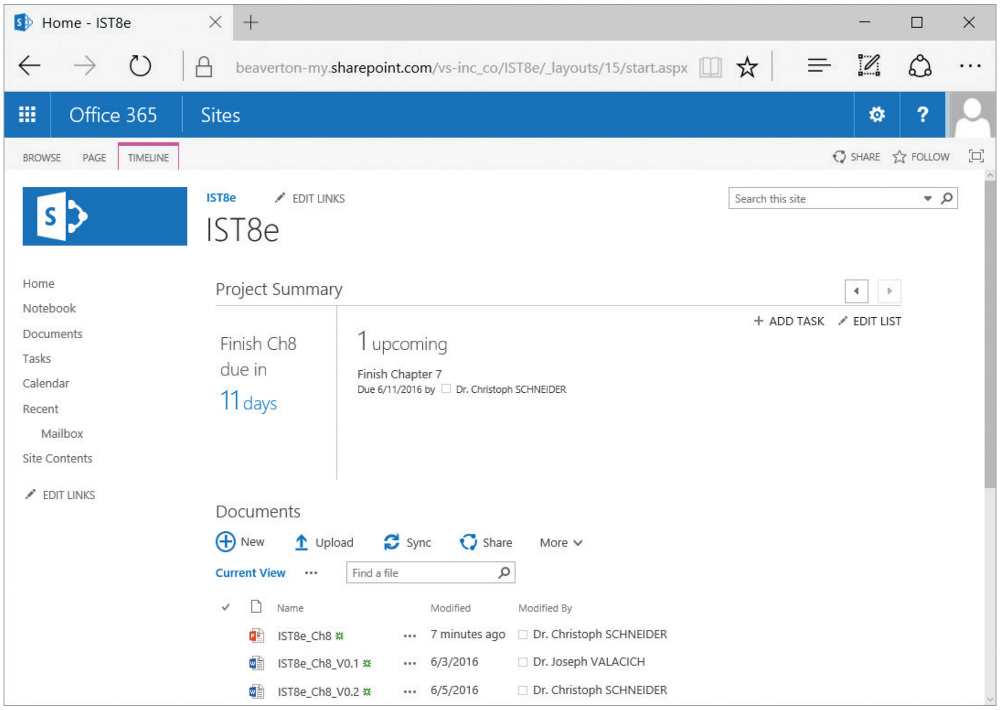


FIGURE 5.15

The Microsoft SharePoint content management system can assist in project collaboration.

Source: SharePoint 2016, Windows 10, Microsoft Corporation.

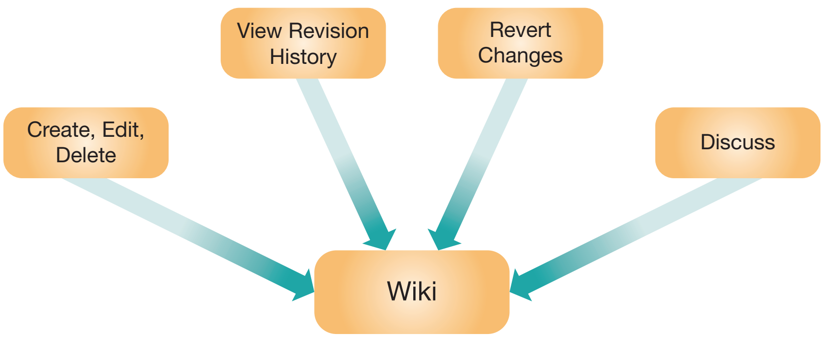
Open Source Software Traditionally, software—ranging from Adobe Acrobat to large ERP systems—has been developed by software companies. In contrast, open source software, such as the Firefox web browser, the Linux operating system, or the Apache OpenOffice productivity suite, is created, maintained, and updated by thousands of volunteers located all over the world (see Chapter 9, "Developing and Acquiring Information Systems"). Often, someone with an idea for a useful program develops an initial version; other developers looking for interesting projects to work on may then join the original creator and contribute to the continuing development of the software. Organizations now have access to various high-quality open source software, ranging from operating systems to databases, web servers, and e-commerce solutions; using open source software offers benefits such as security, flexibility, and auditability (of the program's source code). For individuals, participating in open source software projects can help to improve their skill set or boost their CVs. For organizations, participating in open source projects can be a way to influence the direction the software's development may take and to build goodwill by giving back to the community.

Wikis Also based on the concept of collective intelligence, wikis are used for a variety of collaboration tasks. A **wiki** is a website allowing people to create, edit, or delete content as well as discuss about content or suggested changes with other members of the community. In contrast to a regular website, a wiki is linked to a database keeping a history of all prior versions and changes; thus, a wiki allows viewing prior versions of the pages as well as reverting any changes made to the content. The idea behind wikis is that by allowing anyone to contribute content or edit others' contributions, the collaborative work performed by the community helps to minimize vandalism and ensure high-quality content (Figure 5.16). For example, Wikipedia articles are created by Wikipedia users, and almost any of these articles can be edited by either anonymous or registered users. By allowing easy access, Wikipedia has grown exponentially within just a few years. However, Wikipedia is not without critics. Some argue that by allowing anyone to create and edit articles, systematic biases in the content can occur. This includes the ability for users to add misinformation that is hard to verify. For example, recent news show that politicians, companies, and other entities of interest frequently edit their Wikipedia pages to portray a more positive image. Sometimes, so-called "wiki wars" arise, where contributors continuously edit or delete each others' posts. Also, Wikipedia has been found to have a significant cultural bias on some topics, as most contributors are males from either North America or Europe, and the information is not always backed by verifiable sources. Given these issues, many universities discourage students from citing Wikipedia, and in some instances professors have been failing students for using Wikipedia as their primary (or only) source. Still, the contributors' collective intelligence ensures that the quality of many articles matches (or surpasses) that of traditional encyclopedias, and a Wikipedia article may be a good starting point for researching about a topic; as always, it is good practice to evaluate the sources used within an article, and to consult other sources as well. Wikipedia openly acknowledges this situation and encourages users to check the facts against multiple sources.

Wikis have been used for many more things than just an online encyclopedia. The ability for users to contribute and edit content has a wide variety of applications, such as designing software, helping people find media, and even helping people play video games. In fact, many organizations are using wiki technology to create internal knowledge repositories.

FIGURE 5.16

The ability to create, edit, or delete content, view prior versions, revert any changes, and discuss about content and suggested changes are key to the creation of high-quality content by a community.



HUMAN-BASED COMPUTING (CROWDSOURCING). Another way companies are using the collective intelligence of individuals is through crowdsourcing. When companies look for cheap labor, many immediately think about outsourcing work to *companies* in different countries, such as India, China, or Russia (see Chapter 1). However, companies have now found a way to use *everyday people* as a cheap labor force, a phenomenon called **crowdsourcing**.

Amazon.com took crowdsourcing mainstream with its micro-task marketplace called Mechanical Turk. Using this marketplace, requesters can crowdsource so-called human intelligence tasks (HITs), which are small, self-contained tasks that humans can solve easily but would be difficult for a computer to solve. Examples of HITs include tagging images, generating potential search key words for a product, fixing product titles on e-commerce sites, and so on (Figure 5.17; see also Chapter 4 for more on consumer-to-business business models). Users can find HITs that are of interest to them, solve the tasks, and earn money that is credited to their Amazon.com account. As you can see, for companies, crowdsourcing is an innovative way to reduce costs by using the expertise of the crowds. Similar to grid computing (see Chapter 3), a person's "idle time" is used for a certain business task, and many people are willing to provide their resources in exchange for a relatively small amount of money. In order to harness the power of the crowds, some companies have even created their own, internal, micro-task marketplaces; for example, Microsoft's "Universal Human Relevance System" is used by Microsoft to crowdsource tasks related to improving Bing search results, conduct research, and so on. A related concept is that of open innovation. As discussed in Chapter 2, companies are increasingly attempting to create ad hoc research-and-development networks by integrating external stakeholders into their innovation processes so as to harness the power of the crowds.

Enhancing Connection with Social Media

Social media applications also aid in connecting people with each other, companies with their customers or stakeholders, or people with content. Without a doubt, social networking has become the most popular type of application in this category; we explore social networking and other, lesser-known applications in the following sections.

SOCIAL NETWORKING. In addition to direct collaboration, **social networking** has become one of the most popular uses of the Internet over the past few years. Social networking sites create **social online communities** where individuals with a broad and diverse set of interests meet, communicate, and collaborate. Facebook exemplifies this trend, being the third most popular site on the web (and being surpassed only by YouTube and Google), according to Alexa.com. Facebook took the spot as the most frequented social network from Myspace.com, which originally was designed to be a social network based on musical interests but then changed to a general interest social network used primarily by teens and young adults; over time, the importance of Myspace has declined tremendously, and in May 2014, Myspace was barely ranked in the top 1,000 sites on the web. Because of the network effect, as Facebook grew, it became ever more attractive for other people to join. In March 2016, Facebook announced that it had 1.65 billion monthly active users, and it is still growing. Other social networks are built on the tremendous increase in mobile devices. For example, the location-based social network Swarm is built around the idea of people using their mobile devices to "check in" at places.

FIGURE 5.17

Anyone can earn money on micro-task marketplaces by solving small, well-defined tasks.

Social networks were initially primarily popular among preteens, teens, and young adults, but social networking demographics have slowly shifted, with 79 percent of American Internet users between 30 and 49 years and 64 percent of Internet users between 50 and 64 years using Facebook. In addition to general interest social networks, several social online communities are targeted at professional audiences, allowing users to meet business contacts, post career profiles, present themselves in a professional context, ask for expert advice, or be contacted regarding job opportunities. For example, LinkedIn has more than 414 million members, and Xing (popular in the German-speaking market) has almost 11 million members. Further, enterprise-oriented social software such as IBM Connections features social networking tools that allow people within organizations to connect to one another; similarly, Yammer, part of Microsoft, is designed as a private social network for communication and collaboration within organizations (Figure 5.18). Designed to mirror consumer-oriented social media apps people are used to, applications such as Yammer are but one example of increasing consumerization of IT, where technologies and applications are first designed for the consumer marketplace and then make inroads into organizational settings. Other players in the enterprise social networking market include Slack and Facebook's business-oriented social network named Facebook at Work.

Organizations also increasingly use social networks to connect with their customers. Numerous companies have their own Facebook pages to interact with their customers, get feedback on new products or services, or in general portray a positive brand image.

However, social networks are not without critics. In particular, one area of criticism is the way users' newsfeeds are assembled on social networks such as Facebook, where sophisticated algorithms analyze your (and others') behavior and try to predict which of your friends' posts may be of interest to you; for example, the algorithms analyze which posts you like, which friends you interact with most (e.g., as indicated by your activity in response to your friends' posts), how many comments or likes a post receives, and so on. Facebook's use of advanced analytics thus determines what type of items each user gets to see (or not). While this means that you might be more likely to see items you are actually interested in, this also results in people only being exposed to opinions of like-minded people, and some have accused Facebook of creating a "filter bubble" (see Case 1 at the end of the chapter). Further, many companies are trying to use social media to attract web traffic; often, these companies post incomplete or tantalizing headlines for stories in order to encourage users to click on them. Such types of headlines are often referred to as **clickbait**; as a user clicks on the link, the company earns revenue through ads posted on the page containing the article (which often turns out to be less than informative or useful; see also Case 2 at the end of the chapter).

Social Search As the web has grown explosively since its early days (in the first 6 years, the growth rate was 850 percent, and after only 15 years, the number of websites was larger than 100 million; Nielsen, 2006), finding relevant information has become increasingly difficult. Early search engines such as Altavista were based on key words embedded within pages and often

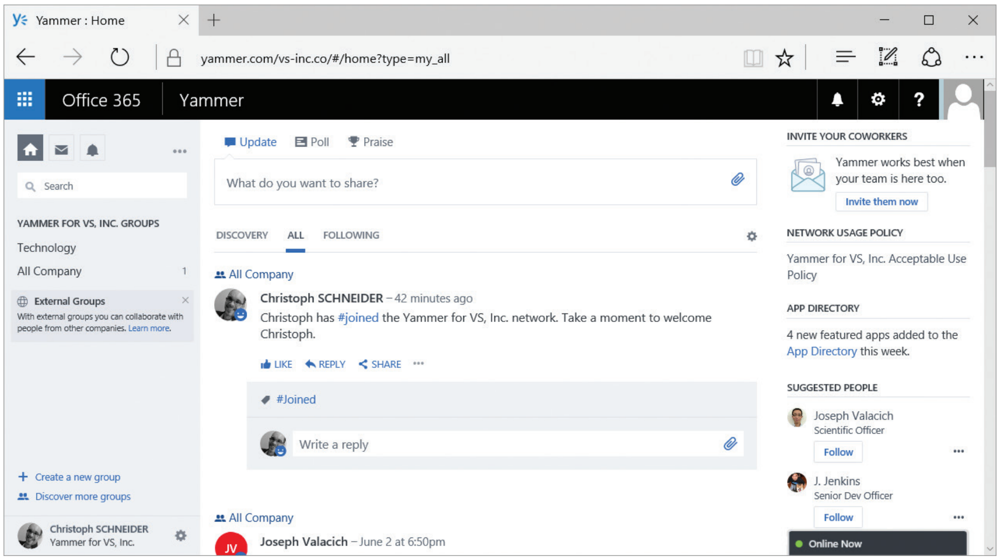


FIGURE 5.18

Organizations use enterprise social networks for communication and collaboration within the organization.

Source: Yammer 2016, Windows 10, Microsoft Corporation.

ETHICAL DILEMMA

Anonymity, Trolling, and Cyberharassment

Using pseudonyms, fictitious accounts, or proxy servers to hide one's online tracks, it is easy to operate anonymously on the Internet; unfortunately, all too frequently, the anonymity offered by the Internet brings out the worst in people. When people are anonymous, they are more likely to enter into a state of deindividuation, a loss of self-awareness often causing antisocial behavior. Deindividuation has been used to explain a lot of humanity's darkest behaviors, including violent crowds, lynch mobs, and even genocide.

While many people just want to lead civilized discussions in online forums, you are likely to have witnessed various vicious posts, nasty discussions, or outright fights in such forums. Many are waged by anonymous combatants who exhibit intolerance and anger toward others they view as being evil or wrong. These angry individuals are often referred to as trolls. More formally, an **Internet troll** is a person who creates discord on the Internet by starting arguments or upsetting people by posting inflammatory content on social media sites with the deliberate intent of provoking readers into an emotional response, often for the troll's own amusement. Most of these trolls operate anonymously.

Much of the behavior of trolls can be classified as cyberharassment, which refers to the use of the Internet to stalk or harass an individual, group, or organization. Cyberharassment can take many forms, from false accusations, defamation, slander, and libel to threats, vandalism, identity theft, and doxing (researching and broadcasting personally identifiable information about an individual). Many feel that the Internet has provided a platform for trolls to join together to become cyber lynch mobs.

An example of such cyberharassment occurred during Gamergate, which began as an online backlash against perceived breaches of journalistic integrity on video game news sites. Beginning in August 2014, Gamergate targeted several women in the video game industry. After a former boyfriend of one of the women wrote a lengthy disparaging blog post about her, others falsely accused her of entering a relationship with a journalist in exchange for positive game reviews and ultimately threatened her with assault, rape, and murder. Most Gamergate supporters were anonymous, making it difficult to identify or prosecute the harassers. Gamergate has led to calls for better methods of tackling and prosecuting online harassment. However, the design of the Internet makes it difficult to dramatically change a person's ability to be anonymous if they want to be.

Questions

1. Reflecting on your past online behavior, do you think that the anonymity of the Internet played a role in you engaging in antisocial behavior?
2. Given the difficulty in prosecuting online trolls and those who engage in cyberharassment, what can society do to reduce these antisocial behaviors?

Based on:

Cyberstalking. (2016, May 28). In *Wikipedia, The Free Encyclopedia*. Retrieved July 1, 2016, from https://en.wikipedia.org/w/index.php?title=Cyberstalking&oldid=722514151

Deindividuation. (2015, November 4). In *Wikipedia, The Free Encyclopedia*. Retrieved July 1, 2016, from https://en.wikipedia.org/w/index.php?title=Deindividuation&oldid=688980515

Dewey, C. (2014, October 14). The only guide to Gamergate you will ever need to read. *The Washington Post*. Retrieved June 30, 2016, from https://www.washingtonpost.com/news/the-intersect/wp/2014/10/14/the-only-guide-to-gamergate-you-will-ever-need-to-read

Doxing. (2016, June 21). In *Wikipedia, The Free Encyclopedia*. Retrieved July 1, 2016, from https://en.wikipedia.org/w/index.php?title=Doxing&oldid=726385601

Gamergate controversy. (2016, June 15). In *Wikipedia, The Free Encyclopedia*. Retrieved July 1, 2016, from https://en.wikipedia.org/w/index.php?title=Gamergate_controversy&oldid=725428951

Internet troll. (2016, June 24). In *Wikipedia, The Free Encyclopedia*. Retrieved July 1, 2016, from https://en.wikipedia.org/w/index.php?title=Internet_troll&oldid=726762067

Martin, A. (2013, May 30). Online disinhibition and the psychology of trolling. *Wired*. Retrieved July 1, 2016, from http://www.wired.co.uk/article/online-aggression

tried to assemble "directories" of the web. In 1996, Sergey Brin and Larry Page, the founders of Google, came up with a new algorithm for Internet search. Called BackRub, the algorithm used the number of *other* pages linking to a web page as a measure of interest, so as to return more relevant results to users. Yet returning the most relevant results to each individual user's query remains the holy grail for search engines. Given that people tend to trust recommendations from their networks of friends, search engines and social networks are trying to capitalize on the fact that content posted by friends is typically more relevant than content posted by complete strangers. **Social search** attempts to increase the relevance of search results by including content from social networks, blogs, or microblogging services. For example, some approaches let users annotate or tag search results, making it easier for others to find relevant information; this is especially valuable for enterprise search applications, where other users within an organization can tag internal documents, making it easier to find information as well as to find people within the organization who have certain skills or knowledge.

VIRAL MARKETING. In the offline world, marketing one's products or services is one of the most important aspects of successfully running a business. In an online context, marketing websites, products, and services is equally important, and business organizations use techniques such as search marketing, paid inclusion, and banner advertisements to promote their websites (see Chapter 4). Building on the foundations of social networking, advertisers are now using **viral marketing** to promote their websites, products, or services. Viral marketing is using the network effect to increase brand awareness. The term *viral marketing* was coined by Harvard business professor Jeffrey Rayport to describe how good marketing techniques can be driven by word-of-mouth or person-to-person communication, similar to how real viruses are transmitted through offline social networks. Rather than creating traditional banner ads or sending out millions of emails, businesses create advertisements in a way that entices the viewers to share the messages with their friends through e-mail or social networks so that the messages will spread like a virus. Viral marketing can take many forms, such as video clips, e-books, flash games, and even text messages.

The power of viral marketing can be a great tool, and there are several techniques that are critical to creating a successful viral marketing campaign. Writer and interaction designer Thomas Baekdal (2006) has outlined some critical factors in viral marketing, including the following:

- Do something unexpected
- Make people feel something
- Make sequels
- Allow sharing and easy distribution
- Never restrict access to the viral content

Following these principles entices users to view content, share it with their friends, and revisit the site to look for new content. For example, Turkish Airlines's "Kobe vs. Messi Selfie Shootout" video quickly went viral. Likewise, Volvo Trucks's "Epic Split" video featuring Jean-Claude van Damme became one of the most successful viral videos (and triggered a large number of user-generated parodies).

One of the earliest viral marketing campaigns was used during the launch of the free Hotmail e-mail service. One of the techniques used was adding a footer to every outbound message. This footer gave a short message about Hotmail.com's free e-mail service, and the message about the service was spread with every e-mail sent through the service. This campaign proved very effective (Hotmail spent only US$500,000 to get 12 million subscribers), and Microsoft later bought Hotmail.

With people increasingly posting pictures or videos of things they like or enjoy, such posts can go viral as well. Thus, another viral marketing strategy is to do good or innovative things that people take pictures of and share and to rely on people's social networks to spread the message.

Managing Social Media Applications in the Enterprise

As you have seen, mobile social, the cloud, and Big Data have enabled various tools that organizations can use for communicating with external stakeholders as well as for enhancing collaboration and connection of employees within the enterprise. In the following sections, we discuss factors organizations should take into account when considering the use of social media applications within the organization. Then we highlight potential pitfalls brought about by these tools when used by people within and outside an organization.

Organizational Issues

In previous discussions, you have learned that in many cases, technology can be an important enabler of strategic advantage if implemented and managed carefully. Similarly, with internal enterprise-oriented social media applications, the technology is a critical success factor, but it is not the only component, and change management can be critical for success or failure of such initiatives. Just providing the tools in the hope that employees will use them for the intended purpose is not enough; rather, management has to ensure that employees are aware of the tools, their purpose, and rules or policies surrounding the use of these tools. Given that social media applications are based on close social interaction, information sharing, and network effects, corporate culture is key to successful implementations of social media applications in the organization. Specifically, a corporate culture of knowledge sharing, trust, and honest feedback is conducive to such implementations. In addition to culture, various other caveats have to be taken into consideration (Khan, 2008) (Figure 5.19).

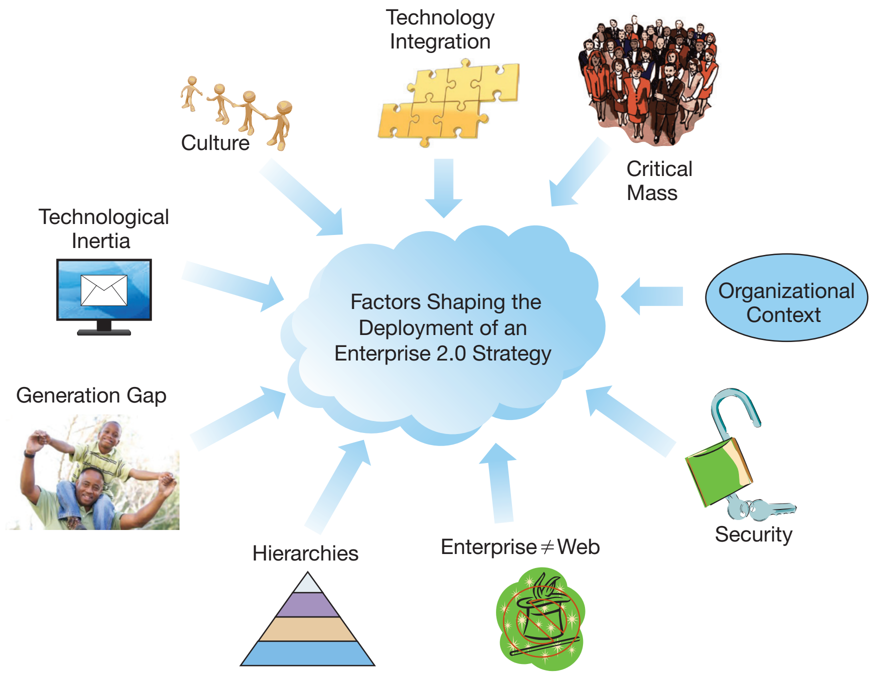


FIGURE 5.19

Various factors have to be taken into account when using social media applications within an organization.

Source: Andy Dean Photography/Shutterstock.

ENTERPRISE≠WEB. While reading this chapter, you have learned about many web-based technologies you are familiar with from your daily life. Although many of those technologies are hugely successful in a consumer environment, this success does not always translate to success in a corporate environment. On the web, sites such as YouTube, Wikipedia, and Facebook have evolved over the years to become as successful as they are today, and examples such as Myspace show that success at one point in time is not guaranteed to continue. Further, what appears as seamless "magic" collaboration is sometimes based on intricate processes. For example, good articles in Wikipedia are based not only on the contributions of many editors but also on many behind-the-scenes discussions over controversial issues or over how to improve an article. In contrast, many open source software projects closely guard changes to the software's programming code such that only a limited number of "committers" can actually implement suggested changes.

CULTURE. As highlighted earlier, organizational culture is a critical success factor for implementing social media applications in organizations, and many proposed projects face strong cultural resistance. Social media applications, based on the premise of open communication, do not always do well within traditional top-down organizational structures based on rigid hierarchies and control. Further, social media applications base their success on user-driven self-expression (if no one were willing to update his or her status on Facebook, people would eventually stop visiting the site); on the web, people participate by choice, but people in organizations cannot be forced to participate. Hence, organizations have to understand the multiple stakeholders, personalities, and perspectives of future users and ensure that any enterprise-oriented social media initiative will appeal to the organization's members.

ORGANIZATIONAL CONTEXT. Any implementation of social media applications should be driven by a specific usage context. Just as users choose popular social media applications such as YouTube or Wikipedia to fulfill a particular need, the work-related context should drive the choice of tools. In other words, organizations should always ask what objective is to be accomplished with the tool and only then decide which type of tool to implement. Merely setting up a wiki site and hoping that the employees will use it for the "right" purpose most likely will not lead to the intended results.

ORGANIZATIONAL HIERARCHIES. Often, enterprise-oriented social media initiatives are driven by user departments, and small-scale pilot implementations appear to work quite well. However, organization-wide implementations typically need changes in terms of organizational culture and processes and often the flattening of organizational hierarchies. Therefore, to be successful, enterprise-oriented social media implementations need the support and active involvement of senior management so as to cope with the large magnitude of changes.

WHEN THINGS GO WRONG

Crowdfunding Failures

Crowdfunding refers to the practice of funding a project or venture by raising small amounts of money from a large number of investors, typically via the Internet. Crowdfunding is a new and innovative way to get financing to support projects that might not otherwise be fundable using traditional methods. Another advantage of crowdfunding is that it connects investors with similar interests that might otherwise not have been able to have come together. Unfortunately, as with many other technological advances, crowdfunding can also be abused by unscrupulous individuals looking to take advantage of unsophisticated investors. There are several ways that crowd funded projects can fall short of expectations.

Some projects simply overpromise and under-deliver. The campaigners may simply not have the experience needed to execute the project or may have underestimated the resources and effort required. The Zano drone project, for example, collected more than US$3.4 million on the popular crowdfunding site Kickstarter and pledged to build a miniature quadcopter drone. After months of delays, the drones were finally delivered. Unfortunately, however, their capabilities and performance fell far short of expectations. Torquing Group, the company behind the project, filed for bankruptcy, and Kickstarter launched an independent investigation.

Another case of setting high expectations and failing to deliver is the Laser Razor from a company called Skarp. The campaign promised to deliver a laser-powered shaving instrument that seemed to push the limits of what is technologically possible. The company raised more than US$4 million in pledges on Kickstarter before Kickstarter pulled the plug. Skarp was unable to demonstrate that it had even a prototype of the product. Skarp relaunched the project on Indiegogo (another crowdfunding site) and collected an additional US$442,000. As of mid-2016, the campaign was delayed and unresponsive to investor inquiries.

Other projects like the Crystal Wash 2.0 are outright scams. This pseudo-scientific approach to clothes washing using "shrinking water molecule clusters" had been previously debunked yet still managed to collect more than US$268,000 in pledges. Lastly, some projects are simply pranks or jokes. A user set up a Kickstarter campaign to fund his board game–playing habit, and another asked for a million dollars to build a custom car.

The moral of the story is that crowdfunding sites are not stores. It's important to understand that you are contributing to a promise and promises can be broken.

Based on:

Knibbs, K. (2015, December 23). The 9 most disgraceful crowdfunding failures of 2015. *Gizmodo.* Retrieved June 30, 2016, from http://gizmodo.com/the-9-most-disgraceful-crowdfunding-failures-of-2015-1747957776

NETWORK EFFECTS AND CRITICAL MASS. Successful social media applications such as Wikipedia base their success on network effects and the long tail (see Chapter 4) and have needed some time to achieve a critical mass. For example, although Wikipedia enjoys millions of page views per day, there is only a small number of people who choose to actively participate in the creation of content. Within organizations, achieving the critical mass needed for successful social media implementations is often difficult and takes considerable time and patience. Although for many smaller organizations collaborative social media applications can be beneficial, they will most likely not be able to harness the network effects that can be achieved with a larger user base.

GENERATION GAP. The success of an enterprise-oriented social media initiative is also heavily dependent on the composition of the organization's workforce. In organizations with large numbers of millennials, who have grown accustomed to highly interactive and communicative online social environments, such initiatives have a higher likelihood of success; in contrast, many baby boomers are used to rigid hierarchies and organizational structures and are less likely to fully embrace the capabilities of organizational social media applications. Further, senior organizational members may not fully grasp the potential and implications of social media applications in organizational settings.

TECHNOLOGICAL INERTIA. One factor hindering the adoption of many new technologies is technological inertia. In many cases, people are not willing to switch to new applications unless they see real, tangible benefits. This can be especially a hindrance with social media applications, many of which incorporate a variety of other tools (such as chat or instant messaging interfaces within social networking sites).

TECHNOLOGICAL INTEGRATION. Organizations will have to ensure that any enterprise-oriented social media applications are integrated well with the organization's existing information systems infrastructure so as to reap the greatest benefits from connecting people with one another and connecting people with information. Typically, organizations choose systems provided by outside vendors such as Yammer, which allows the organization to create its own private social network. However, organizational users will use the tools they are used to as a benchmark, and many consumer-oriented tools such as Facebook create high expectations of usability for any internal tool.

SECURITY. A final issue is related to security and intellectual property. For organizations, securing their information systems infrastructure is of paramount concern (see Chapter 10). Any application that allows closer collaboration by increasing data sharing will necessarily incur greater risks of security breaches. Companies thus have to balance their desire for enhancing collaboration with the need to protect intellectual property and compliance with rules and regulations such as the Sarbanes–Oxley Act.

Downsides and Dangers of using Social Media Applications

Many organizations (and individuals) have learned painful lessons from public relations blunders and from not considering the fundamental rule: The Internet never forgets. Another fundamental rule brought about by social media applications is to constantly monitor social media and quickly and appropriately react to emerging issues. In this section, we highlight potential pitfalls of social media and the enterprise.

ONLINE PRODUCT REVIEWS. Online as well as offline consumers increasingly consult the web before making a purchase decision. Before making a purchase on Amazon.com, many potential buyers first consult the user reviews; relatedly, people read other travelers' reviews of hotels or restaurants on Tripadvisor.com or consult websites dedicated to providing expert reviews. Unfortunately, such reviews are not always as unbiased as they seem, and sometimes companies hire people to deliberately spread positive (or negative) word of mouth across a variety of sites. The act of posting fake product reviews is unethical, to say the least. Fakespot.com, a website analyzing user reviews on Amazon.com using text mining (see Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics"), lists various products having more than 80 percent fake reviews. In 2015, Amazon started suing companies that offer good (read: fake) reviews for a fee. Having sued more than 1,000 people who posted fake reviews, in mid-2016 Amazon.com started suing sellers who offered items for sale on Amazon.com's sites and who purchased fake reviews. While Amazon.com is expending much effort to combat the problem, fake reviews are likely to continue to spread, undermining trust in review systems and leading customers to make suboptimal purchasing decisions.

MICROBLOGGING. Whereas microblogging can be very valuable for corporate communications, it has to be used carefully and is not without controversy. For example, in early 2014, New York City's police department (NYPD), attempting to boost the department's image, encouraged people to tweet images with police officers using the hashtag #myNYPD. Unfortunately, the response was not what the NYPD had hoped for. Rather than tweeting positive photos, the department's critics soon used the hashtag for pictures depicting police brutality and racial discrimination.

For individuals, posting the wrong "tweets" can also have serious consequences, as they are more likely than not to reach the wrong readers—sooner or later. A Chicago woman was recently sued by her landlord for posting a tweet complaining about the management company's reaction to mold in her apartment. The management company sued her for defamation, arguing that the tweet was published on a global scale. Whereas the lady had a mere 22 followers on Twitter, the landlord's lawsuit was covered in major news outlets, online and offline, including the *Chicago Tribune*, the Associated Press, and the *New York Times*.

SOCIAL NETWORKS. While free to host, having and maintaining a page on a social network is not free for organizations—the company should take great care to monitor what is happening on the page and take appropriate action. For example, Starbucks lets its customers upload their favorite Starbucks-related pictures to its Facebook page. However, people frequently post unrelated pictures, play pranks with the company logo, or post otherwise inappropriate content. A company then has to walk the fine line of removing inappropriate content to preserve the company's image while not alienating its fans. Starbucks chooses to liberally allow unrelated content.

As with most social software, posting the "wrong" content can quickly get you in trouble. Companies routinely check social networking sites before making hiring decisions, and many applicants have lost a job offer they almost had secured. Similarly, your posts may make it farther than you think; stories abound of people getting laid off after ranting about their jobs and their bosses in Facebook status updates—unfortunately, the boss was in the employee's contacts list and could immediately see the post. Further, many people never bother to adjust their accounts' privacy settings and inadvertently shout things out for the whole world to read.

BAD VIBES GOING VIRAL. As with other social media, viral marketing can be a blessing or a nightmare. One of the most infamous examples happened back in 2008, when a musician on a tour witnessed from his airplane window how baggage handlers mishandled—and broke—his US$3,500 guitar. After not getting a satisfying response from the airline, the musician decided to write a song and post it on YouTube in 2009. The video quickly went viral, and the airline rushed to "make things right" for the musician. For the airline, however, the damage was done, and the video has since attracted more than 15 million views. Likewise, a Ryanair passenger's complaint letter posted on Facebook was shared more than 68,000 times in less than 10 days. Whereas traditional phone complaints were a one-to-one conversation between the customer and a call center agent, the balance of power has shifted toward the customer, necessitating swift, effective responses by the companies. A case in point is the response of Domino's Pizza, where two employees posted videos on YouTube displaying them playing not-so-harmless pranks and preparing sandwiches with disgusting ingredients; the videos quickly went viral and attracted more than a million viewers in just a few days. Domino's was initially slow in responding and decided not to respond to the crisis, fearing that a reaction might draw even more interest. After 48 hours, however, Domino's changed its strategy, opened a Twitter account to interact with concerned customers, and posted a video response by the president of Domino's on YouTube assuring that the culprits had been found, that the entire store had been closed and sanitized, and that everything would be done to avoid hiring the "wrong" people in the future. A nationwide survey by a media research company has found the response to be fairly successful, with more than 90 percent of the respondents indicating that the response video was effective in restoring trust in the brand.

LESSONS LEARNED. As you probably know from your own experience and have seen from these stories, news travels fast in social media. For the companies in question, this is an enormous threat, as negative publicity can quickly reach millions of people. At the same time, the company's reaction is equally critical, as it can reach people just as fast and thus has to be carefully crafted. Richard Levick, president of Levick Strategic Communications, has provided some tips on how to prepare for and deal with such crises:

1. Identify a crisis team including members from within your organization (e.g., public relations or executive team) and from the outside (e.g., lawyers).
2. Identify your worst social media nightmare (and make sure to know the signs to look for, such as search engine key terms your opposition could use).
3. Monitor your social media environment (such as YouTube, Facebook, and Twitter) and be connected and responsive.
4. Act fast. The first 24 hours count.

As in the offline world, companies should try to avoid such crises in the first place, but being prepared for a public relations disaster is crucial in today's fast-paced world. Many organizations have realized the need for social media monitoring; for example, Dell recently opened its "Social Media Listening Command Center" as a key part of its overall marketing efforts. Monitoring social media posts mentioning Dell in about a dozen languages not only enables Dell to respond to customers' problems before they go viral but also serves as an effective means to gather business intelligence. We will discuss more about the role of social media monitoring and business intelligence in Chapter 8.

SOCIETAL IMPACTS OF SOCIAL MEDIA. Clearly, social media have greatly changed the way we interact and will continue to do so. Over the past decade and a half (Myspace, the once widely popular social network, was launched in 2003), people's attitudes toward sharing content as well as toward privacy have seen a tremendous shift. Likewise, social media have provided people with far wider access to information and have democratized content creation, which has tremendous effects on the way societies function. For example, whereas U.S. presidential campaigns used to be largely funded by big donors, Barack Obama's 2008 campaign made wide use of social media and generated significant funding from small contributors. Similarly, Bernie Sanders's 2016 presidential nomination campaign relied on a large crowd of small donors for support. In addition, the Internet and social media has lowered barriers to entry by giving candidates free platforms to make their voices heard by removing the costs for printing and distributing campaign material. Together, this has lowered the influence of the wealthy on politics.

Yet people also point to downsides brought about by everyone's ability to create content and by the way this content is being spread. In particular, traditional media outlets used editorial judgment to decide what would be covered. In social media, this judgment is increasingly replaced by automated algorithms that determine what content is being shown to social media users. For example, as algorithms on social networks analyze user behavior in order to provide the most relevant content, there is the risk of algorithms filtering out content that is in conflict with the users' viewpoints. Whether these developments are potentially hurting democracy remains to be seen, but it is clear that social media and the accompanying societal changes will continue to have large impacts on individuals, organizations, and society as a whole.

INDUSTRY ANALYSIS

Online Travel

Spring break is coming, and you've decided to go to Puerto Vallarta this year. Chances are that your first step will be to check the websites of Expedia, Priceline, Travelocity, and Orbitz for flights to and hotels in your chosen destination. We all know the big four online travel agencies; in today's digital world, they dominate the travel industry. They took the old brick-and-mortar travel industry and turned it into an online service where you can click to book flights and hotel reservations, change or cancel flights, reserve rental cars—even plan a vacation. In Internet terms, you can think of the big four as still being in Online Travel 1.0. But technology marches relentlessly on, and Online Travel 2.0 is in the works. Evidence of this transition to Online Travel 2.0 is reflected in Expedia recently purchasing both Travelocity and Orbitz. When competition heats up, mergers and acquisitions often follow.

A new crop of travel sites has popped up, offering several benefits over the big online travel agencies. These travel sites are very different from typical online travel services, however. The first, and arguably the most prominent, example is Airbnb. Airbnb allows people to offer houses, condos, apartments, and rooms (private or shared) to anyone who happens to be traveling through the area. If you're planning a vacation, you could book a hotel through the hotel's website or an online travel agency. Alternatively, you could use Airbnb to rent a house or apartment from someone, often for a fraction of the cost. Property owners benefit by generating income from unused living space, and Airbnb handles the processing of all rent payments. The site also offers an extensive rating and review platform that motivates property owners to provide excellent service to attract future renters. Airbnb has been fairly successful so far and as of April 2016 was valued at approximately US$30 billion. If renting a house from a stranger worries you, there will always be hotels for you to use. But if you trust the ratings and experiences from "the crowd," you can save a bundle in many popular locations to which you might travel.

Once you get to your location, however, you'll need a way to get around. Again, you could book a rental car through a car rental company or an online travel agency. Or you could save some more cash and use a social taxi service like Uber. This service provides a platform through which individuals can request and pay for a "taxi" service from qualified drivers in 449 cities in 66 countries (as of mid-2016). Using the Uber mobile app, riders can request a ride at the tap of a button and then monitor the location of the reserved car in real time. Upon completion of the trip, the Uber app allows the driver to collect payment. Uber requires that drivers submit to an insurance and background check and has typically targeted a higher-end market of users. The first Uber drivers had such cars as Cadillac Escalades, BMW 7 Series, and Mercedes-Benz S550 sedans. The company has since expanded to a wider selection of cars to appeal to more riders and has recently implemented a ride-sharing system that allows riders to quickly request to "ride along" with someone to a specific destination. Similar to Airbnb, Uber encourages the use of a rating and review system to incentivize drivers to provide excellent service.

So next time you go on a trip, consider the benefits available through these social travel platforms. You might save a few bucks and maybe even make a friend in the process.

Questions

1. Do you use online travel agencies for assisting you with travel plans? If so, which service provider do you use, and why did you make this choice? If not, why not?
2. What features would you identify as crucial to the success of social travel services such as Airbnb and Uber?

Based on:

Airbnb. (2016, June 26). In *Wikipedia, The Free Encyclopedia*. Retrieved June 29, 2016, from https://en.wikipedia.org/w/index.php?title=Airbnb&oldid=727088256

Picker, L. & Isaac, M. (2016, June 28). Airbnb is said to be seeking funding valuing it at $30 billion. *The New York Times*. Retrieved June 29, 2016, from http://www.nytimes.com/2016/06/29/business/dealbook/airbnb-is-said-to-be-seeking-funding-valuing-it-at-30-billion.html

Singh, M. & Sweeney, P.T. (2016, March 18). Online travel M&A in focus in OTA market. *Bloomberg*. Retrieved June 29, 2016, from http://www.bloomberg.com/professional/blog/consolidation-in-online-travel

Uber (company). (2016, June 29). In *Wikipedia, The Free Encyclopedia*. Retrieved June 29, 2016, from https://en.wikipedia.org/w/index.php?title=Uber_(company)&oldid=727469300

Key Points Review

1. ***Explain organizations' needs for communication and collaboration.*** In today's increasingly competitive world, organizations need to communicate and collaborate effectively and efficiently within and outside organizational boundaries. For example, virtual teams, composed of team members located around the globe that are forming and disbanding as needed, have communication needs that often cannot be met by traditional communication media. Traditionally, organizations used tools such as groupware, videoconferencing, or intranets for their communication and collaboration needs.
2. ***Explain social media and evolving web capabilities.*** In contrast to traditional web 1.0 sites, web 2.0 applications allow people to collaborate and share information online, with a shift in the users' role from passive consumer of content to creator of user-generated content. Owing to societal changes, using social media can be an important factor in being able to attract or retain employees as younger generations are joining the workforce. Future web capabilities extending web 2.0 are the semantic web and the "contextual web," which is characterized by devices providing the information and content needed depending on the user's specific context. To harness the opportunities brought about by these changes, organizations are increasingly using social software to connect with customers and internal or external stakeholders in order to become more innovative or productive.
3. ***Describe various social media applications, and explain their role in enhancing communication, collaboration, cooperation, and connection.*** Social software can enhance communication within organizations as well as between an organization and its stakeholders. Blogs, microblogging, and instant messaging are widely used by individuals and organizations to communicate with internal and external stakeholders. Social media applications such as media sharing, social bookmarking, or social cataloging applications facilitate cooperation by using the network effect to provide the greatest benefit to users. Further, social media applications have enabled new forms of collaboration for organizations and individuals. These and other technologies have enabled cloud-based collaboration tools, content management systems, and wikis as well as the use of collective intelligence and crowdsourcing. Finally, social media applications aid in connecting people with each other. For individuals, social networking has become an important way to meet new friends, connect with family members, or meet new colleagues and business partners. The reach of social networks is also used by business organizations to market their products or services through viral marketing, which resembles offline word-of-mouth communication, in which advertising messages are spread like viruses through social networks.
4. ***Describe how companies can manage enterprise-oriented social media applications and deal with potential pitfalls associated with social media.*** Organizations have to take into account that success in a consumer environment does not necessarily translate into success in a corporate environment. Further, organizations have to take into account issues associated with culture, organizational context, and organizational hierarchies; in addition, lack of critical mass, the generation gap, and technological inertia can hinder the success of enterprise-oriented social media initiatives. Finally, in organizational contexts, integration with existing technologies and security are of primary concern. Further, an organization's opponents can use social media to spread damaging content or information to people all over the world within a very short time. Organizations should therefore carefully prepare for such incidents.

Key Terms

MyMISLab™ | Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

5-1. What are virtual teams, and how do they help to improve an organization's capabilities?
5-2. What are mashups? How do they enable social media applications?
5-3. What capabilities will define the web of the future?
MyMISLab **5-4.** How can social software help harness the wisdom of the crowd?
5-5. Why is using social media an important factor for attracting and retaining employees?
5-6. How can social software enhance communication?
5-7. How can social bookmarking and social cataloging help in an organization's knowledge management efforts?
MyMISLab **5-8.** What is a wiki? Why would an organization want to implement a wiki?
5-9. Explain what is meant by crowdsourcing and how the web is enabling this form of collaboration.
5-10. How can organizations use social networking to connect with their customers?
5-11. Why is organizational culture an important factor in enterprise-oriented social media initiatives?
MyMISLab **5-12.** Why can social media be both a blessing and a threat for organizations?
5-13. How can organizations plan for social media disasters?

Self-Study Questions

5-14. Collective intelligence is based on the notion that distributed groups of people with a divergent range of information and expertise will be able to outperform the capabilities of ______________.
A. crowds
B. customers
C. individual experts
D. virtual teams

5-15. Microblogging is used primarily for ______________.
A. creating an online text diary
B. providing location information
C. short status updates
D. customer support functions

5-16. Tagging is adding ______________ to content such as maps, pictures, or web pages.
A. metadata
B. comments
C. blogs
D. knowledge

5-17. The process of adding metadata such as latitude and longitude to pictures, videos, or other content is called ______________.
A. adding geodata
B. location tagging
C. geotagging
D. tagging

5-18. Successful enterprise-oriented social media initiatives consider ______________.
A. organizational culture
B. organizational hierarchies
C. technological inertia
D. all of the above

5-19. ______________ is the process of creating an online diary made up of chronological entries.
A. Wikiing
B. Tagging
C. Blogging
D. None of the above

5-20. Webcasts are also known as ______________.
A. podcasts
B. blogcasts
C. radiocasts
D. weblogs

5-21. A wiki ______________.
A. allows users to add content
B. allows users to revert edits
C. allows anyone to read content
D. allows all of the above

5-22. ______________ is using the network effect to increase brand awareness.
A. Brand marketing
B. Shared marketing
C. Social marketing
D. Viral marketing

5-23. ______________ communication is when people are all meeting at the same time or in real time.
A. Synchronous
B. Asynchronous
C. Instantaneous
D. None of the above

Answers are on page 218.

Problems and Exercises

5-24. Match the following terms with the appropriate definitions:

i. Microblog
ii. Asynchronous
iii. Metadata
iv. Social networking
v. Peer production
vi. Social software
vii. webcasts
viii. Folksonomy
ix. Network effect
x. Blog

a. Web-based applications embodying core web 2.0 values such as collaboration and social sharing, allowing people to communicate, interact, and collaborate in various ways
b. Digital media streams that can be distributed to and played by digital media players
c. The creation of goods or services by self-organizing communities
d. The notion that the value of a network (or tool or application based on a network) is dependent on the number of other users
e. User-created categorization system
f. Chronological online text diary that can focus on anything the user desires
g. Data about data
h. Social networking service that allows to post relatively short status updates
i. Using web-based services to link friends or colleagues
j. Not coordinated in time

5-25. Visit a popular social network (such as Facebook). What features entice you to visit such site repeatedly? Do you have an account in an online social network? If yes, why? If no, what is keeping you from having such account? Is there any content you definitely would or would not post on such a site?

5-26. Go to www.programmableweb.com. List some interesting mashups you find. What factors do you think make a good mashup website?

5-27. Go to Amazon's Mechanical Turk website (www.mturk.com). Which of the HITs do you think could be completed using a computer, and which could not? Why?

5-28. Search the web for a social networking site that you have not heard about before. Describe the target users of this online social network. Are the features of this site different from those you are familiar with? If so, describe those features. If not, describe common features.

5-29. Visit Google Drive (drive.google.com) and Microsoft Office Online (products.office.com/office-online). Compare and contrast the features of each productivity suite. Which suite would you choose to use, and why?

5-30. Have you ever blogged? If so, what did you like or dislike about the experience? What do you see for the future in blogs?

5-31. Find an article you can contribute to on a wiki page. What do you like or dislike about this process? What would encourage you to contribute more to the wiki? Why?

5-32. Envision and describe general features of web 3.0 applications. Describe a feature you would like to see in the next version of the web.

5-33. Describe an application or service you would like to be able to use on the web that is not yet available. Describe the potential market for this application or service. Forecast how long you believe it will take before this will occur.

5-34. Search the web for public relations blunders involving social media. How did the companies in question react? In your opinion, were the reactions effective? Why or why not?

5-35. Have you listened to or watched a webcast (or podcast)? If so, describe your experience. If not, why?

5-36. Describe the pros and cons of collaborating with colleagues over the web. What is useful about this form of collaboration? What is difficult?

5-37. Describe an example of viral marketing that you have experienced.

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Online Versus Traditional Spreadsheets

5-38. Campus Travel is currently evaluating the possibility of using online spreadsheet software as opposed to the traditional locally installed spreadsheet application. There are a variety of issues involved in this decision. The company wants you to investigate the possibilities that are currently available while also paying special attention to the company requirements. Campus Travel has the following requirements: (1) the ability to share spreadsheets easily, (2) the ability to secure this information, (3) the ability to save the spreadsheets into other formats (i.e., CSV files), and (4) the ability to work from anywhere in the world. Prepare the following information:

- On the Internet, find different options for online and traditional spreadsheets and list the available options.
- Using the company requirements, list the pros and cons for each spreadsheet option.

- Using an online spreadsheet, summarize the findings and provide a recommendation to the company. Present your findings with tables and/or graphs, if available.

Database Application: Tracking Website Visits

5-39. As Campus Travel expands its web presence, the importance of tracking what the competitors are doing has become very important. This includes making sure Campus Travel tracks the prices of packages and services that its closest competitor offers. To do so, a database must be created to track this information. Follow these steps to create the database:

- Create a database called "tracking."
- Create a table called "company_info." In this table, create fields for company_name and company_URL.
- Create a table called "products." In this table, create fields for the company_name, product_name, product_description, product_price, and date_retrieved.
- Create a table called "services." In this table, create fields for company_name, service_name, service description, service_price, and date_retrieved.
- Once these tables are created, go to the relationship view (select "Relationships" under the "Database Tools" tab) and connect the company_info (one side) and products (many side) tables and the company_info (one side) and service (many side) tables.
- Make sure that when you create the relationships, the referential integrity option is selected. (This will make sure that when you delete a company, the products associated with the company are also deleted.)
- Test the referential integrity by adding data to the tables and make sure that when a company is deleted in the company table, the products table is updated, too.

Team Work Exercise

Net Stats: Most Popular Facebook Fan Pages

More and more organizations have discovered Facebook as a way to connect with their customers and drive word-of-mouth advertising. Any company can create a Facebook page containing basic information about the business, a "wall" to share content, a space for uploading photos or pictures (many organizations use this to show "behind-the-scenes" content), and so on. Further, businesses can add apps (such as an app that allows customers to make a reservation at a restaurant) to further engage with their customers.

Facebook users who "like" a page automatically receive the business's status updates in their newsfeeds. As the liking of a page is announced to others in the user's newsfeed and his or her profile, the liking of the page can spread throughout the user's network of friends. Further, each business's page has a listing of all Facebook users who like the page. What businesses are liked by most Facebook users? As of April 2016, the top 10 most-liked product pages were the following:

Rank	Page	Likes (millions)
1	Facebook for Every Phone	506.96
2	Facebook	170.72
3	Cristiano Ronaldo	110.82
4	Shakira	104.54
5	Vin Diesel	98.48
6	Coca-Cola	97.21
7	Eminem	91.97
8	FC Barcelona	91.96
9	Real Madrid CF	88.14
10	Lionel Messi (Leo Messi)	84.34

Questions and Exercises

5-40. Search the web for the most up-to-date statistics. Try to find the number of "likes" for pages that interest you most.

5-41. As a team, interpret these numbers. What is striking/important about these statistics?

5-42. How have the numbers changed since April 2016? Which categories seem to draw most attention in social networks? Why?

5-43. Using your spreadsheet software of choice, create a graph/figure that effectively visualizes the statistics/changes you consider most important.

Based on:

Statista. (2016) Most popular Facebook fan pages as of April 2016, based on number of fans. *Statista.com.* Retrieved May 3, 2016, from http://www.statista.com/statistics/269304/international-brands-on-facebook-by-number-of-fans

Answers to the Self-Study Questions

5-14. C, p. 203 **5-15.** C, p. 195 **5-16.** A, p. 198 **5-17.** C, p. 198 **5-18.** D, p. 209

5-19. C, p. 195 **5-20.** A, p. 197 **5-21.** D, p. 204 **5-22.** D, p. 208 **5-23.** A, p. 185

CASE 1 | Living in a Bubble: Facebook, Newsfeeds, and Journalism

Social media platforms like Facebook have become an integral part of how we interact with the world around us. From posting about what we had for lunch to our political views to our favorite movies, TV shows, and products, we express ourselves digitally in these online forums. With so many people posting so much information, it can be challenging to keep up with everything that is going on in our circle of friends and acquaintances. To make things easier and help us better manage the volume of posts, platforms like Facebook have introduced algorithmic prioritization of posts. These algorithms study what you are most interested in, whom you have close relationships with, even where you are located to determine which of the posts in your feed are most likely to interest you. In most cases, this is a good thing—the posts in your feed are the most relevant to your interests. A problem arises, however, when we consider the impact of social media on the shifting landscape of political thought and expression.

For many years, professional journalists have been challenged by the ease at which virtually "anyone" can publish information on social media. Historically, traditional newspaper companies controlled the physical distribution of sheets of paper. Content was generated by newspaper employees, edited, and then distributed. Print newspapers during this period were the primary mechanism by which not just news but editorial and political opinions were shared across society. The system certainly wasn't perfect—political expression on a mass scale was concentrated in the hands of a few major publishers. Regulations were required, and social norms had to evolve to address the threats this concentration of control posed. Yellow journalism scares in the early 1900s led to improvements in editorial standards and laws restricting consolidation in the industry.

Fast-forward to today and digital media has drastically changed the publishing landscape. It is no longer necessary to invest heavily in a printing and distribution system to reach a mass audience, and many traditional print newspapers have disappeared. This shift has taken a great deal of power out of the hands of traditional publishers and left the market for news and content wide open. As a result, we are left with a new set of challenges on how political thought and opinions are disseminated throughout society. The old regulations and social norms may no longer be adequate to mitigate the threats posed by dysfunctional distribution systems. Stepping into this wide open market for news and content distribution are platform providers like Google, Apple, Facebook, and others. These platform providers have traditionally thought of themselves as technological enablers, agnostic to the political whims of the public they serve. The reality is that the content posted and consumed by the public on these new media platforms has become the de facto political discourse of our day.

Enter the algorithmic newsfeed. The algorithms are designed to show us things we will like and the things we want to read. It is possible that most of this content is benign, such as the latest gossip on celebrities or a new fashion trend; however, a good deal has to do with news and political issues of the day. Indeed, many people now get their news primarily from social media. In an election year, our feeds are choked with news and opinions about this candidate or that. When the algorithms start to sift through this tidal wave of information, they do what they are designed to do—pick out things that we will like. Opposing views or dissenting opinions are suppressed—not through active censorship but simply by being less preferred by the viewer. We are then essentially living in an information bubble—only seeing content we like, news presented from a perspective aligned with our own, and opinions that agree with our own. This filtering and silent censorship of our worldviews can have a profound effect. We may come to believe that everyone shares our views and opinions because that is what we see in our newsfeeds—a self-reinforcing collection of stories and content. We are surprised to encounter others with views different from our own and in some cases react angrily by removing ("unfriending") the offending individual from our network. This can amplify divisions between groups and can ratchet up tensions in political discourse by making it far less likely that we are aware of and even understand opposing views, let alone empathize with those who hold them.

Technology is always evolving, and our society both reacts to and drives technological change. When new content distribution platforms take over the mechanisms of social discourse, many of our assumptions about the nature of politics and the nature of political debate can be undermined. How these new mechanisms and social interactions will shape up in the long run is an open question. The only certainty is that change is inevitable and only diligence will allow us to maintain the free and open society we have enjoyed for so long. Conscious effort will be required to amplify the benefits and mitigate the risks of a changing technological and social landscape.

Questions

5-44. Have you personally experienced the information bubble effect? How would you know if you did? What was the topic?

5-45. How might the information bubble effect be overcome? What technological and social changes might be needed to mitigate algorithmic self-reinforcement?

5-46. What role should platform providers play in social discourse? Do these technology companies have an obligation to understand the impacts they are having on society? Do they have a responsibility to participate?

Based on:

Bell, E. (2016, March 7). Facebook is eating the world. *Columbia Journalism Review.* Retrieved June 29, 2016, from http://www.cjr.org/analysis/facebook_and_media.php

Bradley, T. (2016, March 16). Leave me out of your Instagram algorithm bubble. *Forbes.* Retrieved June 29, 2016, from http://www.forbes.com/sites/tonybradley/2016/03/16/leave-me-out-of-your-instagram-algorithm-bubble

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Shah, R. (2015, July 2). Do privacy concerns really change with the Internet of Things? *Forbes*. Retrieved July 1, 2016, from http://www.forbes.com/sites/rawnshah/2015/07/02/do-privacy-concerns-really-change-with-the-internet-of-things

CASE 2 | Like Farming and Clickbait

Facebook uses algorithms to select what content goes in your newsfeed. These algorithms take a variety of things into account, such as your relationship to the poster, your interests, and even your location. However, one of the most important factors is the number of likes or shares that a post has received. If a post has been liked or shared by a large number of people, it will be more likely to show up in other people's feeds. The assumption here is that because lots of people are liking or sharing the post, it must contain popular or desirable content. Usually, this is a good thing—it can help you quickly get to content that your friends and family have already vetted and that you are likely to enjoy and want to see. Unfortunately, scammers have developed a variety of mechanisms to take advantage of this functionality.

Scammers take advantage of their victims by getting them to view content related to their scams or to download viruses or other malware. Just like spam e-mail, it only requires a very small percentage of recipients to click on a malicious link or to run a malicious attachment in order for the scammer to make money. As a result, scammers have an incentive to get as many people as possible to view their content or click their links. To accomplish this on a social media platform, scammers look for ways to get lots of people to view their content by having it show up in their newsfeed. Because a post's popularity can drive how frequently it shows up in people's feeds, scammers look for ways to artificially inflate the popularity of their posts. One mechanism is so-called "like farming."

Like farming begins when a scammer posts an article or story that is seemingly innocuous and designed to get people to like or share it. Often, these posts appeal to the emotions or political views of the readers. "This poor little girl with cancer lost her hair to chemotherapy—'like' this post to let her know she's still beautiful!" or "This new government policy is outrageous—'like' this post if you're outraged, too!" Another approach is to try to convince readers that they can win a valuable prize—such as the latest smartphone or even plain old cash—by liking the story. Any story offering to enter you in a contest or give you something for simply liking or sharing is highly suspicious and unlikely to be legitimate. Stories promising that "If I get X number of likes, then something amazing will happen for me" or "I was challenged to get X number of likes" are also highly likely to be like-farming schemes.

Once the scammer has convinced enough people to like or share the story, the scammer changes out the content. The post is edited such that it no longer contains the emotional story, puzzle, or contest but instead shows marketing material for the scam or other undesirable content. In some cases, the scammer will sell the rights to edit the post to other scammers on a black market. A post with a high popularity rating that can be edited at will is a valuable commodity to those looking to do you harm. Either way, you and your friends are now seeing questionable and even dangerous content thanks to the farmed likes.

Other, less malicious forms of abuse take advantage of the algorithmic post selection as well. Many organizations will create headlines for their stories that are incomplete or tantalizing in order to encourage users to click on them, like "You won't believe what happens next." These "clickbait" headlines force users to actually click on the story in order to learn a key detail or to find out the answer to a question. When the story gets clicked on, the social media platform counts that as a vote toward the popularity of the story. The user has unwittingly bumped up the popularity of the post and made it more likely that it will be seen by members of the network. This increases the popularity rating of the post or the poster and makes it more likely that the content will be seen by more people. This type of abuse isn't necessarily perpetrated by actual scammers, just organizations looking to improve their online popularity ratings and the effectiveness of their advertising and marketing material. However, scammers often use these techniques as well. Falling for clickbait can lead you to malware and other scam sites.

How can one avoid falling victim to like farming and clickbait? It starts with being better informed. Look at the source of a post. Is it a reputable news organization or an unknown site? User behavior is also an important factor. Avoid liking or sharing suspicious posts and stories. If something sounds too good to be true, it probably is. Most social network platforms, including Facebook, provide tools that allow users to review their activity log and see what they have liked or shared. Users can take advantage of these tools to look back at their history and identify content that has changed or that they now recognize as like-farming or clickbait material. By reporting or un-liking suspicious content, this type of abuse can be mitigated. In mid-2016, Facebook announced a new algorithm to reduce the amount of clickbait in users' newsfeeds. To assess the likelihood of a headline being clickbait, humans scored thousands of headlines on their likelihood of being clickbait; these scores were then used to train the new algorithm. Using this algorithm, Facebook is now able to automatically classify headlines based on their likelihood of being clickbait, and filter (or punish) those with high clickbait likelihood scores.

Questions

5-47. Have you personally encountered like farming? Have you reviewed your activity log? Have you ever liked a post that has turned bad?

5-48. You have now seen some techniques for identifying and avoiding scams. How can the social media–using general public be better educated to avoid online scams such as like farming and clickbait?

5-49. Who is responsible for this type of malicious activity? Is it simply the fault of the scammers abusing the system? Do users and platform providers have a responsibility to reduce the risk of abuse? If so, how might this be accomplished?

Based on:

Abel, J. (2015, April 22). Like-farming Facebook scams: Look before you "like." *Consumer Affairs*. Retrieved July 1, 2016, from http://www.consumeraffairs.com/news/like-farming-facebook-scams-look-before-you-like-042215.html

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Komando, K. (2016, March 4). Don't click 'like' on Facebook again until you read this. *USA Today.* Retrieved July 1, 2016, from http://www.usatoday.com/story/tech/columnist/komando/2016/03/04/dont-click-like-facebook-again-until-you-read/81264440

MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

5-50. What is blogging, and why are blogs sometimes controversial?

5-51. What is viral marketing? What capabilities of the web help to spread the virus?

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6 Enhancing Business Intelligence Using Big Data and Analytics

Preview

Today, organizations operate in a global, highly competitive, and rapidly changing environment. A key to effective management is high-quality and timely information to support decision making. Yet, to enhance decision-making, this high-quality and timely information needs to be extracted from ever-increasing amounts of structured and unstructured data gathered from a variety of sources. Here, we first describe the need for enhanced decision making, followed by a description of databases and data warehouses, two fundamental components for gaining business intelligence. Then we describe the primary IS components utilized by organizations to extract meaningful insights from data. In Chapter 2, "Gaining Competitive Advantage Through Information Systems," you learned about general types of information systems supporting organizations' different decision-making levels and business functions that execute various business processes in order to realize the strategic goals of the organization. Here, we introduce business intelligence and advanced analytics tools utilized at various decision-making levels of modern organizations. Finally, we discuss how knowledge management systems help organizations effectively capture, store, and retrieve organizational knowledge, and how geographic information systems help analyze spatially referenced data to make better business decisions.

MANAGING IN THE DIGITAL WORLD:

Intelligence Through Drones

Over the past years, commercially available drones have made great progress; they can recognize obstacles, maintain stable flying positions even under windy conditions, or safely return to their starting position in case of low battery levels. In the robotics lab at the University of Pennsylvania, researchers are hard at work creating flying robots that can sense each other and features of the environment, giving the impression that they have a mind of their own. In one demonstration, a group of eight flying devices—called quadcopters—rise from the ground in unison and fly around the room in a carefully orchestrated formation. They then fly through a small window, one by one, and form up on the other side. What is particularly impressive about the devices is that they are autonomous, meaning that other than receiving instructions about going from point A to point B in the room, the devices are fully autonomous, get to decide where to move and how fast to get there, and are responsible for avoiding collisions. These devices are the precursor to drones that could be used in the real world for various purposes, ranging from package delivery to surveillance to search and rescue operations.

DARPA, the U.S. government research agency, is also actively working on improving the capabilities of such "micro-drones" and is developing a new class of small UAVs that will be able to navigate inside buildings without relying on GPS for navigation or having a remote pilot.

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

1. **Describe the need for business intelligence and advanced analytics and how databases serve as a foundation for making better business decisions.**
2. **Explain core concepts of business intelligence and advanced analytics.**
3. **Describe how organizations can enhance decision making by using knowledge management and geographic information systems.**

These small autonomous UAVs will be able to fly through an open window and then navigate rooms, stairways, corridors, and other obstacle-filled environments—all at 45 mph! Such UAVs will provide previously unattainable intelligence in battle and other high-security situations.

In a more mundane context, Amazon.com is aggressively working on a drone delivery system, called Amazon Prime Air, that would allow a package ordered online to be delivered within 30 minutes by a small flying drone. In Amazon.com's ideal future, each city would have a local warehouse and a small task force of delivery drones, ready at a moment's notice to deliver thousands of small packages to Amazon.com's happy customers.

Another implementation of drone technology is in gathering geographic data to help farmers find plots of soil that are most suitable for crop growth (Figure 6.1). For example, researchers at the University of Aberdeen are developing drones with advanced imaging capabilities. These drones can be sent out to survey vineyards to find soil that is most optimal for grape growth. This could be especially valuable for growers given that soil content and area humidity tends to vary from year to year. Likewise, drones can be used by scientists to map tree cover.

The technology described here is still under development, but things are progressing rapidly. You are likely to have already seen drones at sports events, and drones have made inroads into the hobby sector, where individuals use drones to take travel pictures, hone their flying skills, or spy on their neighbors. With the capabilities of relatively inexpensive drones developing rapidly, varied applications of these technologies can benefit society in a number of different ways.

FIGURE 6.1

Drones are providing valuable data for countless purposes.
Source: Stockninja/Fotolia.

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

1. How can databases support the operation of autonomous and semiautonomous drones?
2. How can the creators of drones use advanced analytics to enable drone technology?
3. How can drones support spatial decision making?

Based on:

Amazon Prime Air. (2016, June 14). In *Wikipedia, The Free Encyclopedia*. Retrieved June 29, 2016, from https://en.wikipedia.org/w/index.php?title=Amazon_Prime_Air&oldid=725315546

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Enhancing Organizational Decision Making

In Chapter 2, you learned about the importance of strategic planning for gaining and sustaining competitive advantage. To stay ahead of the competition, organizations use information systems to gather and analyze data and information from internal and external sources in order to make better business decisions. To improve organizational performance, business executives are seeking answers to questions such as "How effective is this year's promotion as compared with last year's?" "Which customer segments should we focus on?" "Which customers are most likely to switch to a competitor if we raise prices by X percent?" or, even more important, "Do we care if those customers switch?" Answers to such questions require analyzing data of past and current transactions to understand what happened. **Business intelligence (BI)**, referring to tools and techniques for analyzing and visualizing *past* data, can provide such answers. In contrast, **advanced analytics** refers to tools and techniques used to understand why something happened, predict *future* outcomes, or discover hidden patterns in large data sets (sometimes **business analytics** is used as an umbrella term for these concepts). Today, the need for business intelligence and advanced analytics goes beyond traditional "businesses"; rather, all types of organizations, ranging from political parties to hospitals, utilize business intelligence and analytics to improve their data-driven decision making (see Table 6.1). Next, we will discuss the need for business intelligence and advanced analytics for making better business decisions.

Why Organizations Need Business Intelligence and Advanced Analytics

Although an organization's overall direction is decided on at the strategic level, business processes span all organizational levels and are highly interconnected. As discussed in Chapter 2, business processes refer to the activities that organizations perform in order to reach their business goals. Unfortunately, the business processes outlined within strategic plans are often not implemented as envisioned at the managerial and operational levels of the organization because the information needed to effectively monitor and control these processes is simply not available. This "missing" information, in fact, often exists but resides in disconnected spreadsheets, reports, or databases.

DATA-DRIVEN ORGANIZATIONS. In today's dynamic world, organizations must have up-to-date, accurate, and *integrated* information to monitor and fine-tune a broad range of business processes and to realize the goals of their strategic plans. Consequently, many organizations are trying to create meaningful insights from a variety of data sources to make better business decisions. Organizations that make decisions that can be backed up with verifiable data are referred to as **data-driven organizations**; such organizations are measurably more productive and profitable (McAfee & Brynjolfsson, 2012), can better respond to ongoing threats and opportunities, and can better plan for the future. Also, by letting data drive decisions, decision making can be pushed lower into the organization, freeing up senior management time for more important decisions (Redman, 2013). Thus, information systems—such as business intelligence and advanced analytics tools—that enable collecting and analyzing large amounts of data from various sources and delivering needed information to the right decision maker at the right time facilitate the transition to a data-driven organization. As with any technologies,

TABLE 6.1 Sample Uses of Business Intelligence and Analytics in Non-Business Contexts

Context	Example
Political parties	Model the influence of social media on election outcomes
Government	Analyze performance of public benefits programs
Defense	Manage maintenance and logistics during overseas deployments
Hospitals	Predict patient volume and resource utilization
Nonprofit organizations	Manage fundraising campaigns and target donors

however, having the right tools is not sufficient for business success. In data-driven organizations, familiarity with data analysis and analytics tools is not only the responsibility of data analysts but is a skill required of every business user. In addition, whereas business intelligence and advanced analytics can provide valuable insights, it is human judgment and creativity that are needed to translate these insights into action and make better business decisions.

RESPONDING TO THREATS AND OPPORTUNITIES. External factors such as globalization, competitive pressures, consumer demands, societal changes, and governmental regulations can create opportunities as well as threats for modern organizations. For example, globalization provides opportunities to compete in new markets, but it also creates the challenge of gathering new types of data in order to effectively exploit these opportunities. Globalization can also lead to the threat of increased competition from developing countries, forcing organizations to rethink strategies or to further improve business processes. Thus, as the world becomes increasingly interconnected, market opportunities will expand, but at the same time, markets will become more competitive, forcing companies to develop new products at an ever-increasing rate. Similarly, today's consumers have increasing access to information via social media and mobile devices and can much more easily switch to a competitor's products or services. Further, large corporate and banking failures have brought about more stringent rules and regulations (such as the Sarbanes–Oxley Act; see Chapter 10, "Securing Information Systems"), and organizations have to comply with ever-increasing government reporting requirements. In sum, today's business environment is characterized by factors such as unstable market conditions, fierce competition, shorter product life cycles, more stringent regulations, and wider choices for customers than ever before. Business intelligence and advanced analytics can help organizations make better decisions in this increasingly complex, fast-changing, and competitive environment by enabling them to more effectively collect and analyze both internal and external data (Figure 6.2).

With increasing pressure to reduce costs, organizations have to focus on investing in systems that provide the greatest returns. Business intelligence and advanced analytics solutions can provide quick returns, as they help to quickly react to problems by providing the right information at the right time. Further, these tools help to leverage existing systems (such as enterprise-wide information systems; see Chapter 7, "Enhancing Business Processes Using Enterprise Information Systems") by enabling decision makers to extract and analyze data provided by those systems. Finally, focusing on customer satisfaction can provide quick returns by helping to retain the most profitable customers.

BIG DATA. One significant opportunity for organizations is the abundance of data available for decision making. As highlighted in Chapter 1, "Managing in the Digital World," with

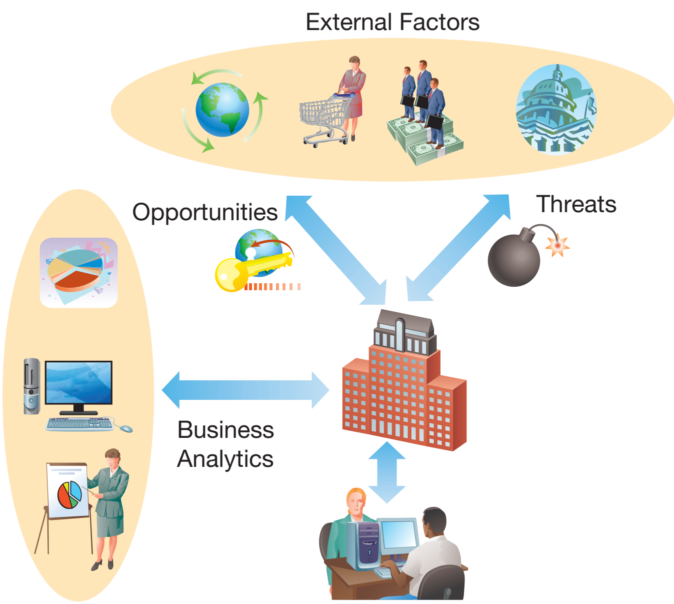


FIGURE 6.2

Business analytics helps organizations swiftly respond to external threats and opportunities.

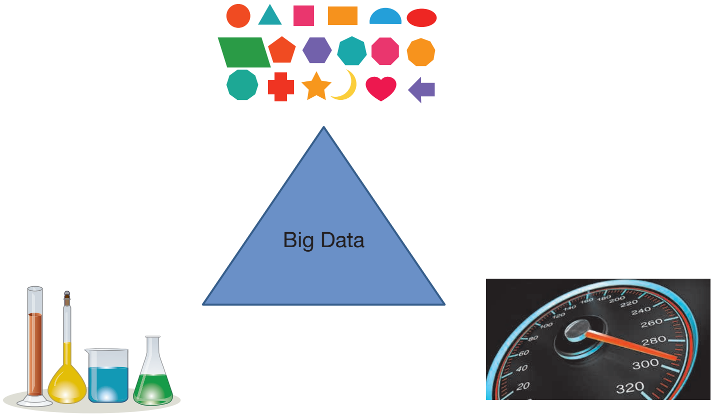


FIGURE 6.3

Big Data is characterized by volume, variety, and velocity.
Source: Alswart/Fotolia.

decreasing costs for capturing and storing data, data are now not only ubiquitous but also cheap. With ever-increasing amounts of data increases the ability to detect meaningful relationships and regularities; thus, insights gained from analyzing Big Data can not only contribute to business success but can also help to address the tremendous challenges society faces. Research has demonstrated a strong linkage between effective data management and organizational performance, and organizations have long tried to collect, analyze, and use internal and external data to gain and sustain competitive advantage. The megatrends mobile and social, as well as the Internet of Things, have led to a tremendous increase in potentially useful data, gathered from mobile devices, social media, automated sensors, and other devices. Big Data is typically characterized as being of high *volume*, *variety*, and *velocity* (see Figure 6.3). One of the biggest opportunities is the sheer volume of data, which, for example, enables organizations to make business decisions based on more factors; yet at the same time, storing, analyzing, and managing increasing amounts of data pose tremendous challenges. The second characteristic is variety; useful data can come in the form of **structured data** (such as transaction data), which fit neatly into spreadsheets or databases; **semistructured data**, such as clickstreams and sensor data; or **unstructured data**, such as text, audio and video data, comments on social networks, and so on. Especially semistructured and unstructured data tend to be messy and are often incomplete, and the quality and origins of data such as user-generated content are typically unclear and at times questionable; further, analyzing unstructured data tends to be expensive in terms of effort, time, and expertise needed. Finally, Big Data is characterized based on its high velocity. On the one hand, data flow into organizations at increasingly higher rates; on the other hand, data-driven organizations have to process and use the data ever more quickly, such as when online retailer Amazon .com is providing recommendations for additional products. Thus, Big Data, ranging from geospatial data to customer sentiments, can prove invaluable for formulating and executing an organization's strategy. Data are becoming increasingly abundant, yet many organizations find themselves unable to use these data to make sound business decisions; being able to ask the right questions and successfully utilize Big Data remains elusive for many organizations. Realizing the opportunities and challenges brought about by Big Data and its management, high-level company executives are increasingly focusing on designing an organization-wide data management strategy.

EFFECTIVE PLANNING IS CONTINUOUS. In the past, organizations lacked the necessary data and tools to continuously plan for their future. Typically, organizations would first develop a strategic plan for some planning cycle (say, a year); then, once a strategic plan was agreed on, managers of various business units would prepare budgets for executing their portion of the plan. These budgets were often "backward looking" because they were typically based on historical data rather than being based on a clear understanding of current conditions and forecasts of future trends. Over time, managers would then execute their portions of the plan. For many organizations, this method of planning and managing was adequate given the relatively slow pace of change.

Today, however, given the need to swiftly respond to a highly competitive and rapidly changing environment, organizations must implement new ways of planning. In fact, successful

GREEN IT

Big Data, Internet of Things, and Analytics Fuel Greener Facilities

Two megatrends, specifically Big Data and the Internet of Things (IoT), are transforming countless areas of business and society. One area that is being transformed through the use of Big Data and analytics is facilities management, an interdisciplinary business function that coordinates space, infrastructure, and people within an organization. Often associated with the administration of office blocks, arenas, schools, universities, sporting complexes, convention centers, shopping complexes, hospitals, hotels, or manufacturing and shipping, facilities management is big business, currently representing about 5 percent of global GDP.

Within a large building or campus of buildings, there are a variety of systems and components working together to light, heat, or cool the environment. For example, Microsoft's campus in the Puget Sound area consists of more than 100 separate buildings. In those buildings, there are more than 30,000 building systems components and more than 2 million points where building systems ranging from heating, ventilation, and air-conditioning (HVAC) to lighting to power monitoring are connected to sensors—i.e., each being a separate IoT device. In a 24-hour period, those systems produce more than a billion data points. These data provide the Big Data to fuel many analytical systems for better facilities operations and management.

For example, in addition to better management of heating and cooling, motion sensors can be used to identify underutilized space or to better organize departments so that collaboration can be enhanced. With such data, a facilities manager could identify the amount of employee time being wasted moving between different parts of a workspace and then use these insights to plan more efficient workspace layouts. Likewise, if rooms are underutilized, they could be repurposed for a more fitting use.

Ultimately, Big Data—generated through IoT and other sensors—holds great promise for identifying cost savings, preventing equipment failures, and conserving energy when managing facilities. Today, we are just beginning to understand how to optimize facilities management using such Big Data insights. Also, older buildings with old systems are only slowly being retrofitted with sensors to provide better business intelligence. However, in the future, when new buildings are designed and constructed, they will include a plethora of sensors, truly providing smart buildings for improved facilities management.

Based on:

Facility management. (2016, May 27). In *Wikipedia, The Free Encyclopedia*. Retrieved May 27, 2016, from https://en.wikipedia.org/w/index.php?title=Facility_management&oldid=722364047

Laughman, C. (2013, September). Microsoft uses Big Data to manage buildings. *Facilitiesnet.* Retrieved May 27, 2016, from http://www.facilitiesnet.com/energyefficiency/article/Microsoft-Uses-Big-Data-To-Manage-Buildings-Facilities-Management-Energy-Efficiency-Feature--14359

Patel, B. (2015, May/June). Technology and FM: The Internet of Things. *Facility Executive.* Retrieved May 27, 2016, from http://facilityexecutive.com/2015/05/the-internet-of-things

Spence, D. (2016, April 16). What FMs need to know about Big Data. *Office Space Software.* Retrieved May 27, 2016, from http://www.officespacesoftware.com/blog/what-fms-need-to-know-about-big-data

organizations are utilizing a **continuous planning process** (Figure 6.4). In a continuous planning process, organizations *continuously* monitor and analyze data and business processes; the results lead to ongoing adjustments to how the organization is managed, but these results are also reflected in ongoing updates to the organizational plans. It is only through timely and accurate insights gained from analyzing relevant data that continuous planning can be executed.

Responding to threats and opportunities and continuous planning are based on analyzing internal data (primarily from the operational level of the organization) as well as external data. In the next section, we describe how databases can be used to provide the necessary inputs to business intelligence and advanced analytics applications.

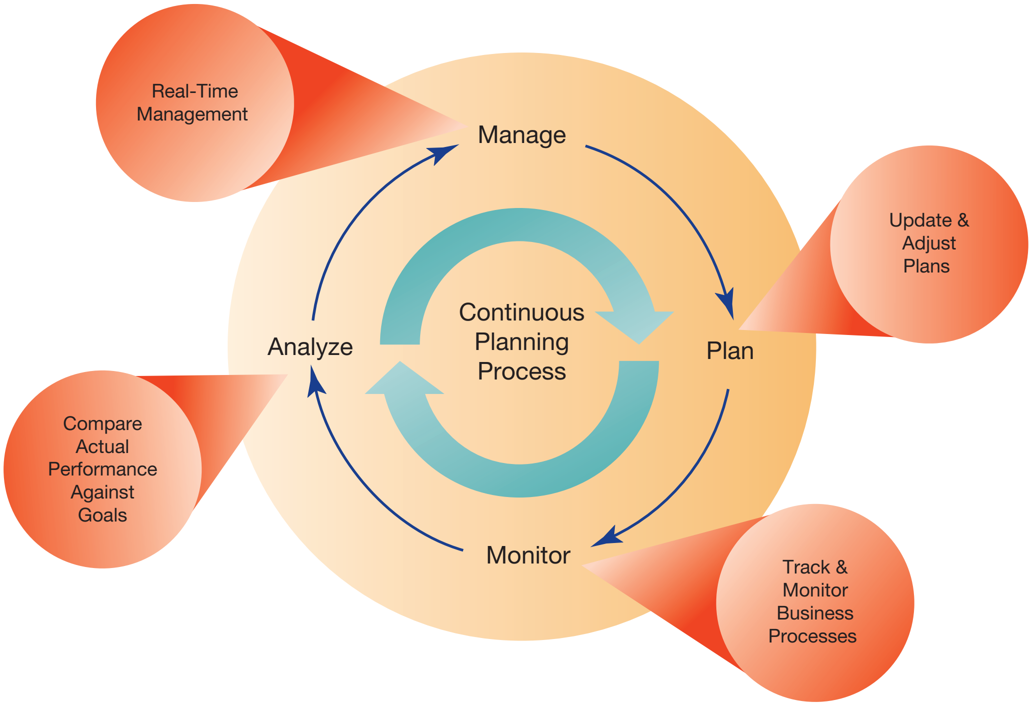
Databases: Providing Inputs into Business Intelligence and Advanced Analytics

Data and knowledge are probably among the most important assets an organization has, as both are essential for executing business processes, gaining business intelligence, and performing advanced analytics. Databases, which are collections of related data organized in a way that facilitates data searches, are vital to an organization's success.

For instance, databases are essential for maintaining customer records and supporting business processes such as sales transactions and tracking inventory but are also needed for marketing purposes, such as identifying target customers for personalized marketing communications. Additionally, database technology fuels electronic commerce, from tracking available products

FIGURE 6.4

Effective business planning is continuous.



for sale to providing customer service. Databases are a foundation of the digital world. Data about all the products that are available for sale at Amazon.com are stored in databases, and data about all the courses available at your university are stored in a database. While you may expect organizations to use a variety of databases, databases are also powering many of the apps you are interacting with daily on your personal devices. For example, data (such as storage location, ratings, or comments) about all of the songs in your iTunes library, together with your playlists, are stored in a database. Databases not only store data about products, courses, songs, and playlists, they also store the interrelationships between various things. For example, Amazon.com has databases that keep track of its millions of customers and other databases that keep track of the billions of sales transactions linking products to specific customers. Without databases, much of what we take for granted in the digital world would be impossible.

ENABLING INTERACTIVE WEBSITES USING DATABASES. In today's highly dynamic digital world, any organization engaged in e-commerce makes extensive use of databases to provide dynamic and customized content on their web pages. As described in Chapter 3, "Managing the Information Systems Infrastructure," actions such as people using an organization's website to view product catalogs, check inventory, and place orders all ultimately read from and write to the organization's databases. Similarly, data about products (name, description, dimensions, shipping weight, and so on) are stored in databases and dynamically inserted into a web page template, freeing the company from having to develop a separate web page for each individual product. For example, companies such as Amazon.com need only a few page templates for different product categories. Depending on what the user is looking for, these templates are then populated dynamically with the relevant product data that are pulled from a database; similarly, whenever a registered user places an order, the customer's billing and shipping information is retrieved from a database and displayed to the customer for confirmation.

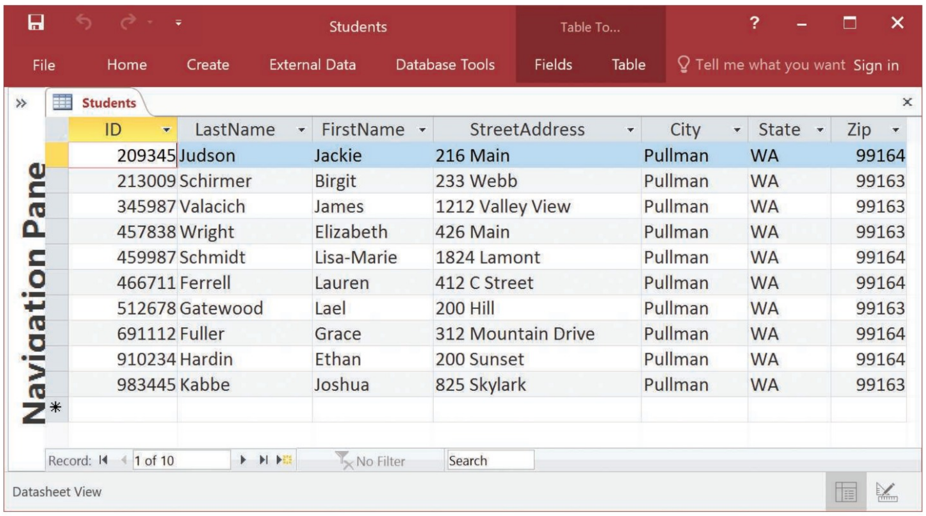
Some electronic commerce applications can receive and process millions of transactions per day. To ensure adequate system performance for customers, as well as to gain the greatest understanding of customer behavior, organizations must manage online data effectively. For example, Amazon.com, the world's largest bookstore, is open 24 hours a day, 365 days a year, and its servers log millions of transactions per day, with dozens of database reads and writes for every single transaction. This is but one example that shows that the key to effectively designing an online electronic commerce business is the effective management of online data. Beyond websites and e-commerce, it is important to stress that databases are at the heart of your university's student registration system, the inventory system at the local grocery store, Apple's iTunes store, and virtually anything

FIGURE 6.5

Computers make the process of storing and managing data much easier.

else you can think of that requires recording and analyzing large amounts of data. Next we examine some basic concepts, advantages of the database approach, and database management.

DATABASES: FOUNDATION CONCEPTS. The database approach dominates nearly all computer-based information systems used today. To understand databases, we must familiarize ourselves with some terminology. In Figure 6.5, we compare database terminology (middle column) with equivalents in a library (left column) and a business office (right column). We use database management systems (DBMSs, such as Microsoft Access, a popular DBMS for personal computers) to interact with the data in databases (see Chapter 3, “Managing the Information Systems Infrastructure and Services”). A DBMS is a software application with which you create, store, organize, and retrieve data from a single database or several databases. In the DBMS, the individual database is a collection of related attributes about entities. An **entity** is something you collect data about, such as people or classes (Figure 6.6). We often think of entities as **tables**, where each row is a **record** and each column is an **attribute** (also referred to as field). A record is a collection of related attributes about a single instance of an entity. Each record typically consists of many attributes, which are individual pieces of data. For example, a name and a Social Security number are attributes of a particular person.



ID	LastName	FirstName	StreetAddress	City	State	Zip
209345	Judson	Jackie	216 Main	Pullman	WA	99164
213009	Schirmer	Birgit	233 Webb	Pullman	WA	99163
345987	Valacich	James	1212 Valley View	Pullman	WA	99163
457838	Wright	Elizabeth	426 Main	Pullman	WA	99163
459987	Schmidt	Lisa-Marie	1824 Lamont	Pullman	WA	99164
466711	Ferrell	Lauren	412 C Street	Pullman	WA	99164
512678	Gatewood	Lael	200 Hill	Pullman	WA	99163
691112	Fuller	Grace	312 Mountain Drive	Pullman	WA	99164
910234	Hardin	Ethan	200 Sunset	Pullman	WA	99164
983445	Kabbe	Joshua	825 Skylark	Pullman	WA	99163

FIGURE 6.6

This sample data table for the entity *Student* includes 10 records and 7 attributes.

Source: Access 2016, Windows 10, Microsoft Corporation.

DATABASES: ADVANTAGES. Before the advent of DBMS, organizations used the file processing approach to store and manipulate data electronically. As data were usually kept in long, sequential computer files that were often stored on tape, data about entities often appeared in several different places throughout the information system; further, the data were stored along with and sometimes embedded within the programming code that used the data. People had not yet envisioned the concept of separately storing data about entities in non-redundant databases, so different files frequently contained repetitive data about a customer, a supplier, or another entity. When someone's address changed, it had to be changed in every file where it occurred, a tedious process. Similarly, if programmers changed the code, they had to change the corresponding data along with it. Further, the programmer would have had to know *how* the data were stored in order to make any changes. This was often no better than a pen-and-paper approach to storing data.

It is possible for a database to consist of only a single file or table. However, most databases managed under a DBMS consist of multiple tables or entities, often organized in several files. A DBMS can manage hundreds or even thousands of tables simultaneously by linking the tables as part of a single system. The DBMS helps us manage the tremendous volume and complexity of interrelated data so that we can be sure that the right data are accessed, changed, or deleted. For example, if a student or customer address is changed, that change is made through all the parts of the system where that data might occur. Using a database approach prevents unnecessary and problematic redundancies of the data, and the data are kept separate from the applications' programming code. This means that the database does not need to be changed if a change is made to an application. Consequently, there are numerous advantages to using a database approach to managing organizational data; these are summarized in Table 6.2.

DATABASES: TYPES. Traditionally, organizations have used **relational database management systems (RDBMSs)** to support their business processes. An RDBMS attempts to balance efficiency of storage needs, ease of retrieval, and other factors by storing data in tables linked via relationships. However, RDBMSs are not easily scalable in response to peaks in demand, as is often the case in data-intensive applications such as e-commerce and social media, and traditional RDBMSs may simply not be able to handle massive volumes of often-unstructured

TABLE 6.2 Advantages of the Database Approach

Advantages	Description
Minimal data redundancy	A single copy of data ensures that storage requirements are minimized.
Improved data consistency	Eliminating redundancy greatly reduces the possibilities of inconsistency.
Increased security	A centralized system makes it easier to enforce access restrictions.
Improved data quality	Centralized control, minimized redundancy, and improved data consistency help to enhance the quality of data.
Improved data accessibility and sharing	A centralized system makes it easier to deploy and control access for personnel within or outside organizational boundaries.
Enforcement of standards	A centralized system makes it much easier to enforce standards and rules for data creation, modification, naming, and deletion.
Program–data independence	It is much easier to evolve and alter software to changing business needs when data and programs are independent.
Increased productivity of application development	Data standards make it easier to build and modify applications.
Reduced program maintenance	Data changed in the central database is replicated seamlessly throughout all applications.

WHEN THINGS GO WRONG

Twitter Fever—Look Before You Tweet

Over the past several years, Twitter has successfully transformed both the ways of information transmission and the pulse of pop culture. Serving as a source of news for growing numbers of people, Twitter also works as a gathering place for expressing compassion, sharing grief, and supporting disaster relief efforts. When the rock star Prince died in 2016, for example, countless collaborators, friends, and well-known fans shared their sadness and memories over the tragic news. For example, actor Will Smith posted, "I am stunned and heartbroken. I just spoke with him last night. Today, Jada & I mourn with all of you the loss of a beautiful poet, a true inspiration, and one of the most magnificent artists to ever grace this earth." The speed at which the "Twitterverse"—the collective of members who use the social media platform—reacts to important events has transformed how people learn about and react to important events throughout the world.

Indeed, Twitter users' ability to post thoughts in small snippets (called tweets) allows quick and easy dissemination of content to a broad audience. A tweet cannot exceed 140 characters and can thus easily be read out of context; the sheer number of tweets, appearing at a rapid pace and often with little context, can easily result in endless confusion. Thanks to the network effect, Twitter has become capable of gathering momentum so quickly that it is sometimes difficult to differentiate between truth and fiction. And, because tweets can be sent so easily, often without a lot of thought by the sender, there are countless examples of so-called "dumb" tweets that instantly go viral. For example, Oprah Winfrey talked about her love of the Microsoft Surface tablet computer by tweeting: "Gotta say love that SURFACE! Have bought 12 already for Christmas gifts." The Twitterverse was quick to identify that her adoring tweet was sent from her iPad!

In a more serious problem, Twitterbots are causing confusion in the Twitterverse. A Twitterbot is a program used to produce automated posts or to automatically follow Twitter users. Twitterbots come in various forms. For example, many post clickbait, enticing clicks on promotional links. Others post replies or automatically "retweet" (i.e., forward) messages that include a certain word or phrase. Malicious Twitterbots follow the accounts of famous people who typically have millions of followers. In some macabre instances, the accounts of famous people who have passed away have been hijacked by bots, seemingly sending out messages from beyond the grave. In one instance, deceased journalist David Carr's account was hijacked by a so-called "porn bot" in 2016, changing the account's cover picture and sending out disturbing messages to Carr's followers. Twitter currently doesn't offer any access to the accounts of the deceased unless account credentials were given to friends or family members by the account owner prior to their death. However, family members can request to have an account deactivated. Otherwise, it continues to exist and can potentially be hacked. Many are discussing what is the most appropriate thing to do with the online accounts of the deceased. While there is no clear answer, it demonstrates some unintended consequences that occur in the digital world.

When properly used for good, Twitter is undoubtedly a meaningful platform for reaching out to people. Sometimes, however, people seem to retweet first and ask questions later; it may be better to do "due diligence" and try to Google a topic first to ensure that it indeed is true before retweeting. Also, if you follow some famous people on Twitter, if you get a crazy message from them, it *may* be from a bot.

Based on:

David Carr (journalist). (2016, April 11). In *Wikipedia, The Free Encyclopedia*. Retrieved May 26, 2016, from https://en.wikipedia.org/w/index.php?title=David_Carr_(journalist)&oldid=714740240

Fee, R. (2015, August 18). 20 of the dumbest celebrity Tweets of all times, Vol. 2. *Mandatory*. Retrieved May 26, 2016, from http://www.mandatory.com/2015/08/18/20-of-the-dumbest-celebrity-tweets-of-all-time-vol-2

Golding, S. (2016, April 21). When doves cry: Celebrities react on Twitter to Prince's untimely death. Retrieved May 26, 2016, from http://www.vibe.com/2016/04/twitter-reacts-prince-death

Twitter. (2016, May 25). In *Wikipedia, The Free Encyclopedia*. Retrieved May 26, 2016, from https://en.wikipedia.org/w/index.php?title=Twitter&oldid=722022910

Twitterbot. (2016, May 25). In *Wikipedia, The Free Encyclopedia*. Retrieved May 25, 2016, from https://en.wikipedia.org/w/index.php?title=Twitterbot&oldid=721939432

Big Data. For example, fueled by the megatrends Internet of Things (IoT), mobile, and social, various types of data are now generated by countless sensors and millions of users. Further, as RDBMSs tend to be highly complex, any changes need to be carefully planned and managed, potentially reducing the agility of a business. To overcome these limitations, a new breed of database management systems, called *NoSQL*, is increasingly becoming popular. **NoSQL** databases such as Amazon.com's SimpleDB are highly scalable, as they can be distributed across multiple machines, which works especially well in a cloud computing infrastructure. The ability to use not only a single computer but also a distributed computing environment, dividing the processing tasks among hundreds or thousands of machines and using frameworks such as Apache Hadoop (see the Technology Briefing), is key for handling and processing Big Data. Further, NoSQL databases often offer much flexibility in the types of data they can handle (such as comments of various lengths made by Facebook users or audio or video data). However, implementing NoSQL databases comes at a cost, as they are still in their early stages of development; thus, some needed features may be lacking, and it may be difficult to find experienced NoSQL developers.

DATABASES: EFFECTIVE MANAGEMENT. Now that we have outlined why databases are important to organizations, we can talk about how organizational databases can be managed effectively. The best database in the world is no better than the data it holds. Conversely, all the data in the world will do you no good if they are not organized in a manner in which there are few or no redundancies and in which you can retrieve, analyze, and understand them. The two key elements of an organizational database are the data and the structure of those data. The structure of the data is typically captured in a **data model**, that is, a map or diagram that represents entities and their relationships. Further, the structure of the data is documented to facilitate management of the database.

Each attribute in the database needs to be of a certain type. For example, an attribute may contain text, numbers, or dates. This **data type** helps the DBMS organize and sort the data, complete calculations, and allocate storage space. If tables are designed correctly, they will be easier to update, and it will be faster to extract vital information to improve an organization's business intelligence capabilities.

Once the data model is created, the format of the data is documented in a **data dictionary**. The data dictionary (or metadata repository) is a document explaining several pieces of metadata for each attribute, such as its name, the type of data expected (dates, alphanumeric, numbers, and so on), and valid values. Data dictionaries can include information such as why the data item is needed, how often it should be updated, and on which forms and reports the data appear.

Data dictionaries often include **business rules**—that is, the policies by which a business runs—which help to prevent illegal or illogical entries from entering the database. For example, designers of a warehouse inventory database could capture a rule in the data dictionary to prevent an invalid ship date for a future order from being entered into the database. Although NoSQL databases may not be as rigid as RDMBSs or may not enforce business rules at all (leaving the enforcing to applications), it is wise to create data models and to consider what data will be captured, how the data will be related, and what rules should be enforced.

Master Data Management To make sound operational, tactical, and strategic business decisions, it is imperative that decisions made in different departments are based on the same underlying data, definitions, and assumptions—that is, there is a "single version of the truth." For example, do the marketing and accounting departments have the same definitions of a customer or a sale? Does a "customer" entail anyone who may be interested in the company's product or service (marketing view) or only those who actually made a purchase (accounting view)? Part of creating a single version of the truth is **master data management**. **Master data** are the data deemed most important in the operation of a business. Typically shared among multiple organizational units, master data include data about customers, suppliers, inventory, employees, and the like. You can think of master data as the "actors" in an organization's transactions; for example, a *customer* purchases something, an *employee* is paid, and so on. Given the importance of an organization's master data, master data management is a management- rather than a technology-focused issue, as different business units and different corporate levels have to come to consensus on the meaning of master data items or on how to deal with duplicates. Especially for large organizations, arriving at a single version of the truth can be a challenge, as master data often have to be integrated from multiple systems. Likewise, after mergers or acquisitions, organizations have to try to consolidate the master data from two or more companies. Once the meaning and format of the master data have been agreed on, business intelligence applications can base their analyses on the single version of the truth.

ENTERING AND QUERYING DATA. At some point, data must be entered into the database. Traditionally, a clerk or other data entry professional would create records in the database by entering data. These data may come from telephone conversations, preprinted forms that must be filled out, historical records, or electronic files. Today, much organizational data are captured electronically, as is the case with a user's input in a web form; whenever you place an order on the web, sign up for a newsletter, or respond to an online survey, your input is directly stored

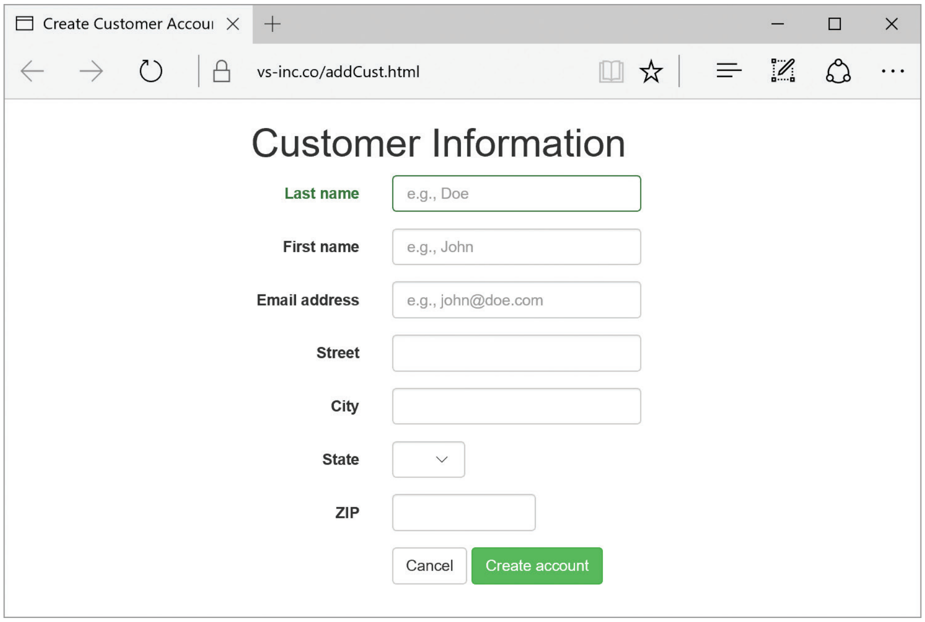


FIGURE 6.7

A computer-based form used for entering customer information.

in a database. A **form** (Figure 6.7) typically has blanks where the user can enter data or make choices, each of which represents an attribute within a database record (such as the user's first name, last name, gender, and so on). A form should be organized in an intuitive way so that the user can easily see the required items and enter the data. Forms are often used to capture data to be added, modified, or deleted from the database (e.g., for modifying your password or removing your old shipping address on Amazon.com). Further, in today's dynamic environment, data are increasingly generated and captured automatically. For example, capturing transactional data from a point-of-sale terminal or entering sensor data from smartphones or IoT devices requires no human intervention; likewise, autonomous agents (discussed later) can collect various data that are published on the web or posted in social media.

To retrieve data from a database, we use a **query**. In fact, whenever a web page is dynamically populated with content, a query is executed to retrieve the data from a database. The most common language used to interface with RDBMSs is **Structured Query Language (SQL)**. Figure 6.8 is an example of an SQL statement that an online bookstore would use to retrieve the information needed to populate a summary page containing all books written by the first author of this textbook, sorted by publication date. Writing SQL statements can be difficult, especially when you are dealing with complex databases with many entities or when you are writing complex queries with multiple integrated criteria—such as adding numbers while sorting on two different attributes. Many desktop DBMS packages provide graphical user interfaces, where the user can pick the desired data from the database to create queries quickly and easily (Figure 6.9).

AD HOC QUERIES AND REPORTS. Business users across an organization need the right information at the right time; thus, in order to support decision making, the results of queries are typically presented in the form of reports. A **report** is a compilation of data from the database that is organized and displayed to the user (either on screen or on paper). Sophisticated **report generators** and analysis tools such as Crystal Reports or Tableau can help users to quickly

```
SELECT AUTHOR, TITLE, PUBLICATION_DATE, PRICE
FROM BOOKS
WHERE AUTHOR="VALACICH"
ORDER BY PUBLICATION_DATE;
```

FIGURE 6.8

This sample SQL statement would be used to retrieve the information needed to populate a summary web page containing all books written by the first author of this textbook, sorted by publication date.

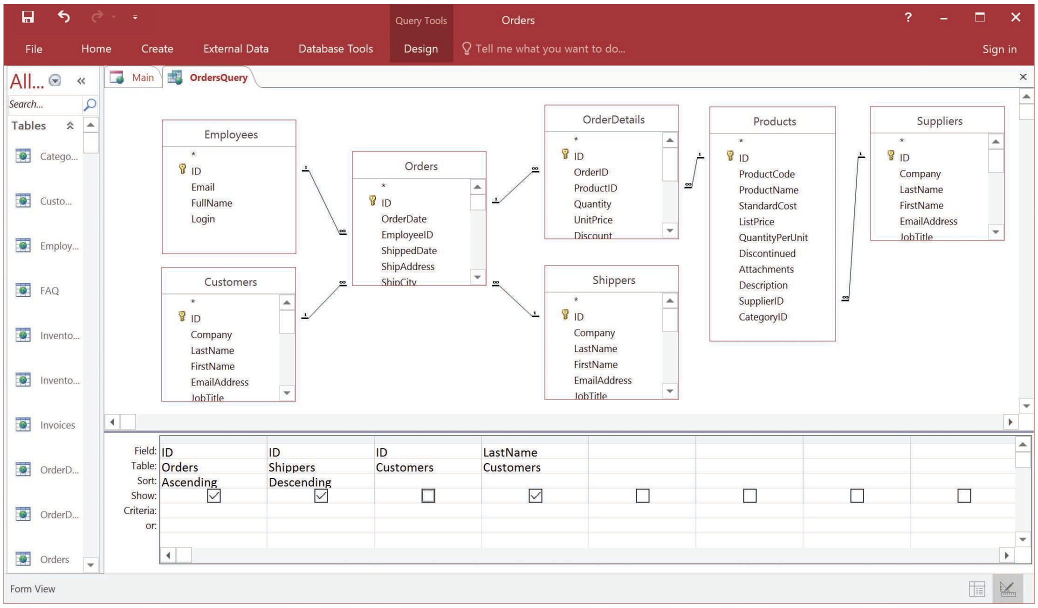


FIGURE 6.9

Microsoft Access provides a graphical user interface to let users select the required data.

Source: Access 2016, Windows 10, Microsoft Corporation.

build interactive reports and visualizations to present data in a useful format and help business users make sense of large amounts of data that are typically stored in organizational databases. Reports can take the form of **scheduled reports**, **drill-down reports**, **exception reports**, and **key-indicator reports** (Table 6.3) (as discussed in Chapter 2, key performance indicators are the metrics deemed most critical to assessing progress toward a certain goal). These reports are either produced at prespecified intervals or created whenever a prespecified event happens; often, this is combined with automated alerts if certain thresholds are reached. However, decision makers frequently have information needs that are unforeseen and may never arise again. In such instances, the users need to run **ad hoc queries** (i.e., queries created because of unplanned information needs that are typically not saved for later use). Ad hoc query tools provide an easy-to-use interface, allowing managers to run queries and reports themselves without having to know query languages or the structure of the underlying data. Installed on a person's desktop, notebook computer, or mobile device, these tools can be used to run queries and reports whenever an unplanned information need arises without having to resort to calling the IS department for help in creating a complex query or a special report.

ONLINE TRANSACTION PROCESSING. The systems that are used to interact with customers and run a business in real time are called **operational systems**. Examples of operational systems are sales order processing and reservation systems. As fast customer response is fundamental to having a successful Internet-based business, immediate automated responses to the requests of

TABLE 6.3 Common Reports and Queries

Report/Query	Description
Scheduled reports	Reports produced at predefined intervals—daily, weekly, or monthly—to support routine decisions
Key-indicator reports	Reports that provide a summary of critical metrics on a recurring schedule
Exception reports	Reports that highlight situations that are out of the normal range
Drill-down reports	Reports that provide greater detail, so as to help analyze why a key indicator is not at an appropriate level or why an exception occurred
Ad hoc queries	Queries answering unplanned information requests to support a nonroutine decision; typically not saved to be run again

users are required. **Online transaction processing (OLTP)** systems provide this and are designed to handle multiple concurrent transactions from customers. Typically, these transactions have a fixed number of inputs, such as order items, payment data, and customer name and address, and specified outputs, such as total order price or order tracking number. Common transactions include updating customer data, processing orders, and generating sales receipts. Consequently, OLTP is a big part of interactive electronic commerce applications. Because customers can be located virtually anywhere in the world, it is critical that transactions be processed efficiently. The speed with which OLTP systems can process transactions is, therefore, an important design decision. In addition to which technology is chosen to process the transactions, how the data are organized in the database is also a major factor in determining system performance.

Although the database operations behind most transactions are relatively simple, designers often spend considerable time making adjustments to the database design in order to "tune" processing for optimal system performance. Once an organization has all these data, it must design ways to gain the greatest value from its collection; each individual OLTP system could be queried individually, but the real power for an organization comes from analyzing the aggregation of data from different systems using methods such as online analytical processing (discussed later).

OPERATIONAL AND INFORMATIONAL SYSTEMS. Operational systems can generate a wealth of data that can serve as useful inputs into business intelligence and advanced analytics applications. For example, a grocery checkout system processes a specific transaction (the purchase) that can be linked to an inventory system (for reordering purposes), but it can also capture valuable data such as time of the purchase, items purchased together, form of payment, or loyalty program details. Coupled with external data (such as store location, weather data, or competitor information), these data can be analyzed for spending patterns, effectiveness of sales promotions, or customer profiling.

Systems designed to support decision making based on stable point-in-time or historical data are called **informational systems**. The requirements for designing and supporting operational and informational systems are quite different (Table 6.4). In a distributed online environment, performing real-time analytical processing diminishes the performance of transaction processing. For example, complex analytical queries require the locking of data resources for extended periods of execution time, whereas transactional events—data insertions and simple queries from customers—are fast and can often occur simultaneously; further, the operational databases typically only contain current data. Thus, a well-tuned and responsive transaction processing system may have uneven performance for customers while analytical processing occurs. As a result, many organizations replicate all transactions on a second database server so that analytical processing does not affect transaction processing performance. This replication typically occurs in batches during off-peak hours, when site traffic volumes are at a minimum. However, especially for situations where real-time analytics is needed (such as fraud detection), even a few hours' delay is unacceptable. Therefore, modern database management systems provide real-time operational analytics—allowing OLTP and analytics to be performed simultaneously—for the analysis of data coming from a single data source (such as an organization's ERP system).

TABLE 6.4 Comparison of Operational and Informational Systems

Characteristic	Operational System	Informational System
Primary purpose	Run the business on a current basis	Support managerial decision making
Type of data	Current representation of state of the business	Historical or point-in-time (snapshot)
Primary users	Online customers, clerks, salespersons, administrators	Managers, business analysts, and customers (checking status and history)
Scope of usage	Narrow and simple updates and queries	Broad and complex queries and analyses
Design goal	Performance	Ease of access and use

TABLE 6.5 Sample Industry Uses of Data Warehousing

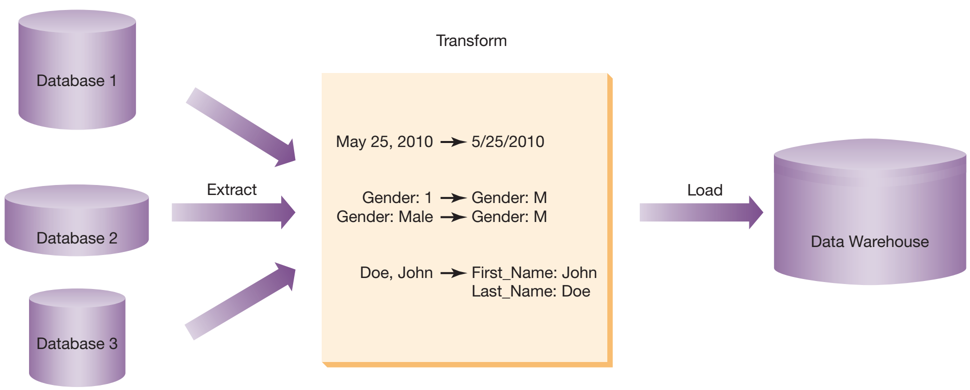
Uses of Data Warehousing	Representative Companies
Analysis of scanner checkout data	Safeway
Tracking, analysis, and tuning of sales promotions and coupons	Costco, CVS Corporation
Frequent customer program management	Target, United Airlines
Profitability analysis and market segmentation	Walgreens, Toyota
Product promotions for focused market segments	Walmart, Williams-Sonoma
Cross-segment marketing	Citigroup
Risk and credit analysis	HSBC
Customer profiling	Morgan Stanley

DATA WAREHOUSES. For many complex analyses, however, data from various sources are needed. Therefore, large organizations, such as Walmart, UPS, and Alaska Airlines, have built **data warehouses** that integrate multiple large databases and other data sources into a single repository. Such a repository, containing both historic and (almost) current data for analysis and reporting, is suitable for direct querying, analysis, or processing. Much like a physical warehouse for products and components, a data warehouse stores and distributes data on computer-based information systems. A data warehouse is a company's virtual storehouse of valuable data from the organization's disparate information systems and external sources. It supports the analysis of sales, inventory, and other vital business data that have been culled from operational systems. The purpose of a data warehouse is to put key business information into the hands of more decision makers, and an organization that successfully deploys a data warehouse has committed to pulling together, integrating, and sharing critical corporate data throughout the firm. Table 6.5 lists sample industry uses of data warehouses. Data warehouses can take up hundreds of gigabytes (even terabytes) of data. They usually run on fairly powerful mainframe computers and can cost millions of dollars.

While no changes to the existing, historical data contained in the data warehouse are made, the data in a data warehouse are periodically appended with "new" data from operational systems. Consequently, a crucial process for consolidating data from operational systems with other organizational data (to facilitate the use of data mining techniques to gain the greatest and broadest understanding from the data) is **extraction, transformation, and loading**. First, the data need to be extracted from various different source systems. In the transformation stage, data are being cleansed and manipulated to fit the needs of the analysis (such as by creating new calculated fields or summary values). **Data cleansing** refers to the process of detecting, correcting (e.g., standardizing the format), or removing corrupt or inaccurate data retrieved from different source systems (such as differences in the way dates or ZIP codes are stored). Finally, the transformed data are loaded into the data warehouse and are ready for being used for complex analyses (Figure 6.10).

FIGURE 6.10

Extraction, transformation, and loading are used to consolidate data from operational systems into a data warehouse.



COMING ATTRACTIONS

Emotion Aware Gaming

Imagine playing a video game that seems to be able to read your mind or at least know when you are confident or when you are scared. And, depending upon how you are feeling, it would adapt to either make things easier or tougher on you. Affectiva, a Boston area tech company, is using a webcam to capture a person's facial expression and uses complex algorithms to interpret how the person is feeling while playing a video game. With this information, game designers are able to adjust the level of play. In a recently released psychological thriller game called *Nevermind,* the technology makes the game harder when players are more frightened or more anxious. For example, the game will unexpectedly introduce a stressful challenge, such as trapping a player in a threatening environment, forcing the player to maintain calm as he or she plays the way to safety.

To build their technology, Affectiva's researchers have studied the faces of millions of people from throughout the world, asking them to watch videos and mapping how different people's faces change while different types of videos are watched. In addition, they are researching how changes in heart rates align with changes in facial expressions. Affectiva's researchers have collected more than 40 billion data points for interpreting emotion from a person's face—a true Big Data problem. While video games are designed to take players on an emotional journey, they have not been able to adapt to changes in a player's emotional state. With its emotion-sensing technology, Affectiva hopes to design more immersive games. The application of this technology can be used far beyond video games and can be extremely useful for understanding how people are feeling when watching movies, political candidates, and advertising.

Based on:

Affectiva. (2016). Retrieved May 25, 2016, from http://www.affectiva.com

Subbaraman, N. (2016, March 1). Affectiva teams up with developers to make video games that know your feelings. *The Boston Globe.* Retrieved May 25, 2016, from http://www.betaboston.com/news/2016/03/01/affectiva-teams-up-with-developers-to-make-video-games-that-know-your-feelings

DATA MARTS. Rather than storing all enterprise data in one data warehouse, many organizations have created multiple data marts, each containing a subset of the data for a single aspect of a company's business, such as finance, inventory, or personnel. A **data mart** is a data warehouse that is limited in scope. It contains selected data from the data warehouse such that each separate data mart is customized for the decision support needs of a particular end-user group. As a data mart only contains the data needed by a limited segment of users (as opposed to a company-wide data warehouse), it is typically easier to query and reduces the time needed to perform analytical queries. Data marts have been popular among small and medium-sized businesses and among departments within larger organizations, all of which were previously prohibited from developing their own data warehouses because of the high costs involved.

Data marts typically contain tens of gigabytes of data as opposed to the hundreds of gigabytes in data warehouses. Therefore, data marts can be deployed on less powerful hardware. The difference in costs between different types of data marts and data warehouses can be significant. The cost to develop a data mart is typically less than US$1 million, while the cost for a data warehouse can exceed US$10 million. However, with the advent of cloud computing, several vendors are offering data warehousing as a service, which can help to significantly lower the company's initial investment (see Chapter 3); similarly, companies such as SAP are offering on-demand business intelligence as a service.

Business Intelligence and Advanced Analytics

Various different vendors offer a wide variety of tools for decision support; such tools are often classified as business intelligence and advanced analytics applications. Typically, business intelligence tools provide decision support by enabling business users to perform analyses to obtain an understanding what *has* happened. Advanced analytics tools, in contrast, provide decision support by enabling business users as well as business analysts and data scientist to gain a deeper understanding of *why* things happened and to build predictive models. Although each type of application by itself can be valuable to an organization, it is their convergence that enables organizations to gain and sustain competitive advantage through enhanced decision making. In the following sections, we discuss these categories as well as the various systems and technologies that each encompasses.

Business Intelligence

Business intelligence tools are used by business users to analyze both structured and unstructured data to obtain an understanding of current and past performance, helping to guide planning processes. Given vast amounts of data, business intelligence tools help users perform analyses and interpret data. In the following sections, we describe some of these applications.

DECISION SUPPORT SYSTEMS. Traditionally, organizations used **decision support systems (DSSs)** to analyze structured data and support their decision making. DSSs are often used by managerial-level employees to help them solve problems such as sales forecasting or resource optimization, yet DSSs can be used to support decisions at virtually all levels of the organization. A DSS is designed to be an "interactive" decision aid that uses **models** to manipulate data. For example, if you have some historic sales data, you can use many different types of models to create a forecast of future sales. One technique is to take an average of past sales and adjust it for seasonal changes. The formula you would use to calculate and adjust the average is the model. A more complicated forecasting model might use time-series analysis or linear regression.

Using such models, DSSs can augment human decision-making performance and problem solving by enabling managers to perform "what-if" analyses to examine alternative solutions to a problem. A **what-if analysis** allows users to make hypothetical changes to the data associated with a problem (e.g., loan duration or interest rate) and observe how these changes influence the results. For example, a cash manager for a bank could examine what-if scenarios modelling the effects of various interest rates on cash availability. Some types of problems utilize a variety of input variables that each may have a different likelihood of occurring (e.g., there is a 25 percent likelihood that inflation will stay the same and a 75 percent likelihood that inflation will increase). Sensitivity analysis allows to understand how different input values and their probability of occurring (e.g., rate of inflation and its probability of occurring) will affect the results of a model. Similarly, goal-seeking analyses help in determining how input parameters need to be changed to achieve a desired end state. Finally, optimization models allow finding the best balance between certain parameters within given constraints. Together, DSSs provide managers with various decision analysis tools to either analyze data or create meaningful information to support the decision making related to a variety of organizational problems. See Table 6.6 for a summary of the ways organizations can use DSS to support decision making in organizations. While DSSs are useful for supporting a variety of managerial decisions, they are typically limited to relatively simple analyses of structured data, typically from transaction processing systems.

TABLE 6.6 Common DSS Uses for Specific Organizational Areas

Area	Common DSS Uses
Corporate level	Corporate planning, venture analysis, mergers and acquisitions
Accounting	Cost analysis, breakeven analysis, auditing, tax computation and analysis, depreciation methods, budgeting
Finance	Discounted cash flow analysis, return on investment, buy or lease, capital budgeting, bond refinancing, stock portfolio management, compound interest, after-tax yield, foreign exchange values
Marketing	Product demand forecast, advertising strategy analysis, pricing strategies, market share analysis, sales growth evaluation, sales performance
Human resources	Employee business expenses, fringe benefit computations, payroll and deductions
Production	Production scheduling, transportation analysis, product mix, inventory levels, quality control, plant location, material allocation, maintenance analysis, machine replacement, job assignment, material requirements planning

ONLINE ANALYTICAL PROCESSING. **Online analytical processing (OLAP)** refers to the process of quickly conducting complex, multidimensional analyses of data stored in a database that is optimized for retrieval, typically using graphical software tools. OLAP tools enable users to perform ad hoc analyses of different dimensions of data beyond simple data summaries and data aggregations of normal database queries. A typical question asked would be "What were the profits for each week in 2018 by sales region and customer type?" In contrast to relatively simple queries on two-dimensional tables, running such multidimensional queries requires a deeper understanding of the underlying data. Given the high volume of transactions within Internet-based systems and the potential business value in the data, business intelligence tools must provide extensive OLAP capabilities to business users. The chief component of an OLAP system is the **OLAP server**, which understands how data are organized in the database and has special functions for analyzing the data. The use of dedicated databases allows for tremendous increases in retrieval speed. In the past, multidimensional queries against large transactional databases could take hours to run; in contrast, OLAP systems pre-aggregate data so that only the subset of the data necessary for the queries is extracted, greatly improving performance. Given the decrease in cost of random access memory (RAM, see the Technology Briefing), a recent trend is **in-memory computing**, where the data are stored in a computer's main memory rather than on a comparatively slow hard drive, removing the bottlenecks associated with reading and writing data. Further, using in-memory computing for both transaction and analytical processing can help provide answers to questions as they arise and enable making business decisions based on real-time data.

Measures and Dimensions Whenever a business transaction occurs, associated data can be stored and then analyzed from a variety of perspectives. To facilitate efficient processing of transactions, databases supporting online transaction processing systems treat all data in similar ways. In contrast, OLAP systems are designed for efficient retrieval of data and categorize data as measures and dimensions. **Measures** (or sometimes called **facts**) are the values or numbers the user wants to analyze, such as sales revenues or the number of orders placed. **Dimensions** provide a way to summarize the data, such as region, time, or product line. Thus, sales revenue (a measure) could be analyzed by product, time (year, quarter, or week), geographical region, or distributor (the dimensions). To enable the analysis of data at more or less detailed levels, the dimensions are organized as hierarchies (such as in year, quarter, month, or day). For example, when analyzing sales by geographical regions, a user can **drill down** from state, to county, to city, or to the individual store location or **roll up** from state to sales region (northwest, south, southeast, and so on), to country, or to continent.

Cubes, Slicing, and Dicing To enable such multidimensional analyses, OLAP arranges the data in so-called cubes. An **OLAP cube** is a data structure allowing for multiple dimensions to be added to a traditional two-dimensional table (Figure 6.11). Although the figure only shows three dimensions, data can be analyzed in more than three dimensions. Analyzing the data on subsets of the dimensions is referred to as **slicing and dicing**. For example, a slice may show sales by product type and region only for the second quarter of 2018. Another slice may only show sales for desktops in the western region (Figure 6.12).

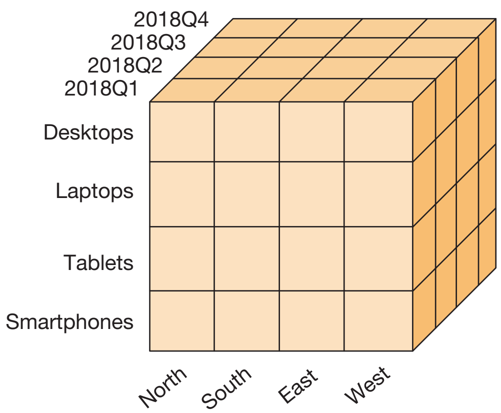


FIGURE 6.11

An OLAP cube allows for analyzing data by multiple dimensions.

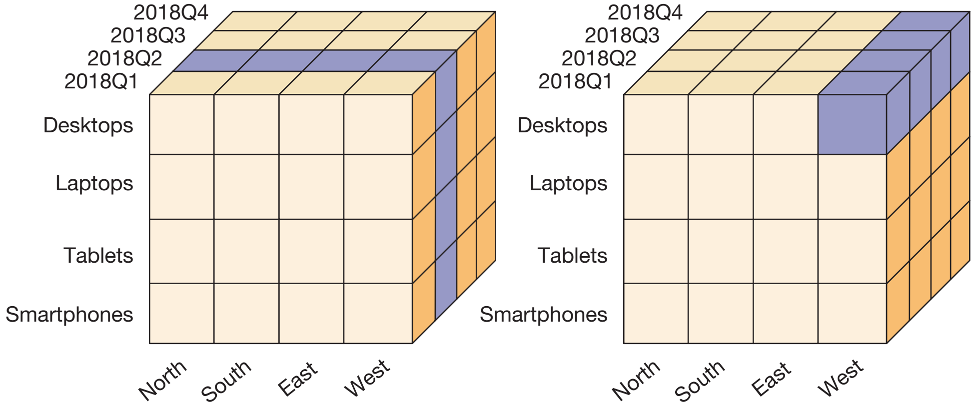


FIGURE 6.12

Slicing and dicing allows for analyzing subsets of the dimensions.

INFORMATION VISUALIZATION. In addition to allowing business users to perform various queries and analyses, an important aspect of business intelligence applications is information visualization. **Visualization** refers to the display of complex data relationships using a variety of graphical methods, enabling managers to quickly grasp the results of the analyses.

Digital Dashboards **Digital dashboards** are commonly used to visually present key performance indicators and other summary information used by managers and executives to make decisions. To provide the greatest benefits for decision makers, digital dashboards typically support three usage models: push reporting, exception reporting and alerts, and pull reporting. Digital dashboards not only provide the decision makers with a quick, visual overview of key performance indicators and other key operational statistics and trends (i.e., push reporting) but also alert the user of any items that require immediate attention (i.e., exception reporting and alerts); if the user wants to analyze the root causes of an exception or perform other analyses, he or she can drill down or perform self-service ad hoc queries (i.e., pull reporting).

Digital dashboards (sometimes called executive dashboards) provide top-level managers with the needed information to support business processes, such as cash and investment management, resource allocation, and contract negotiation. Typically, executives require information presented in a highly aggregated form so that they can scan information quickly for trends and anomalies (Figure 6.13).

Although data are typically provided in a highly aggregated form, the executive also has the capability to drill down and see the details if necessary. For example, suppose a digital dashboard summarizes profits by states. If the executive wants to get a deeper understanding about a particular state, a selection on the screen can provide the details behind the aggregate. By drilling down into the data, the executive can see that the majority of the profits were made in a particular region or city or even store. Also, the information provided can be easily shared throughout the organization so that the executive can quickly send a message to the appropriate managers to discuss solutions to the problem discovered in the drill-down.

Dashboards make use of a variety of design elements to present the data in the most user-friendly way. To highlight deviations that need to be addressed or to symbolize changes over time, dashboards use maps, charts, spark lines, or graphics symbolizing traffic lights, thermometers, or speedometers (Figure 6.14); conditional formatting is often used to highlight exceptions and draw the user's attention to deviations from the normal course of business.

One recent trend influencing the design of dashboards is mobile business intelligence. With the advances in mobile communication technology, today's executives want to be in touch with their organizational performance anytime, anywhere. Further, most of today's knowledge workers are increasingly mobile in terms of the device they're using—during a workday, one may use a desktop computer, a laptop, a smartphone, or an iPad. Hence, dashboard vendors are offering solutions for multiple devices and screen sizes so that each user can get the most current information regardless of location and device used, facilitating business decisions based on real-time data (Figure 6.15).

One of the growing trends of mobile business intelligence (BI) is the use of location data that can easily be gained from GPS or Wi-Fi networks. This capability can be an important part

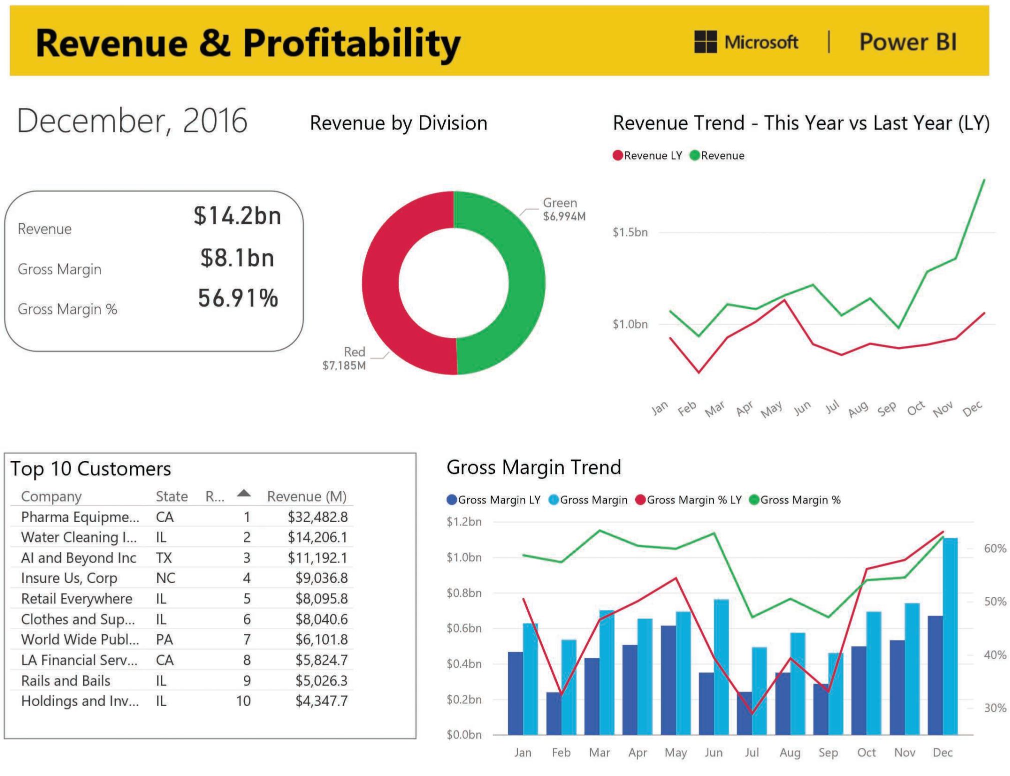


FIGURE 6.13

A digital dashboard presents information in a highly aggregated form, enabling executives to scan information quickly for trends and anomalies.

Source: Power BI 2016, Windows 10, Microsoft Corporation.

of an innovative BI solution because location-relevant information can be delivered to the device based on its location. For example, details about particular people, such as customers, colleagues, and staff, within a particular vicinity can be sent to the device in addition to location-specific reports. With such capabilities, the mobile device uses its data generation capabilities to enhance the intelligence of the user.

Visual Analytics As discussed in previous sections, business intelligence systems can provide business decision makers with a wide variety of analyses to support decision making. However, in the end, it is still the humans who have to interpret the output from these systems. With the growing complexity of the underlying data (such as multiple dimensions, including spatial dimensions), interpreting the outputs becomes extremely

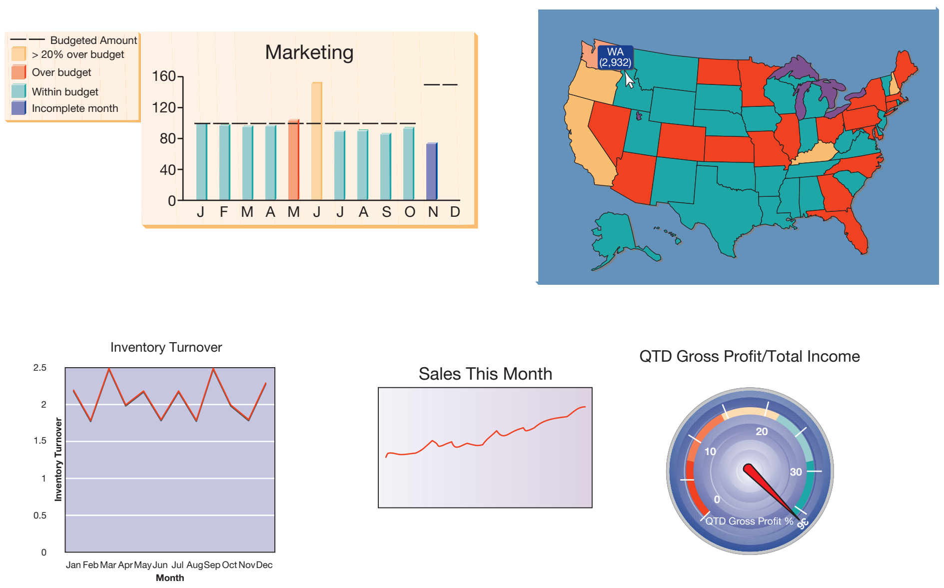


FIGURE 6.14

Dashboards use various graphical elements to highlight important information.

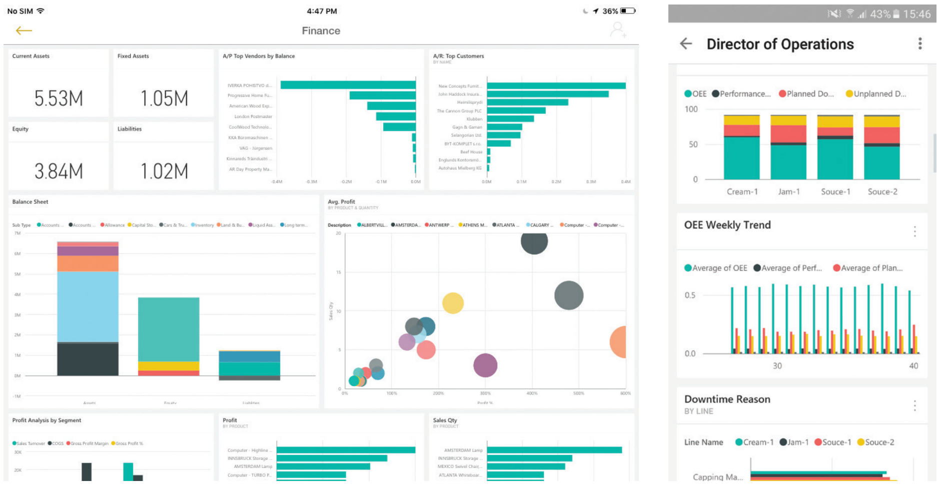


FIGURE 6.15

Mobile business intelligence can provide executives with relevant information regardless of location and device.

Source: Power BI 2016, Windows 10, Microsoft Corporation.

challenging. **Visual analytics** (sometimes called **visual data discovery**) is the combination of various analysis techniques and interactive visualization to solve complex problems. By combining human intelligence and reasoning capabilities with technology's retrieval and analysis capabilities, visual analytics can help in decision making, as the strengths of both the human and the machine are merged. With the humans' ability to make sense of "noisy" data, unexpected patterns or relationships in the data can be discovered, and results of complex queries can be quickly interpreted. Visual analytics is used in a variety of settings, ranging from homeland security to disaster relief. For example, making sense of tabular data about the strength of a hurricane (including information about location of clouds, etc.) is nearly impossible. Figure 6.16 shows the visualization of a hurricane as it is gaining strength. The image shows towering thunderclouds (in red), called hot towers, that were spotted just before the hurricane intensified to a Category 5 hurricane. Once the hurricane is represented visually, analysts can view changes over time to better understand its behavior. In similar ways, organizations around the world are utilizing visualization technologies to enhance business intelligence.

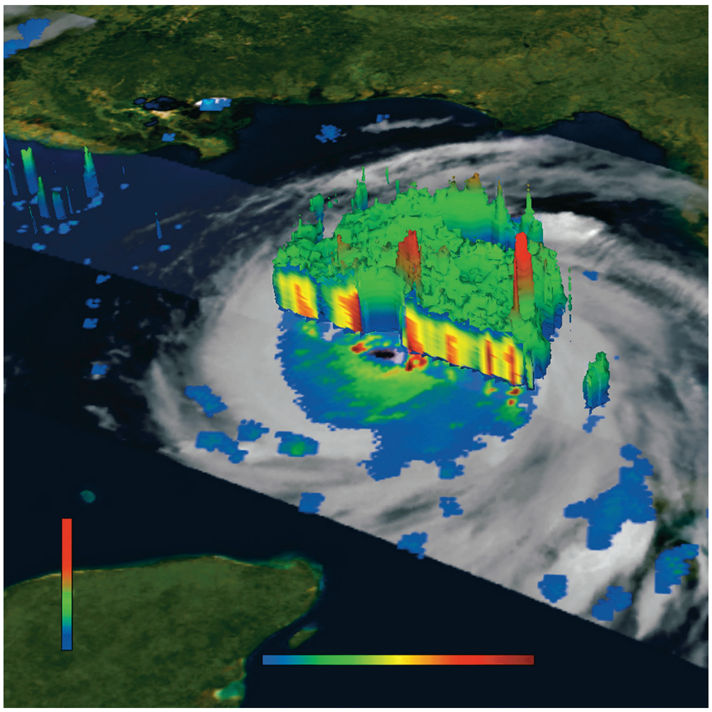


FIGURE 6.16

Visual analytics can help making sense of complex data relationships using a variety of graphical methods.

Source: NASA.

WHO'S GOING MOBILE

Identifying Malaria Hotspots

A hotspot is a place of significance—whether it be a place for commerce or a place that is popular for dining and dancing. When we think about mobile technology and hotspots, we tend to think of busy places with free public access to Wi-Fi. Such Wi-Fi hotspots are often located where people gather together such as airports, train stations, libraries, convention centers, coffee shops, and hotels. Because hotspots are often surrounded by a large and dynamic number of individuals, researchers can use them to study a broad range of topics ranging from crowd movements to fashion and entertainment trends. To aid in this work, researchers have also created algorithms for estimating the number of people in a room that cannot be seen or even the number of people in a large crowd by analyzing the number of smartphone devices with their Wi-Fi antenna turned on within a given area. In the United States and in much of the developed world, there are lots of restrictions related to cell phone tracking due to numerous privacy concerns, but there are currently no laws restricting the tracking of devices connected to Wi-Fi. While using such techniques to estimate the number of people cannot lead to a *perfect* measure—as researchers have to make assumptions about the number people without devices, the number with Wi-Fi turned off, and even those with more than one device—it allows for a pretty good estimate. With a good estimate of the total number of people, forecasts of various things can be made based on random sampling and knowing the population size.

In rural Africa, however, such Wi-Fi hotspots are not prevalent, but cell towers are. In contrast to much of the developed world, many parts of the developing world allow cell phone tracking either through agreements with wireless providers or with local governments. While privacy concerns remain, researchers are using cell phone tracking data to study various health and infrastructure issues. Because many of these regions do not have complete wireless coverage, individuals intentionally travel near cell towers in order to be able to make calls or send and receive messages. Thus, in many ways, a cell tower is a bigger version of the popular Wi-Fi hotspots we have all become accustomed to utilizing through our daily routines. When a mobile phone is within range of a cell tower, it communicates with the tower to let it know it is there. And, if there are messages stored in the network, they can be delivered to the device. By knowing which phones are there, when, and for how long, researchers are able to identify who lives near a tower and who is traveling through the region. By studying the communication patterns, they can also gain insights on an individual's social network of friends and family members.

Given lacking medical services in many areas of sub-Saharan Africa, infectious diseases are a big problem, with outbreaks often spreading within members of a social network. Thus, health researchers are studying cell phone traffic data to not only understand social networks but also gain insights related to the transmission of infectious diseases. For example, in studying the data from a single tower in Kenya, researchers found that people making calls or sending text messages from a particular tower were more likely to be carriers of malaria. As malaria is transmitted from person to person through mosquito bites, researchers could predict who was likely to become infected by studying whom these people communicated with. They were also able to identify the source of the outbreak, a busy tea plantation that had many migrant workers. While the tracking of cell phone traffic raises many privacy concerns, using data mining and advanced analytics on these data is allowing researchers to better combat the spread of disease. Typical in the digital world, many advances come with equally troubling concerns.

Based on:

Liszewski, A. (2015, June 9). Wifi networks can count people—no phones required. *Gizmodo.* Retrieved June 28, 2016, from http://gizmodo.com/wi-fi-networks-can-count-people-no-phones-required-1710033051

Talbot, D. (2013). Big Data from cheap phones. *Technology Review.* Retrieved June 28, 2016, from https://www.technologyreview.com/s/513721/big-data-from-cheap-phones

Advanced Analytics

In contrast to business intelligence tools, which primarily focus on analyzing structured or semi-structured data to examine past and current performance, advanced analytics are designed to help users gain a deeper understanding of why things happened and build predictive models to support human and automated decision making (the term **data science** is used to describe the advanced analytics field of study and practice). As such, advanced analytics uses both structured and unstructured data to automatically gain meaningful insights by discovering patterns, trends, and relationships. Whereas business intelligence tools are primarily used by business users, advanced analytics are often used by business analysts or data scientists due to the complexity of the models and the underlying data. Enabled by advanced analytics are intelligent systems, which are designed to take some of these decisions out of the hands of the human decision makers, thus freeing up valuable resources.

DATA MINING. **Data mining** complements OLAP in that it provides capabilities for discovering "hidden" predictive relationships in the data. Using complicated algorithms on powerful multiprocessor computers or cloud computing architectures, data mining applications can analyze massive amounts of data to identify characteristics of profitable customers, purchasing patterns, or even fraudulent credit card transactions. An **algorithm** refers to the step-by-step procedures used to make a calculation or perform some type of computer-based process. Typically, data mining algorithms search for patterns, trends, or rules that are hidden in the data so as to develop predictive models. Results from a data mining exercise (such as the characteristics of customers most likely to respond to a marketing campaign for a specific new product) can then be used in an ad hoc query (e.g., to identify customers sharing those characteristics so as to target them in the next campaign). It is important to note that any interesting predictive model derived from data mining should be tested against "fresh" data to determine if the model actually holds what it promises.

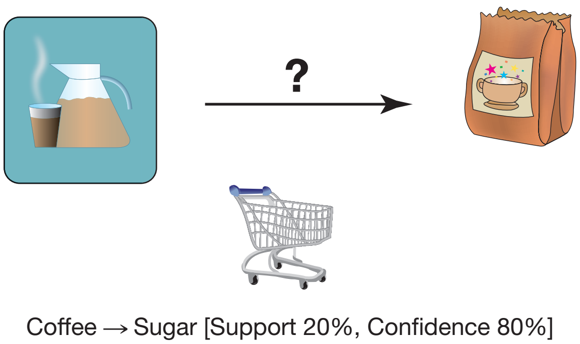
Sometimes, data mining is completely atheoretical, and companies search for hidden relationships between data, akin to panning for gold. In other cases, business users formulate hypotheses (such as "customers with a household income of US$150,000 are twice as likely to respond to our marketing campaigns as customers with an income of US$60,000 or less"), and these hypotheses are tested against existing data. However, as with other business intelligence tools, being able to ask the right questions is the most crucial skill and should come before jumping into conclusions about the outcomes.

In order to increase predictive power, data mining algorithms are run against large data sets. Depending on the size of the data set (large data sets can contain many terabytes of data), data mining algorithms can take a long time to run; thus, an important preparatory step to running data mining algorithms is **data reduction**, which reduces the complexity of the data to be analyzed. This can be achieved by rolling up a data cube to the smallest level of aggregation needed, reducing the dimensionality, or dividing continuous measures into discrete intervals.

Association Discovery One frequently used application of data mining is association discovery. **Association discovery** is a technique used to find associations or correlations among sets of items. For example, a supermarket chain wants to find out which items are typically purchased together in order to redesign the store's layout and optimize the customers' "navigational path" through the store or to launch a new promotion. Mining sales transactions over the past 5 years may reveal that 80 percent of the time, people who purchase coffee also purchase sugar (Figure 6.17). Association rules typically contain two numbers: a percentage indicating support (e.g., the combination of coffee and sugar occurs in 20 percent of all transactions analyzed) and a confidence level indicating the reliability (e.g., 80 percent of all transactions that contain coffee also contain sugar). These numbers help managers decide if the association rule is meaningful and if any changes (e.g., to store layout or pricing) based on the findings are worthwhile. Similar to association discovery, **sequence discovery** is used to discover associations over time. For example, it may be discovered that 55 percent of all customers who purchase a new high-definition TV set also purchase a Blu-ray disc player within the next 2 months.

FIGURE 6.17

Association rules symbolize associations among sets of items.



ETHICAL DILEMMA

Orwellian Internet of Things

In 1949, English author George Orwell wrote the novel "1984," which described a futuristic tyrannical society with omnipresent government surveillance by an entity known as "Big Brother." Big Brother was not a helpful and nurturing sibling but an entity that seeks power for its own sake and not for the good of others. Since his writing, *Orwellian* is an adjective reflecting actions that could be destructive to the welfare of a free and open society. Privacy advocates are concerned that many types of gadgets and home automation devices, falling under the Internet of Things (IoT) megatrend, when paired with advanced analytics capabilities, have the potential to have *Orwellian* impacts on society.

There are a wide range of IoT devices that are designed to scoop up massive amounts of data to aid humans and other systems in our modern society. But as more and more data are collected and analyzed, many privacy advocates fear we are losing more and more of our anonymity and individual freedom. For example, when considering IoT devices, privacy advocates are concerned with a variety of questions. What data are IoT devices collecting? Who has access to these data? How can these data be used? And, as news reports demonstrate, IoT data can be used in unexpected, interesting, and legally significant ways.

Imagine all of the things that could be equipped with a sensor and have data collected about their use. For example, *things* like your toaster, refrigerator, thermostat, lighting, and even the front door lock on your apartment. All of those seem kind of cool, right? What about your toilet? That doesn't sound too cool. If you have any concerns about a government reading your e-mail, how would you feel about a database collecting information on every time your toilet flushes? Imagine what a medical research group could do with such data. In sum, the data collected for every *thing* could end up in the hands of law enforcement, the government, marketing companies, and even malicious hackers. And this is not science fiction.

In 2016, the U.S. government admitted it was using IoT devices for spying and snooping on possible terrorists and criminals. The U.S. director of national intelligence, James Clapper, made it clear that IoT sensors and devices are providing ample opportunities for intelligence agencies to spy on targets. "In the future, intelligence services might use the [Internet of Things] for identification, surveillance, monitoring, location tracking, and targeting for recruitment, or to gain access to networks or user credentials," Clapper told a Senate panel as part of his annual "assessment of threats" against the United States.

In combination with advanced analytics, the IoT will allow companies to provide unprecedented services to customers. Reminders, automatic ordering, activity tracking, and a plethora of other conveniences will become a normal part of our lives. However, with all of these conveniences, we will also be providing an abundance of data about our daily lives that can at a minimum be a privacy invasion or be misused by malicious hackers or even our own government. While such Orwellian concerns were not possible in 1984, in today's digital world, Big Brother has arrived.

Questions

1. If you use a fitness tracker or some other IoT device, should the company be able to sell your data? Would it be acceptable to share the data with some but not others? Explain.
2. Typically, the company providing an IoT device owns its customers' data. What laws or rules are needed to balance the needs of the company and the privacy of customers?

Based on:

Krieger, M. (2016, February 10). Top U.S. official admits—government will use "Internet of Things" to spy on the public. *Liberty Blitz Krieg.* Retrieved May 27, 2016, from http://libertyblitzkrieg.com/2016/02/10/top-u-s-official-admits-government-will-use-internet-of-things-to-spy-on-the-public

Sullivan, C.C. (2016, January 20). FTC chairwoman raises concerns over the Internet of Things. *FindLaw.* Retrieved May 27, 2016, from http://blogs.findlaw.com/technologist/2016/01/ftc-chairwoman-raises-concerns-over-the-internet-of-things.html

Swanson, B. (2015, February 25). The FCC's Orwellian Internet policy. *ComputerWorld.* Retrieved May 27, 2016, from http://www.computerworld.com/article/2888366/the-fcc-s-orwellian-internet-policy.html

Timm, T. (2016, February 9). The government just admitted it will use smart home devices for spying. *The Guardian.* Retrieved May 27, 2016, from http://www.theguardian.com/commentisfree/2016/feb/09/internet-of-things-smart-devices-spying-surveillance-us-government

Ts, M. (2014, July 2). The Internet of Things is watching. *Security Intelligence.* Retrieved May 27, 2016, from https://securityintelligence.com/internet-of-things-all-well-or-orwell

Clustering and Classification Another useful application of data mining is clustering and classification. **Clustering** is the process of grouping related records together on the basis of having similar values for attributes, thus finding structure in the data. For example, a manufacturer of consumer electronics may find clusters around model preferences, age groups, and income levels. These results can then be used for targeting certain groups of customers in marketing campaigns. In contrast, **classification** is used when the groups ("classes") are known beforehand, and records are segmented into these classes. For example, a bank may have found that there are different classes of customers who differ in their likelihood of defaulting on a loan. As such, all customers can be classified into different (known) risk categories in order to ensure that the bank does not exceed a desired level of risk within its loan portfolio. Typically, classification would use a decision tree to classify the records.

UNSTRUCTURED DATA ANALYSIS. Although the methods just described can help decision makers get a better view of their organization's performance or their customers' behavior, they only provide a partial picture. By focusing purely on structured data (such as transactions, credit lines, and so on), a wealth of unstructured data (such as customer sentiments voiced in online forums, letters, or service-related call center records) is left untapped; in fact, researchers estimate that 80 percent of all enterprise data consist of unstructured or semistructured data (Andriole, 2015), and with the tremendous increase of user-generated content on the web, this figure is likely to increase further. Therefore, making important business decisions purely based on structured data can be dangerous, as the massive amounts of unstructured data could either strengthen or contradict findings derived from analyzing only structured data. Hence, organizations are trying not only to reach a single version of the truth but also to get the whole truth by analyzing unstructured data using *text mining, web content mining,* or *web usage mining*.

Text Mining and Web Content Mining **Text mining** refers to the use of analytical techniques for extracting information from textual documents. For organizations, the analysis of textual documents can provide extremely valuable insights into business performance, competitors' activities, or regulatory compliance. Such textual documents can include internal data such as letters or e-mails from customers, customer calls, internal communications, or external data such as blog posts, wikis, Twitter messages, and Facebook posts as well as competitor's web pages, marketing materials, patent filings, and so on. Text mining systems use text processing, statistical analyses, *machine learning,* and other techniques to analyze a document's linguistic structures to extract data such as places, companies, concepts, or dates. Most systems can easily extract a wide range of content and can be customized to meet an organization's needs by adding specific key words related to competitors, product names, persons of interest, and the like. Obviously, when analyzing and using user-generated content, companies have to be aware of issues related to ethics and privacy but also security.

Web content mining refers to extracting textual information from web documents. To extract information from the overall Internet (or from some subset of websites), a document collection spider, or *web crawler* (discussed later), would gather web pages and documents that match some prespecified criteria and place their content in a massive document warehouse. Once collected, the text mining system would apply a variety of analytical techniques to produce reports that can be used to gain additional insights beyond what is typically gained when only mining structured data (Figure 6.18). The next challenge for organizations will be extracting useful information from audio or video streams on the web (so-called multimedia mining).

Analyzing textual documents can help organizations in various ways:

- The marketing department can use **sentiment analysis** to learn about customers' thoughts, feelings, and emotions by analyzing not only customer e-mails or letters but also blogs, wikis, or discussion forums.
- The operations department can learn about product performance by analyzing service records, customer calls, or online product reviews and improve the product's features or performance based on insights gained.
- Strategic decision makers can gather **competitive intelligence** by analyzing press releases, news articles, or customer-generated web content about competitors' products.
- The sales department can learn about major accounts by analyzing news coverage.
- The human resources department can monitor employee satisfaction or compliance with company policies by analyzing internal communications (this is especially important in order to comply with regulations such as the Sarbanes–Oxley Act; see Chapter 10).
- News reporters or intelligence agencies can find out what topics are trending when trying to understand public sentiments in unstable countries.
- Investigators can identify possible instances of noncompliance and fraud by analyzing e-mail communication within a company in a regulated industry.

Many major companies, including Capital One, Marriott International, United Airlines, and Walmart, use text mining solutions to assess customer sentiments and increase customer satisfaction. Similarly, raveable.com provides hotel ratings by aggregating information from sources

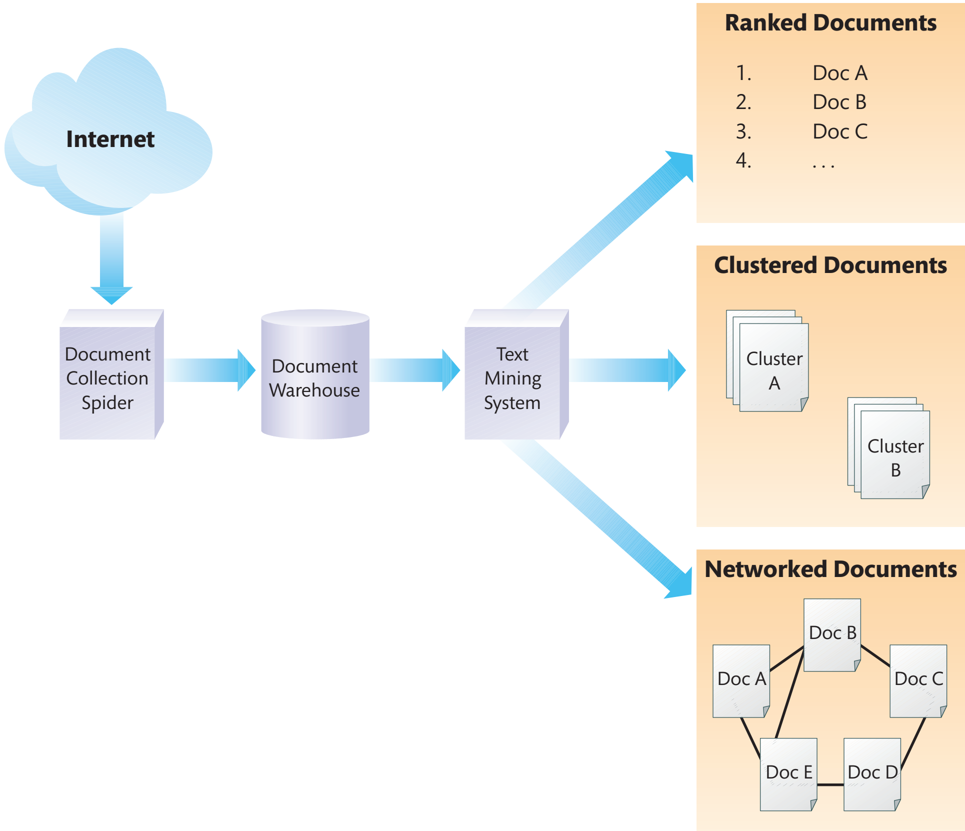


FIGURE 6.18

Text mining the Internet.

such as Tripadvisor, Expedia, and Travelocity as well as individual travel blogs; in addition to aggregating numerical ratings given for aspects such as cleanliness, value, or location, raveable .com uses text mining to analyze review comments based on key words such as *earplugs*, *noise*, or *clean* and the associated sentiments so as to categorize the reviews and classify them as positive or negative. We will further discuss social media monitoring and sentiment analysis and their role in customer relationship management in Chapter 8, "Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management."

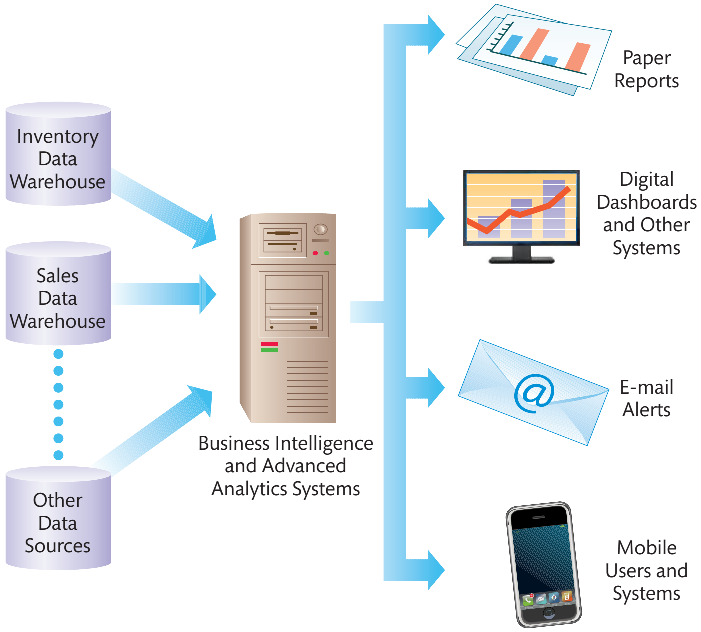
Web Usage Mining **Web usage mining**—also referred to as web analytics—is used by organizations such as Amazon.com to determine patterns in customers' usage data, such as how users navigate through the site or how much time they spend on different pages. By analyzing users' **clickstream data** (i.e., a recording of a user's path through a website), a business such as Amazon.com can assess its pages' **stickiness** (i.e., the ability to attract and keep visitors) and how customers navigate through different item categories, ultimately helping Amazon.com to optimize the structure of its website. In addition, organizations can monitor users' mouse cursor movements to infer which areas of a web page get most attention by the visitors.

As with other business analytics systems, results from these analyses can be provided on digital dashboards, paper reports, web portals, e-mail alerts (using monitoring or data mining agents), and mobile devices as well as used by a variety of other information systems (Figure 6.19).

MACHINE LEARNING. Whereas "conventional" computers are very adept at processing large amounts of data by rapidly executing a program's instructions, they cannot easily adapt to different circumstances or deal with noisy data. If a conventional computer is presented with a novel problem that it is not programmed to solve, it cannot deal with this situation. **Machine learning** is a branch of artificial intelligence that allows systems to learn by identifying meaningful patterns when processing massive amounts of structured or unstructured data. Machine learning has enabled great advances in various fields; intelligent systems (discussed below) such as Google's self-driving cars but also speech recognition, natural language processing, computer vision, web searching, image recognition, or predictive typing

FIGURE 6.19

Business intelligence can be delivered to users in a variety of ways.



(e.g., using smartphone keyboards such as SwiftKey or Swype) are based on advances in machine learning algorithms. Recently, Netflix started applying machine learning algorithms to improve movie recommendations. One frequently used approach to machine learning is the use of artificial neural networks; **neural networks**, composed of a network of processing elements (i.e., artificial "neurons") that work in parallel to complete a task, attempt to approximate the functioning of the human brain and can learn by example. Typically, a neural network is *trained* by having it categorize a large database of past information (e.g., a database of handwritten digits) for common patterns so as to infer rules (e.g., what features differentiate the digit 1 from a 7). These rules can then be applied to new data and conclusions drawn. For example, many financial institutions use neural network systems to analyze loan applications. These systems compare a person's loan application data with the neural network containing the *intelligence* of the success and failure of countless prior loans, ultimately recommending loan acceptance (or rejection) (Figure 6.20). Newer neural-network based approaches—called deep learning—are getting ever closer to mimicking the human brain and enable great advances in areas such as voice or speech recognition; in 2016, banks started using voice recognition to identify online banking customers. In recent years, machine learning algorithms have made great progress, especially in applications where inputs and tasks are imprecise, such as classifying images. In particular, using Bayesian statistics or **fuzzy logic** allows using approximations or subjective values in order to handle situations where information about a problem is incomplete or imprecise. For example, a loan officer, when assessing a customer's loan application, may generally categorize some of the customer's financial information, such as income and debt level, as high, moderate, or low rather than using precise amounts. In addition to numerous business applications, fuzzy logic is used to better control antilock braking systems and household appliances as well as when making medical diagnoses or filtering offensive language in chat rooms.

PREDICTIVE MODELING. Traditional business intelligence applications are designed to focus on past and current performance, thus helping decision makers to get a detailed picture about the current state of a business. Advanced analytics augments business intelligence by using combinations of statistical analysis, data mining, and machine learning for **predictive modeling** to build explanatory models, which help understand the data, identify trends, or predict business outcomes; whereas business intelligence is good for knowing what *is*, advanced analytics helps in understanding *why* something is a certain way and foreseeing what *will be*. As such, predictive modeling tools extend traditional DSS and other BI tools by supporting forecasting, simulation, and optimization based on large volumes of structured, semistructured, and sometimes unstructured data. For example, predictive modeling can help

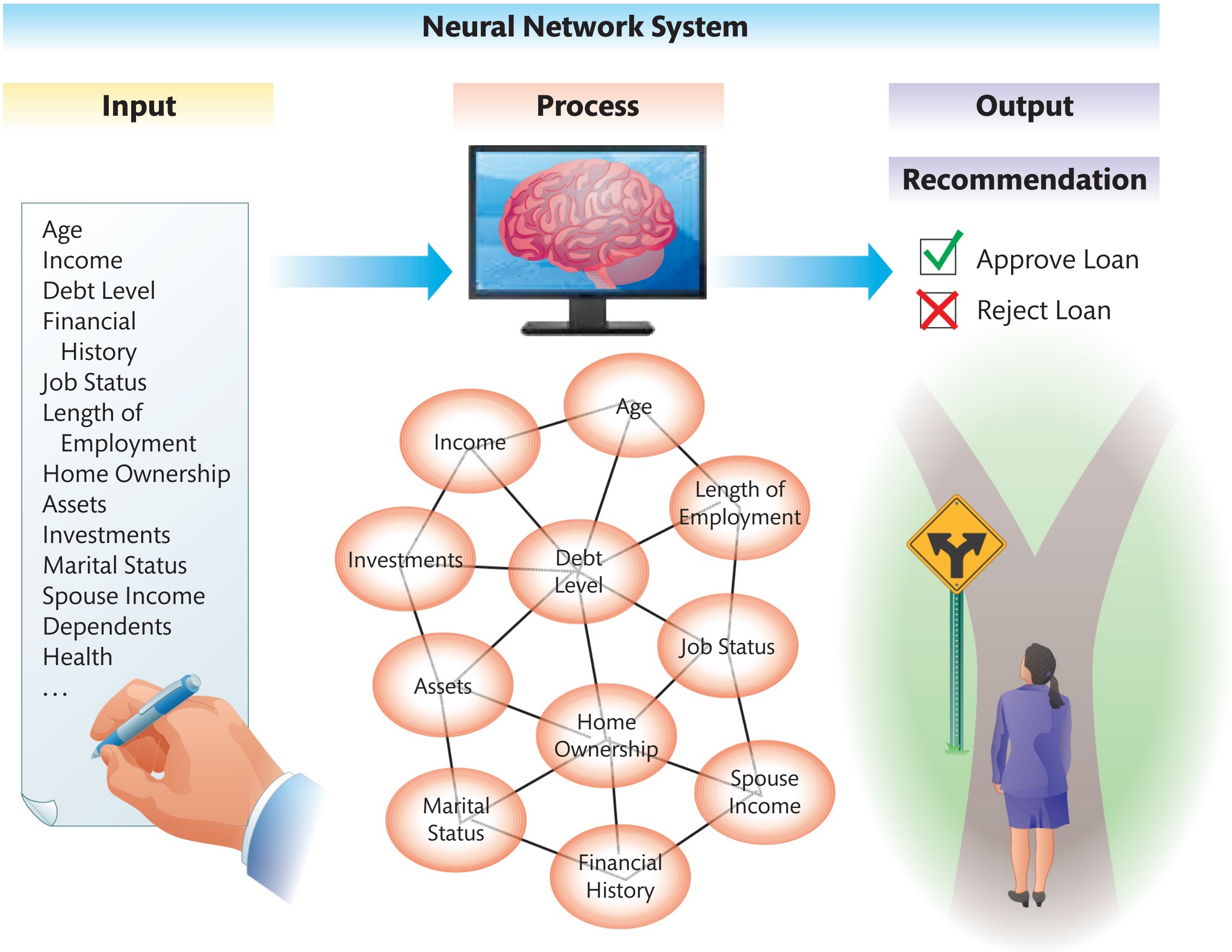


FIGURE 6.20

Neural networks approximate the functioning of the brain by creating common patterns in data and then comparing new data to learned patterns to make a recommendation.

in developing predictive patterns based on not only historic purchase data (structured data) but also customer sentiments voiced in social media or call center records (unstructured data). Likewise, Uber is attempting to improve its pricing mechanism using predictive modeling. Under Uber's current "surge pricing" mechanism, fares increase if there is increased demand (such as after concerts or during bad weather), which, in theory, should bring more drivers into an area where this increase in demand takes place. However, customers are often frustrated by being charged higher prices. Thus, Uber tries to build predictive models that are better able to forecast increased demand in certain areas at certain times, decreasing the effect of surges. However, predictive modeling is heavily dependent on statistical models and their underlying assumptions; likewise, as with all advanced analytics, analyzing unstructured data still remains relatively costly.

INTELLIGENT SYSTEMS. **Artificial intelligence (AI)** is the science of enabling information technologies—software, hardware, networks, and so on—to simulate human intelligence, such as reasoning and learning, as well as gaining sensing capabilities, such as seeing, hearing, or feeling. AI has had a strong connection to science fiction writers, who have written stories about AI-enabled technologies aiding humans (e.g., Mr. Data in *Star Trek: The Next Generation*), attempting world domination (e.g., *The Matrix*), or enabling humans to exist on an alien planet (e.g., *Avatar*). The current reality of AI is that it is lagging far behind the imagination of most science fiction writers; nevertheless, great strides have been made.

Based on complex machine learning algorithms, **intelligent systems**—composed of sensors, software, and computers embedded in machines and devices—emulate and enhance human capabilities. Intelligent systems are having a tremendous impact in a variety of areas, including banking and financial management, medicine, engineering, and the military. Big Data has been both a challenge and an opportunity for artificial intelligence. On the one hand, vast amounts of different forms of data make machine algorithms increasingly complex; on the other hand, Big Data provides a treasure trove of potential insights and applications of intelligent systems. For many applications, intelligent systems assist in or perform real-time decision making, often using vast amounts of data. For example, many see vast promises in the use of AI for trading, removing the influence of traders' emotions, which often lead to suboptimal trading decisions. Likewise, advanced driver assistance systems (such as adaptive cruise control or lane-keeping systems offered in various new car models) or driverless cars of the future rely on intelligent systems to make real-time decisions based on up to 1GB of data per second, coming from various sensors, cameras, or radar. Over the past few years, the cost of sensors has been in free fall; for example, accelerometer sensors (built into many smartphones to measure motion) now cost only around US$0.50. The combination of machine learning and decreasing prices of sensors is fueling the development of sensor-driven computing. Sensors providing data about everything from motion to voltage to pressure or even chemistry can provide a tremendous amount of useful data, which can then be used to improve performance, a device's life span, and so on. Artificial intelligence also fuels the rapid advances in drone technology and robotics that we see today, such as drones that can monitor product placement and stock levels in Walmart's warehouses or robots built to replace human pickers in Amazon's warehouses. Further, the combination of AI and sensors has enabled the creation of collaborative robots, which can work alongside human workers (and react if there is possible danger) instead of having to be placed in segregated areas.

However, advances in artificial intelligence have fueled many ethical debates, such as how to ensure that AI (and robots) only learns in the way humans intend. For example, using unsupervised learning, a robot (or other intelligent system) can improve its own learning by making changes to learning rules and monitoring the results; as a consequence, such intelligent systems must be programmed to stop the system without the system learning how to circumvent this.

Intelligent Agent Systems An **intelligent agent**, or simply an *agent* (also called a **bot**—short for "software robot"), is a program that works in the background to provide some service when a specific event occurs. There are several types of agents for use in a broad range of contexts, including the following:

- **User Agents.** Agents that automatically perform a task for a user, such as automatically sending a report at the first of the month, assembling customized news, or filling out a web form with routine information.
- **Buyer Agents (Shopping Bots).** Agents that search to find the best price for a particular product you wish to purchase.
- **Monitoring and Sensing Agents.** Agents that keep track of key data, such as data provided by various sensors, meters, cameras, and the like, notifying the user when conditions change.
- **Data Mining Agents.** Agents that continuously analyze large data warehouses to detect changes deemed important by a user, sending a notification when such changes occur.
- **Web Crawlers.** Agents that continuously browse the web for specific information (e.g., used by search engines)—also known as **web spiders**.
- **Chatbots.** Agents that simulate human conversations, such as in online help systems.
- **Destructive Agents.** Malicious agents designed by spammers and other Internet attackers to farm e-mail addresses off websites or deposit spyware on machines.

One example of an intelligent agent is Apple's Siri personal assistant, built into its iPhones. Similarly, Cortana is a personal assistant built into various Microsoft platforms. Over time, Cortana learns about a user's habits and performs certain actions based on certain triggers such as time of the day, location, incoming or outgoing phone calls, searches, and so on. For example, in the morning, the user automatically receives an alert about the weather in his or her current location; when passing by a subway station, public transport information is presented; when on a trip, the time to travel back home is automatically calculated (taking into consideration factors such as traffic situation); and so on (Figure 6.21).

SECURITY MATTERS

Hacktivists Versus Fembots: The Ashley Madison Case

On July 15, 2015, the Impact Team, a group of hacktivists, broke into the systems of the extramarital dating website Ashley Madison, which it accused of deceptive business practices, such as requiring users to pay for having their account (and the associated data) deleted. Having gained access to several gigabytes of data, including login names, identifying information, and even expressed sexual desires of the site's users, the hacktivists demanded the site to shut down, threatening to publish user data. To reinforce the demand, the Impact Team released a small amount of its data several days later, after the site was not shut down as requested by the hackers. Later in August 2015, the hackers posted data about 32 million users, resulting in a chain reaction of events in the lives of many of those named in the posted data. Some denied involvement, some committed suicide, and many others began a long ordeal of explaining to loved ones how their names, credit card data, and other personal data became part of the released data.

Later analysis of the hacked data revealed that a large proportion of the female accounts were chatbots—so-called fembots, (more or less) intelligent agents designed to start a chat with unsuspecting men, enticing them to purchase credits to contact the make-believe female members. As most people, Ashley Madison's users probably had not read Ashley Madison's terms and conditions before agreeing to them: In the terms and conditions, Ashley Madison stated that conversations may not be authentic, may be exaggerated, or may even be fictitious. Whether or not running a dating portal for extramarital affairs in the pursuit of earning money is ethical is debatable. Whether asking users to pay for deleting account data or using chatbots to lure unsuspecting customers would be considered deceptive business practices is debatable. Likewise, whether or not the Impact Team's actions in response to Ashley Madison using deceptive business practices were warranted is debatable. What is clear is that Ashley Madison did not sufficiently protect user data, allowing the hacktivists to gain access to the data, resulting in an avalanche of negative consequences for many.

Based on:

Ashley Madison data breach. (2016, May 19). In *Wikipedia, The Free Encyclopedia*. Retrieved May 28, 2016, from https://en.wikipedia.org/w/index.php?title=Ashley_Madison_data_breach&oldid=721001290

Calpito, D. (2015, September 16). Ashley Madison's terms of service says so: Users are cheating on their spouses with fembots. *Tech-Times*. Retrieved June 17, 2016, from http://www.techtimes.com/articles/85172/20150916/ashley-madison-s-terms-of-service-says-so-users-are-cheating-on-their-spouses-with-fembots.htm

Dreyfuss, E. (2015, August 19). How to check if you or a loved one were exposed in the Ashley Madison hack. *Wired*. Retrieved June 15, 2016, from https://www.wired.com/2015/08/check-loved-one-exposed-ashley-madison-hack

McHugh, M. (2015, September 4.). The dangers of looking at Ashley Madison hack infographics. *Wired*. Retrieved June 15, 2016, from http://www.wired.com/2015/09/dangers-looking-ashley-madison-hack-infographics

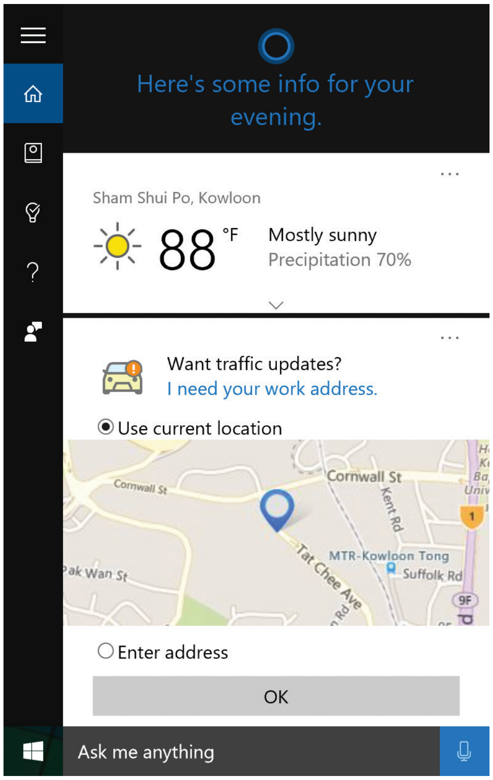


FIGURE 6.21

Cortana, an intelligent agent built into various Microsoft platforms, presents pertinent information based on factors such as the user's habits, location, and time of day.
Source: Cortana, Windows 10, Microsoft Corporation.

In sum, there are ongoing developments to make information systems *smarter* so that organizational decision makers gain business intelligence. Although intelligent systems have yet to realize the imagination of science fiction writers, they have taken great strides in helping organizations enhance decision making.

Knowledge Management and Geographic Information Systems

As you have seen, there are various tools organizations can use to enhance their decision making. In addition to analyses and predictions using various types of structured and unstructured data, organizations draw on other sources of data and knowledge. In particular, organizations use knowledge management systems to manage organizational knowledge assets and use geographic information systems to manage and analyze spatially referenced data to provide spatial decision support. These are discussed next.

Knowledge Management Systems

There is no universal agreement on what exactly is meant by the term *knowledge management*. In general, however, **knowledge management** refers to the processes an organization uses to gain the greatest value from its knowledge assets. In Chapter 1, we contrasted data, information, and knowledge. Recall that data are raw, unformatted symbols such as characters or numbers. Information is data that have been formatted, organized, or processed in some way so that the result is useful to people. We need knowledge to understand relationships between different pieces of information. Consequently, what constitutes **knowledge assets** are all the underlying skills, routines, practices, principles, formulas, methods, heuristics, and intuitions. All databases, manuals, reference works, textbooks, diagrams, displays, computer files, proposals, plans, and any other artifacts in which both facts and procedures are recorded and stored are considered knowledge assets. From an organizational point of view, properly used knowledge assets enable an organization to improve its efficiency, effectiveness, and, of course, profitability. Additionally, as many companies are beginning to lose a large number of baby boomers to retirement, companies are using knowledge management systems to capture these crucial knowledge assets. Clearly, effectively managing knowledge assets will enhance business intelligence.

Knowledge assets can be categorized as being either explicit or tacit. **Explicit knowledge assets** reflect knowledge that can be documented, archived, and codified, often with the help of information systems. Explicit knowledge assets reflect much of what is typically stored in a DBMS. In contrast, **tacit knowledge assets** reflect the processes and procedures that are located in a person's mind on how to effectively perform a particular task (Figure 6.22). Identifying key

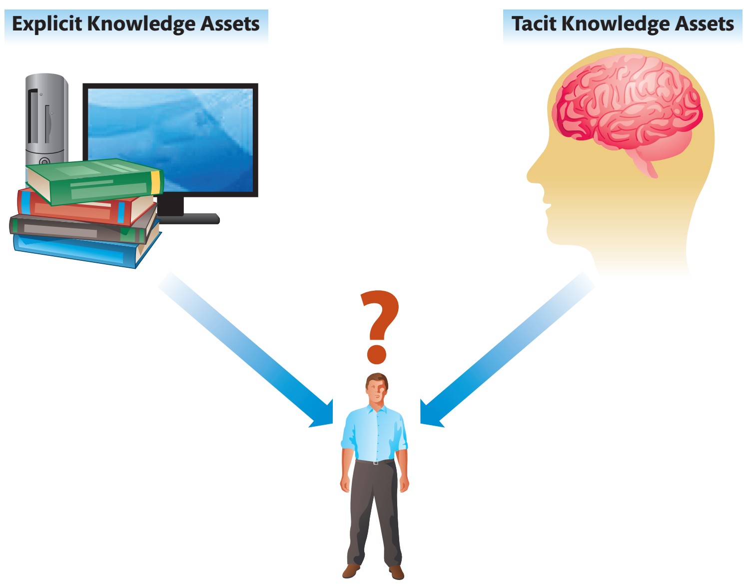


FIGURE 6.22

Explicit knowledge assets can easily be documented, archived, and codified, whereas tacit knowledge assets are located in a person's mind.

TABLE 6.7 Benefits and Challenges of Knowledge Management Systems

Benefits	Challenges
Enhanced innovation and creativity	Getting employee buy-in
Improved customer service, shorter product development, and streamlined operations	Focusing too much on technology
Enhanced employee retention	Forgetting the goal
Improved organizational performance	Dealing with knowledge overload and obsolescence

tacit knowledge assets and managing these assets so that they are accurate and available to people throughout the organization remains a significant challenge.

Tacit knowledge assets often reflect an organization's *best practices*—procedures and processes that are widely accepted as being among the most effective and/or efficient. Identifying how to recognize, generate, store, share, and manage this tacit knowledge is the primary objective for deploying a knowledge management system. Consequently, a **knowledge management system** is typically not a single technology but rather a collection of technology-based tools that include communication technologies—such as e-mail, groupware, instant messaging, and the like—as well as information storage and retrieval systems, such as wikis or DBMSs, to enable the generation, storage, sharing, and management of tacit and explicit knowledge assets (Malhotra, 2005).

Benefits and Challenges of Knowledge Management Systems Many potential benefits can come from organizations' effectively capturing and utilizing their tacit knowledge assets (Levinson, 2010) (Table 6.7). Although there are many potential benefits for organizations that effectively deploy knowledge management systems, to do so requires that several substantial challenges be overcome.

First, effective deployment requires employees to agree to share their personal tacit knowledge assets and to take extra steps to utilize the system for identifying best practices. Therefore, organizations must create a culture that values and rewards widespread participation.

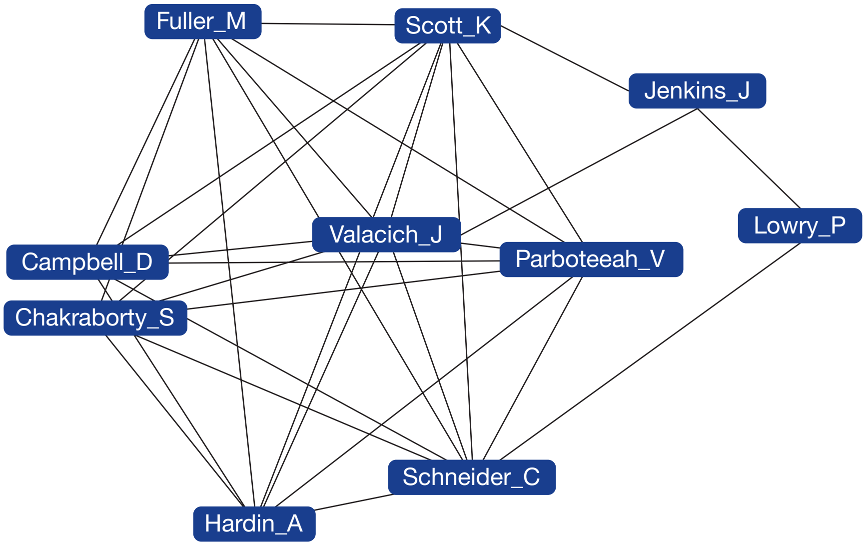
Second, experience has shown that a successful deployment must first identify what knowledge is needed, why it is needed, and who is likely to have this knowledge. Once an organization understands "why, what, and who," identifying the best technologies for facilitating knowledge exchange is a much easier task.

Third, the successful deployment of a knowledge management system must be linked to a specific business objective (e.g., increase innovativeness); and fourth, the knowledge management system must be easy to use, not only for entering but also for retrieving knowledge. Similarly, the system cannot overload users with too much information or with information that is obsolete. Just as physical assets can erode over time, knowledge can also become stale and irrelevant. Therefore, an ongoing process of updating, amending, and removing obsolete or irrelevant knowledge must occur, or the system will fall into disarray and will not be used.

How Organizations Utilize Knowledge Management Systems The people using a knowledge management system will be working in different departments within the organization, performing different functions, and will likely be located in different locations around the building, the city, or even the world. Each person—or group of people—can be thought of as a separate island that is set apart from others by geography, job focus, expertise, age, and gender. Often, a person on one island is trying to solve a problem that has already been solved by another person located on some other island. Finding this "other" person is often a significant challenge. The goal of a successful knowledge management system is to facilitate the exchange of needed knowledge between these separate islands. To find and connect such separate islands, organizations use **social network analysis**, a technique that maps people's contacts to discover connections or missing links (sometimes called structural holes) within the organization (Figure 6.23); thus, social network analysis can be used to attempt to find groups of people who work together, to find people who don't collaborate but should, or to find experts in particular subject areas. In addition to social network analysis, organizations use social bookmarking and social cataloging to capture and structure employees' knowledge and harness

FIGURE 6.23

Social network analysis can help to analyze collaboration patterns.



their collective intelligence (see Chapter 5, “Enhancing Organizational Communication and Collaboration Using Social Media”).

Once organizations have collected their knowledge into a repository, they must find an easy way to share it with employees (often using an intranet), customers, suppliers (often using an extranet), or the general public (often using the Internet). These **knowledge portals** can be customized to meet the unique needs of their intended users. For example, the U.S. Food and Drug Administration (FDA) uses a web-based knowledge portal for keeping the public (e.g., citizens, researchers, and industry) informed on the most up-to-date information related to food (e.g., information on mad cow disease or product recalls) and drugs (e.g., the status of a drug trial) (Figure 6.24).

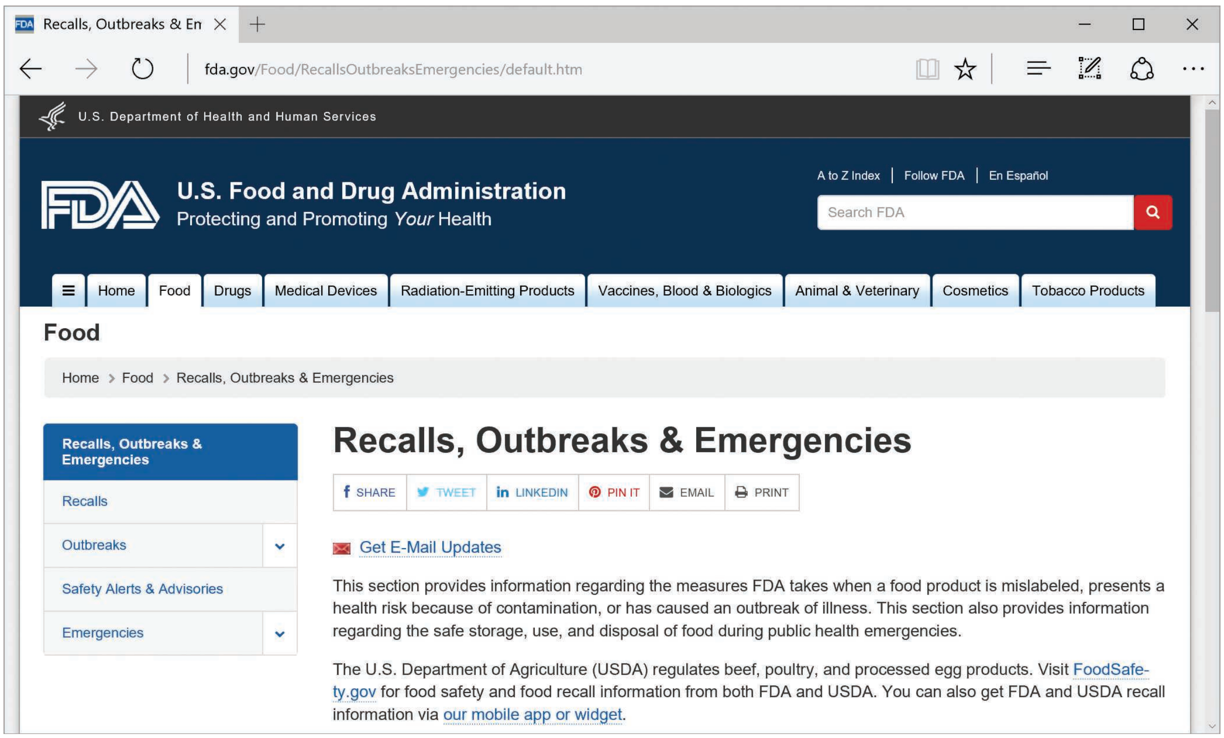


FIGURE 6.24

Countless organizations are using web-based knowledge portals to provide information to employees, customers, and partners.

Source: United States Food and Drug Administration.

In addition to the FDA, countless other organizations, such as Ford Motor Company, Eli Lilly, Walmart, and Dell Computers, are also using knowledge management systems. We are learning from these deployments that all organizations, whether for-profit or nonprofit, struggle to get the right information to the right person at the right time. Through the use of a comprehensive strategy for managing knowledge assets, organizations are much more likely to gain a competitive advantage and a positive return on their IS investments.

Geographic Information Systems

One type of information system used to enhance decision making is called a **geographic information system (GIS)**. A GIS is a system for creating, storing, analyzing, and managing geographically referenced data. In other words, GISs augment and extend other business analytics tools by adding a spatial dimension to data; a GIS captures various characteristics about geographic locations, allowing these characteristics to be coupled with other data to support querying, analysis, and decision making (sometimes referred to as **location analytics**). For example, a GIS could link the square footage of commercial real estate to its exact location in terms of latitude and longitude. These data could be paired with population density, average incomes of people living within an area, travel accessibility (e.g., interstate highways and major thoroughfares), proximity to services (e.g., fire, police, restaurants, public transportation stops), or virtually any other characteristic. A business such as a restaurant chain could use this information to identify optimal locations for the placement of new outlets. On a personal level, you probably frequently interact with GISs. For example, when you're accessing Google Maps to search for a restaurant in your town, you can view geographic data (such as the map or the satellite image) as well as attribute data about restaurants, including name, address, opening hours, and customer reviews. With the increase in mobile devices, geospatial data is increasingly becoming part of many applications and often serves as the foundation for many business models. For example, companies such as the car-hailing app Uber could not provide services without being able to match the locations of riders and drivers.

Businesses typically face many decisions with a spatial dimension: Where are my customers located? Where is the best location to open a new store? Which areas should be included in the next mailing? How far are my customers willing to drive? One application of GISs is their use as spatial decision support system, helping to create models used to answer questions such as where a company such as Levi Strauss should add authorized resellers or how, where, and what kinds of fertilizers farmers should apply, enabling precision farming (see Table 6.8 for various industry uses of GISs). Depending on the problem to be solved, spatial decision support systems can use factors such as climate, water, transportation, resource management, agriculture, and so on, to build models that help forecast potential outcomes of land use decisions.

In organizational settings, analysts can use GISs to combine geographic, demographic, and other data for locating target customers, finding optimal site locations, or determining the right product mix at different locations; additionally, GISs can be used to perform a variety of analyses, such as market share analysis and competitor analysis. Cities, counties, and states also use GISs for aiding in infrastructure design and zoning issues (e.g., where should the new elementary school be located?). For the various geospatial aspects you can map with GISs, refer to Table 6.9. How does a GIS help in visually analyzing geospatial and related data? Typically, a GIS provides a user with a blank map of an area. The user can then add data stored in different **layers**, each resembling a transparency containing different information about the area; for example, one layer may contain all roads, another layer may contain ZIP code boundaries, and yet other layers may contain floodplains, average household sizes, locations of coffee shops, or other information of interest (in Google Earth, you can view various layers, such as roads, traffic patterns, weather, earthquakes, golf courses, and so on; see Figure 6.25). Adding or removing those layers helps to view the relevant information needed to answer questions that have a spatial dimension.

One question that organizations often face is where the customers come from. In order to answer this question, organizations typically use data from survey respondents (or the cashier asks for customers' ZIP codes); these data are then geocoded (i.e., transformed into coordinates) to create a layer containing customer data that can then be added to a map. Comparing customers' locations with the location of one's business can help in deciding whether the store has the

TABLE 6.8 Various Industry Uses of GISs

Industry	Sample Uses
Agriculture	Analyze crop yield by location, soil erosion, or differences in fertilizer needs (precision farming)
Banking	Identify lucrative areas for marketing campaigns
Disaster response	Analyze historical events, set up evacuation plans, and identify areas most likely to be affected by disasters
Environment and conservation	Analyze wildlife behaviors or influences of climate change
Insurance	Risk analysis (e.g., earthquake insurance)
Government	Urban planning, zoning, and census planning
Law enforcement	Analyze high-crime areas
Marine biology	Track movements of fish swarms
Media	Create maps to visualize locations of events and analyze circulation
Mining and drilling	Locate potential areas for extraction of natural resources
Real estate	Create maps to visualize locations of properties
Retail	Analyze sales, inventory, customers, and so on, by location; identify new retail locations; and visualize and present business data
Transportation and logistics	Route planning

Source: Based on ESRI, http://www.esri.com/what-is-gis/who-uses-gis.

optimal location or whether opening a new store would be warranted. Relatedly, trade area analysis helps to assess where customers are coming from by combining location information with, for example, drive time information to determine if certain areas are underserved or if two stores' trade areas overlap. Another way to visualize geospatial data is by using thematic maps. Thematic maps color-code data that are aggregated for specific geographic regions. For example, a thematic map could display the median household income in different blocks, or it could display average household sizes, helping a business to identify areas with the most promising target population; similarly, an insurance company could use GISs to determine where certain crimes

TABLE 6.9 Various Ways of Representing Geospatial Data

Mapping	Example
Features and patterns (i.e., distribution of features)	Earthquake epicenters (features) and areas where the hazard may be highest (patterns)
Quantities	The number of young families with a high income in a census district
Densities	Number of high-income families per square mile in a census district
What's inside	Does a luxury real estate development fall within a 15-minute driving radius of a store?
What's nearby	How many Starbucks stores are within 5 miles of my new coffee shop?
Change	How have store sales changed after a large ad campaign?

Source: Based on ESRI, http://www.esri.com/what-is-gis/overview.

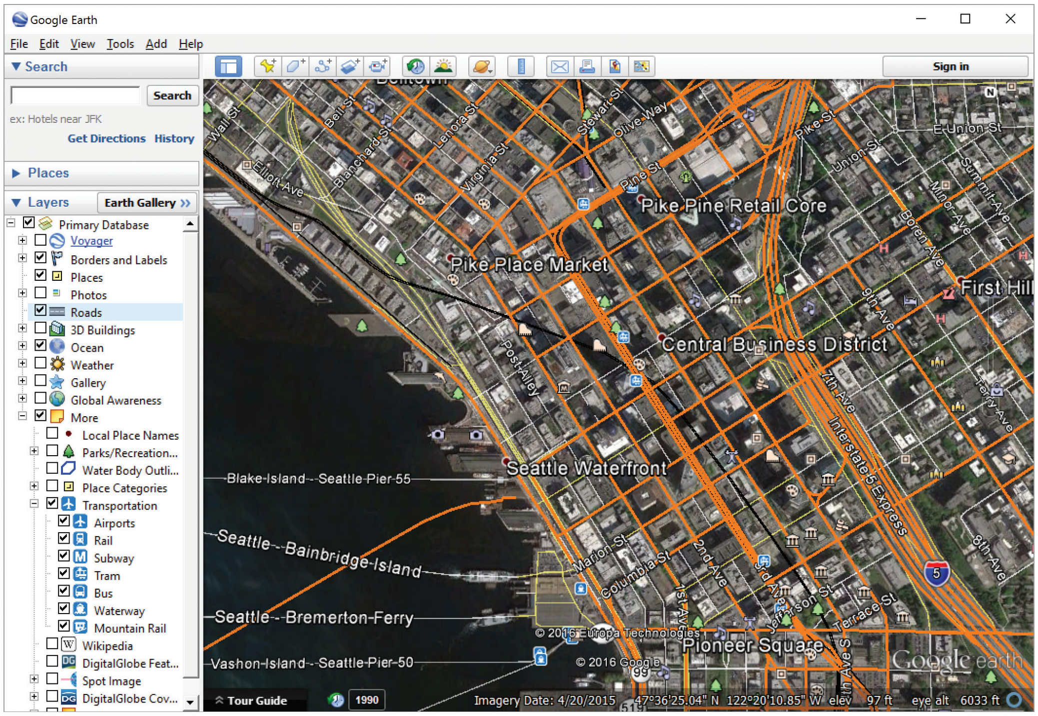


FIGURE 6.25

Google Earth uses layers to display information related to a specific geographical area.

(such as car theft) most frequently occur. Another use of GIS is analyzing paths shoppers take in a retail store, allowing retailers to assess whether the placement of products or promotional displays is effective.

GIS benefit greatly from advances in machine learning, especially for recognizing and classifying geographical features, such as land or soil. In particularly, many situations (such as in agriculture, resource extraction, or nature conservation) require the analysis of aerial imagery (acquired using satellites or drones). Typically, such classification tasks are inherently imprecise and do not lend themselves easily to binary classifications. Machine learning algorithms, however, enable such analyses, offering much potential for applications ranging from agriculture to disaster recovery.

Further, the Internet of Things and mobile technologies have enabled far more meaningful analyses than ever. For example, Google Maps performs real-time analyses of location data from literally hundreds of millions of mobile phone users (such as Android users who have location services enabled or iPhone users running Google Maps) to estimate the number of cars and traffic conditions on any given road; such analyses enable Google to provide information about traffic conditions and suggest alternative routes in case there are traffic jams on a given route. In addition, Google has used these data to build a tremendous repository of historical traffic data, allowing Google to predict how traffic conditions are likely to be once a user reaches a certain area. Likewise, the data collected by countless IoT devices can be augmented with geospatial data, allowing users to harness the benefits of IoT technologies in mobile settings, where precise information about a sensor's location is needed.

In addition to helping in analysis, GISs are also increasingly used by governments and organizations to effectively communicate with stakeholders. For example, many retail chains such as Best Buy and Walmart incorporate map-based store locators into their websites. When users search for a store by city, state, or ZIP code, the website returns a map showing the store's location (geographic data) along with attribute data such as distance, street address, phone number, and opening hours. Similarly, organizations use output from GISs to communicate to their stockholders about expansion plans, retail store density, and the like.

Clearly, GISs, like all the systems described here, are providing organizations with business intelligence to better compete in the digital world.

INDUSTRY ANALYSIS

Healthcare

Do you remember the times when your doctor wrote a prescription and the handwriting was worse than your professor's, making you wonder how the pharmacist could ever decipher it and dispense the correct drugs? If you recently went to a doctor, you may have noticed that information systems have had a huge impact on the healthcare field; indeed, health informatics (or healthcare IS) has become a key focus of healthcare providers, insurance companies, and governments. Now, many doctors carry laptops or tablets, allowing them to digitally store any diagnosis, facilitating the sharing of information between the physician, nurses, and even your medical insurance provider. In addition to providing access to electronic patient records, the laptop or tablet provides your physician access to medical and drug information, as offered by the *Physician's Desk Reference* website (www.pdr.net), where your physician can obtain the latest information about drugs and clinical guidelines or check interactions between different drugs.

Information systems have also tremendously changed the diagnosis and monitoring of patients. For example, modern electroencephalogram (EEG) and electrocardiogram (EKG) devices heavily depend on computer technology, and, as the name implies, computed tomography (used to produce images of internal organs) could not be performed without computer technology. Even diagnostic tests such as X-rays now use digital technology, allowing the doctor to digitally enhance the image for improved diagnosis or to electronically transmit the image to a remote specialist. Following the diagnosis of a serious condition, technology can even help in the operating room. For example, many modern clinics use surgical robots and endoscopes for delicate procedures such as neurosurgery or gastrointestinal surgery. Taken a step further, such systems can be used for what is referred to as telemedicine, including remote diagnosis and remote surgery. Whereas traditionally a patient had to travel thousands of miles to visit a specialized surgeon, many surgeries can now be performed remotely, reducing the strain on the patient and potentially saving precious time. Further, telemedicine applications can be used for remote locations, battlefields, or even prisons, reducing costs for transporting patients and improving care.

Just as physicians, insurance companies, and healthcare providers are turning to information systems to improve business processes and better serve patients' needs, consumers are increasingly using the Internet for health information. For example, WebMD is one of the most popular websites providing health-related information, priding itself on having high-quality, timely, and unbiased information. In addition to objective information, people use social media to obtain information beyond what's published by the experts. Specifically, people seeking physician and hospital rankings or recommendations frequent blogs, health-related discussion forums, or review sites such as RateMDs (ratemds.com) or Angie's List (angieslist.com). Further, major search engines such as Microsoft's Bing are constantly refining their search algorithms to provide the most relevant information to health-related queries. Another important trend is the use of personal sensors, devices, and services to keep track of a variety of things about your health and well-being. For example, there are numerous products to help you quantify various aspects of your life, from Wi-Fi–connected body scales and fitness trackers to mood monitoring, blood testing, sleep monitoring, and even DNA sequencing. The Internet of Things is playing a huge role in fueling various aspects of the *quantified self*, a movement to incorporate data acquisition on various aspects of a person's daily life in order to chart self-improvement and other objectives. These and other data sources throughout the digital world are creating massive amounts of data that can be used by researchers to better understand various health-related issues. Likewise, doctors and hospitals are increasingly using IoT-enabled healthcare devices, and healthcare providers are using data analytics for everything from researching drug interactions to monitoring healthcare costs, quality of service, and effectiveness of treatments. Needless to say, Big Data and analytics are transforming the healthcare industry.

Regardless of whether you're visiting your doctor about a condition or for a routine checkup or if you need more information about what your doctor is telling you, various information systems are likely to play a major role.

Questions

1. Discuss the benefits and drawbacks of online medical records.
2. Computer-aided diagnosis can replace years of experience, providing opportunities for young, inexperienced physicians. Contrast the benefits and drawbacks for the patients and the physicians.
3. Will there be a place for physicians without computer skills in the future? Why or why not?

Based on:

Anonymous. (n.d.). What is telemedicine? *American Telemedicine Association*. Retrieved June 29, 2016, from http://www.americantelemed.org/about-telemedicine/what-is-telemedicine

Massey, P. M. (2016). Where do U.S. adults who do not use the Internet get health information? Examining digital health information disparities from 2008 to 2013. *Journal of Health Communication, 21*(1), 118–24.

Quantified self. (2016, June 28). In *Wikipedia, The Free Encyclopedia*. Retrieved June 29, 2016, from https://en.wikipedia.org/w/index.php?title=Quantified_Self&oldid=727407441

Telemedicine. (2016, June 22). In *Wikipedia, The Free Encyclopedia*. Retrieved June 29, 2016, from https://en.wikipedia.org/w/index.php?title=Telemedicine&oldid=726471226

Key Points Review

1. ***Describe the need for business intelligence and advanced analytics and how databases serve as a foundation for making better business decisions.*** Businesses need to quickly respond to external threats and opportunities arising from unstable market conditions, fierce competition, short product life cycles, government regulation, or fickle customers; business intelligence and advanced analytics tools can help organizations gain meaningful insights from ever-increasing amounts of structured and unstructured data. Organizations use databases to capture and manage the data that can later be used as input to business intelligence applications. A database is a collection of related data organized in a way that facilitates data searches and contains entities, attributes, records, and tables. A DBMS is a software application with which you create, store, organize, and retrieve data from a single database or several databases. The data within a database must be adequately organized so that it is possible to store and retrieve data effectively. To support more effective business processes, businesses use online transaction processing. Data from operational systems serve as an input to informational systems. Master data management helps organizations to arrive at a "single version of the truth" to gather business intelligence; data warehouses and data marts support the integration and analysis of large data sets.
2. ***Explain core concepts of business intelligence and advanced analytics.*** Business intelligence tools enable business users to analyze past and current data to obtain an understanding what has happened. Traditionally, decision support systems were used to support human and automated decision making. OLAP tools offer the ability to perform complex multidimensional queries. Visualization refers to the display of complex data relationships using a variety of graphical methods. Results of complex analyses as well as key performance indicators are displayed on digital dashboards, which are often used to provide decision makers with the right information in an easy-to-understand way. Visual analytics combines the human visual system and analysis techniques to aid in the analysis of complex relationships and make sense of "noisy" data. Advanced analytics tools, in contrast, are used by business users as well as business analysts and data scientists to gain a deeper understanding of why things happened and to build predictive models. Advanced analytics models are often used to discover "hidden" relationships in data. Data mining is used for association discovery and clustering and classification. Unstructured data analysis is used to extract information from textual documents. Intelligent systems, based on machine learning and artificial neural networks, work to emulate and enhance human capabilities.
3. ***Describe how organizations can enhance decision making by using knowledge management and geographic information systems.*** Knowledge management systems are a collection of technology-based tools that enable the generation, storage, sharing, and management of tacit and explicit knowledge assets. GISs aid in storing, analyzing, and managing geographically referenced data and provide spatial decision support for a variety of applications.

Key Terms

location analytics 257
machine learning 249
master data 234
master data management 234
measure 241
model 240
monitoring and sensing agent 252
neural network 250
NoSQL 233
OLAP cube 241
OLAP server 241
online analytical processing (OLAP) 241
online transaction processing (OLTP) 237
operational system 236
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MyMISLab™ | Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

6-1. How can a continuous planning process help businesses respond to external threats and opportunities?

6-2. Describe the differences between entities, tables, rows, and attributes in a database.

MyMISLab **6-3.** What is the importance of master data management?

6-4. What are the advantages of a DBMS?

6-5. Explain the differences between OLAP and OLTP.

MyMISLab **6-6.** How can visual analytics be used to improve decision making?

6-7. Describe how OLAP enables a user to conduct multidimensional queries.

6-8. Explain the difference between clustering and classification.

6-9. What is the relationship between measures and dimensions?

MyMISLab **6-10.** Describe and give examples of two types of web mining.

6-11. What is a website's stickiness, and why is it important?

6-12. Explain the purpose of a model within a DSS.

6-13. Describe four types of intelligent agents. How can they be used to benefit organizations?

6-14. What is a knowledge management system, and what types of technologies make up a comprehensive system?

6-15. What is the purpose of using layers in GIS applications?

Self-Study Questions

6-16. In an RDBMS, an entity is represented as a(n) ______________.
A. attribute
B. table
C. row
D. association

6-17. A(n) ______________ report provides a summary of critical metrics on a recurring schedule.
A. scheduled
B. exception
C. key indicator
D. drill-down

6-18. In order to swiftly respond to a highly competitive and rapidly changing environment, organizations utilize a ______________.
A. continuous planning process
B. structured decision-making process
C. structured decision support process
D. continuous decision-making process

6-19. To determine the likelihood of new customers to default on a loan, a manager in a bank would typically use ______________.
A. association discovery
B. sequence discovery
C. classification
D. clustering

6-20. Web usage mining entails analyzing ______________.
A. clickstream data
B. page content
C. associations among sets of items
D. unstructured data

6-21. Market share analysis is typically used by the ______________ function of an organization.
A. marketing
B. accounting
C. production
D. management science

6-22. Big Data is characterized by all of the following except ______________.
A. verifiability
B. velocity
C. variety
D. volume

6-23. ______________ agents keep track of key information such as inventory levels, notifying the users when conditions change.
A. User
B. Buyer
C. Monitoring and sensing
D. Data mining

6-24. What is true about knowledge management?
A. As baby boomers retire at an increasing rate, knowledge management is helping organizations capture their knowledge.
B. A knowledge management system is not a single technology but a collection of technology-based tools.
C. Finding the right technology to manage knowledge assets is much easier than identifying what knowledge is needed, why it is needed, and who has this knowledge.
D. All of the above are true.

6-25. Which of the following is an example of attribute data commonly used in GIS applications?
A. structured data
B. longitude
C. trade area
D. annual sales

Answers are on page 265.

Problems and Exercises

6-26. Match the following terms with the appropriate definitions:

i. Social network analysis
ii. Measures
iii. Master data
iv. Web content mining
v. Continuous planning process
vi. Data mining
vii. Business intelligence
viii. Digital dashboard
ix. Geographic information system
x. DSS

a. An information system designed to store and analyze spatially referenced data
b. Tools and techniques for analyzing and visualizing both structured and unstructured data to obtain an understanding of current and past performance
c. A technique that attempts to find groups of people who work together, to find people who don't collaborate but should, or to find experts in particular subject areas
d. A set of methods used to find hidden predictive relationships in a data set
e. A strategic business planning process involving continuous monitoring and adjusting of business processes to enable rapid reaction to changing business conditions
f. The values or numbers a user wants to analyze
g. A special-purpose information system designed to support organizational decision making
h. Extracting textual information from web documents
i. A user interface visually representing summary information about a business's health, often from multiple sources
j. The data that are deemed most important in the operation of a business

6-27. Interview a top-level executive within an organization with which you are familiar and find out the organization's most important external threats. Can business intelligence or advanced analytics tools help to respond to these threats? If so, how; if not, why not?

6-28. Visit www.amazon.com and search for a product of interest to you. What attributes are likely stored in Amazon.com's database?

6-29. Using a search engine, enter the key word "data warehousing." Who are the large vendors in this industry? What type of solutions do they offer to their clients? Do you see any common trends in data warehousing?

6-30. Visit CNN Money (http://money.cnn.com/calculator/retirement/retirement-need) on the web to plan your retirement using a DSS. What did you learn? To what extent is the DSS useful in planning your retirement? If you browse through CNN Money, what other interesting stuff do you find?

6-31. Interview a top-level executive within an organization with which you are familiar and determine the extent to which the organization utilizes tools for information visualization or digital dashboards. Does this individual utilize these tools in any way? Why or why not? Which executives do utilize such tools?

6-32. Think about the junk mail you receive every day in your postal mail. Which mailings do you believe to be a result of data mining? How have the companies chosen you for their targeted mailings?

6-33. Think about the junk mail in your e-mail program's spam folder. What types of advanced analytics methods does your e-mail program's spam filter use to identify spam e-mails?

6-34. Describe your experiences with GIS. What tasks or problems have you used GIS for? For which personal decisions would a GIS be especially relevant? Provide specific examples.

6-35. Go out onto the web and compare three shopping bots (e.g., www.mysimon.com, www.shopzilla.com, www.shopping.com, or www.pricegrabber.com) for a product you are interested in. Did the different agents find the same information, or were there any differences? Did you prefer one over the others? If so, why?

6-36. Have you seen or used ad hoc, exception, key-indicator, and/or drill-down reports? What is the purpose of each report? Who produces and who uses the reports? Do any of these reports look or sound familiar from your work experience?

6-37. Interview an IS manager within an organization. What types of information and knowledge discovery tools does the organization use? Was there an increase or decrease in the past few years? What predictions does this manager have regarding the future of these systems? Do you agree? Prepare a 10-minute presentation to the class on your findings.

6-38. For your university, identify several examples of various knowledge assets, classify these as tacit or explicit, and rate them on their value to the university on a 10-point scale (1 = low value to 10 = high value).

6-39. Examine your university's website to identify examples where a knowledge management system could be used or is being used to help provide improved services to students.

6-40. How do you prefer your desired information to be presented? Do you use any type of visualization tools? If so, which ones?

6-41. Visit Google maps (http://maps.google.com) and try out the different layers provided. What other information would you like to see? Are there any publicly available mashups that offer this information as layers on top of Google Maps?

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Travel Loan Facility

6-42. A new aspect of the business has been added to Campus Travel. Students can apply for a loan to help pay for their travels. However, loans for travel are available only to students who are traveling outside the country for at least 2 weeks. Because the costs for this type of international travel differ depending on how you travel, where you stay, and what you do at the destination, different loan packages are available. For a month in Europe, you have decided to take out a loan. You have already taken a look at several offers but are unsure whether you can afford it. Set up a spreadsheet to calculate the payments per month for the following situations:

- 2 weeks in Eastern Europe; price: US$2,000; interest rate: 5.5%; Time: 1 year
- 2 weeks in Western Europe; price: US$3,000; interest rate: 6.0%; time: 1 year
- 3 weeks in Eastern Europe; price: US$3,000; interest rate: 6.5%; time: 2 years
- 3 weeks in Western Europe; price: US$3,500; interest rate: 5.5%; time: 2 years
- 4 weeks in Eastern Europe; price: US$4,000; interest rate: 6.0%; time: 2 years
- 4 weeks in Western Europe; price: US$5,000; interest rate: 6.5%; time: 2 years

Once you have calculated the payments, calculate the total amount to be paid for each option as well as the total interest you would pay over the course of the loan. Make sure to use formulas for all calculations and submit a professionally formatted page displaying the results and a page displaying the formulas. (Hint: In Microsoft Excel, use the "PMT" function in the category "Financial" to calculate the payments. Use Ctrl+` [grave accent] to switch between formula and data views; calculate the number of payments before using the formula.)

Database Application: Tracking Regional Office Performance at Campus Travel

6-43. The general manager wants to know which offices were most profitable during the previous year and asks you to prepare several reports. In the file FY2012.mdb, you find information about the offices, sales agents, and destinations. Use the report wizard to generate the following reports:

- List of all sales agents grouped by office (including total number of agents per office)
- List of all sales agents for each destination (grouped by destination, including total number of agents)
- Destinations sold by each sales agent (including total number of destinations)

Hint: You will need to generate the necessary queries before creating the reports.

Team Work Exercise

Net Stats: The Demise of Broadcast TV

Recent studies of the broadcast TV industry indicate that it is in trouble. More and more people are choosing not to watch TV in the conventional "appointment" way. According to Nielsen, in 2015, 226 million people in the United States watched TV/video content via their TV set, either live or via a DVR, compared with 191 million who watched content on a smartphone, 162 million who watched content using a PC connected to the Internet, 106 million who watched on a tablet, and another 158 million who watched DVR (i.e., time-shifted) content. And, of course, many consume content using a combination of formats and methods. Nevertheless, while traditional radio and broadcast TV continue to reach the most users, their market share is eroding to Internet- and mobile-delivered content. These changes tend to be especially strong in young people, with broadcast TV consumption dropping steadily in favor of digital delivery on smartphones, tablets, and PCs.

Questions and Exercises

6-44. Search the web for the most up-to-date statistics. Try to find the statistics for other demographics and countries as well.

6-45. As a team, interpret these numbers. What is striking/important about these statistics? What may be the reason for differences between countries?

6-46. How have the numbers changed since 2016?

6-47. Using your spreadsheet software of choice, create a graph/figure that effectively visualizes the statistics/changes you consider most important.

Based on:

Anonymous. (2016, June 27). The total audience report: Q1 2016. *Nielsen*. Retrieved June 28, 2016, from http://www.nielsen.com/us/en/insights/reports/2016/the-total-audience-report-q1-2016.html

Answers to the Self-Study Questions

6-16. B, p. 231	**6-17.** C, p. 236	**6-18.** A, p. 229	**6-19.** C, p. 247	**6-20.** A, p. 249
6-21. A, p. 240	**6-22.** A, p. 228	**6-23.** C, p. 249	**6-24.** D, p. 254	**6-25.** D, p. 257

CASE 1 | NSA: National Surveillance Agency?

In the 1950s, shortly after the end of World War II, President Harry S. Truman oversaw the organization of a secret security and intelligence organization, tasked with gathering and analyzing intelligence data in defense of the interests and operations of the United States and its government. The organization—named the National Security Agency (NSA)—has since grown to become one of the largest intelligence organizations in the world, with an estimated workforce of about 40,000 employees and annual budget of nearly US$11 billion (these are estimates because this type of information about the NSA is classified). The NSA has been involved in gathering intelligence on a wide range of issues and individuals, from the Vietnam War to Martin Luther King Jr. to the post-9/11 War on Terror. By design, many of the NSA's successes are classified and not known to the general public, but the agency has been credited with providing key intelligence in support of major military and investigatory operations over the past several decades.

In its relentless pursuit of intelligence to defend U.S. national interests, the NSA has embraced technology and the vast amounts of digital data available across the globe. In late 2013, a series of disclosures of classified internal NSA documents revealed the extent of the NSA's spying activities. Most of these disclosures were provided by a former NSA contractor named Edward Snowden. These documents revealed that the NSA regularly intercepts the telephone and Internet communications of more than a billion people worldwide. The NSA tracks the locations of hundreds of millions of cell phones per day. The organization reportedly has access to at least some communications made via services provided by AOL, Google, Microsoft, Facebook, and Yahoo! and collects hundreds of millions of contacts lists from personal e-mail and instant messaging accounts every year. The NSA also collects and stores cell phone call records from major cell phone providers. These surveillance activities have not been limited to countries considered to be enemies of the United States—they include longtime friendly countries such as France, Germany, and Spain. Perhaps most unsettling for U.S. citizens is the fact that NSA surveillance has also been targeted at U.S. citizens within U.S. borders, which appears to many as a clear violation of the Foreign Intelligence Surveillance Act of 1978—a law designed to limit the practice of mass surveillance in the United States.

Given that many of the NSA's activities are classified, it is hard to know how effective these massive surveillance practices have been in defending U.S. national interests and U.S. citizens. To some extent, many citizens likely expect the government to engage in spying and other intelligence-gathering practices to protect the public against terrorism, crime, or other dangers. To this end, the NSA reportedly provides foreign intelligence to the Central Intelligence Agency (CIA) regarding terrorist activities and domestic intelligence to the Drug Enforcement Administration (DEA) and Federal Bureau of Investigation (FBI) regarding drug and other criminal activities. But just how much intelligence gathering the NSA should engage in, and from whom, is a matter that has come under strong debate. Judging by the public outcry in response to the revelations from Edward Snowden's leaked documents, many people, both within and outside of the United States, believe that the NSA has gone too far. It was disclosed in the Snowden documents that the NSA monitored who was reading specific related topics such as "car bomb" or "jihad." In 2016, researchers reported that people significantly reduced, by nearly 30 percent, their viewing of such information compared with before the NSA's surveillance program was revealed.

In some sense, the NSA surveillance activities are little more than advanced business intelligence initiatives. In the modern world, we leave digital footprints in nearly all of our daily activities, from e-mail to text messages to phone calls to social media. The NSA has developed methods to collect and store these data, much to the consternation of many people now learning of these practices. But many large businesses engage in similar activities, perhaps not on the same scale but with equal disregard for the privacy of the people being tracked. Google, Facebook, and many online advertising networks that you have likely never heard of go to great lengths to record where we go and what we are watching, listening to, and reading. These activities provide powerful business opportunities for segmented marketing, and they are the revenue source supporting many of the online services that we enjoy for free.

So how do we balance the privacy issues caused by surveillance—both by governments and online companies—with the valid purposes that these organizations use to justify their activities? Would you rather that the U.S. government miss the opportunity to stop a terrorist organization before it strikes because the NSA stopped monitoring electronic communications? Would you be willing to pay a yearly subscription fee to Google in order to use its search engine or e-mail services? Would you be willing to pay a fee each time you "friended" someone or posted a new photo album on Facebook? These are extreme examples, but they highlight the conflict inherent in any discussion that tries to weigh privacy against business intelligence practices. For governments and companies to succeed and provide the services we expect, we may need to become more comfortable with giving up some of our privacy.

Questions

6-48. Do you think that the NSA has gone too far in its surveillance activities? Why or why not?

6-49. What are the pros and cons inherent to data collection for business or national intelligence?

6-50. Propose a set of guidelines for the NSA to direct its surveillance activities in the future.

Based on:

Blake, A. (2016, April 27). NSA surveillance has had a chilling effect on Internet browsing: report. *The Washington Times*. Retrieved June 29, 2016, from http://www.washingtontimes.com/news/2016/apr/27/nsa-surveillance-has-had-chilling-effect-internet-

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CASE 2 | Gathering Social Intelligence

In recent years, social media have become pervasive throughout society. No one can deny that social media have completely changed the context of privacy, shaping and reshaping relationships, exaggerating ideals of sharing, and reconstructing daily routines in order to visit one's online friends at least once a day. Thanks to social media, people can now share every detail about the most mundane things in life. Updating where you are at any given moment alerts your friends to what you are up to but also allows enterprises to learn how to better market products and promote celebrities.

Responding to the growing influence of social media and, in turn, demonstrating another crucial function of the phenomenon, all types of organizations are finding value in monitoring and digesting the nonstop flow of posts in the social media world. For example, traditional business intelligence (BI) will inform you where your products are selling well and where they are not. But it will not tell you *why* your product is selling well in one location but not another. By integrating social media with traditional BI tools, you can monitor everything that is being said about your products on various platforms. With such *social intelligence,* you can gain deeper and more timely insights about customers, learning why a product is not selling. As we all know, information can travel fast on social media sites, as information goes viral when people like, share, and retweet information. By carefully monitoring trends, companies can stay ahead of the competition as new information is starting to trend. Countless successful organizations are actively monitoring social media to gain social intelligence regarding the sentiments of current and future customers.

Social media has not only become an important source of up-to-date information for businesses, but it is also emerging as a valuable resource for police and other first responders. Social media users have demonstrated that information about crises can travel at a rate that rivals 911 services. Indeed, analyzing public information is not unusual in the world of intelligence gathering either. Today, social media have people racing to express who they are and what they think, information that has never been this vast and openly accessible. Using such information, the U.S. government is developing tools to forecast everything from revolutions to upheavals to economic changes. Recently released documents also reveal that the U.S. National Security Agency (NSA) uses Facebook and other social media profiles to create maps of social connections. From business corporations to government agencies, insights about what is happening, or about to happen, can be gleaned from social media where people are compelled to share what they know or think with just about anyone.

Have you checked your Facebook newsfeed today? Or, more accurately, how many times have you been on Facebook since you woke up this morning? It is astonishing to see what a large part of our lives social media have become. By just keeping an eye on the number of posts your feed gets in an hour, you can easily imagine how analyzing these massive numbers of posts can quickly become a Big Data problem. On the other hand, gaining social intelligence has become a Big Data opportunity for countless organizations.

Questions

6-51. How will organizations know what to look for when using social media for business intelligence?

6-52. How can government organizations analyze social media activities to predict social upheavals?

6-53. Given the speed and volume of activity on social media, what business analytics and visualization tools could be used to make sense of the information?

Based on:

Burbank, J. (2016, March 25). Why your business intelligence efforts need to involve social media. *TweetFavy*. Retrieved June 29, 2016, from https://www.tweetfavy.com/blog/2016/03/why-your-business-intelligence-efforts-need-to-involve-social-media

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MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

6-54. What is the meaning of support and confidence in the context of data mining?

6-55. Explain the difference between explicit and tacit knowledge.

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7 Enhancing Business Processes Using Enterprise Information Systems

Preview

This chapter describes how companies are deploying enterprise-wide information systems to support and enable core business processes. Enterprise systems help to integrate various business activities, to increase coordination among various business departments and partners, to streamline and better manage interactions with customers, and to coordinate better with suppliers in order to more efficiently and effectively meet rapidly changing customer demands.

Companies continue to find that they need systems that span their entire organization to tie everything together. As a result, an understanding of enterprise systems is needed to succeed in today's competitive and ever-changing digital world. This chapter focuses on how organizations are utilizing enterprise-wide information systems to best support internal business processes. In Chapter 8, "Strengthening Business-to-Business Relationships Via Supply Chain and Customer Relationship Management," we focus on systems that support business processes spanning multiple organizations, critical in today's competitive global environment.

MANAGING IN THE DIGITAL WORLD:

Amazon.com

Amazon.com has transformed how we shop. Having started as an online bookseller, Amazon.com now retails nearly everything, from kitchen appliances to garden furniture and even groceries. Amazon.com strives to provide a superior product selection well beyond the biggest malls and big-box stores paired with the convenience of allowing customers to purchase the products with one click from their computers or mobile devices.

Founded and headed by Jeff Bezos, Amazon.com started in 1994 with a commitment to be "customer-centric." Amazon.com custom-tailors its home page with recommendations for books, music, and other products that may entice you; these recommendations are provided by analyzing your prior purchases and comparing them to those of millions of other customers with similar tastes. Amazon.com offers free shipping when you place orders over US$25 for books or US$49 for other types of products. In certain cities, Amazon.com offers same-day delivery on items placed before a cutoff time. Amazon.com is working on a package delivery system that uses small, unmanned drones to deliver small packages within 30 minutes of placing the order.

In order to keep its competitive advantages, Amazon.com uses enterprise-wide information systems to optimize its business processes, ranging from acquiring and receiving the right goods at the right time from its suppliers to efficiently shipping physical goods to its

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

1. Explain core business processes that are common in organizations.
2. Describe what enterprise systems are and how they have evolved.
3. Describe enterprise resource planning systems and how they help to improve internal business processes.
4. Understand and utilize the keys to successfully implementing enterprise systems.

customers. Amazon.com has built not only a network of dozens of North American and international fulfillment centers for its physical products but also a number of sophisticated data centers to support its operations and offer various digital products and services. Now, Amazon.com even manages online stores and sales fulfillment for many small and large companies, creating a win–win situation: For small, independent retailers, warehousing becomes a variable cost, and for Amazon.com, this creates additional revenue streams and helps to utilize excess capacity (Figure 7.1). Using its information systems (IS) infrastructure, Amazon.com offers Amazon Web Services (AWS), a solid and reliable IS infrastructure that allows companies to rent computing resources or storage space on an as-needed basis or even deploy enterprise resource planning systems in the cloud.

Clearly, Amazon.com is more than a vibrant online store. Having designed an impressive IS infrastructure, Amazon.com is constantly developing new and innovative products and services that utilize this infrastructure. In 2015, with more than 304 million active customer accounts worldwide, Amazon.com posted net sales of US$107 billion (an increase of nearly US$20 billion over 2014), making it the leading online retailer in the United States. What the future holds for Amazon.com is inconceivable, given its current rate of innovation and growth.

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

1. How do the core business processes differ for Amazon.com's various product and service offerings?

FIGURE 7.1

Companies can rent Amazon.com's warehouse infrastructure on an as-needed basis.

Source: Bombaert Patrick/Fotolia.

2. How do enterprise-wide information systems enable Amazon.com's strategy?
3. What benefits would an organization realize by running its enterprise resource planning system on Amazon.com's Amazon Web Services (AWS) cloud computing infrastructure?

Based on:

Amazon.com. (2016, April 26). In *Wikipedia, The Free Encyclopedia*. Retrieved April 29, 2016, from https://en.wikipedia.org/w/index.php?title=Amazon.com&oldid=717233888

Anonymous. (2016). Statistics and facts about Amazon. *Statista.com*. Retrieved April 29, 2016, from http://www.statista.com/topics/846/amazon

Bensinger, G. (2016, April 28). Cloud unit pushes Amazon to record profit. *Wall Street Journal*. Retrieved April 29, 2016, from http://www.wsj.com/articles/amazon-reports-surge-in-profit-1461874333

Core Business Processes and Organizational Value Chains

Traditionally, companies are organized around five distinct functional areas: marketing and sales, supply chain management, manufacturing and operations, accounting and finance, and human resources. Each of these functional areas is responsible for various well-defined business functions, such as marketing a product; sales forecasting; procuring raw materials and components; manufacturing goods; planning and budgeting; or recruiting, hiring, and training. Although this model suggests that a company can be regarded as being composed of distinct independent silos, the different functional areas are highly interrelated to perform value-added activities (Figure 7.2). In fact, most business processes cross the boundaries of business functions, so it is helpful for managers to think in terms of business processes from a customer's (both internal and external) point of view.

Core Business Processes

In most cases, customers do not care about how things are being done; they care only that things are being done to their satisfaction. When you buy a book at Amazon.com, you typically do not care which functional areas are involved in the transaction; you care only about quickly getting the right book for the right price. Buying a book at Amazon.com can help to illustrate one of the core business processes, namely, *order-to-cash.* Similarly, *procure-to-pay* and *make-to-stock* are core business processes also common to most business organizations. Other important business processes are related to tracking a firm's revenues and expenses, managing employees, and so on. Next, we discuss the core business processes involved in generating revenue.

ORDER-TO-CASH. For business organizations, selling products or services is the main way of generating revenue. In the example of Amazon.com, you need to create an account and add items to your shopping cart. You then need to complete your order by entering shipping and billing information and submitting the order. Amazon.com will then confirm that your address is valid and will check your credit card information. Your order will then be put together and

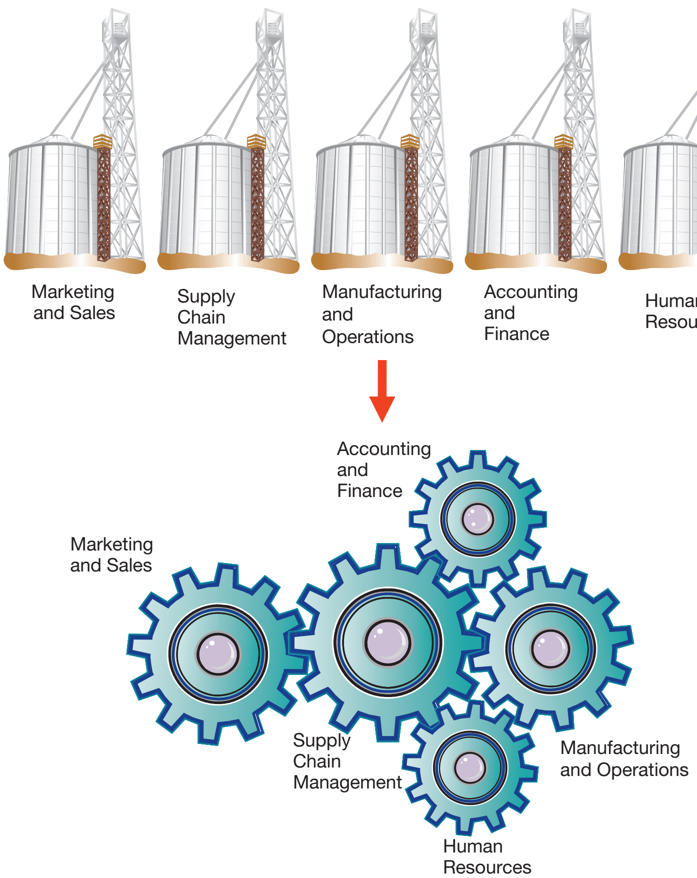


FIGURE 7.2

A company's functional areas should be interrelated.

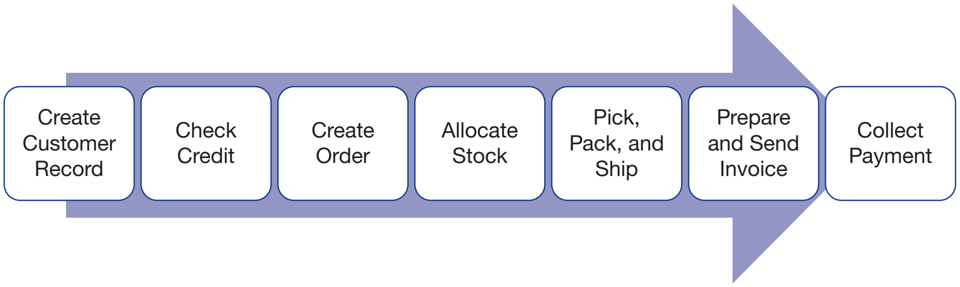


FIGURE 7.3

The order-to-cash process.

shipped, and your credit card will be charged. Together, the processes associated with selling a product or service are referred to as the **order-to-cash process** (Figure 7.3). As with all business processes, the order-to-cash process can be broken down into multiple subprocesses (most of which are common across organizations). For most businesses, the order-to-cash process entails subprocesses such as creating a customer record; checking the customer's creditworthiness; creating an order; checking and allocating stock; picking, packing, and shipping; invoicing; and collecting the payment. Depending on the nature of the transaction, the individual subprocesses and the time in which these are completed can differ considerably. For example, a sale in a convenience store may take only several seconds, and many of the subprocesses mentioned (such as creating a customer record) are not needed (although many stores now try to gather information such as customers' ZIP codes for business intelligence). In contrast, large volume orders in business-to-business contexts may take months or years to fulfill and may involve many more steps. The subprocesses can be further broken down to a more granular level.

Obviously, an ineffective order-to-cash process can have various negative effects for organizations; for example, the manual input of order information often causes errors, as do suboptimal picking and shipping processes. Together, such errors can lead to a high rate of disputes that have to be resolved, ineffective collection processes, and, ultimately, defecting customers. In contrast, an effective order-to-cash process can create customer satisfaction, speed up the collection process, and serve to provide valuable inputs into business intelligence and customer relationship management applications (see Chapter 8).

PROCURE-TO-PAY. In order to be able to sell books and other products, Amazon.com needs to acquire these from its suppliers. Amazon.com needs to manage literally thousands of suppliers, place purchase orders, receive the products, allocate warehouse space, receive and pay invoices, and handle potential disputes. These processes associated with procuring goods from external vendors are together referred to as the **procure-to-pay process** (Figure 7.4). Subprocesses of the procure-to-pay process include price and terms negotiations, issuing of the purchase order, receiving the goods, and receiving and paying the invoice.

An ineffective procure-to-pay process can increase error rates in purchase order and invoice processing; further, it inhibits a company from developing close relationships with preferred vendors. Together, this can increase the cost per transaction, lead to an increase in disputes to be resolved, and prevent the company from obtaining the most favorable conditions from its vendors. In contrast, an effective procure-to-pay process can help to obtain favorable conditions, reduce transaction costs, and, ultimately, create customer goodwill as it helps to efficiently fulfill customer orders.

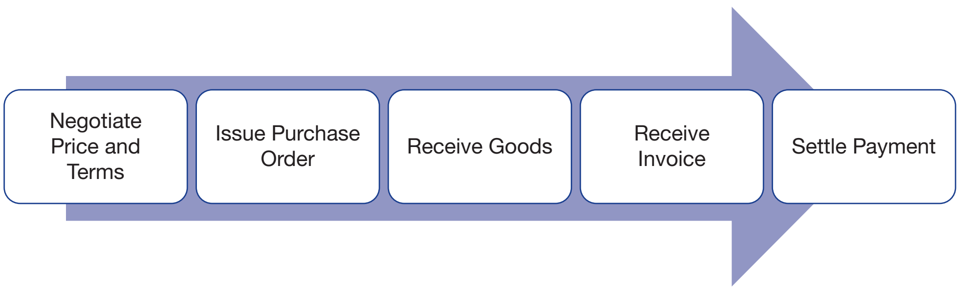


FIGURE 7.4

The procure-to-pay process.

MAKE-TO-STOCK/MAKE-TO-ORDER. A third set of core business processes is associated with producing goods (such as Amazon.com's Kindle e-book reader) and entails make-to-stock and make-to-order. In the **make-to-stock process**, goods are produced based on forecasts and are stocked in a warehouse (i.e., a push-based approach); customers' orders are then fulfilled from inventory. In contrast, in the **make-to-order process**, raw materials, subcomponents, and accessories are procured based on forecasts, but actual manufacturing does not start until an order is received (a pull-based approach); in extreme cases, even design and engineering start only when an order is received. For example, mass-produced goods, such as television sets or home appliances, are typically produced under a make-to-stock approach. Here, the organization stocks the produced goods, *pushing* the products out to customers after orders are received. In contrast, highly customizable or very expensive low-volume goods are often produced under a make-to-order approach, as is the case with Dell computers or with commercial aircraft, where the assembly starts only after a customer has placed an order. Here, the organization waits for an order, allowing it to initiate a *pulling* sequence to move the order through the production process. The processes associated with making products are composed of processing customers' orders, procuring the inputs to the manufacturing process, scheduling production, production, quality control, packaging, and stocking or shipping the product. Figure 7.5 illustrates the make-to-stock and make-to-order processes.

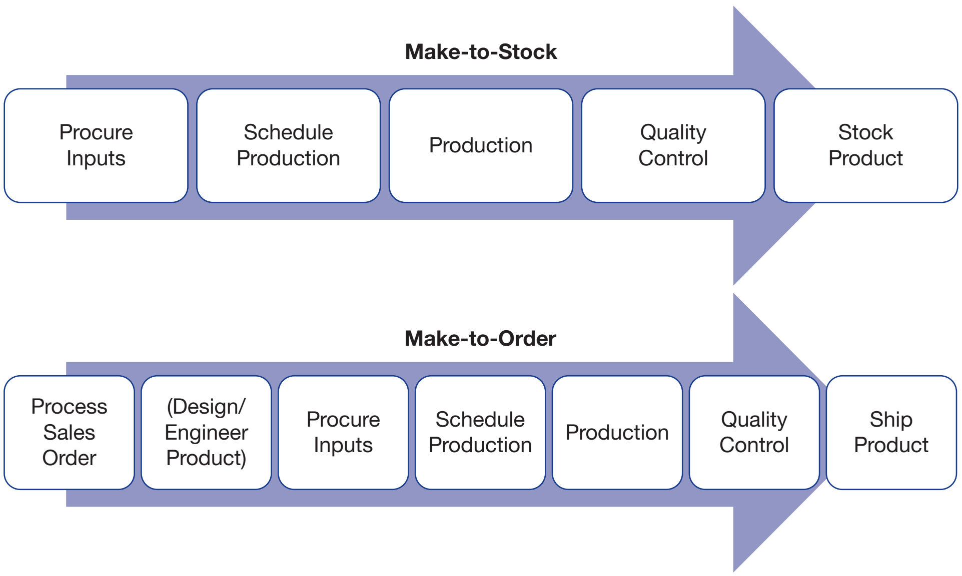
Together, these core business processes enable the creation of supply chains that are involved in transforming raw materials into products sold to the end customer. A typical supply chain resembles a river, where the raw materials start out at the source and move downstream toward the end customer; at each step, the goods are transformed to make the end product. To meet the needs for various different inputs, each organization typically has multiple upstream suppliers; similarly, each organization typically sells to multiple downstream customers. Figure 7.6 shows the supply chain of a book. Within this supply chain, one company's sales-related processes overlap with the downstream company's procurement-related processes (supply chains are discussed in detail in Chapter 8).

Organizational Activities Along the Value Chain

To gain competitive advantage over their rivals, companies are trying to optimize the core business processes in different ways so as to increase effectiveness and/or efficiency. One of the first challenges an organization must face is to understand how it can use information systems to support core and other business processes. For example, Amazon.com excels at using information systems to optimize both the procure-to-pay and the order-to-cash process. Generally, the set of business activities that add value to the end product is referred to as a *value chain* (Porter & Millar, 1985), in which information flows through functional areas that facilitate an

FIGURE 7.5

The make-to-stock versus the make-to-order process.



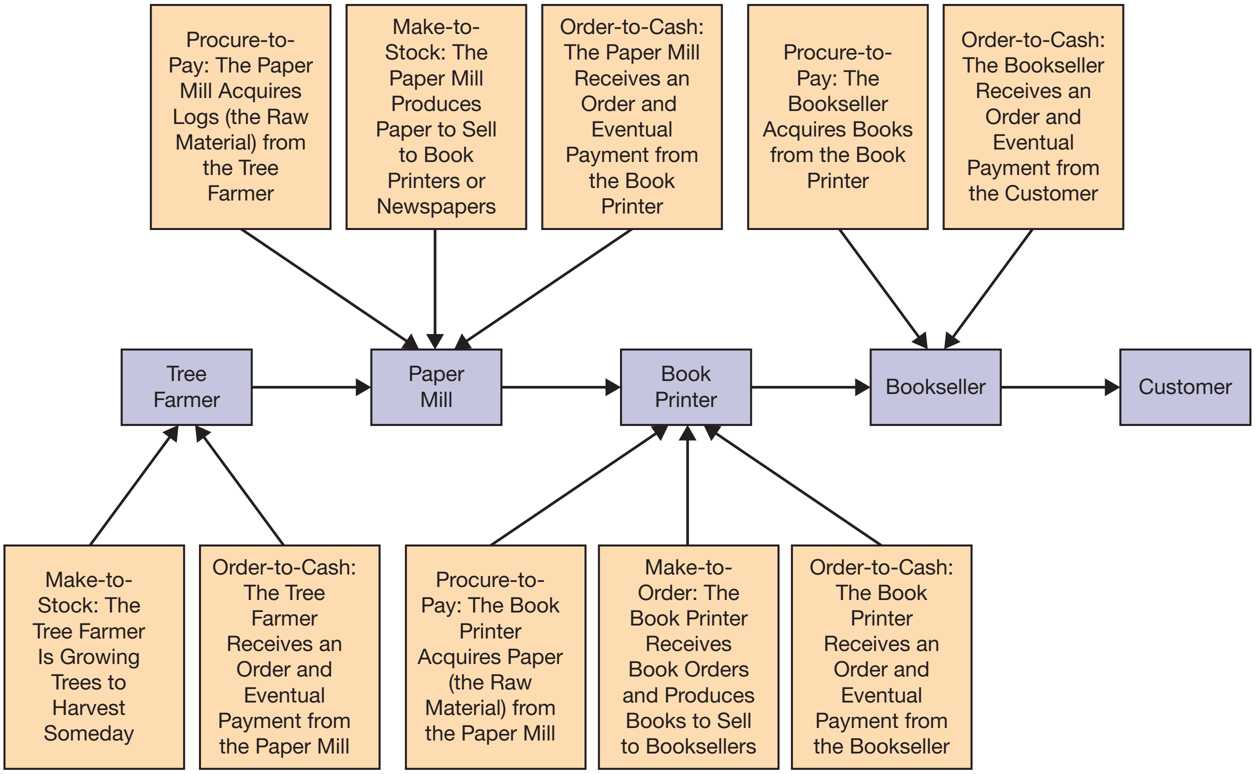


FIGURE 7.6

Supply chain of a book.

organization's business processes. Figure 7.7 depicts the value chain framework. In Chapter 2, "Gaining Competitive Advantage Through Information Systems," we spoke of the strategic value of analyzing a value chain. Here, we show you how the activities along the value chain support business processes.

Many business processes depend on activities performed by various functional areas within an organization; for example, Amazon.com's order-to-cash process involves activities performed by sales, shipping, accounting, and other functional areas. The functional areas directly involved in the process are responsible for the core activities, whereas other functional areas are performing support activities. In other words, *core activities* are performed by the functional areas that process inputs and produce outputs, and *support activities* are those activities that enable core activities to take place. In the following sections, we focus on core activities and then turn our attention to the support activities that make them possible.

CORE ACTIVITIES. **Core activities** include inbound logistics (receiving), operations and manufacturing, outbound logistics (shipping), marketing and sales, and customer service. These

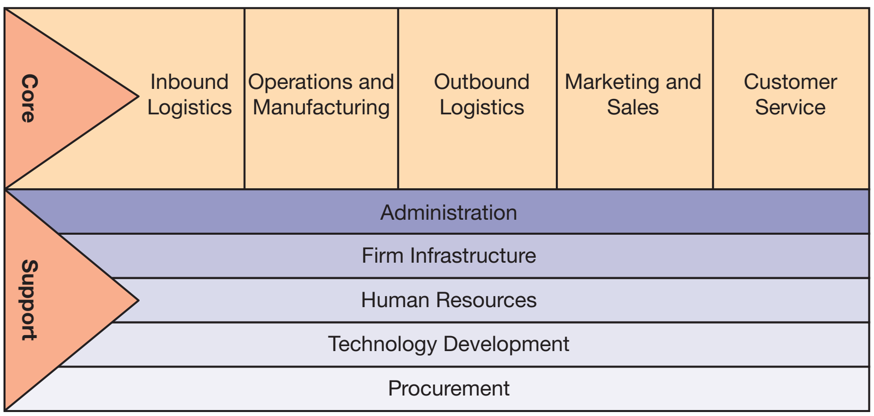


FIGURE 7.7

Value chain framework.

Source: Based on How Information Gives You Competitive Advantage. Published by *Harvard Business Review*, 1985.

activities may differ widely depending on the unique requirements of the industry in which a company operates, although the basic concepts hold in most organizations.

Inbound Logistics Activities Inbound logistics involves the business activities associated with receiving and stocking raw materials, parts, and products. For example, inbound logistics at Amazon.com involves not only the receipt of books, e-book readers, and various other products for sale but also the receipt of packaging materials and shipping labels. Shippers deliver these products to Amazon.com, where employees unwrap the packages and stock the products in the company's warehouse or directly route the products to operations in order to fill open orders. Amazon.com can automatically update inventory levels at the point of delivery, providing purchasing managers access to up-to-date information related to inventory levels and reorder points. Inbound logistics activities (also referred to as supply chain management) are a crucial part of the procure-to-pay business process, as these activities enable the company to efficiently and effectively fill customer orders.

Operations and Manufacturing Activities Once the components have been stocked in inventory, operations and manufacturing activities transform the inputs into outputs. Operations and manufacturing can involve such activities as order processing (e.g., at Amazon.com) and/or manufacturing or assembly processes (e.g., at Dell) that transform raw materials and/or component parts into end products (i.e., the make-to-stock and make-to-order business processes). Companies such as Dell utilize web-based information systems to allow customers to enter orders online. This information is used to coordinate the manufacturing of a customized personal computer in which the component parts are gathered and assembled to create the end product. During this process, inventory levels from inbound logistics are verified; if the appropriate inventory exists, workers pick the components from existing supplies and build the product to the customer's specifications. When components are picked, items are deducted from inventory; once the product is assembled, inventory levels for the final product are updated.

Outbound Logistics Activities The activities associated with outbound logistics mirror those of inbound logistics. Instead of involving the receipt of raw materials, parts, and products, outbound logistics focuses on the distribution of end products within the order-to-cash business process. For example, outbound logistics at Amazon.com involves the shipping of books that customers have ordered. Orders that have been processed by operations are forwarded to outbound logistics, which picks the products from inventory and coordinates shipment to the customer. At that point, items are packaged and deducted from the company's inventory, and an invoice is created that will be sent to the customer. Amazon.com can automatically update sales data at the point of distribution, allowing managers to view inventory and revenue information in real time.

Marketing and Sales Activities Marketing and sales activities are associated primarily with the presales (i.e., before the sale) activities of the company. These activities include the creation of marketing literature, communication with potential and existing customers, and pricing of goods and services. Most companies support the business activity of marketing and sales by creating websites, building pages on Facebook, or communicating on other social media such as Twitter (for further discussion, see Chapter 4, "Enabling Business-to-Consumer Electronic Commerce"). Many companies, especially those focused on selling products or services to the end consumer (e.g., passenger airlines such as United or online retailers such as Amazon.com), use information systems to update pricing information and/or schedules. This information is entered directly into the pricing and scheduling systems, allowing the information to become immediately accessible throughout the organization and to end consumers through the organization's website.

Customer Service Activities Whereas marketing and sales focus on presales activities, customer service focuses on post-sales (i.e., after the sale) activities. Customers may have questions and need help from a customer service representative. For most companies, such as Amazon.com, utilizing information systems to provide customer service is essential, especially given the vast number of products offered. These applications allow customers to search for and download information related to the products that they have purchased or the purchase itself.

GREEN IT

Why Your Enterprise Systems Should Be in the Cloud

Green IT refers to the practice of using computers and other IT resources in a more efficient and environmentally responsible way. A big part of the Green IT movement has focused on cloud computing. Recall that cloud computing refers to a computing model that enables ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., servers, applications, etc.) that can be rapidly provisioned and released as needed with very little human intervention. Compared with traditional in-house architectures, cloud-based architectures are very efficient, allowing for the sharing of resources among multiple organizations in a much more efficient manner, and are therefore widely considered to be a much *greener* alternative than separate dedicated facilities for each company. One of the largest and most resource-consuming computer application for many companies is their enterprise-level systems. Thus, moving a company's enterprise systems into the cloud can provide many benefits.

One obvious benefit of moving an enterprise system onto a greener platform is that the organization will become known for sustainable business practices. Being known as a sustainable business can provide a competitive advantage in a world where a company's social responsibility (or lack thereof) can play a great role in its success (or failure). In addition to the marketing benefits, the economics of a cloud-based architecture can be compelling. Benefits of using a cloud-based architecture include low capital outlays to get a system up and running, lower operating costs, better IT resource utilization, increased security, better ability to adjust to demand changes, and faster and more efficient deployment and upgrading. By going to the cloud, companies are often concerned with the reduced control over data and operations, but as cloud architectures continue to mature, such concerns are rapidly diminishing.

Increasingly, companies are moving their enterprise systems to the cloud, feeling that the benefits outweigh the risks. When moving to the cloud, it is critical that a strong and reliable cloud service provider be chosen. If a provider unexpectedly shuts down, the benefits of choosing the lowest-priced provider will quickly turn into an IT nightmare. Likewise, companies moving their enterprise systems to the cloud should take into account the energy sources used by the cloud service provider.

Based on:

Boyce, A. (2016, April 27). The difference between on-premises and cloud ERP software. *TechTarget*. Retrieved May 17, 2016, from http://searchmanufacturingerp.techtarget.com/feature/The-differences-between-on-premises-and-cloud-ERP-software

Williams, S. (2016, January 13). How to give your business the competitive edge. *BizEdge*. Retrieved May 17, 2016, from https://bizedge.co.nz/story/how-give-your-business-competitive-edge

For example, on Amazon.com customers can view their order status or can view and print invoices of current and past orders. Similarly, customers can find additional information and support about the Amazon Kindle or other digital products. Rather than calling a customer service representative, customers can easily find the needed information through a self-service customer support application. Information systems also enable customer service representatives to quickly locate information about products or services offered.

Companies can also use information systems to track service requests. When a customer calls in for repairs to a product, customer service representatives can access a bevy of information related to the customer. For instance, an agent can access technical information concerning the specific product as well as review any problems the customer has encountered in the past. This enables customer service representatives to react quickly to customer concerns, improving the customer service experience.

SUPPORT ACTIVITIES. **Support activities** are business activities that enable the primary activities to take place. Support activities include administrative activities, infrastructure, human resources, technology development, and procurement.

Administrative Activities Administrative activities focus on the processes and decision making that orchestrate the day-to-day operations of an organization, particularly those processes that span organizational functions and levels. Administration includes systems and processes from virtually all functional areas—accounting, finance, marketing, operations, and so on—at all levels of an organization.

Infrastructure Activities Infrastructure refers to the buildings, machinery, and IS infrastructure components that must be implemented to provide the necessary components that facilitate both primary and support activities (see Chapter 3, "Managing the Information Systems Infrastructure and Services"). For example, an order entry application requires that employees who enter orders have a computer that is connected via the network to a database containing the order information so that the order can be saved and recalled later for processing.

Human Resource Activities Human resource activities encompass all business activities associated with employee management, such as hiring, interview scheduling, payroll, and benefits management. Human resource activities are classified as support activities because the primary activities cannot be accomplished without the employees to perform them. In other words, all the primary activities rely on human resource–related business activities.

Technology Development Activities Technology development includes the design and development of applications that support the primary business activities so as to improve products and/or services. If you are planning on pursuing a career in the management information systems (MIS) field, you will frequently participate in activities related to the development or acquisition of new applications and systems. Technology development can involve a wide array of responsibilities, such as the selection of packaged software or the design and development of custom software to meet a particular business need. Many companies are leveraging the technology development business activity to build Internet, intranet, extranet, or mobile applications to support a wide variety of primary business activities. Likewise, technology development increasingly involves developing analytics solutions to support the transition to a data-driven organization.

Procurement Activities Procurement refers to the purchasing of goods and services that are required as inputs to the primary activities. Procurement receives, approves, and processes requests for goods and services from the primary activities and coordinates the purchase of those items. Allowing each functional area to send out purchase orders can create problems for companies, such as maintaining relationships with more suppliers than necessary and not being able to take advantage of volume discounts. The procurement business activity can leverage information systems by accumulating purchase orders from the different functional areas within the organization and combining multiple purchase orders containing the same item into a single purchase order. This facilitates negotiating volume discounts and allows the primary activities to concentrate on running the business rather than adding to their workload.

VALUE CHAIN ACTIVITIES IN SERVICE INDUSTRIES. Originally, the value chain framework was developed for analyzing the value-adding activities of manufacturing industries, but it can also be used to understand service-based industries. Many of the processes within service industries are similar to processes performed in manufacturing industries (e.g., customer service, sales, and support). However, whereas manufacturing industries deal with physical products, service industries deal with tangible and/or intangible products, which typically have to be experienced and often cannot be tried out in advance. As a result, activities such as inbound logistics and outbound logistics are sometimes less important in the service sector, and many activities can occur simultaneously (e.g., both delivery and consumption). Likewise, in the manufacturing sector, operations include the physical handling of goods when transforming them from raw materials or components to finished products; in contrast, operations in the service sector often encompass the manipulation of data and information. For example, consider the value chain activities for booking and taking a commercial airline flight. Such activities would include booking the flight, checking in, in-flight experience, baggage handling, and so on. While service activities don't always perfectly map to Porter's value chain steps, there are clearly a set of integrated or related service-oriented activities that together provide value to a customer. Additionally, in many service encounters, each separate activity is essentially a value chain in and of itself. For instance, booking a flight is a series of steps, from advertising to obtaining a ticket, including flight selection, payment, confirmation, and various types of customer services that might include seat selection and other changes. In such service encounters, a finished product equates to a booked ticket, a closed file such as a bank loan that has been issued, an insurance claim that has been filed, or an investment that has been made. As a result, optimizing the value-adding activities in the services sector does typically not include eliminating physical bottlenecks or improving inventory management but enhancing the flow of information.

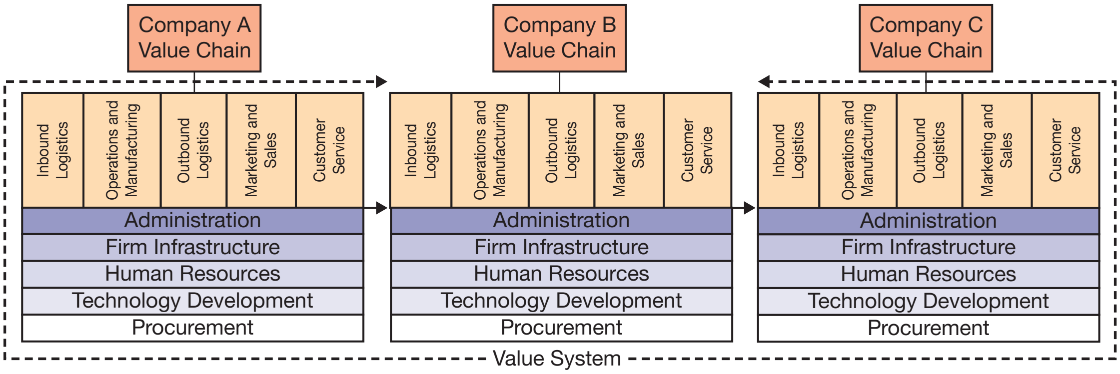


FIGURE 7.8

Three companies combine their value chains, forming a value system.
Source: Based on How Information Gives You Competitive Advantage, July 1985.

Value Systems: Connecting Multiple Organizational Value Chains

The flow of information can be streamlined not only within a company but across organizational boundaries as well. A company can create additional value by integrating internal applications with suppliers, business partners, and customers. Companies accomplish this by connecting their internal value chains to form a **value system** (Porter & Millar, 1985), in which information flows from one company's value chain to another company's value chain. Figure 7.8 depicts the value system framework. In this diagram, three companies are aligning their value chains to form a value system. First, Company A processes information through its value chain and forwards the information along to its customer, Company B, which processes the information through its value chain and sends the information along to its customer, Company C, which processes the information through its value chain. Adding additional suppliers, business partners, and customers can create complex value systems. However, for our purposes, we simply view an organization's information systems as an important part of a value chain that interacts with the value chains of other organizations.

As information systems can be used to streamline an organization's internal value chain, they can also be used to coordinate a company's value chain with another company's value chain or with consumers (such as in business-to-consumer electronic commerce). Any information that feeds into a company's value chain, whether its source is another company's value chain or an end consumer, is considered part of the value system.

A supply chain can be viewed as a river, where physical goods "flow" from a source to an ultimate destination. Like a river, at any particular point there is a flow coming from upstream and progressing downstream. In a similar way, a value system can be viewed as a river of information, comprising upstream and downstream information flows. An **upstream information flow** consists of information that is received from another organization, whereas a **downstream information flow** relates to the information that is produced by a company and sent along to another organization. For instance, in the value system depicted in Figure 7.8, the upstream and downstream information flows for Company B become quite evident. In this case, Company B receives information from its upstream supplier, processes the information through its internal value chain, and subsequently passes information downstream to its distributors and/or customers (see Chapter 8 for a discussion of product and information flows in the opposite direction). These flows of external information into and from a company can be leveraged to create additional value and gain competitive advantage.

Enterprise Systems

Businesses have leveraged information systems to support business processes for decades, beginning with the installation of individual, separate applications to assist companies with specific business tasks, such as issuing paychecks. However, in order to efficiently and effectively conduct the core business processes (as well as other business processes), the different functional areas within a company need to share data. For example, data about your book order need to be shared between accounting (for billing purposes), marketing and sales (e.g., to feed into product recommendations for other customers), and operations and supply chain management (e.g., to fulfill the order and replenish the inventory).

The Rise of Enterprise Systems

As companies began to leverage IS applications, they typically started out by fulfilling the needs of particular business activities in a particular department within the organization, and purchased a variety of proprietary software systems from different software vendors or developed department-specific software (e.g., accounting) to support specific business processes. Systems that focus on the specific needs of individual departments are typically not designed to communicate with other systems in the organization (essentially, they are "speaking different languages") and are therefore referred to as **standalone applications**. Although such systems enable departments to conduct their daily business activities efficiently and effectively, these systems often are not very helpful when people from one part of the firm need information from another part of the firm. For example, if the applications for inbound logistics and operations are not integrated, companies will lose valuable time in accessing information related to inventory levels. When an order is placed through operations, personnel may have to access two separate applications to verify that the components are available in inventory before the order can be processed. Figure 7.9 provides an example of how information flows through standalone systems within an organization. As the diagram depicts, information is generated by the inbound logistics business activity, but it does not flow through to the next business activity, in this case operations; in other words, there are too many "rocks" in the river, impeding the flow of information. Since the inbound logistics and operations departments use different standalone systems, information cannot readily flow from one business activity to another.

Understandably, this creates a highly inefficient process for operations personnel, who must have access to two systems or a common interface that pulls data together in order to get both the order entry and the inventory information. This can be challenging, as applications running on different computing platforms are difficult to integrate, and IS managers are faced with the problem of "knitting together" a hodgepodge portfolio of discordant proprietary applications into a system that shares data; often, custom interfaces are required in order for one system to communicate with another, and such integration is typically very costly. In some cases, data may be stored on both systems, creating redundancy. Should data be updated in one system but not the other, the data become inconsistent. In addition, there are further unnecessary costs associated with entering, storing, and updating data redundantly. As a result, many standalone applications are typically either fast approaching or beyond the end of their useful life within the organization; such systems are referred to as **legacy systems**.

To utilize data stored in separate standalone systems to facilitate business processes and decision making, data must be reentered from one system to the next (by either manual typing, copying and pasting, or even downloads to Excel) or be consolidated by a third system. Further, the same data may also be stored in several (sometimes conflicting) versions throughout the

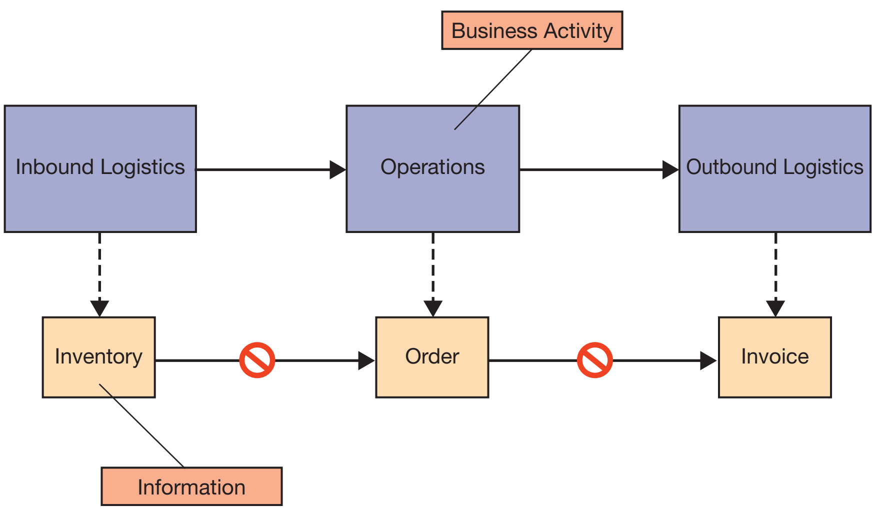


FIGURE 7.9

Information flows using standalone systems.

organization, making the data harder to consolidate, often causing the business to lose money because of inefficiencies or missed business opportunities. In addition, organizations need integrated data to demonstrate compliance with standards, rules, or government regulations. To address these challenges, organizations have turned to enterprise-wide information systems. An **enterprise-wide information system** (or **enterprise system**) is an integrated suite of business applications for virtually every business process, allowing companies to integrate data across functional areas on a company-wide basis. Rather than storing data in separate places throughout the organization, enterprise systems use an integrated database to provide a central repository common to all users. The central database alleviates the problems associated with multiple computing platforms by providing a single place where all data relevant to the company and particular departments can be stored and accessed. This, along with a common user interface, allows personnel to share information seamlessly, no matter where the user is located or who is using the application (Figure 7.10).

Enterprise systems come in a variety of shapes and sizes, each providing a unique set of features and functionality. When deciding to implement enterprise solutions, managers need to be aware of a number of issues. One of the most important involves selecting and implementing applications that meet the requirements of the business as well as of its customers and suppliers. In the following sections, we examine the ways in which information systems can be leveraged to support business processes and how companies are using these systems to support their internal and external operations.

Supporting Business Processes

As discussed previously, information systems can be used to gain and sustain competitive advantage by supporting and/or streamlining activities along the value chain. For example, an information system could be used to support a billing process in such a way that it reduces the use of paper and, more important, the handling of paper, thus reducing material and labor costs. This system can help managers keep track of that same billing process more effectively because they will have more accurate, up-to-date information about the billing process, enabling them to make smart, timely business decisions.

Information systems can be used to support either internally or externally focused business processes. **Internally focused systems** support functional areas, business processes, and decision making *within* an organization. These activities can be viewed as a series of links in a chain along which information flows within the organization. At each stage (or link) in the process, value is added in the form of the work performed by people associated with that process, and

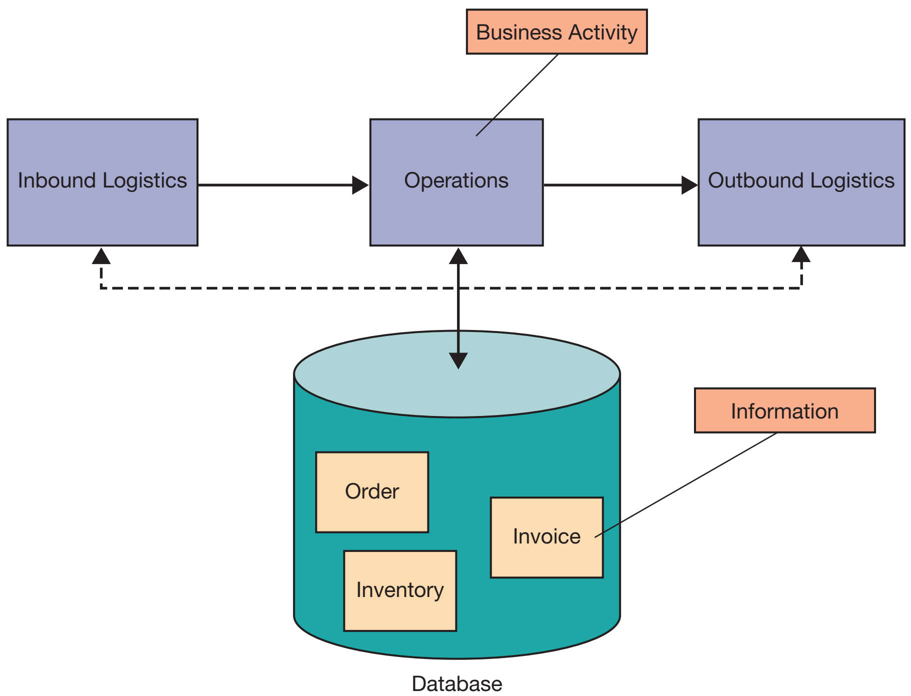


FIGURE 7.10

Enterprise systems allow companies to integrate information on a company-wide basis.

ETHICAL DILEMMA

Too Much Intelligence? RFID and Privacy

Radio frequency identification (RFID) tags have become increasingly popular for tracking physical objects. Each tag contains unique identification information that can be accessed by an RFID reader. The identification is then sent to the information system that can identify the product that was tagged. For example, the pharmaceutical industry tags certain drugs in large quantities, such as 100-pill bottles of Viagra and Oxycontin, in order to track them as they move through the supply chain and thus prevent counterfeits from reaching the public.

As with all electronic tracking devices, privacy advocates are concerned about misuse. Because RFID tags can be read by anyone who has an RFID reader, the tags have the potential of revealing data customers may wish to keep private. For example, if you buy a product that has an RFID tag, someone with an RFID reader could possibly identify where you bought the product and how much you paid for it, if the retailer does not have erasers that can clear data from the tags before you leave the store. The amount of data imprinted on an RFID tag is limited, however, and because few retail businesses have purchased RFID writers or readers, the likelihood of privacy abuse is currently slim.

In addition to tracking products, RFID technologies can be embedded within people. For example, Mexico's attorney general and senior members of his staff have been implanted with security chips from a company called VeriChip that give them access to secure areas of their headquarters. VeriChip has been actively working to promote its chips to be used in older patients with Alzheimer's or patients with diabetes to aid medical staff in tracking their care and recently announced a partnership with the National Foundation for the Investigation of Lost and Kidnapped Children to promote embedding VeriChips in children to help prevent kidnappings.

Questions

1. Using RFID implants to speed up medical assistance may be a good thing, but what if crackers manage to access a person's medical conditions?
2. What are the ethical implications of using RFID chips to track one's child?

Based on:

Gillespie, I. (2014, April 17). Human microchipping: I've got you under my skin. *The Sydney Morning Herald*. Retrieved May 19, 2016, from http://www.smh.com.au/digital-life/digital-life-news/human-microchipping-ive-got-you-under-my-skin-20140416-zqvho.html

Griffiths, S. (2015, September 3). Would YOU be microchipped? *DailyMail.com*. Retrieved April 29, 2016, from http://www.dailymail.co.uk/sciencetech/article-3221287/Would-microchipped-Kaspersky-implants-chip-man-s-hand-one-day-used-pay-goods-unlock-home.html

Klugman, C. (2015, October 21). Human chipping: Fishing for uses. *Bioethics.net*. Retrieved April 29, 2016, from http://www.bioethics.net/2015/10/human-chipping-fishing-for-uses

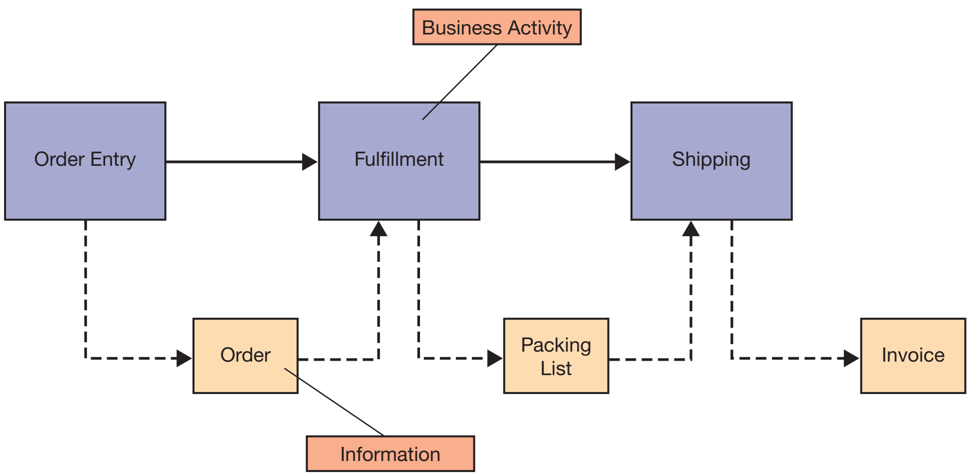
Microchip implant (human). (2016, April 13). In *Wikipedia, The Free Encyclopedia*. Retrieved April 29, 2016, from https://en.wikipedia.org/w/index.php?title=Microchip_implant_(human)&oldid=715010273

new, useful information is generated. Information begins to accumulate at the point of entry and flows through the various links, or business processes, within the organization, progressing through the organization with new, useful information being added every step of the way (Figure 7.11).

Companies can gain several advantages by integrating and converting legacy systems so that data stored on separate computing platforms can be consolidated to provide a centralized point of access. However, although internally focused systems do an excellent job of serving the needs of internal business operations on an organization-wide basis, they are not necessarily

FIGURE 7.11

Information flow for a typical order.



designed to completely accommodate the communication of information outside the organization's boundaries. The emergence of the Internet and the web has resulted in the globalization of customer and supplier networks, opening up new opportunities and methods to conduct business. For example, raw materials and component parts for a computer may come from China and be shipped to Europe for fabrication, and the final products are assembled and shipped to customers across the globe (see Chapter 1, "Managing in the Digital World"). Customers have an increasing number of options available to them, so they are demanding more sophisticated products that are customized to their unique needs. They also expect higher levels of customer service. If companies cannot keep their customers satisfied, the customers will not hesitate to do business with a competitor. Therefore, companies need to provide quality customer service and develop products faster and more efficiently to compete in global markets.

To this end, **externally focused systems** help to streamline communications and coordinate business processes with customers, suppliers, business partners, and others who operate *outside* an organization's boundaries. A system that communicates across organizational boundaries is sometimes referred to as an **interorganizational system**. The key purpose of an interorganizational system is to streamline the flow of information from one company's operations to another's (e.g., from a company to its potential or existing customers).

Competitive advantage can be achieved here by integrating multiple business processes in ways that enable a firm to meet a wide range of unique customer needs. Sharing information between organizations helps companies to adapt more quickly to changing market conditions. For instance, should consumers demand that an additional component be added to a product, a company can gain this information from its information systems that support sales and instantaneously pass it along to its component suppliers. Information systems allow the company and its suppliers to satisfy the needs of customers efficiently because changes can be identified and managed immediately, creating a competitive advantage for companies that can respond quickly. In addition, streamlining the information flows can help companies find innovative ways to increase accurate on-time shipments, avoid (or at least anticipate) surprises (such as shortages in raw materials or weather problems), minimize costs, and ultimately increase customer satisfaction and the overall profitability of the company. We can view processes and information flows across organizations just as we previously viewed the processes and information flows within an organization. At each stage (or link) in the process, value is added by the work performed, and new, useful information is generated and exchanged between organizations (Figure 7.12). Using an interorganizational system, one company can create information and transmit it electronically to another company.

Systems that facilitate interorganizational communications focus on the upstream and downstream information flows. On the upstream side, *supply chain management* applications integrate the value chains of business partners within a supply chain, improving the coordination

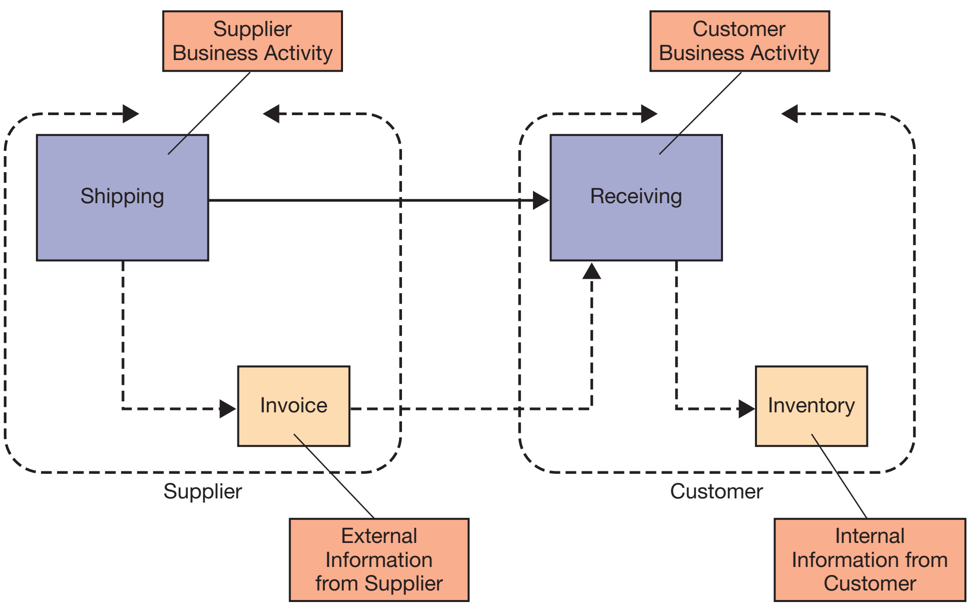


FIGURE 7.12

Information flow for a typical shipment across organizational boundaries.

of suppliers, product or service production, and distribution. On the downstream side, *customer relationship management* applications concentrate on the activities involved in promoting and selling products to the customers as well as providing customer service and nourishing long-term relationships (both types of applications are discussed in Chapter 8). Integrating internally focused and externally focused applications can be extremely valuable for companies operating in global markets.

IMPROVING BUSINESS PROCESSES THROUGH ENTERPRISE SYSTEMS. Software programs come in two forms—packaged and custom. **Packaged software**, sometimes referred to as **off-the-shelf software**, is written by third-party vendors for the needs of many different users and organizations, supporting standardized, repetitive tasks, such as word processing, payroll processing, or preparing taxes. These programs can be quite cost effective because the vendor that builds the application can spread out development costs through selling to a large number of users.

Yet packaged software may not be well suited for tasks that are unique to a particular business. In these cases, companies may prefer to develop (or have developed for them) **custom software**, which is designed and developed exclusively for specific organizations (see Chapter 9, "Developing and Acquiring Information Systems") and can accommodate their particular business needs. However, obtaining custom software is much more expensive because the organization has to bear all costs (in terms of time, money, and other resources) associated with designing and developing the software. Furthermore, applications need to be maintained internally when changes are required. With packaged software, the vendor makes the changes and distributes new versions to its customers. In all, there are trade-offs when choosing between the packaged and custom software routes. Managers must consider whether packaged software can meet the business requirements and, if not, conduct a cost–benefit analysis to ensure that taking the custom software approach will prove worthwhile to the company.

Because no two companies are alike, no packaged software application will exactly fit the unique requirements of a particular business. Thus, enterprise systems are designed around **modules**, which are components that can be selected and implemented as needed. In essence, each module is designed to replace a legacy system, be it a finance, human resources, or manufacturing system; after the conversion to an enterprise system, each business function has access to various modules that serve its needs, but the modules (and the underlying data) are tightly integrated and share the same look and feel (Figure 7.13).

Vanilla Versus Customized Software The features and modules that an enterprise system comes with out of the box are referred to as the **vanilla version**. If the vanilla version does not support a certain business process, the company may require a customized version. **Customization** provides either additional software that is integrated with the enterprise system or consists of direct changes to the vanilla application itself. Most enterprise systems include

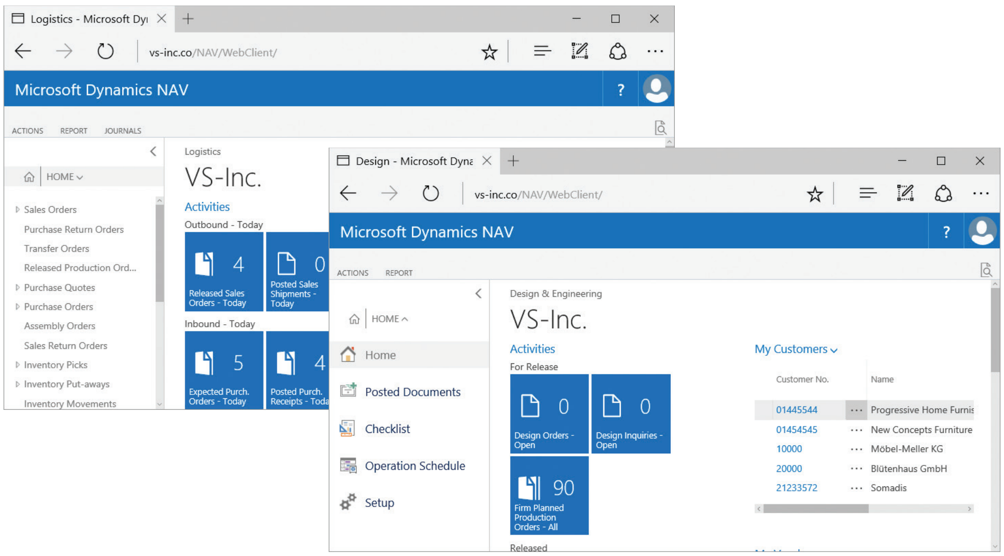


FIGURE 7.13

Each module in an enterprise system is designed to replace a standalone legacy system.

Source: Dynamics NAV 2016, Windows 10, Microsoft Corporation.

COMING ATTRACTIONS

The Internet of Things Will Transform ERP and Organizations

The Internet of Things (IoT), which refers to a broad range of physical objects (such as computers, sensors, or motors) that are interconnected and automatically share data over the Internet, has seen rapid developments. Many think that the IoT is primarily about your toaster talking to your refrigerator. While this may (or may not) occur, there are many other applications of IoT, particularly when creating products and services, where IoT technologies can be transformative.

Early enterprise software focused on people; systems were designed to help people complete activities such as paying a bill, ordering a part, or paying an employee. The systems interacted with people. People provided data, people started processes, or people paid a bill. While all of these activities are needed and useful, the integration of "things" will significantly transform the way organizations do business. For example, there are many more *things* than people. When virtually every product, every assembly, and every machine is connected to the enterprise system, there is a lot more data available to understand what is happening. With such data, many operations can happen automatically without human intervention. Also, *things* can tell you more than people. Complex machines can have dozens of sensors that provide much more data than could ever be generated by a single machine operator. And these data can be collected continuously (e.g., every millisecond if necessary) and, again, without human intervention. Finally, *things* never get tired or run out of things to say. Such things, and their sensors, will silently and diligently do their job sending updates as often as needed.

When IoT technologies provide data for enterprise-wide systems, the enterprise will have a better understanding of virtually every aspect of the business, and at a depth and precision never before possible. With such business intelligence, organizations not only will operate more efficiently and effectively, they also will learn much more about their business processes, such as where improvements can be made and what tasks are most vulnerable to disruption. Such insights will result in process improvements and better products. Over time, IoT technologies will help companies rapidly and iteratively improve how their business is performed.

Based on:

Chou, T. (2016, May 17). The wide world of IoT and precision technology. *CFO*. Retrieved May 18, 2016, from http://ww2.cfo.com/internet-of-things/2016/05/wide-world-iot-precision-technology

literally thousands of elements that can be customized. Companies must take special care when dealing with customization, as customization can be extremely costly, and maintaining and upgrading customizations can be troublesome. For example, a customization made to the vanilla version will need to be reprogrammed when a new release of the system is implemented because subsequent releases of the software will not include the previous customizations. In other words, new vanilla versions must be continually upgraded to accommodate the company-specific customizations. This process can involve a substantial investment of time and resources, diverting attention away from other key business activities and reducing company profits.

Best Practices–Based Software One of the major hurdles facing companies that implement enterprise systems involves changing business processes to accommodate the manner in which the software works. Enterprise system implementations are often used as a catalyst for overall optimization of underlying business processes. As a result, most enterprise systems are designed to operate according to industry-standard business processes, or **best practices**, and vendors offer many industry-specific versions that have already been customized for particular industries based on best practices and the data types and requirements of the specific industries. Best practices reflect the techniques and processes, identified through experience and research, that have consistently shown results superior to those achieved with other means. In fact, because they have proven to consistently lead to superior performance, most enterprise system vendors build best practices into their applications to provide guidelines for management to identify business activities within their organizations that need to be streamlined. Implementations and future upgrades to the system will go more smoothly when companies change their business processes to fit the way the enterprise system operates, and companies that reject these best practices are in for a long and time-consuming implementation (although the vendors and external consultants typically offer help in the process).

However, many organizations have spent years developing business processes that provide them with a competitive advantage in the marketplace. Adopting their industry's best practices may force these companies to abandon their unique ways of doing business, putting them on par with their industry competitors. In other words, companies can potentially lose their competitive advantages by adopting the best practices within their industry. Given the importance and difficulty of changing business processes with enterprise and other systems implementations, we now briefly describe business process management.

Business Process Management Optimizing business processes is key for organizational efficiency, effectiveness, and agility, and over the years, various approaches for improving business processes have been developed. Given the magnitude of change that an enterprise system can impose on an organization's business processes, understanding the role of business process management in the implementation of an enterprise system is necessary. **Business process management (BPM)** is a systematic, structured improvement approach by all or part of an organization whereby people critically examine, rethink, and redesign business processes in order to achieve dramatic improvements in one or more performance measures, such as quality, cycle time, or cost.

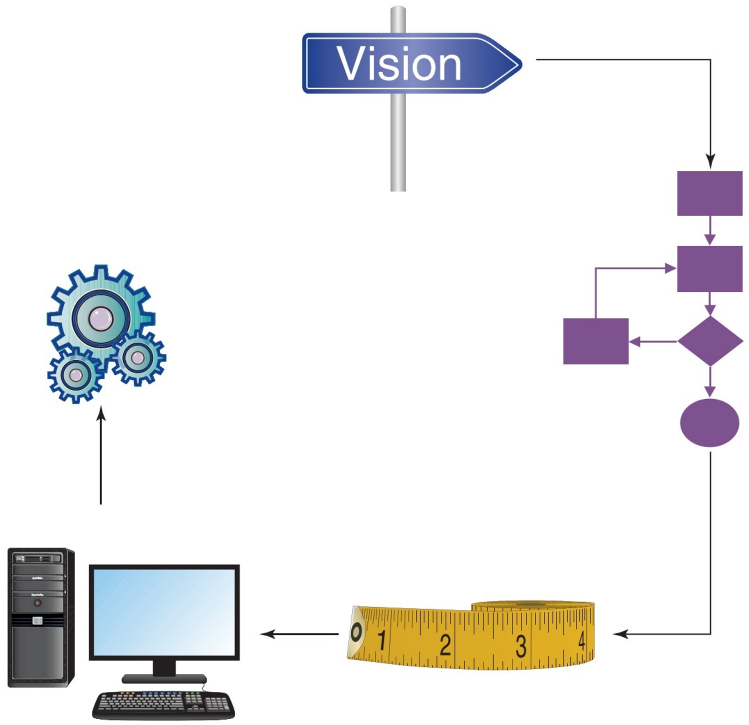
BPM, which became very popular in the 1990s (and was then called **business process reengineering [BPR]**), is based on the notion that radical redesign of an organization is sometimes necessary in order to lower costs and increase quality and that information systems are the key enabler for that radical change. The basic steps in BPM can be summarized as follows (Figure 7.14):

1. Develop a vision for the organization that specifies business objectives, such as reducing costs, shortening the time it takes to get products to market, improving quality of products and/or services, and so on.
2. Identify the critical processes that are to be redesigned.
3. Understand and measure the existing processes as a baseline for future improvements.
4. Identify ways that information systems can be used to improve processes.
5. Design and implement a prototype of the new processes.

At the heart of BPM initiatives are information systems that enable the streamlining of business processes. Given the importance of information systems in such endeavors, organizations are increasingly hiring IS consultants and business analysts who have a sound understanding of the business but who are also well versed in technology. In fact, business analysts and systems analysts are often listed among the hottest jobs because of good job prospects, high salaries, and the diversity of work. In enterprise systems projects, business analysts are deeply involved in

FIGURE 7.14

The basic steps of BPM include developing a vision, identifying the critical processes that are to be redesigned, understanding and measuring the existing processes, identifying ways that information systems can be used to improve processes, and designing and implementing the new processes.



analyzing and improving business processes and mapping the processes to the different enterprise systems modules.

BPM is similar to quality improvement approaches such as *total quality management* and *continuous process improvement* in that they are intended to be cross-functional approaches to improve an organization. BPM differs from these quality improvement approaches, however, in one fundamental way. These quality improvement approaches tend to focus on incremental change and gradual improvement of processes, while the intention behind BPM is radical redesign and drastic improvement of processes.

When BPR was introduced in the 1990s, many efforts were reported to have failed. These failures occurred for a variety of reasons, including the lack of sustained management commitment and leadership, unrealistic scope and expectations, and resistance to change. In fact, BPR gained the reputation of being a nice way of saying "downsizing."

Nevertheless, BPR (and its successors such as BPM) lives on today and is still a popular approach to improving organizations. No matter what it is called, the conditions that appear to lead to a successful business process improvement effort include the following:

- Support by senior management
- Shared vision by all organizational members
- Realistic expectations
- Participants empowered to make changes
- The right people participating
- Sound management practices
- Appropriate funding

In any event, it is clear that successful business process change, especially involving enterprise systems, requires a broad range of organizational factors to converge that are far beyond the technical implementation issues.

Benefits and Costs of Enterprise Systems Beyond the improvements in critical business processes, there are various types of benefits and costs associated with the acquisition and development of enterprise systems. According to industry research, implementation costs run over budget 57 percent of the time (Panorama, 2016), and 11 percent of organizations surveyed had not recouped their implementation costs. On average, projects costs were around US$10 million but running nearly US$2 million over budget. Top reasons cited for budget overruns are that the initial project scope was expanded and that unanticipated technical or organizational change management issues resulted in additional costs.

Gaining a better understanding of both project benefits and costs can help to develop an improved understanding of the project's total cost of ownership and help make the business case for a particular investment decision (see Chapter 9). Benefits of enterprise systems that can be used to make the business case include:

- Improved availability of information
- Increased interaction throughout the organization
- Improved (reduced) lead times for manufacturing
- Improved customer interaction
- Reduced operating expenses
- Reduced inventory
- Reduced IS costs
- Improved supplier integration
- Improved compliance with standards, rules, and regulations

The two mostly likely benefits realized from utilizing enterprise systems are improvements in information availability and increased interaction across the organization as a result of streamlining business processes.

Just as there are many possible benefits that can be realized when implementing an enterprise system, there are also many potential costs that can affect the total cost of ownership of these large and complex systems. Many companies underestimate these costs and, as a result, ultimately go over budget. Understanding all of the items that make up the total cost of ownership will help guide organizations into making better financial projections and project approval decisions. Beyond the system acquisition costs—for example, software licenses and maintenance costs, technical implementation, and hardware costs—other costs that are often overlooked when estimating project costs include:

- Travel and training costs for personnel
- Ongoing customization and integration costs
- Business process studies
- Project governance costs

If all costs are not considered, it can result in unexpected budget increases, delayed project timelines, and angry management. Next, we examine enterprise resource planning systems.

Enterprise Resource Planning

Today, most enterprise-wide information systems come in the form of **enterprise resource planning (ERP) systems**. In the 1990s, we witnessed companies' initial push to implement integrated applications, as exhibited by skyrocketing sales of ERP systems at that time. Be aware that the terms *resource* and *planning* are somewhat misnomers, meaning that they only partially describe the purpose of ERP systems, since these applications do much more than just planning or managing resources. The reason for the term *enterprise resource planning* is that these systems evolved in part during the 1990s from material requirements planning and manufacturing resource planning packages. Do not get hung up on the words *resource* and *planning*. The key word to remember from the acronym *ERP* is *enterprise*.

ERP systems replace standalone applications by providing various modules based on a common database and similar application interfaces that serve the entire enterprise rather than portions of it. Data stored on legacy systems is converted into a large, centralized database that stores data related to the various business activities of an organization. Thus, ERP systems make accessing data easier by providing a central repository, giving personnel access to accurate, up-to-date information throughout the organization. For example, inventory data is accessible not only to inbound logistics and operations but also to accounting, sales, purchasing, and customer service personnel (Figure 7.15). Storing data in a single place and making it available to everyone within the organization empowers all employees in the organization to be aware of the current state of business and to perform their jobs better. In addition, many ERP systems support business processes of globally operating organizations. For example, the ERP systems of SAP, the German enterprise systems pioneer, have multilingual interfaces and automatically convert measurement units (e.g., kilograms to pounds or centimeters to inches) and currencies. This way, engineers in Germany, Spain, or Italy can input the bill of materials, manufacturing engineers and factory specialists can buy the parts and set up the production run, and marketing and sales staff in the United States can easily communicate with their clients.

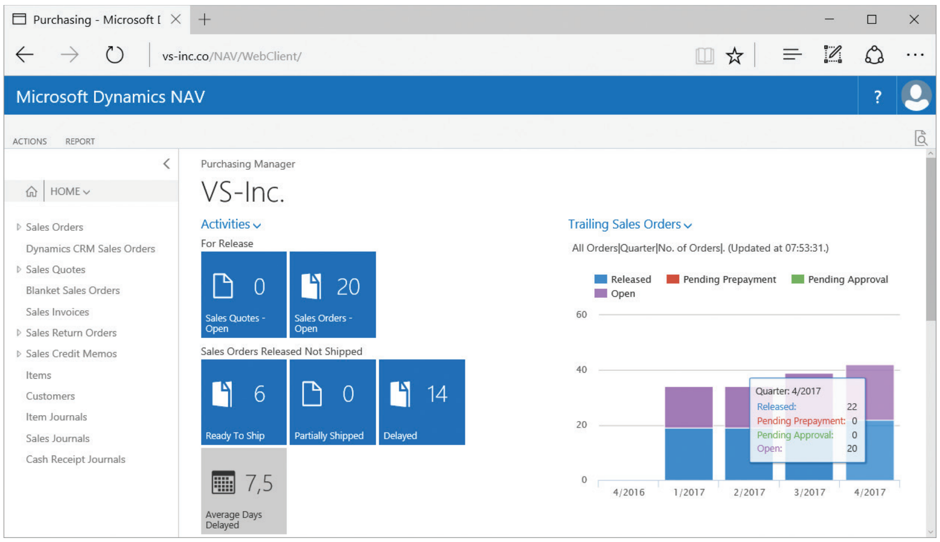


FIGURE 7.15

An ERP system can provide employees with relevant, up-to-date information.

Source: Dynamics NAV 2016, Windows 10, Microsoft Corporation.

ERP modules that access the database are designed to have the same look and feel regardless of the unique needs of a particular department. Inbound logistics and operations personnel will use a common user interface to access the same pieces of data from the shared database. Although the inbound logistics module and the operations module will have different features tailored to the unique needs of the business functions, the screens will look comparable, with similar designs, screen layouts, menu options, and so on. The Microsoft Office products provide a useful analogy. Microsoft Word and Microsoft Excel are designed to provide different functions (word processing and spreadsheets, respectively), but overall the products look and feel very similar to one another. Word and Excel have similar user interfaces but differ vastly in the purpose, features, and functionality that each application offers. Likewise, the look and feel of Microsoft Dynamics (Microsoft's suite of enterprise-wide information systems) resembles that of Microsoft Office so as to reduce the learning curve for new users.

Responding to Compliance and Regulatory Demands

In addition to helping improve business processes, ERP systems improve and ease an organization's ability to implement audit controls and comply with government-imposed regulations. Compliance with far-reaching government mandates like the Sarbanes–Oxley Act and other evolving and emerging regulatory standards is based on the implementation and documentation of internal controls, procedures, and processes. All ERP systems are designed to include an abundance of control features that can mirror an organization's business processes (e.g., controlling who has access to data and process steps, segregating duties across job functions, etc.). Such enterprise-wide capabilities provide organizations with tested solutions for developing and deploying a comprehensive compliance strategy. While the ERP system may not provide answers to all regulatory requirements, deploying an ERP system has been a central strategy for many organizations struggling to adhere to the myriad legal, regulatory, and supply chain mandates that are common in today's highly regulated business environment.

Choosing an ERP System

When selecting an appropriate ERP system for an organization, management needs to take many factors into careful consideration. Although ERP systems come in a variety of shapes and sizes, each designed to accommodate certain transaction volumes, industries, and business processes, they come as packaged software, which means that they are designed to appeal to many different companies. However, businesses have unique needs even within their own industries. In other words, like snowflakes, no two companies are exactly alike. Management must carefully select an ERP system that will meet the unique requirements of its particular company and must consider a number of factors in the ERP selection. Among the most prevalent issues facing management are ERP control and ERP business requirements.

ERP CONTROL. ERP control refers to the locus of control over the computing systems and data contained in those systems as well as decision-making authority. Companies typically either opt for centralized control or allow particular business units to govern themselves. In the context of ERP, these decisions are based on the level of detail in the information that must be provided to management. Some corporations want to have as much detail as possible made available at the executive level, whereas other companies do not require such access. For instance, an accountant in one company may want the ability to view costs down to the level of individual transactions, while an accountant in another company may want only summary information. Another area related to control involves the consistency of policies and procedures. Some companies prefer that policies and procedures remain consistent throughout an organization. Other companies want to allow each business unit to develop its own policies and procedures to accommodate the unique ways that they do business. ERP systems vary widely in their allowance for control, typically assuming either a corporate or a business-unit locus of control. Some ERP systems allow users to select or customize the locus of control. In either case, management must consider the ERP's stance on control to ensure that it will meet the business requirements of the company.

SECURITY MATTERS

To Update or Not to Update, *That Shouldn't Be the Question*

Virtually all commercial software has known or unknown security flaws. When such flaws are detected, the software vendor typically provides an update. Recall getting occasional updates on your personal computer, tablet, or smartphone. Such updates often provide a new capability, but more often than not, they provide updates to fix a discovered security problem.

For example, in May 2016, Homeland Security's Computer Emergency Response Team (US-CERT) released an alert that 36 unnamed organizations were running misconfigured or outdated SAP software that could leave them vulnerable to attacks by malicious hackers. According to US-CERT, if attackers successfully exploited the flaw, they would be able to gain full access and complete control of the enterprise system. While the flaw was detected and fixed in 2010, it persists in many organizations' computing platforms due to lax updating policies or other serious problems.

You might ask, "Why wouldn't the company update its software?" Well, there is no single reason for this. In fact, there are many reasons why organizations fail to upgrade software to its latest version. For example, some may not upgrade because they feel that some new features may not be needed or be necessary. Others may avoid an upgrade in order to avoid paying associated upgrading fees. Some may conclude that the system is running fine as is, so "why fix what isn't broken?" However, for ERP software, the biggest reason for organizations not to update outdated software is that many of these systems have been customized to a particular organization's manner of working and business processes. These custom software modules are often not compatible with the latest versions of the ERP without extensive rewriting and testing. So, rather than modifying the customized modules to be compatible with the ERP's latest release, many organizations literally "roll the dice" by keeping the older generating software so that they can continue to use their custom-designed features.

Failing to upgrade an ERP system is especially problematic and risks much more than losing some old text messages or photos. A single ERP system can support hundreds of different business process; the databases can be massive, often larger than many terabytes. ERP systems touch nearly every aspect of an organization, from sales to production and inventory to payroll. Given their massive size, scope, and complexity, a system failure can literally bankrupt a company. Just as you should always run updates on your computer and smartphone, so too should organizations. Which risk is greater, a change in business processes or bankruptcy? While the risks may be low, many companies are making the wrong choice when it comes to updating their ERP software.

Based on:

Grey, L. (2015, July 10). Why is ERP security so difficult? *HelpNetSecurity*. Retrieved May 17, 2016, from https://www.helpnetsecurity.com/2015/07/10/why-is-erp-security-so-difficult

Kronen, M. (2016, February 5). Top 6 reasons why your company shouldn't use outdated software. *LinkTek*. Retrieved May 17, 2016, from http://www.linktek.com/top-6-reasons-why-your-company-shouldnt-use-outdated-software

Monahan, M. (2013, May 30). Top six ERP implementation failures. *360 Cloud Solutions*. Retrieved May 17, 2016, from http://blog.360cloudsolutions.com/Top-Six-ERP-Implementation-Failures

Shinder, D. (2015, January 14). Patch or not? Weighing the risks of immediate updating. *WindowsSecurity.com*. Retrieved May 17, 2016, from http://www.windowsecurity.com/articles-tutorials/misc_network_security/patch-or-not-weighing-risks-immediate-updating.html

US-CERT (2016, May 11). Alert (TA16-132A) exploitation of SAP business applications. Retrieved May 17, 2016, from https://www.us-cert.gov/ncas/alerts/TA16-132A

Whittaker, Z. 2016, May 11). Homeland Security warns of hackers exploiting SAP security flaw. *ZDNet*. Retrieved May 17, 2016, from http://www.zdnet.com/article/homeland-security-warns-of-hackers-exploiting-sap-security-flaw

ERP BUSINESS REQUIREMENTS. When selecting an ERP system, organizations must choose which modules to implement from a large menu of options—most organizations adopt only a subset of the available ERP components. There are two major categories of ERP components—ERP *core* components and ERP *extended* components (Figure 7.16).

ERP Core Components **ERP core components** support the important *internal* activities of the organization for producing its products and services. These components support internal operations such as the following:

1. ***Financial Management.*** Components to support accounting, financial reporting, performance management, and corporate governance
2. ***Operations Management.*** Components to simplify, standardize, and automate business processes related to inbound and outbound logistics, product development, manufacturing, and sales and service
3. ***Human Resource Management.*** Components to support employee recruitment, assignment tracking, performance reviews, payroll, and regulatory requirements

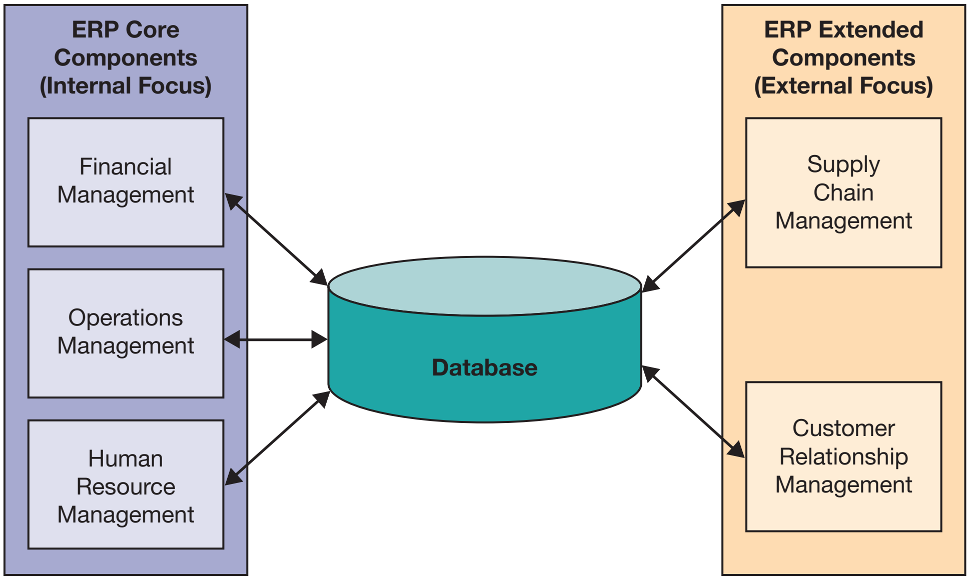


FIGURE 7.16

An ERP system consists of core and extended components.

Whereas the operations management components enable the core activities of the value chain, financial management and human resources management are associated with activities supporting the core activities (Figure 7.17).

ERP Extended Components **ERP extended components** support the primary *external* activities of the organization for dealing with suppliers and customers. Specifically, ERP extended components focus primarily on supply chain management and customer relationship management. Both are discussed in detail in Chapter 8.

Enabling Business Processes Using ERP Core Components

To fit the needs of various businesses in different industries, an ERP system's core components are typically implemented using a building-block approach through a series of modules that support internally focused business processes. For example, Oracle's JD Edwards EnterpriseOne offers more than 70 different modules to support a variety of business processes. ERP vendors typically package the various modules that enable industry-specific processes and offer such systems as "industry solutions." This way, organizations have to spend less effort in selecting the needed modules and can more easily implement the ERP system. For example, SAP's ERP application is built around modules that are modeled after the best practices for 25 different

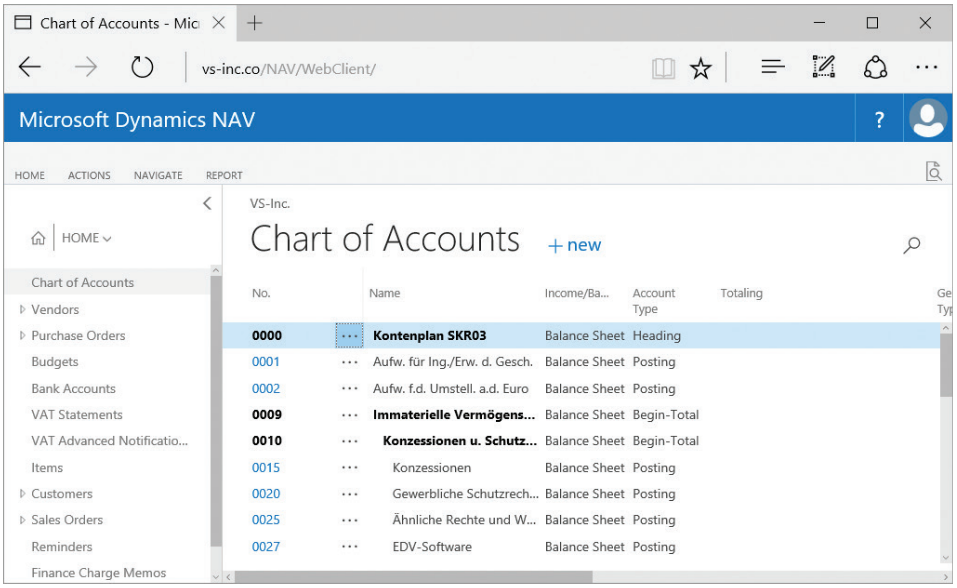


FIGURE 7.17

The financial management component of an ERP enables core value chain activities to take place.

Source: Dynamics NAV 2016, Windows 10, Microsoft Corporation.

TABLE 7.1 Industry-Specific Versions of the Microsoft Dynamics ERP System

Construction	Distribution
Education	Financial services
Government	Healthcare
Manufacturing	Not-for-profit
Professional services	Retail

industries. Depending on the industries, the modules are localized for different countries: Whereas the modules for the automotive industry are localized for Japan or Germany, the modules for apparel and footwear industries are localized for China and India, the modules for the pharmaceutical industry are localized for Germany and the United States, and so on. Similarly, Microsoft offers its Dynamics ERP system for various industries, including construction, healthcare, manufacturing, retail, and others (Table 7.1). Depending on the way processes are typically performed in an industry, the modules within each industry-specific ERP system work together to enable the business processes needed to run a business efficiently and effectively. However, the modules provided by different vendors may vary in the specific business processes they support as well as in what they are called, and it is critical for managers to understand the vendors' naming conventions and software modules to gain an understanding of how these features can be implemented to support the company's business processes.

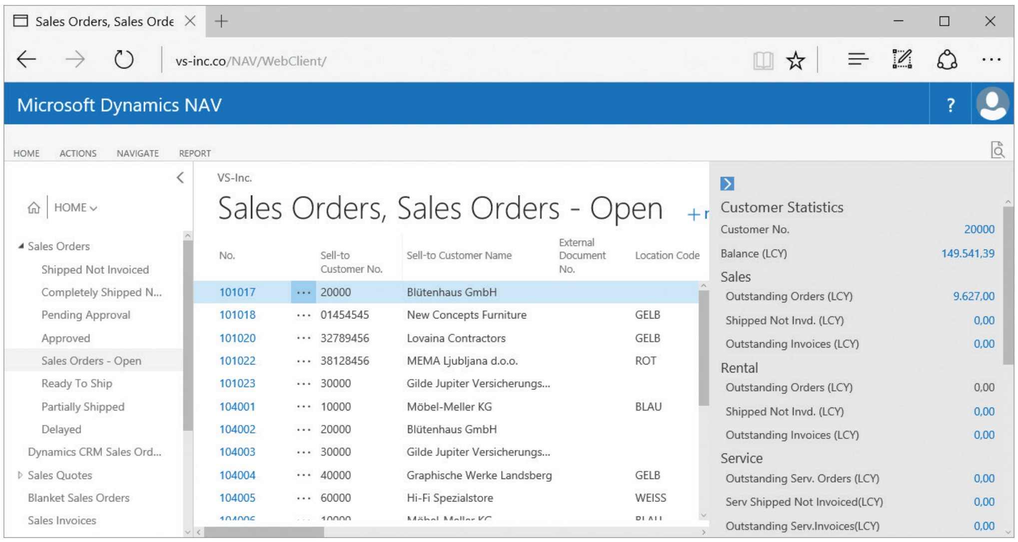
ORDER-TO-CASH. As discussed, the order-to-cash process entails the processes related to selling goods or services. Depending on the industry, the order-to-cash process can be very simple or extremely complex. In a retail environment, this process can be as simple as capturing product data, modifying the sale price (if needed), processing payment cards, and processing loyalty cards for customer profiling purposes. For a wholesale distributor, the order-to-cash process is more elaborate and consists of price quotation, stock allocation, credit limit check, picking, packing, shipping, billing, and receiving payment. For these processes to take place, different modules of the financial and operations management components work together. For example, the financial management component provides modules for checking credit limits, billing, and processing incoming payments. The operations management component provides modules related to sales and warehouse management operations, such as price quotation, stock allocation, picking, packing, and shipping (Figure 7.18).

PROCURE-TO-PAY. Recall that a generic procure-to-pay process entails negotiating price and terms, issuing purchase orders, receiving the goods, receiving the invoice, and settling the payment. As the order-to-cash process differs between industries, so does the procure-to-pay

FIGURE 7.18

An ERP system can support all aspects of the order-to-cash process.

Source: Dynamics NAV 2016, Windows 10, Microsoft Corporation.



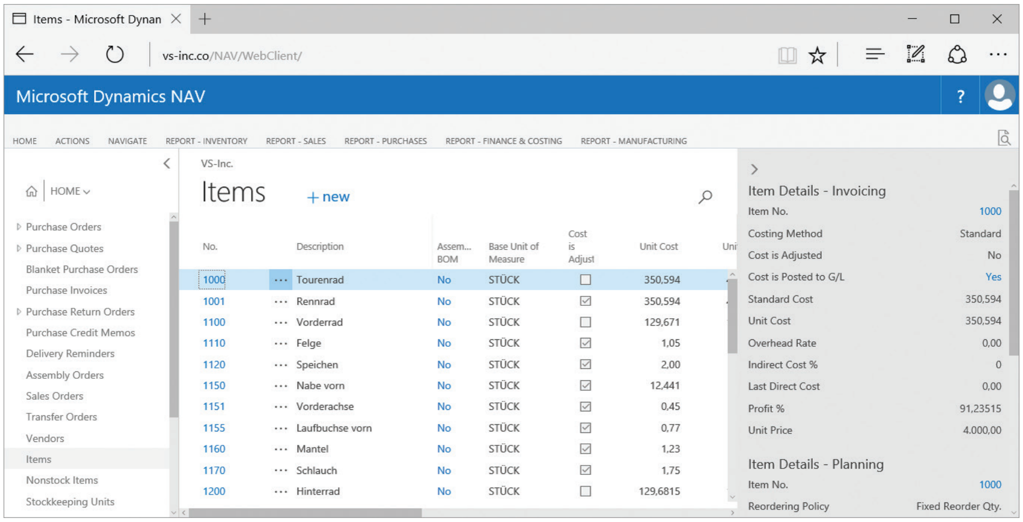


FIGURE 7.19

An ERP system can support all aspects of the procure-to-pay process.

Source: Dynamics NAV 2016, Windows 10, Microsoft Corporation.

process. A grocery store, for example, typically orders a standard assortment of products but also faces additional constraints such as having to optimize order quantities, taking into account not only demand and storage costs but also seasonality and perishability of products. In contrast, a construction company procures diverse materials, depending on the project at hand, and the procurement process could entail a lengthy sourcing process, including requests for quotations, a bidding process, reviewing of bids, awarding the contract, and thoroughly inspecting the delivered products or materials (see also Chapter 9 for the process of purchasing a new information system). Similar to the order-to-cash process, different modules of the financial management and operations management ERP components work together to enable the different activities related to the procure-to-pay process (Figure 7.19).

MAKE-TO-STOCK/MAKE-TO-ORDER. The processes related to producing goods differ widely between different industries. The biggest distinction is between the make-to-stock and make-to-order processes. As indicated, the make-to-stock process is typically used for commodities, whereas the make-to-order process is used for highly customizable goods or big-ticket items (such as aircraft or highway bridges). Many beverage companies, for instance, use a make-to-stock approach, involving production planning, manufacturing, and quality control. In contrast, an aerospace company has to start with planning the project and ordering subassemblies or raw materials with long lead times before planning and executing the production for each specific project and finally checking quality and shipping the product. Many of the activities associated with the production process are supported by the operations management component of an ERP system (Figure 7.20).

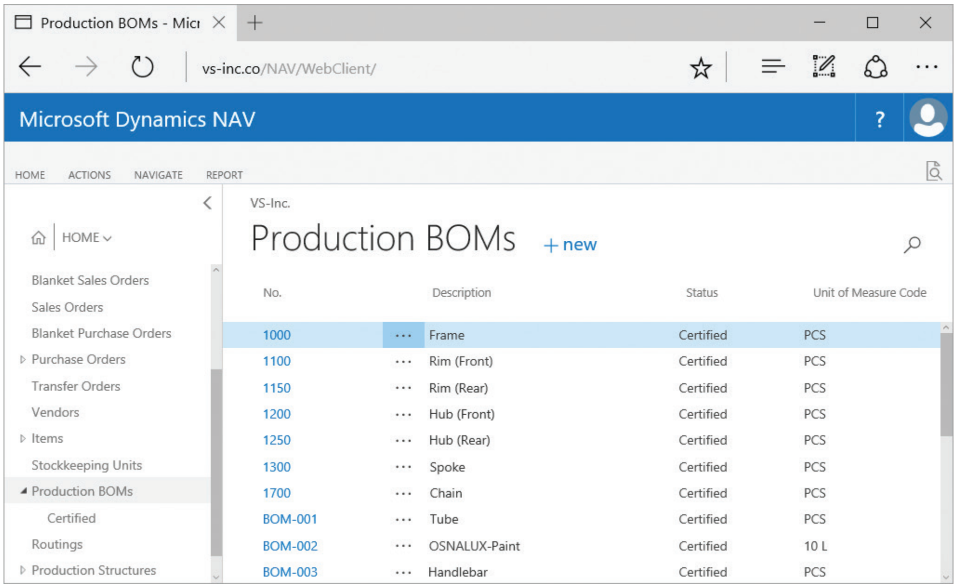


FIGURE 7.20

An ERP system can support all aspects of the production process.

Source: Dynamics NAV 2016, Windows 10, Microsoft Corporation.

OTHER BUSINESS PROCESSES. In addition to these business processes, ERP systems typically enable a variety of other generic as well as industry-specific business processes. Any business needs to manage its workforce, including managing the hiring processes, scheduling the workforce, recording time and attendance, processing payroll, managing benefits, and so on. All these processes are supported by the human resources management component of an ERP system. Similarly, the financial management component supports generic processes such as financial and managerial accounting, corporate governance, and the like. Industry-specific processes and the modules supporting these can vary widely. For example, the business of an aircraft manufacturer consists to a large extent of aftermarket support; a retail chain, in contrast, needs modules supporting retail space planning and price and markdown management; a commercial real estate company needs modules for managing assets, leases, and common spaces; and a large part of an airline's operations is related to maintenance, repair, overhaul, flight operations, catering, and customer care.

ERP Installation

Previously, we discussed how organizations can benefit from the integration of standalone systems; further, you learned how business processes can differ between industries. Thus, any organization considering the implementation of an ERP system has to carefully evaluate the different options available not only in terms of the overall systems offered by different vendors but also in terms of the industry-specific solutions offered by the software vendors. An evaluation should entail the assessment of how far the different modules can support existing business processes, which modules may have to be added, and the extent to which existing business processes have to be modified in order to fit the modules offered by the ERP system.

An activity that is widely underestimated, however, is the *configuration* of ERP systems. Whereas customization involves the programming of company-specific modules or changing how business processes are implemented within the system and is often discouraged, configuration is an activity to be performed during any ERP implementation. Specifically, the system must be configured to reflect the way an organization does business and the associated business rules. As one of the most important parts of an ERP system is the underlying company-wide database, setting up the database is key to a successful ERP implementation, and organizations have to make countless decisions on how to configure hundreds or thousands of database tables to fit the business's needs. Similarly, organizations have to make thousands of decisions related to the different business processes. For example, what should be the format of the unique identifier for a customer, when will a bill be considered overdue, what is considered the "standard" method of shipping, and so on? To make all these decisions, a good understanding of the way the company does its business is needed. Hence, many organizations hire experienced business analysts or outside consultants to assist with these configuration tasks.

ERP Limitations

While ERP systems can help organizations streamline business processes, give personnel access to accurate, up-to-date information throughout the organization, and better respond to regulatory demands, they also pose limitations. In particular, ERP systems typically require organizations to modify various business processes; once an ERP system is implemented, the company is virtually locked in, and it is very difficult to make further changes, limiting organizations' flexibility and agility when facing new external challenges. Typically, even small changes to the way processes are implemented in the ERP system require programming changes, leading to higher costs for ongoing system maintenance.

Achieving Enterprise System Success

To summarize, the main objective of enterprise systems is to help achieve competitive advantage by streamlining business activities within and outside a company. However, many implementations turn out to be costlier and more time-consuming than originally envisioned. It is not uncommon to have projects that run over budget, meaning that identifying common problems and devising methods for dealing with these issues can prove invaluable to management. Industry surveys have shown that more than 80 percent of companies that undertake enterprise system implementations realize some benefits; around 46 percent realize about half of the expected benefits, and 10 percent report that they did not realize any benefits (Panorama, 2016).

WHO'S GOING MOBILE

Big ERP Systems Embracing Small Mobile Devices

As ERP technologies have transformed organizations of all sizes in all industries, mobile devices have transformed how people manage day-to-day activities and organizations. As a result, ERP vendors are rapidly evolving their systems to better support managers with a variety of mobile ERP applications so that managers will be able to take advantage of the functionality, data, and benefits of their ERP application not only in the office but also on the road, enabling real-time management. Mobile ERP applications can provide many benefits to an organization, including:

1. **Improving Service Quality**. Mobile ERP will allow remote workers access to relevant customer information, improving service quality and responsiveness.
2. **Improving Productivity**. Mobile ERP will allow remote workers to access key resources when commuting or waiting in airports, improving productivity and reducing downtime.
3. **Strengthening Customer Relationships**. Mobile ERP will allow remote workers to have key customer information when needed to strengthen customer relationships.
4. **Improving Competitive Advantage**. Mobile ERP can speed responsiveness to customer needs, improving competitive advantage.
5. **Improving Data Timeliness and Accuracy**. Mobile ERP allows for easier, less redundant, and more timely data capture, allowing workers in the field to capture critical data as they emerge without having to rekey the data into multiple systems where errors and inconsistencies can occur.

Historically, ERP systems have not had a reputation of being user friendly. Given the mainframe roots of most systems, high usability was not a priority. Vendors are working hard to improve usability, especially for mobile ERP. Early mobile ERP apps tried to do too much and, much like their desktop-based interfaces, were slow and cumbersome to use. To reduce complexity and improve usability, vendors are now creating apps designed to perform a narrow set of tasks related to a specific business problem. Each app can be streamlined to focus on one problem and is therefore fast and easy to use. ERP giant SAP, for example, has hundreds of different apps to perform specific tasks. While apps are helping with mobile access, such innovation and usability improvements are also being integrated into desktop systems, and overall, ERP systems are becoming much easier to use. As mobility is a megatrend that will only become more and more prevalent in the workplace, organizations should choose ERP systems that have the capability and flexibility to integrate with an expanding array of mobile devices and platforms.

Based on:

Borek, R. (2011, July 22). 5 benefits to mobile ERP. *ERP Software-Blog*. Retrieved May 18, 2016, from http://www.erpsoftwareblog.com/2011/07/5-benefits-to-mobile-erp

SAP Mobile Technology (2016). Mobile technology. *SAP.* Retrieved May 18, 2016, from http://go.sap.com/solution/mobile-technology.html

SAP Store. (2016). SAP store. *SAP*. Retrieved May 18, 2016, from https://store.sap.com/sap/cpa/ui/resources/store/html/Solutions.html?pcntry=US&sap-language=EN&catID=MOB

Given these numbers, should businesses even attempt to tackle large IS projects? The answer is, in most cases, yes. Typically, organizations do not (or should not) start such projects for the sake of starting the projects; rather, organizations are trying to fix certain problems, such as inefficient or ineffective distribution, pricing, or logistics, or lack of compliance with government regulations. Further, businesses have realized that it is all but impossible to improve business processes without the support of information systems. Companies that have successfully installed enterprise systems are found to follow a basic set of recommendations related to enterprise system implementations. As with all large projects, governance and risk mitigation are critical to success, and companies should attempt to share both risks and rewards with the vendors. Although the following list is not meant to be comprehensive, these recommendations will provide an understanding of some of the challenges involved in implementing enterprise systems:

Recommendation 1. Secure executive sponsorship.

Recommendation 2. Get help from outside experts.

Recommendation 3. Thoroughly train users.

Recommendation 4. Take a multidisciplinary approach to implementations.

Recommendation 5. Evolve the implementation.

Secure Executive Sponsorship

The primary reason why enterprise system implementations fail is believed to be a lack of top-level management support. Although executives do not necessarily need to make decisions concerning the enterprise system, it is critical that they buy into the decisions made by project managers. Many problems can arise if projects fail to grab the attention of top-level management. In most companies, executives have the ultimate authority regarding the availability and distribution of resources within the organization. If executives do not support the project, the probability of failure increases dramatically.

A second problem that may arise deals with top-level management's ability to authorize changes in the way the company does business. When business processes need to be changed to incorporate best practices, these modifications need to be completed. Otherwise, the company will have a piece of software that does not fit the way people accomplish their business tasks. Also, as people, in general, are reluctant to change the way they are working, there is bound to be resistance to the implementation of an ERP system. If users and midlevel management perceive the enterprise system to be unimportant, they are not likely to view it as a priority. Enterprise systems require a concentrated effort, and executive sponsorship can propel or stifle the implementation.

Get Help from Outside Experts

Enterprise systems are complex. Even the most talented IS departments can struggle in coming to grips with any enterprise-level system. Most vendors have trained project managers and experienced consultants to assist companies with installing these complex systems. Using consultants tends to move companies through the implementation more quickly and tends to help companies train their personnel on the applications more effectively. However, companies should not rely too heavily on support from the vendors. The salespeople's job is, after all, selling a system, and they are unlikely to thoroughly understand the company's exact business needs. Thus, organizations should also draw on external consultants to help define the functionality *before* selecting a vendor and to ensure that all requirements are incorporated in the contract with the vendor. Once the application goes live and the consultants are no longer there, users have to do the job themselves. A key focus should therefore be facilitating user learning.

Thoroughly Train Users

Training is often the most overlooked, underestimated, and poorly budgeted expense involved in planning enterprise system implementations. Enterprise systems are much more complicated to learn than standalone systems. Learning a single application requires users to become accustomed to a new software interface, but enterprise system users typically need to learn a new set of business processes as well. Once enterprise systems go live, many companies initially experience a dramatic drop-off in productivity. This issue can potentially lead to heightened levels of dissatisfaction among users, as they prefer to accomplish their business activities in a familiar manner rather than doing things the new way. By training users before the system goes live and giving them sufficient opportunities to learn the new system, a company can allay fears and mitigate potential productivity issues.

Take a Multidisciplinary Approach to Implementations

Enterprise systems affect the entire organization; thus, companies should include personnel from different levels and departments on the implementation team. In customer relationship management and supply chain management environments in which other organizations are participating in the implementation, it is critical to enlist the support of personnel in their organizations as well. During implementation, project managers need to include personnel from midlevel management, the IS department, external consultants, and, most important, end users.

Failing to include the appropriate people in the day-to-day activities of the project can prove problematic in many areas. From a needs-analysis standpoint, it is critical that all the business requirements be sufficiently captured before selecting an enterprise solution. Because end users are involved in every aspect of daily business activities, their insights can be invaluable. For instance, an end user might make salient a feature that no one on the project team had thought of. Having an application that does not meet all of the business's requirements can result in poorly fitting software or customizations. Another peril in leaving out key personnel is the threat of alienation. Departments and/or personnel who do not feel included may develop a sense of animosity toward the new system and view it in a negative light. In extreme cases, users will refuse to use the new application, resulting in conflicts and inefficiencies within the organization.

Evolve the Implementation

As you can see, implementing ERP systems is a highly complex undertaking; although a successful implementation can have huge payoffs for an organization, some organizations fear

WHEN THINGS GO WRONG

Software Error Frees Prisoners Early and Is Linked to Killings

The United States has the highest incarceration rate in the world, estimated to be 716 people per 100,000 residents in 2013. To put this into perspective, consider that the United States represents about 4.4 percent of the world's population, and it houses nearly 22 percent of the world's prisoners. The cost of the corrections industry in the United States is substantial, exceeding US$74 billion, which is more than the GDP of 133 nations. The growth of the U.S. prison population is driven by several factors. First, many states have mandatory sentencing laws that require prison time for specific types of crimes (e.g., child molesting) or for repeat offenders. Such laws have acted to lower crime rates but have exploded prison populations. Second, many of the mandatory sentences can be as long as 25 years, which limits when and whether a prisoner can be released due to good behavior or other mitigating factors. With longer sentences in prison, populations continue to grow. Other factors such as the privatization of prisons, strict drug sentencing laws, and even 24-hour news programs have been cited as contributing reasons for increasing prison populations. Needless to say, there is a lot "wrong" with this picture.

In late 2015, a software glitch was discovered that was blamed for the early release of more than 3,200 prisoners since 2002 in the state of Washington. The software problem was discovered when a crime victim believed a convicted prisoner was going to be released too early. The glitch gave some prisoners more good behavior credit than was possible to earn. While many may feel that having such an error in the software for 13 years is not a huge deal, there were at least two incidents where released prisoners were charged with murder during a period of time they should have still been in confinement. In early 2016, 31 of the early released prisoners were back in custody, with only a few being accused of committing new crimes while they were on the outside. For those who were making positive progress, such as holding a job or working on their education, this unexpected re-incarceration came as an unwelcome surprise.

Based on:

Berman, M. (2016, February 9). What happened after Washington State accidentally let thousands of inmates out early. *The Washington Post*. Retrieved May 18, 2016, from https://www.washingtonpost.com/news/post-nation/wp/2016/02/09/heres-what-happened-after-the-state-of-washington-accidentally-let-thousands-of-inmates-out-early

Godard, T. (2016, March 23). The economics of the American prison system. *Smart Asset*. Retrieved May 18, 2016, from https://smartasset.com/insights/the-economics-of-the-american-prison-system

Kaste, M. (2016, January 1). 2 prisoners mistakenly released early now charged in killings. *National Public Radio*. Retrieved May 18, 2016, from http://www.npr.org/2016/01/01/461700642/computer-glitch-leads-to-mistaken-early-release-of-prisoners-in-washington

United States incarceration rate. (2016, May 7). In *Wikipedia, The Free Encyclopedia*. Retrieved May 18, 2016, from https://en.wikipedia.org/w/index.php?title=United_States_incarceration_rate&oldid=719139142

losing the ability to quickly respond to changing business requirements, particularly because large ERP systems are difficult to install, maintain, and upgrade. In addition, the life cycle of a large ERP installation is typically 10 to 15 years. A recent trend, especially for small and midsized companies, is to move away from such large, comprehensive in-house systems toward cloud-based ERP solutions. As with other cloud-based solutions, companies implementing cloud-based ERP can benefit from scalability and agility. In addition, many companies extending into new markets are extending their existing ERP systems with cloud-based solutions. Such two-tier ERP strategy can support operations at the corporate level while providing the needed flexibility and agility at the subsidiary level. This can be especially beneficial when entering global markets, as the cloud-based solutions can be easily adapted to local needs and regulations without having to make extensive changes to the core ERP system.

Another key trend is the ability to manage a business in real time. With the costs of sensors decreasing at a tremendous pace (see Chapter 1), organizations are now able to acquire data about various operational processes in real time. Being able to use this data for business decisions is regarded as critical for successfully competing in the digital world. Traditionally, organizations separated the processing of transactions from the analysis (see Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics") so as to prevent the analytical applications from slowing down the transaction processing. Even then, batch transactions could take hours, and decision makers could not get quick answers to pressing business questions, as transactional data were loaded only periodically into the analytical systems and the data needed for real-time business intelligence were just not available. New technology, using in-memory computing (see Chapter 3), can help to tremendously increase processing speed by reducing disk latency while at the same time enabling the removal of the distinction between transactional and analytical systems. Paired with the continuing trend of mobile access to ERP systems, this enables managers to manage business in real time and quickly respond to changes as they occur.

Although expansive enterprise system implementations are often cumbersome and difficult, the potential payoff is huge. As a result, organizations are compelled to implement these systems. Further, given the popularity and necessity of integrating systems and processes on an organization-wide basis, you are likely to find yourself involved in the implementation and/or use of such a system. We are confident that after reading this chapter, you will be better able to understand and help with the development and use of such systems.

INDUSTRY ANALYSIS

The Automobile Industry

There are more than 1.2 billion cars and light trucks on the road throughout the world, a number that is estimated to reach 2 billion by 2035. With almost 90 million vehicles sold worldwide in 2015, experts predict this number to climb to 100 million by 2018, with China alone accounting for 25 million vehicles sold. In addition, countries such as Brazil, Russia, and India and other emerging economies (especially in Southeast Asia) will significantly contribute to this growth.

Currently, there is growing global demand for small, energy-efficient vehicles. Since 2006, the "World Car of the Year" has been selected by a large jury of international automotive journalists from 22 countries. Cars nominated for this award need to have been sold in at least five countries and on at least two continents. In addition to the overall winner, there are other categories including luxury, performance, and green automobiles. In recent years, the Audi A3 (2014), BMW 2 Series (2015), and Mazda MX-5 (2016), all small and relatively efficient vehicles, have been chosen as the overall winners.

In the meantime, the automobile industry continues to explore other ways of responding to global market demands. Many automobile manufacturers have dramatically evolved their global networks of suppliers (such as Bosch and Continental from Germany, Magna and Lear from the United States, and Yazaki from Japan), leveraging these broad supply chains to bring new innovations to market, ranging from USB ports to hard drives for storing music to mobile data connectivity. In addition, manufacturers and technology companies are finding interesting ways to make cars safer and more convenient. Electric cars are also gaining a growing market share. In 2013, just over 400,000 electrical vehicles were sold globally; in 2015, this number grew to 1.2 million. In Norway, more than 22 percent of all new car sales were electric in 2015.

Another coming trend in this market is driverless cars. For several years, Google has famously been working on technology to support a self-driving car. The system drives the car at the speed limit it has stored from Google's mapping database and maintains distance from other vehicles using an array of sensors. In addition to Google, many other technology companies and automobile manufacturers are focusing a lot of their R&D budgets to driverless cars. Key players include not only Google but also Apple, Ford, General Motors, Tesla, Baidu, and numerous universities around the world.

Beyond optimizing supply chains and adding new innovative features, automakers are trying to attract new customers by finding new ways to present their newest models. For example, automakers are using virtual reality (VR) technology to create virtual showrooms in upscale shopping centers or just about anywhere. In 2016, Audi is using VR headsets to allow potential customers to move around the exterior of the virtual vehicle, open the trunk and doors, check out the headlights and taillights, look underneath the hood, and even get inside and sit in the driver's seat. In such immersive environments, customers can experience all aspects of the shopping experience except for the new car smell.

Questions

1. How has globalization changed the business processes of auto manufacturers?
2. What innovative technologies may be included in the cars of the future?

Based on:

Abkowitz, A. (2016, June 2). Baidu plans to mass produce autonomous cars in five years. *Wall Street Journal.* Retrieved July 21, 2016, from http://www.wsj.com/articles/baidu-plans-to-mass-produce-autonomous-cars-in-five-years-1464924067.

Anonymous. (2015, August 12). Do you know the car population in the world? *Tofucar.* Retrieved May 1, 2016, from http://www.tofucar.com/do-you-know-the-car-population-in-the-world

Anonymous. (2016, May 1). World car market in 2015 hit 89.7 million sales. *Focus2Move.* Retrieved May 1, 2016, from http://focus2move.com/world-car-market

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Autonomous car. (2016, May 1). In *Wikipedia, The Free Encyclopedia*. Retrieved May 1, 2016, from https://en.wikipedia.org/w/index.php?title=Autonomous_car&oldid=718111778

Cavies, A. (2015, October 22). Obviously drivers are already abusing Tesla's autopilot. *Wired.* Retrieved May 1, 2016, from http://www.wired.com/2015/10/obviously-drivers-are-already-abusing-teslas-autopilot

Electric car use by country. (2016, April 29). In *Wikipedia, The Free Encyclopedia*. Retrieved May 1, 2016, from https://en.wikipedia.org/w/index.php?title=Electric_car_use_by_country&oldid=717758461

Gaudiosi, J. (2016, January 8). Audi drives virtual reality showroom with HTC Vive. *Fortune.* Retrieved May 1, 2016, from http://fortune.com/2016/01/08/audi-showroom-uses-vr

Google self-driving car. (2016, April 28). In *Wikipedia, The Free Encyclopedia*. Retrieved May 1, 2016, from https://en.wikipedia.org/w/index.php?title=Google_self-driving_car&oldid=717557267

Key Points Review

1. ***Explain core business processes that are common in organizations.*** Most organizations are organized around distinct functional areas that work together to execute the core business processes order-to-cash, procure-to-pay, and make-to-stock/order. Together, these core business processes enable the creation of value chains that are involved in transforming raw materials into products sold to the end consumer. Value chains are composed of both core activities (inbound logistics, operations and manufacturing, outbound logistics, marketing and sales, and customer service) and support activities (administrative activities, infrastructure, human resources, technology development, and procurement). Companies connect their value chains with suppliers and customers, creating value systems such that information flows from one company's value chain to another company's value chain.
2. ***Describe what enterprise systems are and how they have evolved.*** Enterprise systems are information systems that span the entire organization and can be used to integrate business processes, activities, and information across all the functional areas of a firm. Enterprise systems evolved from legacy systems that supported distinct organizational activities by combining data and applications into a single comprehensive system and can be either prepackaged software or custom-made applications. The implementation of enterprise systems often involves business process management, a systematic, structured improvement approach by all or part of an organization that critically examines, rethinks, and redesigns processes in order to achieve dramatic improvements in one or more performance measures, such as quality, cycle time, or cost.
3. ***Describe enterprise resource planning systems and how they help to improve internal business processes.*** ERP systems allow information to be shared throughout the organization through the use of a large database, helping to streamline business processes and improve customer service. When selecting an ERP system, organizations must choose which modules to implement from a large menu of options—most organizations adopt only a subset of the available ERP components. ERP core components support the major internal activities of the organization for producing its products and services, while ERP extended components support the primary external activities of the organization for dealing with suppliers and customers.
4. ***Understand and utilize the keys to successfully implementing enterprise systems.*** Experience with enterprise system implementations suggests that there are some common problems that can be avoided and/or should be managed carefully. Organizations can avoid common implementation problems by (1) securing executive sponsorship, (2) getting necessary help from outside experts, (3) thoroughly training users, (4) taking a multidisciplinary approach to implementations, and (5) keeping track of evolving ERP trends.

Key Terms

MyMISLab™

Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

7-1. What are core business processes?

MyMISLab **7-2.** Compare and contrast the core and support activities of a value chain.

7-3. Give an example of upstream and downstream information flows in a value system.

MyMISLab **7-4.** Describe what enterprise systems are and how they have evolved.

MyMISLab **7-5.** Compare and contrast customized and packaged software as well as vanilla versions versus best practices–based software.

7-6. What are the core components of an ERP system?

7-7. What are the keys to successfully implementing an ERP system?

Self-Study Questions

7-8. _______________ are information systems that allow companies to integrate information and support operations on a company-wide basis.
A. Customer relationship management systems
B. Enterprise systems
C. Wide area networks
D. Interorganizational systems

7-9. Which of the following is a core activity according to the value chain model?
A. firm infrastructure
B. customer service
C. human resources
D. procurement

7-10. According to the value chain model, which of the following is a support activity?
A. technology development
B. marketing and sales
C. inbound logistics
D. operations and manufacturing

7-11. All of the following are true about legacy systems except _______________.
A. they are standalone systems
B. they are older software systems
C. they are ERP systems
D. they may be difficult to integrate into other systems

7-12. The processes associated with obtaining goods from external vendors are referred to as _______________.
A. make-to-order processes
B. make-to-stock processes
C. procure-to-pay processes
D. order-to-cash processes

7-13. The processes associated with selling a product or service are referred to as _______________.
A. make-to-order processes
B. make-to-stock processes
C. procure-to-pay processes
D. order-to-cash processes

7-14. Which processes are most often associated with pull-based manufacturing of products?
A. make-to-order processes
B. make-to-stock processes
C. procure-to-pay processes
D. order-to-cash processes

7-15. Information systems that focus on supporting functional areas, business processes, and decision making within an organization are referred to as _______________.
A. legacy systems
B. enterprise-wide information systems
C. interorganizational systems
D. internally focused systems

7-16. An enterprise system that has not been customized is commonly referred to as _______________.
A. a vanilla version
B. a root version
C. a core version
D. none of the above

7-17. _______________ is a systematic, structured improvement approach by all or part of an organization that critically examines, rethinks, and redesigns processes in order to achieve dramatic improvements in one or more performance measures, such as quality, cycle time, or cost.
A. Systems analysis
B. Business process management
C. Customer relationship management
D. Total quality management

Answers are on page 302.

Problems and Exercises

7-18. Match the following terms with the appropriate definitions:

i. Enterprise system
ii. Legacy system
iii. Value system
iv. ERP extended components
v. Standalone application
vi. Vanilla version
vii. Make-to-stock process
viii. Business process management
ix. Procure-to-pay process
x. Internally focused system

a. Components that support the primary *external* activities of the organization for dealing with suppliers and customers
b. System that focuses on the specific needs of an individual department
c. The processes associated with producing goods based on forecasted demand
d. Older system that is not designed to communicate with other applications beyond departmental boundaries
e. Information system that allows companies to integrate data on a company-wide basis
f. The features and modules that a packaged software system comes with out of the box
g. The processes associated with acquiring goods from suppliers
h. A systematic, structured improvement approach by all or part of an organization whereby people critically examine, rethink, and redesign business processes in order to achieve dramatic improvements in one or more performance measures, such as quality, cycle time, or cost
i. Information system that supports functional areas, business processes, and decision making within an organization
j. A collection of interlocking company value chains

7-19. Find an organization that you are familiar with and determine how many software applications it is utilizing concurrently. Are the company's information systems cohesive, or do they need updating and streamlining?

7-20. What part does training users in an ERP system play, and how important is it in job satisfaction? What productivity problems can result from an ERP implementation?

7-21. What are the payoffs from taking a multidisciplinary approach to an ERP implementation? What departments are affected, and what is the typical time frame? Research an organization that has recently implemented an ERP system. What could the company have done better, and what did it do right?

7-22. For a business or organization that you are familiar with, describe its order-to-cash process using the steps outlined in Figure 7.3; if the organization doesn't have a particular step, explain why this is so.

7-23. For a business or organization that you are familiar with, describe its procure-to-pay process using the steps outlined in Figure 7.4; if the organization doesn't have a particular step, explain why this is so.

7-24. For a business or organization that you are familiar with, describe either its make-to-stock or make-to-order process using the steps outlined in Figure 7.5; if the organization doesn't have a particular step, explain why this is so.

7-25. Using Figure 7.6 as a guide, develop a supply chain diagram for some other product.

7-26. Explain what is meant by upstream and downstream in the value chain and explain how Walmart influences both ends to control costs.

7-27. Based on your own experiences with applications, have you used customized or off-the-shelf applications? What is the difference, and how good was the system documentation?

7-28. Search the web for the phrase "best practices," and you will find numerous sites that summarize the best practices for a variety of industries and professions. Choose one and summarize these best practices in a one-page report.

7-29. Examine and contrast the differences between packaged and custom software. When is one approach better or worse than the other?

7-30. Search the web for recent articles on business process management and related approaches (e.g., business process reengineering) for improving organizations. What is the current state of the art for these approaches? To what extent are these "headlines" about IS implementations, especially regarding enterprise systems?

7-31. Search the web for recent stories about the use of cloud-based ERP systems. To what extent does it appear that cloud-based ERP systems will be replacing traditional ERP systems?

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Choosing an ERP System at Campus Travel

7-32. Campus Travel is interested in integrating its business processes to streamline processes such as purchasing, sales, human resource management, and customer relationship management. Because of your success in implementing the e-commerce infrastructure, the general manager asks you for advice on what to do to streamline operations at Campus Travel. Use the data provided in the file ERPSystems.csv to make a recommendation about which ERP system to purchase. The file includes ratings of the different modules of the systems and the weights assigned to these ratings. You are asked to do the following:

- Determine the product with the highest overall rating. (Hint: Use the SUMPRODUCT formula to multiply each vendor's scores with the respective weights and add the weighted scores.)
- Prepare the necessary graphs to compare the products on the different dimensions and the overall score.
- Be sure to professionally format the graphs before submitting them to your instructor.

Database Application: Creating Forms at Campus Travel

7-33. After helping Campus Travel off to a good start with its databases, you have decided that it should enter data using forms rather than doing it from tables. From your experience, you know that employees have an easier time being able to browse, modify, and add records from a form view. As this can be implemented using your existing database, you decide to set up a form. You can accomplish this by doing the following:

- Open the database employeeData.mdb.
- Select the employee table in the database window.
- Create a form using the table. (Hint: This can be done by selecting "More Forms >> Form Wizard" under "Forms" in the "Create" tab.)
- Save the form as "employees."

Team Work Exercise

Net Stats: Should They Expect to Fail?

For years, broad surveys have reported surprisingly high rates of ERP project failures. In a survey exploring the nature of these failures, Panorama Consulting Solutions, an ERP systems integrator, found that in 2015, 57 percent of ERP projects experienced cost overruns and schedule overruns. Even worse, 46 percent of the survey respondents reported receiving less than half of the expected benefits from their ERP implementation; 10 percent did not realize any measurable benefits. Clearly, ERP implementations are prone to difficulties and delays, but the reasons behind the problems are difficult to pinpoint.

Questions and Exercises

7-34. Search the web to identify a story about a recent ERP implementation failure.

7-35. As a team, interpret this article. What caused the project to fail? What could have been done differently?

7-36. As a team, discuss how the Panorama survey might look in 5 years and 10 years. Will success rates improve? Get worse? Why?

7-37. Using your presentation software of choice, create two or three slides that summarize the findings you consider most important.

Based on:

Anonymous. (2016). 2016 report on ERP systems and enterprise software. *Panorama Consulting Solutions*. Retrieved May 1, 2016, from http://panorama-consulting.com/resource-center/2016-erp-report

Answers to the Self-Study Questions

7-8. B, p. 279	**7-9.** B, p. 278	**7-10.** A, p. 278	**7-11.** C, p. 280	**7-12.** C, p. 273
7-13. D, p. 273	**7-14.** A, p. 274	**7-15.** D, p. 281	**7-16.** A, p. 284	**7-17.** B, p. 286

CASE 1 | Software as a Service: ERP by the Hour

As you know by now, an organization's IS infrastructure is not simple to construct or maintain but is a complex infrastructure of servers and databases useful for managing large amounts of information. With advances in cloud computing, software as a service (SaaS) has appeared as a model of IS infrastructure and software and is rapidly changing the way many organizations do business. SaaS is a way for organizations to use cloud-based Internet services to accomplish the goals that traditional IS infrastructure and software models have in the past. SaaS allows software application vendors to deploy their products over the Internet through web-based services. SaaS customers pay to use applications on demand, giving them the freedom to access a software service only when needed. Applications and software are developed, hosted, and operated by SaaS vendors, and customers are charged on a pay-per-use basis. Once the customer's "license" expires, the customer no longer has to carry the cost of the software. If a future need for the software arises, the customer simply orders it again to have access. SaaS products can be licensed for single or multiple users within the organization, making them flexible and scalable.

Using the SaaS model has several advantages. Through SaaS applications, organizations can move their data storage into the cloud, reducing the cost of buying storage and diminishing the risk of catastrophic data loss, as it is in the vendor's financial interest to keep the services it provides running at peak performance or risk losing customers to another vendor. In addition, SaaS allows for less resource expenditure on long-term software licensing because an organization can get what it needs when it needs it. SaaS utilization also allows organizations to become more productive outside the physical confines of their buildings. Because SaaS services are in the cloud, employees can access services from remote offices or from their mobile devices.

One of the main disadvantages of SaaS is that customers must give up some autonomy over their applications and data. Some organizations require specialized software solutions and are used to customizing software in-house to meet their needs. Although some SaaS vendors are beginning to offer customizable solutions, the problem is still a roadblock for some. Computing off-site also means that security may be an issue, as organizational operations and data are effectively running on someone else's server. As it is virtually impossible for some types of organizations to keep their data—and their secrets—in the cloud, such concerns are another roadblock that organizations must overcome in order to use SaaS products.

These disadvantages aside, organizations are reaping the benefits of SaaS, utilizing them for human resources activities, e-mail services, collaboration efforts, storage solutions, and financial tasks such as billing, invoicing, and timekeeping. In addition to more general-purpose applications, many organizations are deploying ERP capabilities via SaaS vendors. And the growth of the SaaS industry doesn't appear to be slowing. In fact, a recent study by Gartner found that the global SaaS market is projected to grow from US$49 billion in 2015 to US$67 billion in 2018.

Companies like Google, Amazon.com, and Microsoft have become well-known SaaS vendors offering a range of services to organizations, including shared-document management, communication services, cloud-based e-mail, calendaring, photo and video sharing, web and intranet page management, and data storage services, just to name a few. Given the challenges and issues associated with implementing in-house enterprise systems, ERP vendors are increasingly offering their software as a service as well. For example, SAP offers SAP Business ByDesign, an integrated on-demand ERP solution for small and medium-sized enterprises. Similarly, Microsoft offers its Dynamics customer relationship management system as a service, and Oracle offers the subscription-based Oracle On-Demand customer relationship management solution.

As more organizations continue to adopt SaaS services as a way of carrying out their day-to-day activities, vendors will continue to upgrade and expand the available technologies for use. The question of whether organizations will adopt SaaS services has, for the most part, been answered. The question has now become how much of their business they will put in the cloud.

Questions

7-38. Would you trust an external provider with your organization's data? Why or why not? What would be needed to raise your trust in the reliability, security, and privacy of the data?

7-39. What are the potential drawbacks of using a relatively simple in-house database with limited capabilities versus a more robust, SaaS database solution? Do the benefits outweigh these limitations? Why or why not?

7-40. Are there any types of applications that should only be purchased rather than obtained through a SaaS relationship? If so, why or why not?

Based on:

Columbus, L. (2015, September 27). Roundup of cloud computing forecasts and market estimates Q3 update, 2015. *Forbes.* Retrieved May 1, 2016, from http://www.forbes.com/sites/louiscolumbus/2015/09/27/roundup-of-cloud-computing-forecasts-and-market-estimates-q3-update-2015

Software as a service. (2016, March 5). In *Wikipedia, The Free Encyclopedia*. Retrieved May 1, 2016, from https://en.wikipedia.org/w/index.php?title=Software_as_a_service&oldid=708416639

CASE 2 | Amazon's Order Fulfillment, Automation, and Technological Unemployment

"Work Hard. Have Fun. Make History." So reads a sign above the entrance to many of Amazon's fulfillment centers throughout the world. Inside these massive fulfillment centers, millions of products are waiting to be shipped to the doorsteps of customers. Historically, human pickers walked the isles of these warehouses, pushing carts with baskets as they deposited items that were awaiting to be shipped to someone, from somewhere, who ordered the product online. More and more, robots are being used to support and many times replace these human workers.

While the data are constantly changing, in May 2016, Amazon operated nearly 300 centers across the world to handle order fulfillment, sorting, and delivery for Amazon and Amazon Prime customers. In addition to the United States, fulfillment centers are located in Canada, Mexico, the United Kingdom, Germany, France, Italy, Spain, Czech Republic, Poland, China, Japan, India, and Brazil. The United States alone has more than 160 facilities, with many larger than 1 million square feet. With such a network, Amazon provides same-day delivery to an increasing number of cities including New York City, Atlanta, Baltimore, Boston, Chicago, Indianapolis, Philadelphia, Washington, DC, Dallas, Los Angeles, Phoenix, San Francisco, and Seattle. Amazon has been very strategic about where it places centers. For example, in late 2015, it was estimated that its current centers bring it within 20 miles of 31 percent of the U.S. population. Clearly, Amazon is now competing with many local businesses that always had the advantage of same-day delivery.

As Amazon races for fast order fulfillment and reducing costs, it is very actively integrating robots into the order fulfillment process. An average human picker at a fulfillment center can pick around 1,000 items a day. While humans have fueled Amazon's success in the order fulfillment process, human are becoming the weak link as facilities get bigger and competition necessitates faster and less costly processes. Robots don't get tired, don't need to take lunch or toilet breaks, can work 24 hours per day, and will only make mistakes if the databases driving their operations contain an error. There are, however, many tasks that humans can perform better than robots, at least at this time. For example, robots are still incapable of tasks that require fine manipulation or improvisation. Because of this, Amazon and other large retailers are exploring ways for robots to collaborate with humans in more effective ways.

One approach for utilizing robots is to fundamentally change the picking process. Rather than have workers walk the aisles of these massive warehouses, why not have the shelves come to the pickers? These robotic shelves, sitting atop a small robot about the size of a footstool, know which products are on its shelves. Computer control guides these shelves to a particular picker, who can select the next product needed for an order, and can simultaneously optimize the movement and sequence of a countless numbers of shelves. The shelves can be kept very close to one another as they wait for inventory replenishments or to deliver a product to a picker. Shelves can also be packed tighter. The process is much more efficient than having humans walk around massive warehouses.

Historically, automation has often been viewed as a double-edged sword, providing both benefits and problems for society. Benefits could include the elimination of dangerous jobs, but at the same time, the technology also creates unemployment. Over the years, while technology eliminated some jobs, it often was the catalyst for the creation of new types of jobs, often with better pay. When automation was brought to family farms, for example, a single farmer could work much larger farms, producing enough food for many families. Such productivity gains resulted in the elimination of many farming jobs. These displaced farmers often then moved to the city to work in factories to produce even greater productivity gains in farming and other industries.

As the digital world accelerates change, emerging technologies like industrial robots, artificial intelligence, 3D printing, and machine learning are forecasted to eliminate a variety of jobs at a pace faster than ever before. When automation kills more jobs than it produces in other industries, this is called *technological unemployment.* Historically, such widespread fears of technological unemployment have been viewed as a Luddite fallacy, but now, many fear that a tipping point has been reached where technology will rapidly eliminate not only blue-collar jobs needing manual labor but also many jobs where humans make decisions, so-called white-collar jobs. In fact, some 47 percent of present jobs in the United States could be computerized in the next 10 to 20 years, according to an Oxford University study. How far and how fast this change appears will have a tremendous impact on the digital world.

Questions

7-41. Search the web and find the latest statistics about Amazon's order fulfillment facilities. Where is the largest facility located? What is its size? What large city (or cities) is it closest to?

7-42. The case made the point that automation is often a double-edged sword. Provide at least three examples where the invention of a technology provided both benefits and problems for a society.

7-43. Search the web for recent articles on "technological unemployment." Which jobs are least likely to be replaced by automation?

Based on:

Anonymous. (2016, May). Amazon global fulfillment center network. *MWPVL International.* Retrieved May 18, 2016, from http://www.mwpvl.com/html/amazon_com.html

Frey, C. B., & Osborne, M. S. (2013, September 17). The future of employment: How susceptible are jobs to computerisation? *University of Oxford.* Retrieved May 19, 2016, from http://www.oxfordmartin.ox.ac.uk/publications/view/1314

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Knight, W. (2015, July 7). Inside Amazon's warehouse, human-robot symbiosis. *MIT Technology Review.* Retrieved May 19, 2016, from https://www.technologyreview.com/s/538601/inside-amazons-warehouse-human-robot-symbiosis

Thompson, C. (2015, June 3). We've reached a tipping point where technology is now destroying more jobs than it creates, research warns. *Business Insider.* Retrieved May 19, 2016, from http://www.businessinsider.com/technology-is-destroying-jobs-and-it-could-spur-a-global-crisis-2015-6

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MyMISLab™ Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

7-44. Describe and contrast order-to-cash, procure-to-pay, make-to-stock, and make-to-order business processes.

7-45. Contrast internally and externally focused systems.

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8 Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management

Preview

This chapter extends the prior discussion regarding how companies are deploying enterprise-wide information systems to build and strengthen organizational partnerships. Enterprise systems help integrate various business activities, streamline and better manage interactions with customers, and better coordinate with suppliers in order to meet changing customer demands more efficiently and effectively. In this chapter, two additional powerful systems are introduced: supply chain management (SCM) systems supporting business-to-business (B2B) transactions and customer relationship management (CRM) systems for promoting and selling products and building and nourishing long-term customer relationships. When added to enterprise resource planning (ERP) systems, both of these systems tie the customer to the supply chain that includes the manufacturer and suppliers all the way back to the raw materials that ultimately become the product no matter where in the world they originate.

More and more companies find that they need systems that span their entire organization to tie everything together. As a result, an understanding of supply chain management and customer relationship management is critical to succeed in today's competitive and ever-changing digital world.

MANAGING IN THE DIGITAL WORLD: Walmart

As the world's largest retailer, Walmart is known for its relentless pursuit of lowering costs and passing those savings on to shoppers to undercut competitors' prices. Much of the company's success has been widely attributed to its effective use of technology to support its supply chain. Through a combination of distribution practices, truck fleet management, and technological innovations, Walmart became a model of supply chain efficiency. Being the largest retailer and private-sector employer in the world, Walmart employs more than 2.2 million people worldwide (1.4 million in the United States) and, in 2016, had about 11,500 stores in 28 countries.

One of Walmart's famous supply chain innovations is vendor-managed inventory, where manufacturers are responsible for monitoring inventory levels of their products in Walmart's warehouses, helping Walmart achieve close to 100 percent order fulfillment on merchandise and essentially eliminating the loss of sales due to out-of-stock items. Walmart further streamlined its supply chain by creating communication networks with suppliers to improve product flow and reduce inventories. The network of global suppliers, warehouses, and retail stores has been described as behaving almost like a single firm. Walmart also developed the concept of "cross docking"—direct transfers from inbound to outbound truck trailers without extra storage

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

1. **Describe supply chain management systems and how they help to improve business-to-business processes.**
2. **Describe customer relationship management systems and how they help to improve the activities involved in promoting and selling products to customers as well as providing customer service and nourishing long-term relationships.**

(see Figure 8.1). The company's trucks continuously deliver goods to distribution, where they are stored, repackaged, and distributed without sitting in inventory.

Walmart's investments in technology to support its supply chain have also resulted in powerful customer relationship management capabilities. Walmart's information systems record every purchase in every store around the world, along with a host of other information (location, time of day, other items purchased in the same order, etc.). Its data warehouse containing all of these data is one of the largest in the world. As a result, Walmart can stock more of the most popular products and cluster items that people tend to buy at the same time. As Walmart's online business continues to grow, it is carefully refining its supply chain to optimize both traditional and online sales. These and other innovations have fueled and maintained Walmart's impressive growth and market share. In early 2016, Walmart was estimated to have 11.2 percent of U.S. retail sales, with e-commerce sales of nearly US$14 billion, and global sales of nearly US$500 billion in 2015.

Information systems are increasingly central to streamlining supply chains, coordinating with suppliers and distributors, and managing and leveraging relationships with customers. Those organizations that develop advanced systems capabilities in these crucial areas of business will, like Walmart, gain a significant edge over competitors in the market.

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

1. How has Walmart used its supply chain management systems to lower costs and outperform the competition?

FIGURE 8.1

Walmart uses cross docking to optimize its supply chain.
Source: Fertnig\E+\Getty Images.

2. How can Walmart use the retail data it gathers to improve the activities involved in promoting and selling products to customers as well as providing customer service and nourishing long-term relationships?
3. How can companies like Walmart benefit from combining their SCM and CRM systems into one integrated information system?

Based on:
Chao, L. (2015, August 18). Wal-Mart reins back inventory in a revamped supply chain. *Wall Street Journal.* Retrieved May 4, 2016, from http://www.wsj.com/articles/wal-mart-reins-back-inventory-in-a-revamped-supply-chain-1439933834

Robinson, A. (2015, May 13). Walmart: 3 keys to successful supply chain management any business can follow. *Cerasis.* Retrieved May 4, 2016, from http://cerasis.com/2015/05/13/supply-chain-management

Walmart. (2016). Company facts. *Walmart.com.* Retrieved May 4, 2016, from http://corporate.walmart.com/newsroom/company-facts

Walmart. (2016, May 4). In *Wikipedia, The Free Encyclopedia*. Retrieved May 4, 2016, from https://en.wikipedia.org/w/index.php?title=Walmart&oldid=718550925

Supply Chain Management

In the previous chapter, we discussed the need to share internal data in order to streamline business processes, improving coordination within the organization to improve efficiency and effectiveness. Let's now turn our attention to collaborating with partners along the supply chain. Obtaining the raw materials and components that a company uses in its daily operations is an important key to business success. When deliveries from suppliers are accurate and timely, companies can convert them to finished products more efficiently. Coordinating this effort with suppliers has become a central part of many companies' overall business strategy, as it can help them reduce costs associated with inventory levels and get new products to market more quickly. Ultimately, this helps companies drive profitability and improve their customer service because they can react to changing market conditions swiftly. Collaborating or sharing information with suppliers has become a strategic necessity for business success. In other words, by developing and maintaining stronger, more integrated relationships with suppliers, companies can more effectively compete in their markets through cost reductions and responsiveness to market demands.

What Is a Supply Chain?

The term **supply chain** is commonly used to refer to a collection of companies and processes involved in everything from extracting raw materials to moving a product from the suppliers of raw materials to the suppliers of intermediate components, then to final production, and, ultimately, to the customer. Companies often procure specific raw materials and components from many different "upstream" suppliers. These suppliers, in turn, work with their own suppliers to obtain raw materials and components; their suppliers work with additional suppliers, and so forth. The further out in the supply chain one looks, the more suppliers are involved. As a result, the term "chain" becomes somewhat of a misnomer since it implies one-to-one relationships facilitating a chain of events flowing from the first supplier to the second to the third and so on. Similarly, on the "downstream" side, the products move to many different customers. The flow of materials from suppliers to customers can thus be more accurately described as a **supply network** because of the various interrelated parties involved in moving raw materials, intermediate components, and, finally, the end product within the production process (Figure 8.2).

Most companies are depending on a steady source of key supplies to produce their goods or services. For example, luxury restaurants require their produce to be consistently of high quality; similarly, car manufacturers need steel, paint, or electronic components in the right quantities, at the right quality and price, and at the right time. Thus, most companies are seeking long-term B2B relationships with a limited number of carefully selected suppliers—rather than one-time deals—and invest considerable efforts in selecting their suppliers or business partners; often, suppliers are assessed not only on product features such as price or quality but also on suppliers' characteristics, such as trustworthiness, commitment, or viability.

Business-to-Business Electronic Commerce: Exchanging Data in Supply Networks

Transactions conducted between different businesses in a supply network, not involving the end consumer, are referred to as business-to-business electronic commerce (EC). This type of commerce accounts for more than 90 percent of all EC (excluding services such as healthcare, accommodation, real estate, or finance) in the United States (U.S. Census Bureau, 2016). B2B transactions require proprietary information (such as orders for parts) to be communicated to an organization's business partners. For many organizations, keeping such information private can be of strategic value; for example, Apple tries to keep news about potential new product launches to a minimum, and any information about orders for key components (such as touch screens) could give away hints of what a new product may be. Prior to the introduction of the Internet and web, the secure communication of proprietary information in B2B EC was facilitated using **Electronic Data Interchange (EDI)**. EDI refers to computer-to-computer communication (without human intervention) following certain standards as set by the UN Economic Commission (for Europe) or the American National Standards Institute. Traditionally, using EDI, the exchange of business documents and other information took place via dedicated telecommunication networks between suppliers and customers, and thus the use of EDI was

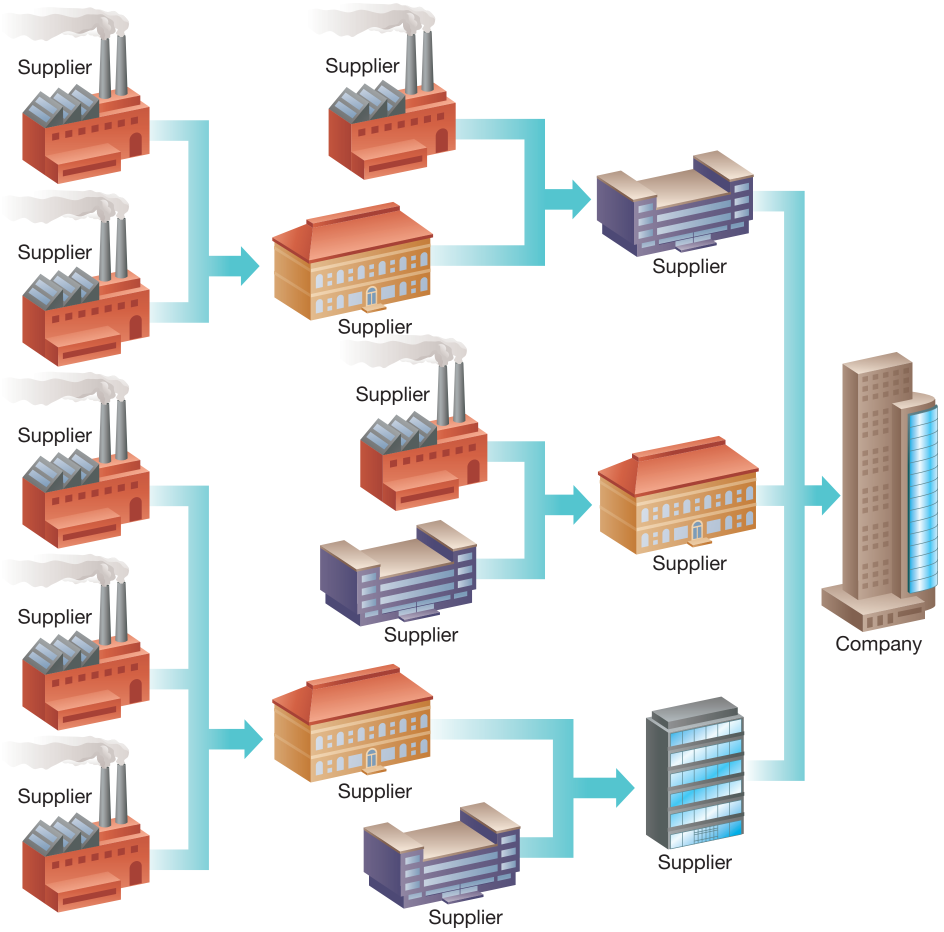


FIGURE 8.2

A typical supply network.

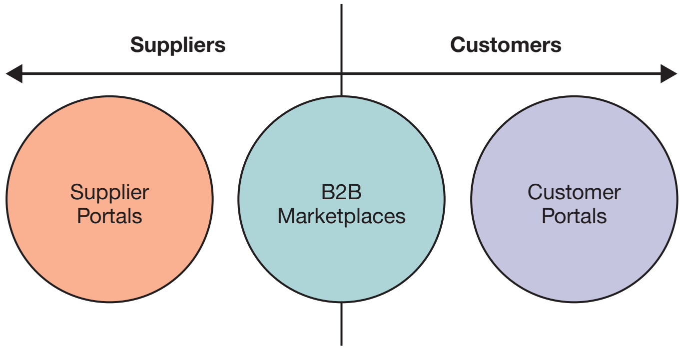
generally limited to large corporations that could afford the associated expenses. Today, the Internet has become an economical medium over which this business-related information can be transmitted, enabling even small to mid-sized enterprises to use EDI; many large companies (such as the retail giant Walmart) require their suppliers to transmit information such as advance shipping notices using web-based EDI protocols. Further, companies have devised a number of innovative ways to facilitate B2B transactions using web-based technologies. Specifically, organizations increasingly use extranets (see Chapter 3, "Managing the Information Systems Infrastructure and Services") for exchanging data and handling transactions with their suppliers or organizational customers. Commonly, portals are used to interact with the business partners; these are discussed next.

PORTALS. **Portals**, in the context of B2B supply chain management, can be defined as access points (or front doors) through which a business partner accesses secured, proprietary information that may be dispersed throughout an organization (typically using extranets). By allowing direct access to critical information needed to conduct business, portals can thus provide substantial productivity gains and cost savings for B2B transactions.

In contrast to business-to-consumer (B2C) EC, where anyone can set up a customer account with a retailer, the suppliers or customers in B2B transactions are typically prescreened by the business, and access to the company's extranet will be given depending on the business relationship (typically, after a review of the supplier's or buyer's application). To support different types of business relationships, portals come in two basic forms: supplier portals and customer portals. Supplier portals are owned or managed by a "downstream" company and automate the business processes involved in purchasing or procuring products from multiple suppliers; they connect a single buyer and multiple suppliers. On the other end of the spectrum, customer portals are owned or managed by an "upstream" company and automate the business processes involved in selling or distributing products to multiple buyers; they connect a single supplier und multiple

FIGURE 8.3

Supplier portals, B2B marketplaces, and customer portals.



buyers. B2B marketplaces are typically run by separate entities and connect multiple buyers and multiple suppliers (Figure 8.3).

Supplier Portals Many companies that are dealing with large numbers of suppliers (e.g., The Boeing Company, Lilly, P&G, and Hewlett-Packard [HP]) set up **supplier portals** (sometimes referred to as sourcing portals or procurement portals). A supplier portal is a subset of an organization's extranet designed to automate the business processes that occur before, during, and after sales transactions between the organization (i.e., a single buyer) and its multiple suppliers. For example, on the HP Supplier Portal, companies can register their interest in becoming a supplier for HP; access terms and conditions or guidelines (such as guidelines related to labeling, shipment, or packaging); and, once a business relationship is established with HP, manage interorganizational business processes associated with ordering and payment.

Customer Portals **Customer portals** are designed to automate the business processes that occur before, during, and after sales transactions between a supplier and multiple customers. In other words, customer portals provide efficient tools for business customers to manage all phases of the purchasing cycle, including reviewing product information, order entry, and customer service (Figure 8.4). For example, MyBoeingFleet, the customer portal of The Boeing Company, is part of Boeing's extranet and allows airplane owners, operators, and other parties to access information about their airplanes' configurations, maintenance documents, or spare parts. In other cases, customer portals are set up as B2B websites that provide custom-tailored offers or specific deals based on sales volume, as is the case with large office retailers such as OfficeMax (www.officemaxsolutions.com) or computer manufacturer Dell, which services business customers through its customer portal Dell Premier.

B2B MARKETPLACES. The purpose of supplier portals and customer portals is to enable interaction between a single company and its many suppliers or customers. Being owned/operated by a single organization, these portals can be considered a subset of the organization's extranet. However, setting up such portals tends to be beyond the reach of small to midsized businesses because of the costs involved in designing, developing, and maintaining this type of system. Many of these firms do not have the necessary monetary resources or skilled personnel to implement such portals on their own, and the transaction volume does not justify the expenses. To service this market, a number of **business-to-business marketplaces** have sprung up. B2B marketplaces are operated by third-party vendors, meaning they are built and maintained by a separate entity rather than being associated with a particular buyer or supplier. These marketplaces generate revenue by taking a small commission for each transaction that occurs, by charging usage fees, by charging association fees, and/or by generating advertising revenues. Unlike customer and supplier portals, B2B marketplaces allow many buyers and many sellers to come together, offering firms access to real-time trading with other companies in their **vertical markets** (i.e., markets composed of firms operating within a certain industry sector). Such B2B marketplaces can create tremendous efficiencies for companies because they bring together numerous participants along the supply network. Some popular B2B marketplaces include http://www.b2bmetal.eu (metals), www.paperindex.com (paper), and www.fibre2fashion.com (textile and fashion supplies).

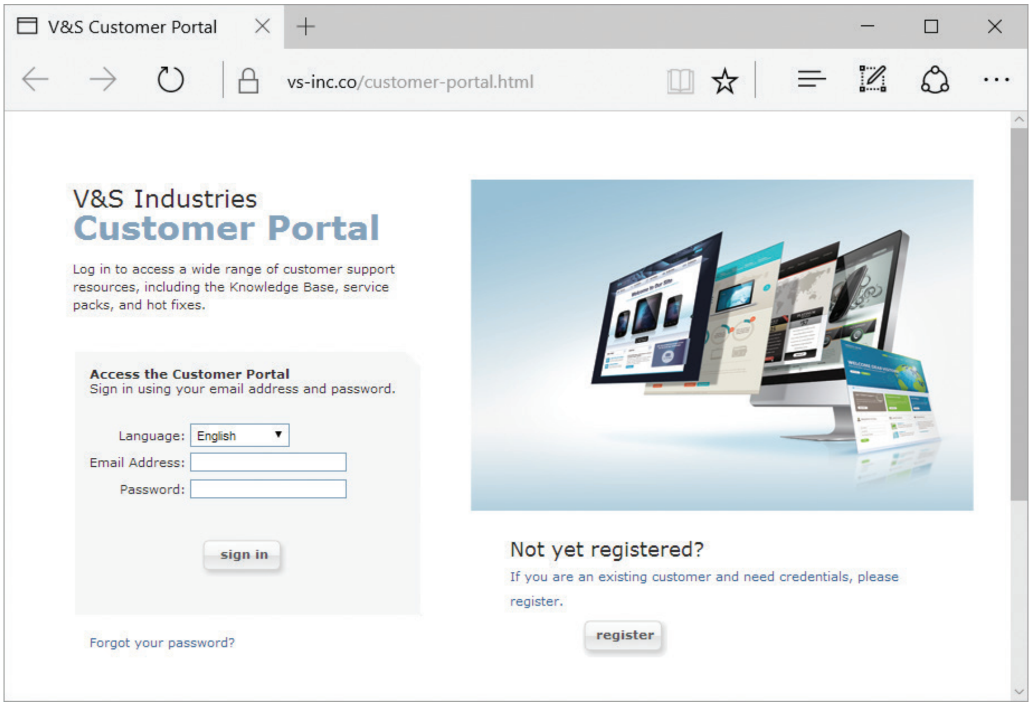


FIGURE 8.4

Customer portals automate business processes that occur before, during, and after sales transactions.

Source: PureSolution/Shutterstock.

In contrast to B2B marketplaces serving vertical markets, other B2B marketplaces are not focused on any particular industry. One of the most successful examples is the Chinese marketplace Alibaba.com. Alibaba.com brings together buyers and suppliers from around the globe, from almost every industry, selling almost any product, ranging from fresh ginger to manufacturing machinery. Alibaba.com offers various services, such as posting item leads, displaying products, and contacting buyers or sellers but also features such as trading tips or price watch for raw materials. Offering various trading tools including online storefronts, virtual factory tours, and real-time chat, such B2B marketplaces have enabled many small or little-known suppliers to engage in trade on a global basis.

Managing Complex Supply Networks

A prime example of a company having to manage extremely complex supply networks is Apple and its extremely successful mobile devices, such as the iPhone and iPad. Typically, Apple sells millions of these devices within the first few days following the product launch. How does Apple manage to produce such an incredible number of these products? If you take a close look at the devices, you will find a statement saying "Designed by Apple in California Assembled in China." Every time a new Apple device is launched, industry observers disassemble these devices to get a sneak peek into Apple's supply chain. The iPhone, like other Apple devices, is by no means *manufactured* by Apple. The components of the iPhone are sourced from dozens of companies located in various different countries. For example, according to market research firm IHS iSuppli, a recent iPhone's flash memory and central processing unit were produced by Korean Samsung; the display was sourced from Korean LG; the phone chips were made by German Infineon (manufactured in Germany or Southeast Asia); the Wi-Fi and global positioning system (GPS) chips were produced by U.S.-based Broadcom (but possibly assembled in China, Korea, Singapore, or Taiwan); the touchscreen controller was made by Texas Instruments; many other parts, such as the camera, were possibly made in Taiwan; and so on (depending on the requirements, companies such as Apple use various suppliers for different product models). The final products are assembled in a factory owned by Taiwanese electronics giant Foxconn, located in Shenzhen, China (a city of more than 10 million people located just north of Hong Kong), from where the finished iPhones are shipped by air to the different countries where the iPhone is for sale (Figure 8.5). Although many have never heard of Foxconn, it is the largest electronics manufacturer in the world, producing components, cell phones, gaming consoles, and so on, for various other companies, including Dell, HP, and Sony.

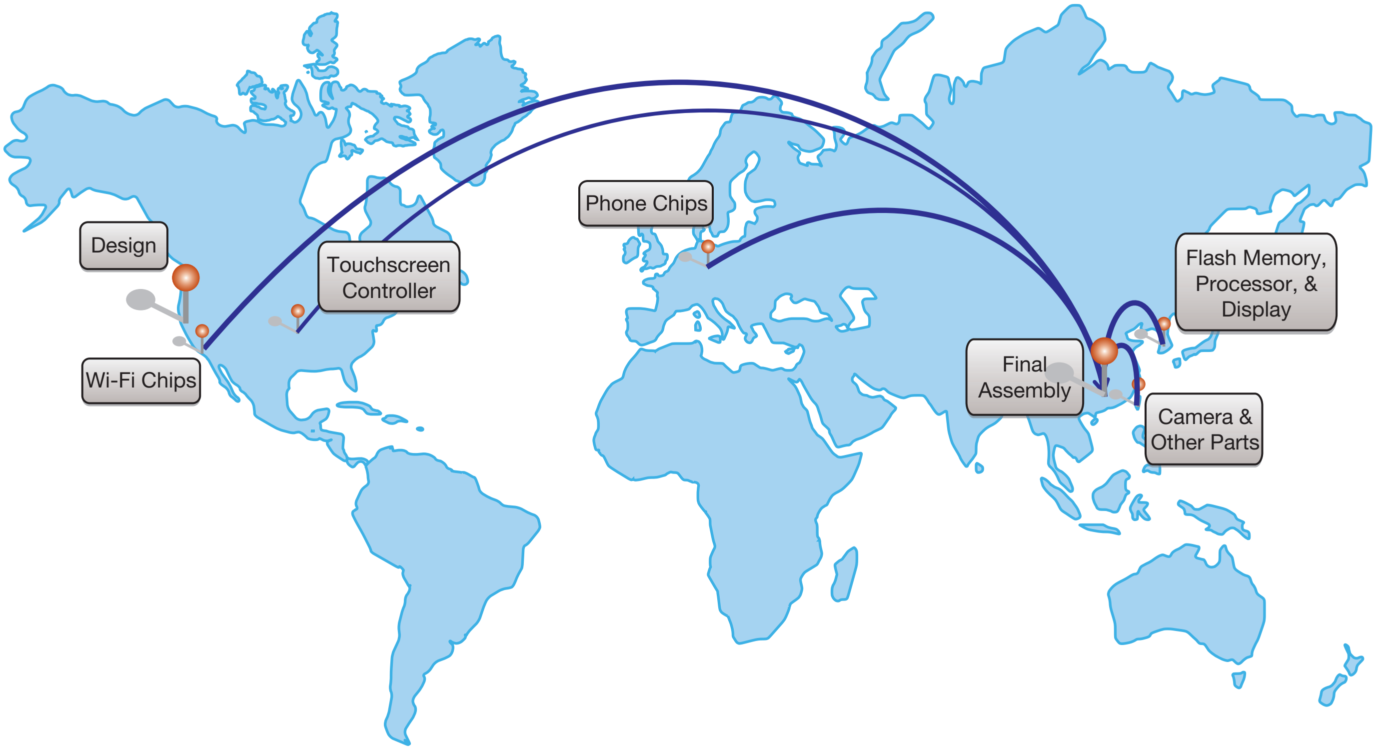


FIGURE 8.5

The iPhone is assembled in China from globally sourced components.

Coordinating such an extensive supply network requires considerable expertise, especially when facing unexpected events such as shortages in touchscreen panels or other issues at suppliers' factories; likewise, natural disasters, such as the series of back-to-back earthquakes that hit Japan in April 2016, can cause disruptions in supply chains, resulting in work stoppages and delayed orders. For example, Toyota, which uses a "just in time" inventory philosophy (discussed below) faced shutdowns and delays; in addition, the earthquakes disrupted production at many other Japanese manufacturing companies including Honda and Sony, which also utilize Toyota's "just in time" inventory philosophy. It is important to note that the impacts of such events are often not limited to the products manufactured locally but ripple through supply networks throughout the world. Disrupted supply chains in Japan also shut down plants around the world, as many key components for downstream products are produced in Japan; due to the earthquakes, these components could not be produced in Japan and be delivered to assembly lines in other countries, creating a domino effect on global supply networks. A limited pool of suppliers for critical components can further exacerbate such problems, as companies have fewer options to switch suppliers if necessary. It is thus important not only to monitor one's own direct suppliers but also to constantly monitor the company's extended supply chain so as to anticipate any issues that may have an impact on one's direct suppliers.

Benefits of Effectively Managing Supply Chains

Whereas effectively managing the supply chain can create various opportunities, many problems can arise when firms within the network do not collaborate effectively. For example, collaboration within supply networks has enabled process innovations such as just-in-time manufacturing and vendor-managed inventory (discussed in the following sections). On the other hand, if firms do not collaborate effectively, information can easily become distorted as it moves through the supply network. Problems such as excessive inventories, inaccurate manufacturing capacity plans, and missed production schedules can run rampant, causing huge ripple effects that lead to degradations in profitability and poor customer service by everyone within the supply network. Further, effectively managing the supply chain is becoming increasingly important in terms of corporate social responsibility.

JUST-IN-TIME PRODUCTION. One of the most significant advances in manufacturing has been the use of **just-in-time (JIT)** approaches. Based on the notion that keeping inventory is costly (in terms of both storage costs and the capital that is tied up) and does not add value, companies using a JIT method are trying to optimize their ordering quantities such that parts or raw materials arrive just when they are needed for production. As the orders arrive in smaller quantities (but at higher frequency), the investment in storage space and inventory is minimized. Pioneered by Japanese automaker Toyota, a JIT approach has now been adopted by many other businesses. For example, computer maker Dell realized the problems with keeping large inventories, especially because of the fast rate of obsolescence of electronics components. To illustrate, recall our discussion of Moore's Law, which suggests that processor technology is doubling in performance approximately every 24 months. Because of this, successful computer manufacturers have learned that holding inventory that can quickly become obsolete or devalued is a poor strategy for success. In fact, Dell now only keeps about 2 hours of inventory in its factories. Obviously, using a JIT method is heavily dependent on tight cooperation between all partners in the supply network, not only suppliers but also other partners, such as shipping and logistics companies.

VENDOR-MANAGED INVENTORY. Under a traditional inventory model, the manufacturer or retailer would manage its own inventories, sending out requests for additional items as needed. In contrast, **vendor-managed inventory (VMI)** is an approach to inventory management in which the suppliers to a manufacturer (or retailer) manage the manufacturer's (or retailer's) inventory based on negotiated service levels. To make VMI possible, the manufacturer (or retailer) allows the supplier to monitor stock levels and ongoing sales data. Such arrangements can help to optimize the manufacturer's (or retailer's) inventory, both saving costs and minimizing stockout situations (thus enhancing customer satisfaction); the supplier, in turn, benefits from the intense data sharing, which helps produce more accurate forecasts, reduces ordering errors, and helps prioritize the shipment of goods.

REDUCING THE BULLWHIP EFFECT. One major problem affecting supply chains are ripple effects referred to as the **bullwhip effect**. Each business forecasting demand typically includes a safety buffer in order to prevent possible stockouts. However, forecast errors and safety stocks multiply when moving up the supply chain, such that a small fluctuation in demand for an end product can lead to tremendous fluctuation in demand for parts or raw materials farther up the supply chain. Like someone cracking a bullwhip, a tiny "flick of the wrist" will create a big movement at the other end of the whip. Likewise, a small forecasting error at the end of the supply chain can cause massive forecasting errors farther up the supply chain. Implementing integrated business processes allows a company to better coordinate the entire supply network and reduce the impact of the bullwhip.

CORPORATE SOCIAL RESPONSIBILITY. Effectively managing the supply chain has also become tremendously important for aspects related to corporate social responsibility. Specifically, transparency and accountability within the supply chain can help organizations save costs and/or create a good image. Two related issues are product recalls and sustainable business practices; both are discussed next.

Product Recalls Given that a typical supply network comprises tens, hundreds, or sometimes thousands of players, many of which are dispersed across the globe, there are myriad possibilities where shortcuts are being taken or quality standards are not being met. Often, such issues are caught somewhere along the supply chain, but sometimes such incidents go unnoticed until the product reaches the end consumer. These problems can be exacerbated if companies are sourcing their products or raw materials globally, as more potential points of failure are added due to differences in quality or product safety regulations in the originating countries.

Hence, it is extremely important to have the necessary information to trace back the movement of products through the supply chain so as to be able to quickly identify the problematic link. Being able to single out the source of a problem can help a company to perform an appropriate response, helping to save goodwill and limiting the costs of a recall. Further, in many cases, only some batches of a product may be problematic (such as when certain raw materials or components are sourced from different suppliers). If a company is not able to clearly identify the affected batches, the recall will have to be much broader, costing the company much more (in both goodwill and money) than just having to recall the affected batches. Hence, companies need to have a clear picture of their supply chain and also need to store these data in case of problems at a later point in time.

Sustainable Business Practices Another aspect related to corporate social responsibility is a growing emphasis on sustainable business practices. Particularly, organizations have come under increasing scrutiny for issues such as ethical treatment of workers (especially overseas) or environmental practices. For instance, because of Apple's vast success in marketing its products around the world, the tech giant has also received an abundance of negative press related to the poor conditions for many workers who assemble the world's favorite phone. A typical worker in such plants endures a 12-hour work shift six days a week. These workers typically live next to the assembly plant in crowded dorms that are often infested with bedbugs, and many have no working toilets. Over the past several years, there were also reports of numerous workers committing suicide due to the stress and poor conditions. While Apple is certainly aware of the negative effects that a supplier's action can have on a company's reputation, it also faces a conundrum, as few (if any) companies have sufficient production capacity, especially when offering such low wages, to meet the demand for hugely popular products such as the iPhone.

Other companies are trying to portray a "green" image and attempt to minimize their carbon footprint. For example, HP takes a proactive approach, being the first major information technology company to publish its aggregate supply chain greenhouse gas emissions, restrict the use of hazardous materials, implement environmentally friendly packaging policies, and so on. In order to do that and to provide sound, convincing numbers to back a "green" image, a company such as HP needs to have a clear view of its entire supply chain. Similarly, U.S. regulations require 95 percent of computers purchased by the U.S. federal government to carry the EPEAT eco-label. To achieve this certification, a manufacturer has to possess and produce extensive evidence that the products meet EPEAT's strict requirements.

Optimizing the Supply Chain Through Supply Chain Management

Information systems focusing on improving supply chains have two main objectives: to accelerate product development and innovation and to reduce costs. These systems, called **supply chain management (SCM) systems**, improve the coordination of suppliers, product or service production, and distribution. When implemented successfully, SCM systems help in not only reducing inventory costs but also enhancing revenue through improved customer service. SCM systems are often integrated with ERP systems to leverage internal and external information in order to better collaborate with suppliers. Like ERP and customer relationship management systems, SCM systems are delivered in the form of modules (Table 8.1) that companies select and implement according to their differing business requirements.

As discussed previously, ERP systems are primarily used to optimize business processes *within* the organization, whereas SCM systems are used to improve business processes that *span* organizational boundaries. Whereas some standalone SCM systems only automate the logistics aspects of the supply chain, organizations can reap the greatest benefits when the SCM system is tightly integrated with ERP and customer relationship management systems modules; this way, SCM systems can use data about customer orders or sales forecasts (from the customer relationship management system), data about payments (from the ERP system), and so on. Given its scope, SCM is adopted primarily by large organizations with a large and/or complex supplier network. At the same time, many smaller suppliers are interacting with the systems of large companies. To obtain the greatest benefits from the SCM processes and systems, organizations need to extend the system to include all trading partners regardless of size, providing a central location for information integration and common processes so that all partners benefit.

For an effective SCM strategy, several challenges have to be overcome. First and foremost, as with any information system, an SCM system is only as good as the data entered into it. This means that to benefit most from an SCM system, the organization's employees have to actually use the system and move away from traditional ways of managing the supply chain, as an order placed by fax or telephone will most likely not find its way into the system. Another challenge to overcome is distrust among partners in the supply chain; for many companies, sales and

WHEN THINGS GO WRONG

SpaceX Rocket Failure due to Supply Chain Failure

The Space Exploration Technologies Corporation, or SpaceX, is an American aerospace manufacturer and space transport services company. Founded in 2002 by former PayPal entrepreneur and current CEO of Tesla Motors Elon Musk, SpaceX has the goal of making space exploration less expensive and ultimately enabling the colonization of the planet Mars. In 2008, SpaceX was the first privately funded company to develop a liquid-propellant rocket (called Falcon 1) to reach orbit. Since then, many other firsts have occurred, including having the first stage of a rocket return and vertically land back at the launch site or onto a platform floating in the ocean. SpaceX has also been contracted by NASA to resupply cargo to the International Space Station (ISS). Overall, SpaceX has had tremendous success and provides evidence that space exploration can be accomplished by a commercial company.

In June 2015, however, SpaceX had a major setback when a rocket destined to bring supplies to the ISS failed soon after launch. The problem that caused the disaster was a failed strut—a commonly used piece of support hardware—that is used to secure a liquid oxygen tank. The strut that failed was designed and certified to handle 10,000 pounds of force but failed at 2,000 pounds, a fifth of what was independently certified. The strut was provided by a long-term contractor to SpaceX. Given that NASA no longer sends rockets to the ISS, the failure was a major setback for the United States. Both Japan and Russia also bring supplies to the ISS, but this failure delayed the delivery of needed equipment and supplies to the station, including those to repair the station's water purification system.

After the failure, SpaceX pledged to more closely scrutinize its supply chain. Specifically, SpaceX outlined that it would implement additional hardware quality audits throughout the vehicle prior to launch and further ensure that all parts received from suppliers perform as expected per their certification requirements. By late 2015, SpaceX resumed flying rockets and plans to launch astronauts for the first time in 2017. When SpaceX's supply chain failed, it created a domino effect, also affecting the supply chain of the ISS.

Based on:

Clark, S. (2015, June 29). SpaceX failure adds another kink in station supply chain. *SpaceflightNow.com*. Retrieved May 4, 2016, from https://spaceflightnow.com/2015/06/29/spacex-failure-adds-another-kink-in-station-supply-chain

McGarry, B. (2015, July 21). SpaceX to scrutinize supply chain after rocket failure. *Defensetech.org*. Retrieved on May 4, 2016, from http://www.defensetech.org/2015/07/21/spacex-to-scrutinize-supply-chain-after-rocket-failure

SpaceX. (2016, May 4). In *Wikipedia, The Free Encyclopedia*. Retrieved May 4, 2016, from https://en.wikipedia.org/w/index.php?title=SpaceX&oldid=718620407

TABLE 8.1 **Functions That Optimize the Supply Network**

Module	Key Uses
Demand planning and forecasting	Forecast and plan anticipated demand for products
Safety stock planning	Assign optimal safety stock and target stock levels in all inventories in the supply network
Distribution planning	Optimize the allocation of available supplies to meet demand
Supply network collaboration	Work with partners across the supply network to improve accuracy of demand forecasts, reduce inventory buffers, increase the velocity of materials flow, and improve customer service
Materials management	Ensure that the materials required for production are available where needed when needed
Manufacturing execution	Support production processes taking into account capacity and material constraints
Order promising	Provide answers to customer relationship management queries regarding product availability, costs, and delivery times
Transportation execution	Manage logistics between company locations or from company to customers, taking into account transportation modes and constraints
Warehouse management	Support receiving, storing, and picking of goods in a warehouse
Supply chain analytics	Monitor key performance indicators to assess performance across the supply chain

Source: Based on http://www.sap.com.

supply chain data are strategic assets, and no one wants to show his or her cards to other members in the supply chain. Further, many organizations (such as Apple) tend to be very clandestine about their suppliers, as such information could reveal their pricing strategies or give clues about new product development. In addition, more and more organizations are reluctant to share data along the supply chain because of an increase in intellectual property theft, especially in China, a major source of supplies for many companies. A final challenge is to get all partners within the supply chain to adopt an SCM system. Several years ago, the retail giant Walmart began mandating its suppliers to use its RetailLink supply chain system and refused to engage in a business relationship with any supplier that was not willing to use the system. Whereas large companies can force their suppliers or partners to use a system, smaller companies typically do not have this power.

Developing an SCM Strategy

When developing an SCM strategy, an organization must consider a variety of factors that will affect the effectiveness and efficiency of the supply chain. **Supply chain effectiveness** is the extent to which a company's supply activities meet the requirements of the external partners involved. In contrast, **supply chain efficiency** is the extent to which a company optimizes the use of resources in its supply chain activities. Focusing on one or the other can result in excessive costs or in not meeting stakeholders' needs, so companies have to evaluate the trade-offs in different areas, such as procurement, production, and transportation (Figure 8.6). In other words, the design of the supply chain must consider natural trade-offs between a variety of factors and should match the organization's competitive strategy to offer the greatest benefits. For example, an organization utilizing a low-cost-provider competitive strategy would likely focus on supply chain efficiency. In contrast, an organization pursuing a superior customer service differentiation strategy would focus on supply chain effectiveness.

SCM systems typically allow for making trade-offs between efficiency and effectiveness for individual components or raw materials. For example, if a hurricane is likely to delay the arrival of a key component by sea, the company can perform simulations to evaluate the effect of the delay on production and can assess the feasibility of temporarily switching suppliers, switching modes of transportation (e.g., expediting the shipment via air freight), or substituting the component altogether. In such cases, making changes to the original plans may be costlier but can help the organization meet promised delivery deadlines, thus maintaining goodwill and avoiding possible contract penalties. On the other hand, companies can dynamically adjust schedules for noncritical components or raw materials so as to minimize costs while still meeting the targets set in the production schedule.

An SCM system includes more than simply hardware and software; it also integrates business processes and supply chain partners. As shown in Table 8.1, an SCM system consists of many modules or applications. Each of these modules supports supply chain planning, supply chain execution, or supply chain visibility and analytics. All are described next.

FIGURE 8.6

In developing a supply chain strategy, companies have to evaluate the trade-offs between effectiveness and efficiency in different areas, such as procurement, production, and transportation.

Supply Chain Strategy	Procurement	Production	Transportation
Effectiveness	More Inventory Multiple Inventory Sources ...	General-Purpose Facilities More Facilities Higher Excess Capacity ...	Fast Delivery Times More Warehouses ...
↕	↕	↕	↕
Efficiency	... Single Inventory Source Less Inventory	... Less Excess Capacity Fewer Facilities Special-Purpose Facilities	... Fewer Warehouses Longer Delivery Times

GREEN IT

Nike's Green Supply Chain

Consumerism, globalization, and mass production are creating large costs for economies, societies, and the environment, with negative effects arising everywhere from resource extraction to manufacturing to the disposal of products. Having realized this, more and more companies are striving to reduce these impacts, aiming to improve their economic, environmental, and social performance through reducing the use of resources, eliminating or reusing waste, or renewing resources by recovering materials from used products. Green supply chain management includes green supply chain planning, green procurement, green distribution, and green logistics. For example, already during the planning stage, products can be engineered so as to reduce their environmental impact, such as by using recycled materials or designing products to be easily recyclable at the end of their lifetime. Better demand and supply planning can also help reduce excess production. When procuring components or raw materials, companies can strive to use sustainable sources, or collaborate with and provide incentives to their suppliers. When packing and shipping goods, companies can use green packaging (e.g., using cardboard rather than Styrofoam), recycle or reuse packaging materials, utilize alternative fuel vehicles, or group shipments to reduce the number of trips needed. At all stages in the supply chain of a product, responsible companies increasingly strive to minimize their carbon footprint.

As with almost all business processes, information systems play a key role in enabling green supply chain management, evaluating performance, and helping to continuously improve the performance of the green supply chain. The sportswear company Nike is but one of many organizations that have realized the many benefits of a green supply chain. Nike is continuously innovating with the aim of "doubling [its] business while halving [its] impact," focusing not only on what they produce, but also on how they produce it and what they produce it from. Nike starts with trying to source regenerative or reclaimed materials, which can be reused after a product's life. In manufacturing, Nike uses information-systems enabled innovations such as 3D printing or digital knitting, which not only reduce waste and improve working conditions, but also help to increase efficiency and enable mass customization. Having realized that sustainability is a common goal, Nike even open-sourced many of its sustainable innovations, promoting sustainability throughout the industry. Fueled by its innovative products, Nike's success shows that focusing on a green supply chain can not only minimize a company's environmental footprint, but can have large positive impacts on a company's bottom line.

Based on:

Blanco, E., Bateman, A., & Craig. A. (2014). ESD.S43 Green Supply Chain Management, Spring 2014. *Massachusetts Institute of Technology: MIT OpenCourseWare*. Retrieved July 25, 2016, from http://ocw.mit.edu

Nike (2016). FY14/15 Nike, Inc. sustainable business report. *Nike.com*. Retrieved July 25, 2016, from http://about.nike.com/pages/sustainable-innovation

Srivasta, S.K. (2007). Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews 9*(1), 53-80.

Supply Chain Planning

Supply chain planning involves the development of various resource plans to support the efficient and effective production of goods and services (Figure 8.7). Four key processes are generally supported by supply chain planning modules:

1. ***Demand Planning and Forecasting.*** Supply chain planning begins with product demand planning and forecasting. To develop demand forecasts, SCM modules examine historical data to develop the most accurate forecasts possible. The accuracy of these forecasts will be influenced greatly by the stability of the data. When historic data are stable, plans can be longer in duration, whereas if historic data show unpredictable fluctuations in demand, the forecasting time frame must be narrowed. SCM systems also support collaborative demand and supply planning such that a sales representative can work together with the demand planner, taking into account data provided by the organization's point-of-sale system, promotions entered in the customer relationship management system, and other factors influencing demand. Demand planning and forecasting leads to the development of the overall *demand forecast*.
2. ***Distribution Planning.*** Once demand forecasts are finalized, plans for moving products to distributors can be developed. Specifically, distribution planning focuses on delivering products or services to consumers as well as warehousing, delivering, invoicing, and payment collection. Distribution planning leads to the development of the overall *transportation plan*.

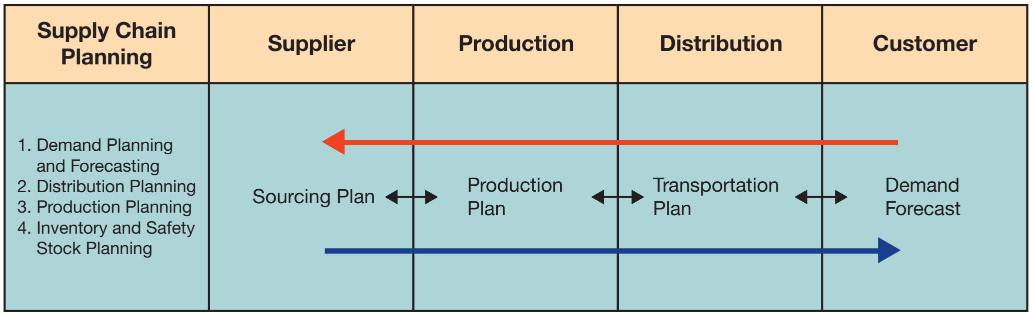


FIGURE 8.7

Supply chain planning includes (customer) demand planning and forecasting, distribution planning, production planning, and (supplier) inventory and safety stock planning.

3. ***Production Scheduling.*** Production scheduling focuses on the coordination of all activities needed to create the product or service. When developing this plan, analytical tools are used to optimally utilize materials, equipment, and labor. Production also involves product testing, packaging, and delivery preparation. Production scheduling leads to the development of the *production plan*.
4. ***Inventory and Safety Stock Planning.*** Inventory and safety stock planning focuses on the development of inventory estimates. Using inventory simulations and other analytical techniques, organizations can balance inventory costs and desired customer service levels to determine optimal inventory levels. Once inventory levels are estimated, suppliers are chosen who contractually agree to preestablished delivery and pricing terms. Inventory and safety stock planning leads to the development of a *sourcing plan*.

As suggested, various types of analytical tools—such as statistical analysis, simulation, and optimization—are used to forecast and visualize demand levels, distribution and warehouse locations, resource sequencing, and so on. Once these plans are developed, they are used to guide supply chain execution. Additionally, it is important to note that SCM planning is an ongoing process—as new data are obtained, plans are updated. For example, if shortages in the capacity for manufacturing touchscreen displays suddenly become evident, Apple has to dynamically adjust its plans so as to obtain the needed quantities to meet customer demand.

Supply Chain Execution

Supply chain execution is the execution of supply chain planning. Essentially, supply chain execution puts the planning into motion and reflects the processes involved in improving the collaboration of all members of the supply chain—suppliers, producers, distributors, and customers. Supply chain execution involves the management of three key elements of the supply chain: product flow, information flow, and financial flow (Figure 8.8). Each of these flows is discussed next.

PRODUCT FLOW. **Product flow** refers to the movement of goods from the supplier to production, from production to distribution, and from distribution to the consumer. Although products primarily "flow" in one direction, an effective SCM system will also support the activities associated with product returns. Effectively processing returns and customer refunds and recycling or properly disposing of products after the end of their life span are critical parts of supply chain execution. Thus, an SCM system should support not only the "downstream" forward logistics processes but also **reverse logistics**. Reverse logistics refers to the processes

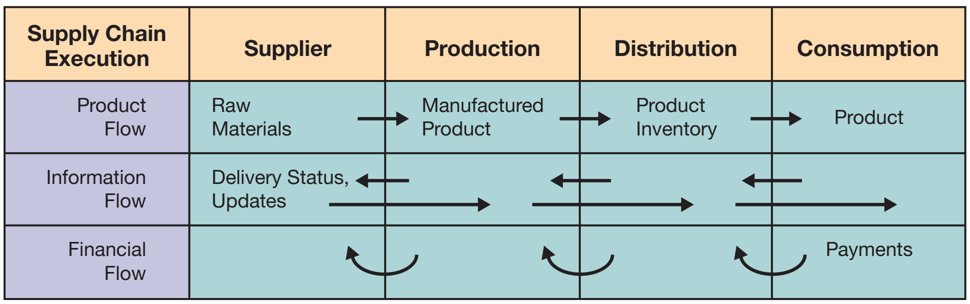


FIGURE 8.8

Supply chain execution focuses on the efficient and effective flow of products, information, and finances along the supply chain.

in place to efficiently receive products from the point of consumption. With an increasing need to recapture value by reusing or recycling materials, recovering these after use is an important aspect of managing product flows, and companies need to plan reverse logistics, where materials flow back from the consumer to the producer, so that valuable materials can be recycled, or hazardous materials can be properly disposed of. In case of receiving excessive or defective products, these processes also include shipping replacements or crediting customer accounts.

As introduced in Chapter 3, RFID (radio frequency identification) systems offer great opportunities for managing supply chains, and virtually all major retailers are adopting RFID to better manage product flows, as are governments for tracking military supplies and weapons, drug shipments and ingredients (i.e., for eliminating counterfeit drugs), and citizens with RFID chips on passports.

INFORMATION FLOW. **Information flow** refers to the movement of information along the supply chain, such as order processing and delivery status updates. Like the product flow, information can also flow up or down the supply chain as needed. The key element to the information flow is the complete removal of paper documents. Specifically, as all information about orders, fulfillment, billing, and consolidation is shared electronically, these paperless information flows save not only paperwork but also time and money. Additionally, because SCM systems use a central database to store data, all supply chain partners have at all times access to the most current data necessary for scheduling production, shipping orders, and so on.

Extensible Markup Language A key enabler for optimizing information flows is XML. **Extensible Markup Language (XML)** is a standard for exchanging structured data over the web. XML allows creating documents consisting of customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

As described in Chapter 3, Hypertext Markup Language (HTML) uses tags to specify the structure and content of a document—such as a web page—that will be presented by a user's browser. Much like HTML, XML also uses tags but focuses on sharing data between applications. An **XML tag** is a label that is inserted into an XML document in order to specify how the data contained in the document or a portion of the document should be interpreted and/or used. For example, the tags <item_no> . . . </item_no> would instruct the application reading the XML file that the numbers enclosed in the tags should be interpreted as a product's item number (Figure 8.9). The application could use this information when displaying a product on a web page or when updating inventory records. As a result, XML is a powerful tagging system that can be tailored to share similar data across applications over the web. With these advanced data

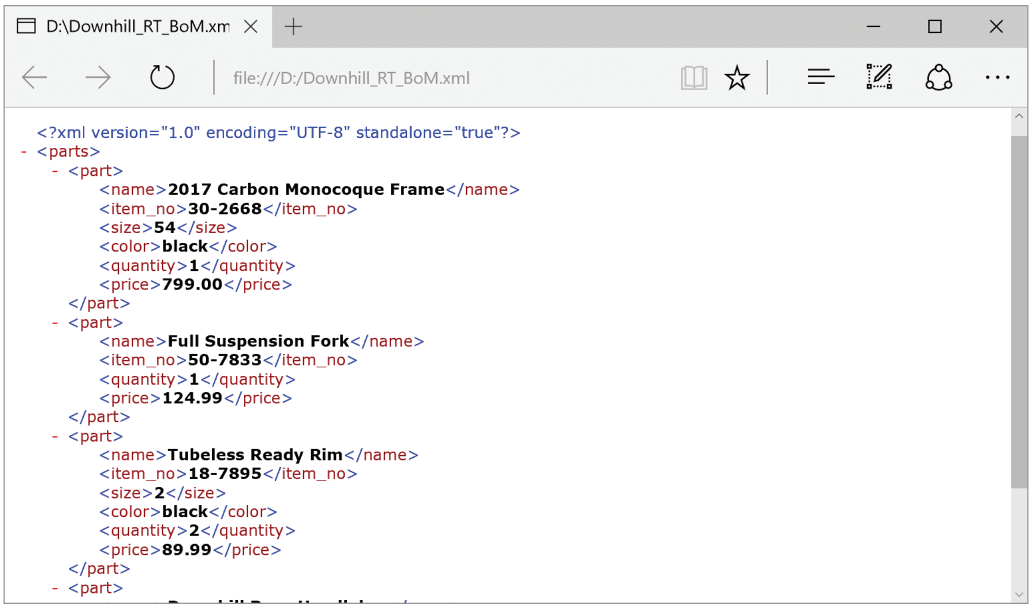


FIGURE 8.9

An XML file for transmitting a bill of materials for a bicycle.

Source: Windows 10, Microsoft Corporation.

definition capabilities built into web applications, organizations can use the web as the worldwide network for electronic commerce and SCM.

XML has become the standard for automating data exchange between business information systems and may well replace all other formats for electronic data interchange. Companies can, for example, use XML to create applications for web-based ordering, for checking on and managing inventory, for signaling to a supplier that more parts are needed, for alerting a third-party logistics company that a delivery is needed, and so on. All these various applications can work together using the common language of XML.

XML is customizable, and variations of XML have been developed. For example, **Extensible Business Reporting Language (XBRL)** is an XML-based specification for publishing financial information. XBRL makes it easier for public and private companies to share information with each other, with industry analysts, and with shareholders. XBRL includes tags for data such as annual and quarterly reports, Securities and Exchange Commission filings, general ledger information, and net revenue and accounting schedules (Figure 8.10). Similarly, many applications, such as Microsoft Office or OpenOffice, use XML-based file formats, such as Microsoft's Open XML or the Open Document Format (ODF).

FINANCIAL FLOW. **Financial flow** refers primarily to the movement of financial assets throughout the supply chain. Financial flows also include information related to payment schedules, consignment and ownership of products and materials, and other relevant information. Linkages to electronic banking and financial institutions allow payments to automatically flow into the accounts of all members within the supply chain.

Managing B2B Financial Transactions In B2C electronic commerce, most transactions are settled using credit cards or electronic payment services such as PayPal; in contrast, B2B payments are lagging far behind. In fact, according to some estimates, about 75 percent of all noncash B2B payments in the United States are made by check. While this may sound archaic, the time needed to process a check serves as a form of trade credit, which can amount to a significant part of an organization's working capital. For smaller purchases, organizations also often use purchasing cards. However, although productivity gains can be realized from using purchasing cards instead of checks, such cards are typically not used for large B2B transactions because of preset spending limits. In global B2B transactions, organizations often use letters of credit issued by a bank to make payments. While letters of credit help to reduce credit risk, these are often used only for relatively large amounts. Alternatively, businesses can make international transfers using providers such as Western Union. In any case, making a B2B payment is far from being as simple as making a purchase at Amazon.com using your credit card, and making B2B payments easier can greatly enhance efficiency as well as reduce costs for organizations. Thus, it is no wonder that businesses have started asking for payment methods as simple as PayPal for B2B transactions. When dealing with new, unknown suppliers, there is considerable fraud risk involved; this is especially of concern in global EC, so businesses often use third-party escrow

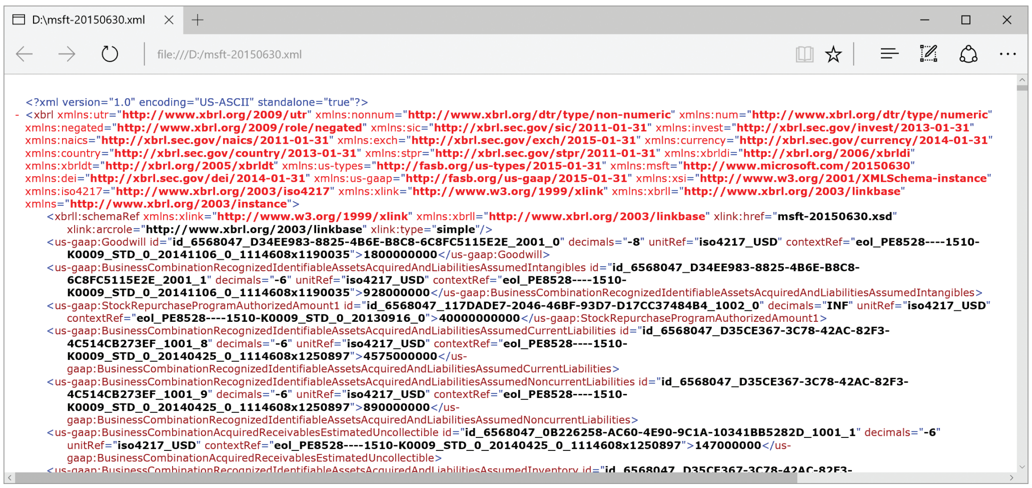


FIGURE 8.10

An XBRL file for sharing Securities and Exchange Commission filings.

Source: Windows 10, Microsoft Corporation.

services, which release payment only when the buyer has confirmed satisfactory delivery of the goods, reducing the risks for the buyer.

Supply Chain Visibility and Analytics

Supply chain visibility refers to the ability not only to track products as they move through the supply chain but also to foresee external events. Being able to see where a shipment is at any given time can be of tremendous help, especially when using JIT methods or when maintaining low inventory levels. For example, knowing where a shipment is and being able to expedite it can help in not losing a sale or help in taking away a sale from a competitor. Further, knowing where a supplier's facilities are located can help to anticipate and react to issues arising from adverse weather conditions, natural disasters, or political issues; if I don't know where in Taiwan my suppliers' factories are located, how will I know whether they might be affected by a fast-approaching typhoon? Similarly, some companies even want to know when labor contracts of key suppliers' workers expire in order to plan for potential labor disputes. Needless to say, such levels of information sharing throughout the supply chain require tremendous trust among the partners. The Internet of Things (IoT) has opened up various ways of enhancing supply chain visibility. For example, sensors or on-board telematics units can transmit data about the location of trucks, enabling real-time location monitoring as well as making accurate predictions about when shipments will arrive. Further, various sensors can provide valuable information about the condition of shipments throughout all phases of the journey: Temperature or humidity sensors can provide information about whether sensitive goods have been kept within the correct temperature or humidity range, or sensors or cameras can be used to send alerts if a shipment has been tampered with.

Supply chain analytics refers to the use of key performance indicators to monitor performance of the entire supply chain, including sourcing, planning, production, and distribution. For example, a purchasing manager can identify the suppliers that are frequently unable to meet promised delivery dates. Being able to access key performance metrics can help to identify and remove bottlenecks, such as by switching suppliers, spreading orders over multiple suppliers, expediting shipping for critical goods, and so on. With the increase in available data from a variety of sources, ranging from IoT sensors used in logistics, to Industrial Internet of Things (IIoT) sensors used in manufacturing, to news reports about global events, Big Data analytics plays an increasingly important role in optimizing supply chains.

Customer Relationship Management

With the changes introduced by the web, in most industries a company's competition is simply a mouse click away. It is increasingly important for companies not only to generate new business but also to attract repeat business from existing customers. This means that to remain competitive, companies must keep their customers satisfied. In today's highly competitive markets, customers hold the balance of power; if customers become dissatisfied with the levels of customer service they are receiving, they have many alternatives readily available.

It is important to note that customers are not just the end consumer but also other businesses in B2B transactions. As mentioned earlier, B2B e-commerce is many times larger than business-to-consumer (B2C) e-commerce. So, any rules or best practices for keeping customers happy apply to not only retailers but also any company within a supply chain. In the past, companies would try to establish long-term relationships with business customers, and establishing relationships with end customers was virtually impossible, especially for large companies. Today, the emphasis has shifted from conducting business transactions to managing relationships even when dealing with individual customers. If a company successfully manages its relationships with customers—satisfying them and solving their problems—then customers are less price sensitive. Hence, leveraging and managing customer relationships is equally as important as product development. Indeed, customer relationship management systems often collect data that can be mined to discover the next product line extension that customers covet.

The megatrends mobile, social media, Big Data, cloud computing, and IoT have tremendously changed the way organizations need to interact with their customers. Some researchers

COMING ATTRACTIONS

Augmenting Supply Chain Success

In the 2002 film *Minority Report*, Tom Cruise used gestures and natural language to interact with a futuristic computer that displayed information on massive screens that surrounded him. Today, such interaction is no longer science fiction but science fact. Augmented reality (AR) refers to interactions in a live direct or indirect view of a physical, real-world environment that is *augmented* (or supplemented) by computer-generated sensory input such as sound, video, graphics, or GPS data. Visual information, for example, can be presented on optical projection systems, monitors, handheld devices, and so on. Such information can be provided on a heads-up display using a headset or eyeglasses or be projected onto large screens or even a vehicle's windshield.

Many believe that AR is going to transform various aspects of supply chain management. For example, an important part of assembling or packing orders is the picking process, where a human "picks" components or completed items for assembly or delivery. AR can allow each picker to see a "digital packing list" on a heads-up display. When an item is selected in a warehouse, the heads-up display can then show the most efficient path to the next item to pick, guiding the person perfectly to the next step in the process. Virtually no mistakes or missteps are made. Once products are collected to be shipped, AR can also aid in loading containers and trucks by providing step-by-step instructions on a heads-up display on how to most efficiently arrange cargo given the size, dimension, and weight of the items. When delivering items, AR can provide more than widely used GPS navigation by providing a heads-up windshield display with real-time traffic analysis so rerouting can occur on the fly without any interactions that might distract the driver. Additional information about the cargo can also be provided if needed (e.g., temperature sensitive items). And the best part of this is that workers using AR support will feel like Tom Cruise in *Minority Report*.

Based on:

Augmented reality. (2016, May 3). In *Wikipedia, The Free Encyclopedia*. Retrieved May 10, 2016, from https://en.wikipedia.org/w/index.php?title=Augmented_reality&oldid=718470443

Glocker, H., Jannek, K., Mahn, J., & Theis, B. (2014). Augmented reality in logistics. *DHL*. Retrieved May 11, 2016, from http://www.dhl.com/content/dam/downloads/g0/about_us/logistics_insights/csi_augmented_reality_report_290414.pdf

Robinson, A. (2016, January 4). 2016 Supply chain trends: 7 of 12 trends that will drive supply chain management in 2016. *Cerasis*. Retrieved on May 10, 2016, from http://cerasis.com/2016/01/04/2016-supply-chain-trends

argue that we have moved from the Internet age to the age of the customer. The age of the customer is characterized by customers being part of social circles and being increasingly empowered by social media (Figure 8.11). For example, customers have much more access to information from various sources; at the same time, customers' word of mouth can be spread anywhere, anytime using mobile devices and has a much wider reach through social media such as blogs, Twitter, or Facebook. This can pose tremendous challenges for organizations trying to present and maintain a positive public image, as unmonitored conversations can have huge negative impacts, and monitoring and participating in ongoing conversations can be an important part of shaping public opinion. In addition, companies face significant changes in the competitive landscape. For example, the Internet has freed customers from having to purchase goods locally and has thus

FIGURE 8.11

Today's empowered customers have many ways to obtain and spread information and opinions about companies.

lowered the barriers to entry for potential rivals. Similarly, many products have been replaced or marginalized by digital substitutes. The power of buyers has increased, as people can quickly and easily find information, reviews, or prices at a competitor's store. At the same time, employees, an important source of supply, have more mobility and thus have higher power. Last but not least, not only one's customers but also one's competitors have tremendous amounts of information about one's products (and their strengths and weaknesses) available at their fingertips and can more easily predict one's next strategic move. Thus, businesses have to rethink their interactions with customers; rather than seeing customers as a passive audience, organizations need to engage in conversations with their customers. In their attempts to engage with customers and build long-lasting relationships, organizations are increasingly utilizing cloud-based systems and Big Data to better understand their customers and predict their needs and desires. Likewise, the IoT serves as a source for additional data not only about customers but also about their usage of products and can offer various opportunities to offer customers better value.

Many of the world's most successful corporations have realized the importance of developing and nurturing relationships with their customers. For example, Starbucks Coffee uses a variety of means to engage with its customers: Like many other businesses, Starbucks uses a loyalty card to entice people to return to its stores; further, Starbucks actively solicits feedback and new product ideas from its customers, not only within the stores but also via its open innovation platform mystarbucksidea.com, and it has one of the most successful fan pages on Facebook. Computer manufacturer Dell, in contrast, has different needs when interacting with its customers. For instance, when Dell sales representatives are dealing with large corporate clients that routinely make large computer purchases, issues of quantity pricing and delivery are likely to be paramount, whereas when dealing with less-computer-savvy individuals ordering a new notebook for personal use, questions about compatibility with an older printer or the ability to run a specific program may be asked. No matter the customer, Dell attempts to provide all customers with a positive experience during both the presale and the ongoing support phases. Large banks and insurance companies are trying to widen and deepen relationships with customers so as to be able to sell more financial services and products, maximizing the lifetime value of each individual customer. Chase Card Services, for example, has more than 4,000 agents handling 200 million customer calls a year. Being able to increase **first-call resolution** (sometimes referred to as first-contact resolution), that is, addressing the customers' issues during the first contact, can help to save costs tremendously while increasing customer satisfaction.

Marketing researchers have found that the cost of trying to win back customers who have gone elsewhere can be up to 50 to 100 times as much as keeping a current one satisfied. Thus, companies are finding it imperative to develop and maintain customer satisfaction and widen (by attracting new customers), lengthen (by keeping existing profitable customers satisfied), and deepen (by transforming minor customers into profitable customers) the relationships with their customers in order to compete effectively in their markets (Figure 8.12). To achieve

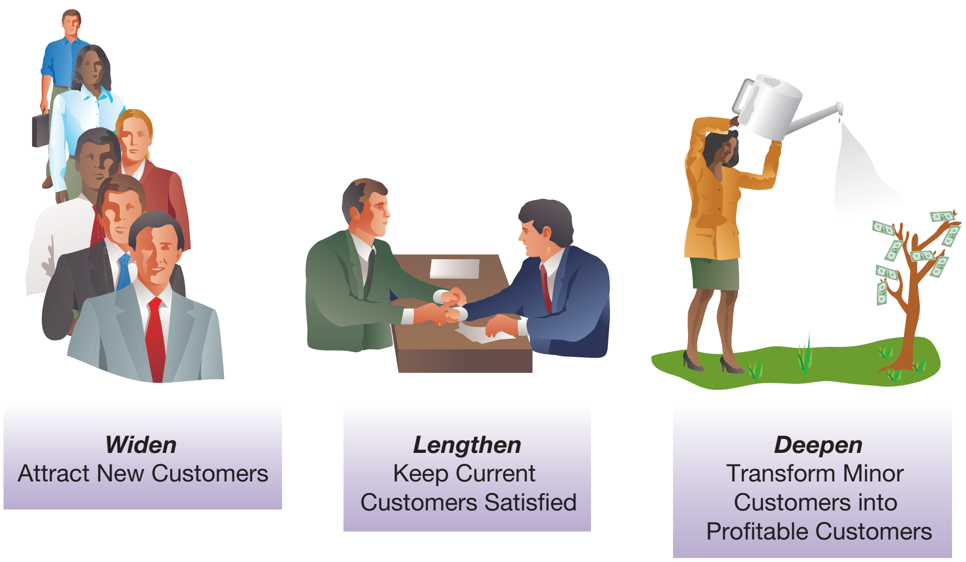


FIGURE 8.12

Companies search for ways to widen, lengthen, and deepen customer relationships.

this, companies need to not only understand who their customers are but also determine the lifetime value of each customer. With the increasing popularity of social media such as social networks, blogs, and microblogs, companies have more ways than ever to learn about their customers.

To assist in deploying an organization-wide strategy for managing these increasingly complex customer relationships, organizations are deploying **customer relationship management (CRM) systems**. CRM is not simply a technology but also a corporate-level strategy to create and maintain, through the introduction of reliable systems, processes, and procedures, lasting relationships with customers by concentrating on downstream information flows. Applications focusing on downstream information flows have three main objectives: to attract potential customers, to create customer loyalty, and to portray a positive corporate image. The appropriate CRM technology combined with the management of sales-related business processes can have tremendous benefits for an organization (Table 8.2). To pursue customer satisfaction as a basis for achieving competitive advantage, organizations must be able to access data and track customer interactions throughout the organization regardless of where, when, or how the interaction occurs. This means that companies need to have an integrated system that captures data from retail stores, websites, social networks, microblogs, call centers, and various other channels that organizations use to communicate downstream within their value chain. More important, managers need the capability to monitor and analyze factors that drive customer satisfaction (as well as dissatisfaction) as changes occur according to prevailing market conditions.

CRM systems come in the form of packaged software that is purchased from software vendors. CRM systems are commonly integrated with a comprehensive ERP implementation to leverage internal and external information to better serve customers. Thus, most large vendors of ERP systems, such as Oracle, SAP, and Microsoft, also offer CRM systems; further, specialized vendors, such as Salesforce.com or SugarCRM, offer CRM solutions on a software-as-a-service basis. Like ERP, CRM systems come with various features and modules. Managers must carefully select a CRM system that will meet the unique requirements of their business processes.

TABLE 8.2 Benefits of a CRM System

Benefit	Examples
24/7/365 operation	Web-based interfaces provide product information, sales status, support information, issue tracking, and so on.
Individualized service	Learn how each customer defines product and service quality so that customized product, pricing, and services can be designed or developed collaboratively.
Improved information	Integrate all information for all points of contact with the customers—marketing, sales, and service—so that all who interact with customers have the same view and understand current issues.
Improved problem identification/resolution	Improved record keeping and efficient methods of capturing customer complaints help to identify and solve problems faster.
Optimized processes	Integrated information removes information handoffs, speeding both sales and support processes.
Improved integration	Information from the CRM can be integrated with other systems to streamline business processes and gain business intelligence as well as make other cross-functional systems more efficient and effective.
Improved product development	Tracking customer behavior over time helps to identify future opportunities for product and service offerings.
Improved planning	This provides mechanisms for managing and scheduling sales follow-ups to assess satisfaction, repurchase probabilities, time frames, and frequencies.

SECURITY MATTERS

Disclosing the Customer Data of the Most Vulnerable

VTech is a Hong Kong–based global supplier of cordless phones as well as electronic learning products designed for infants to preschool children. In November 2015, VTech's learning products app store "Learning Lodge" was compromised by hackers who obtained customers' names, addresses, passwords, and other personal data, including 190 GB of photos and chat logs. The data breach exposed personal data about millions of individuals, including children, who had accounts that allowed them to register or utilize services related to specific products.

While companies are increasingly focusing on ways to better connect with customers, the VTech hack highlights the dark side of CRM in the digital world. VTech did contact all affected customers immediately after the breach. And, fortunately, the hacker didn't appear to be malicious; after completing the breach, the hacker contacted the website Motherboard and provided files containing the sensitive data to prove that VTech's sites had been compromised. According to the hacker, the breach demonstrated how insecure the VTech sites were and suggested that others, with malicious intent, might have compromised the servers prior to November 2015. Security experts gave VTech failing grades for its security policies. In response the breach, VTech changed its end user license agreement to state:

> *You acknowledge and agree that any information you send or receive during your use of the site may not be secure and may be intercepted or later acquired by unauthorized parties. You acknowledge and agree that your use of the site and any software or firmware downloaded therefrom is at your own risk.* (Windows 10, Microsoft Corporation)

While some countries are questioning the legality of VTech's policy change, it is clear that VTech is trying to avoid any liability if future hacks occur. Security experts cite that such incidents are increasing and companies would be better off getting their security right before such failure occurs rather than changing policies to limit their responsibility to their "valued" customers.

Based on:

Ellison, M. (2016, April 21). These toys have eyes (and ears too): VTech security breach raises "Internet of Things" privacy fears. *Lexology*. Retrieved May 8, 2016, from http://www.lexology.com/library/detail.aspx?g=e9fc4a57-4bbb-43d7-a414-24c72b383ac4

Franceschi-Bicchierai, L. (2015, November 27). One of the largest hacks yet exposes data on hundreds of thousands of kids. *Motherboard*. Retrieved May 8, 2016, from http://motherboard.vice.com/read/one-of-the-largest-hacks-yet-exposes-data-on-hundreds-of-thousands-of-kids

Gibbs, S. (2015, November 30). Toy firm VTech hack exposes private data of parents and children. *The Guardian*. Retrieved May 8, 2016, from https://www.theguardian.com/technology/2015/nov/30/vtech-toys-hack-private-data-parents-children

VTech. (2016, March 21). In *Wikipedia, The Free Encyclopedia*. Retrieved May 9, 2016, from https://en.wikipedia.org/w/index.php?title=VTech&oldid=711267165

Companies that have successfully implemented CRM systems can experience greater customer satisfaction and increased productivity of their sales and service personnel, which can translate into dramatic enhancements to the company's profitability. CRM allows organizations to focus on driving revenue as well as on reducing costs as opposed to emphasizing only cost cutting. Cost cutting tends to have a lower limit because there are only so many costs that companies can reduce, whereas revenue generation strategies are bound only by the size of the market itself. The importance of focusing on customer satisfaction is emphasized by findings that institutional investors increase a company's valuation when customer satisfaction is higher and reduce valuations when customer satisfaction is lower (Aalto University, 2013).

Developing a CRM Strategy

To develop a successful CRM strategy, organizations must do more than simply purchase and install CRM software. The first consideration is whether a comprehensive CRM system is even needed for a company; for example, the closer an organization is to the end customer, the more important CRM becomes. Further, companies have to realize that a successful CRM strategy must include enterprise-wide changes, including changes to:

- ***Policies and Business Processes.*** Organizational policies and procedures need to reflect a customer-focused culture.
- ***Customer Service.*** Key metrics for managing the business need to reflect customer-focused measures for quality and satisfaction as well as process changes to enhance the customer experience.

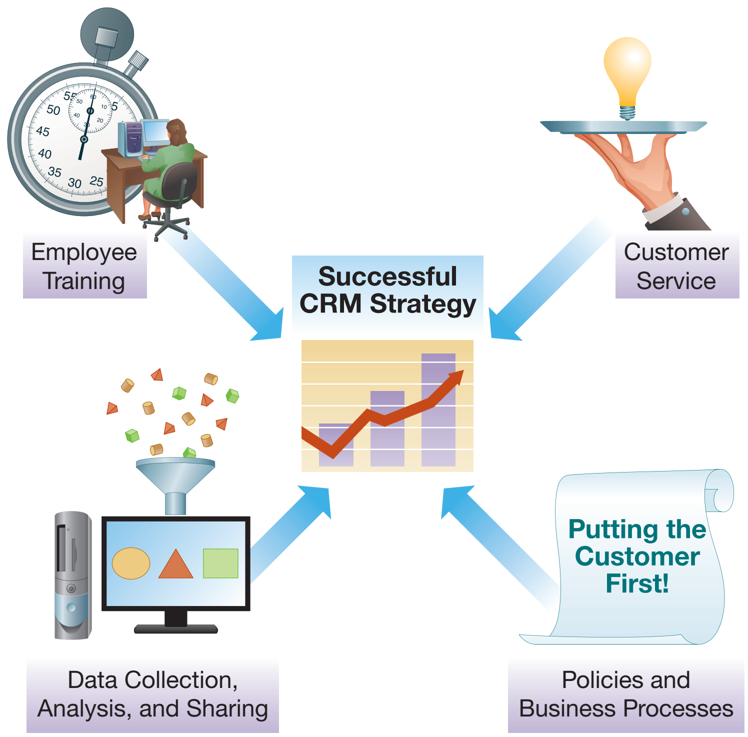


FIGURE 8.13

A successful CRM strategy requires enterprise-wide changes.

- ***Employee Training.*** Employees from all areas—marketing, sales, and support—must have a consistent focus that values customer service and satisfaction.
- ***Data Collection, Analysis, and Sharing.*** All aspects of the customer experience—prospecting, sales, support, and so on—must be tracked, analyzed, and shared to optimize the benefits of the CRM.

In sum, the organization must focus and organize its activities to provide the best customer service possible (Figure 8.13). Additionally, a successful CRM strategy must carefully consider the ethical and privacy concerns of customers' data (discussed later in this chapter).

Architecture of a CRM System

A comprehensive CRM system comprises three primary components:

1. ***Operational CRM.*** Systems for automating the fundamental business processes—marketing, sales, and support—for interacting with the customer
2. ***Analytical CRM.*** Systems for analyzing customer behavior and perceptions (e.g., quality, price, and overall satisfaction) in order to provide business intelligence
3. ***Collaborative CRM.*** Systems for providing effective and efficient communication with the customer from the entire organization

Operational CRM enables direct interaction with customers; in contrast, analytical CRM provides the analyses necessary to more effectively manage the sales, service, and marketing activities. Whereas analytical CRM aids in the development of a company's CRM strategy, operational CRM aids in the execution of CRM strategy; thus, either component alone provides no real benefit for a business. Finally, collaborative CRM provides the communication capabilities of the CRM environment (Figure 8.14). Next, we examine each of these components.

OPERATIONAL CRM. **Operational CRM** includes the systems used to enable customer interaction and service. For example, operational CRM systems help create mass e-mail marketing campaigns wherein each consumer receives an individualized e-mail based on prior purchase history. With an effective operational CRM environment, organizations are able to provide personalized and highly efficient customer service. Customer-focused personnel are provided complete customer information—history, pending sales, and service requests—in order to optimize interaction and service. It is important to stress that the operational CRM environment provides *all* customer information regardless of the touch point (i.e., technical support, customer service, and in-store

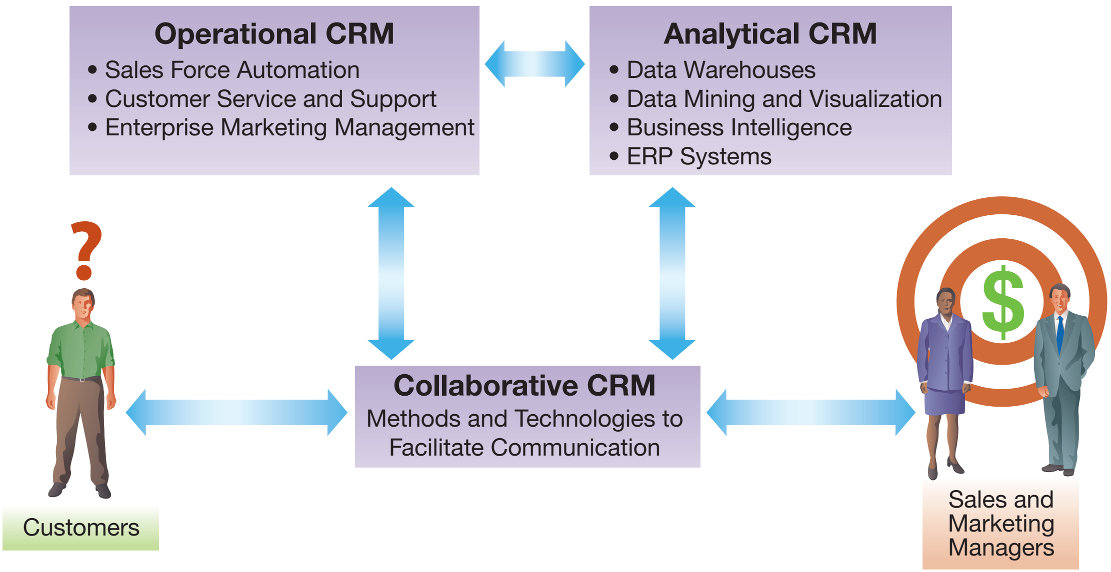


FIGURE 8.14

A comprehensive CRM environment includes operational, analytical, and collaborative components.

sales as well as website interactions such as downloading content and e-commerce clickstream data). This means that marketing, sales, and support personnel see *all* prior and current interactions with the customer regardless of where it occurred within the organization. To facilitate the sharing of information and customer interaction, three separate modules are utilized (Figure 8.15).

Sales Force Automation The first component of an operational CRM is **sales force automation (SFA)**. SFA refers to modules that support the day-to-day sales activities of an

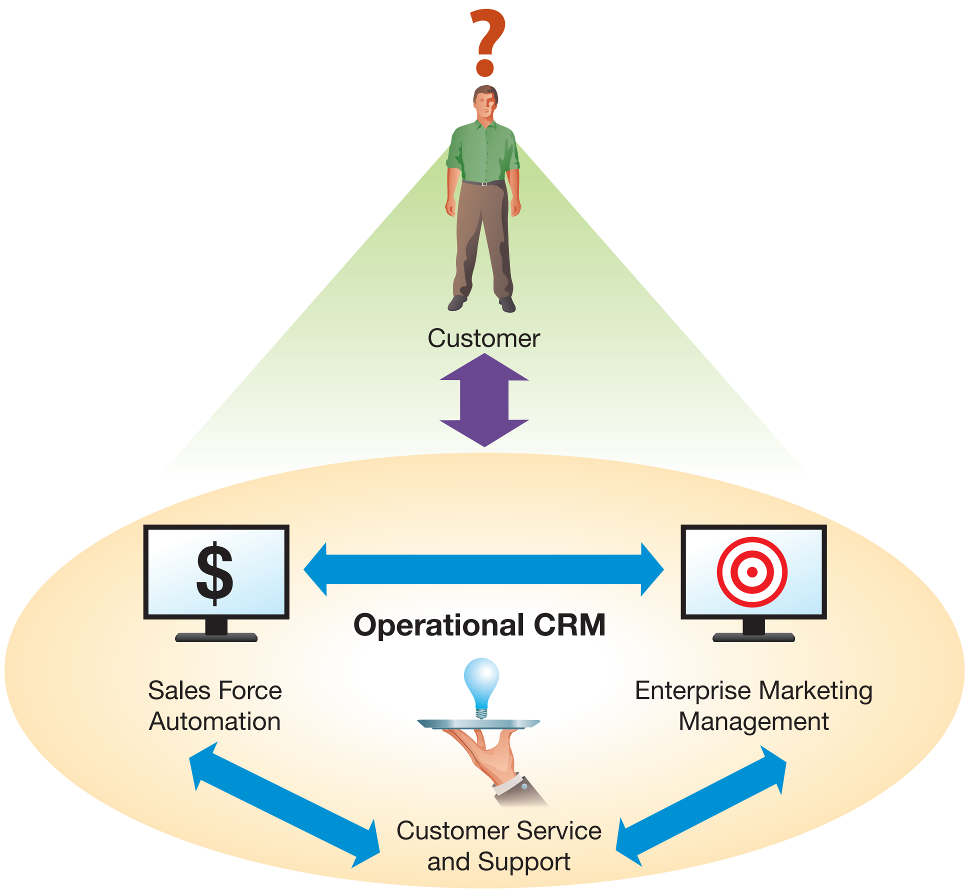


FIGURE 8.15

An operational CRM environment is used to enable customer interaction and service.

organization. For example, companies such as Dell have thousands of sales staff in various different countries working with many different clients. Unless sales personnel and sales managers have an integrated view of Dell's entire sales pipeline, Dell sales staff may be competing with each other for the same contracts unbeknownst to each other. SFA supports a broad range of sales-related business processes, such as order processing and tracking; managing accounts, contacts, opportunities, and sales; and tracking and managing customer history and preferences (both in terms of product and communication). Together, this can help in creating more accurate sales forecasts and analyzing sales performance.

SFA systems provide advantages for sales personnel, sales managers, and marketing managers. For sales personnel, SFA reduces the potentially error-prone paperwork associated with the selling process. Because all the information is within the system, personnel can more easily hand off work and collaborate; it is also easier to train new personnel. Sales personnel can then use their time more efficiently and ultimately focus more on selling than on paperwork and other non-selling tasks. Likewise, for sales managers, the SFA system provides tremendous benefits, such as accurate, up-to-the-minute information on all customers, markets, and sales personnel. This improved information allows for better planning, scheduling, and coordination. Ultimately, SFA provides better day-to-day management of the sales function. For example, SFA allows sales managers to track a plethora of sales performance measures, such as the sales pipeline for each salesperson, including rating and probability (Figure 8.16), revenue per salesperson, per territory, or as a percentage of sales quota, or number of calls per day, time spent per contact, revenue per call, cost per call, or ratio of orders to calls. Further, sales managers can obtain other useful information such as number of lost customers per period or cost of customer acquisition; product-related information such as margins by product category, customer segment, or customer; or percentage of goods returned, number of customer complaints, or number of overdue accounts. All of these measures aid in assessing sales performance and detecting potential problems in certain regions or issues with product or service quality.

Finally, SFA improves the effectiveness of the marketing function by providing an improved understanding of market conditions, competitors, and products. This enhanced information will provide numerous advantages for the management and execution of the marketing function. Specifically, SFA aids in gaining a better understanding of markets, segments, and customers as well as competitors and the overall economic structure of the industry. Such broad and deep understanding of the competitive landscape can help organizations assess their unique strengths and weaknesses, thereby facilitating new product development and improving strategic planning.

In sum, the primary goals of SFA are to better identify potential customers, streamline selling processes, and improve managerial information. Next, we examine systems for improving customer service and support.

Customer Service and Support The second component of an operational CRM system is **customer service and support**. Customer service and support refers to modules that

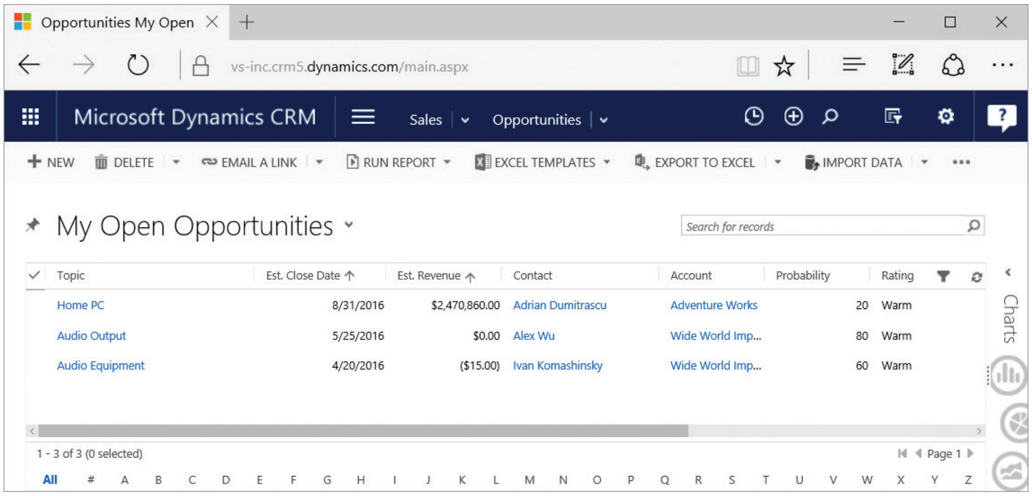


FIGURE 8.16

SFA allows sales managers to track sales performance.

Source: Dynamics CRM 2016, Windows 10, Microsoft Corporation.

automate service requests, complaints, product returns, and information requests. In the past, organizations had *help desks* and *call centers* to provide customer service and support. Today, organizations are deploying **customer engagement centers** that use multiple communication channels to support the communication preferences of customers, such as the web, the company's Facebook page, industry blogs, face-to-face contact, telephone, and so on (see the section "Collaborative CRM " later in this chapter). A customer engagement center utilizes a variety of communication technologies for optimizing customers' communications with the organization. For example, automatic call distribution systems forward calls to the next available person; while waiting to connect, customers can be given the option to use the keypad or voice response technologies to check account status information. Southwest Airlines improves customer service by using "virtual hold technology," where customers can choose to stay on the line or be called back when the next agent is available; this helped to save almost 25 million toll minutes in just one year and reduced the number of abandoned calls, which provided additional opportunities for ticket sales and signals increased customer satisfaction. In essence, the goal of customer service and support is to provide great customer service—anytime, anywhere, and through any channel—while keeping service and support costs low. For example, many customer engagement centers use powerful self-service diagnostic tools that guide consumers to their needed information. Customers can log service requests or gain updates to pending support requests using a variety of self-service or assisted technologies (Figure 8.17). On their websites, companies increasingly use automated chatbots

FIGURE 8.17

A customer engagement center allows customers to use a variety of self-service and assisted technologies to interact with the organization.

WHO'S GOING MOBILE

Developing a Mobile CRM App for Customers

In the past, mobile CRM was focused primarily on allowing employees on the go to use mobile devices to access, update, and interact with customer data wherever they are. These mobile CRM solutions let mobile workers do everything they could do with CRM at their desktop. CRM mobility, in organizations where the sales staff is frequently in the field, is a critical component to the CRM solution and has a significant impact on sales performance for staff and the company.

Mobile CRM is not just for a company's employees anymore, but it is also for customers. Today, mobile apps have become a powerful way for customers to connect with a brand. Mobile apps allow customers to access useful content and information while on the go. Smart companies will carefully design a mobile CRM app to leverage the mobile platform, not just repurpose a set of desktop features. Effective strategies for mobile, for example, will leverage push notifications, and provide personalized and relevant messages based on specific events, segmentation criteria, and in-app behavior.

According to comScore, we now spend more time engaging with mobile sites than with desktop websites, with most of that time being spent on apps. Unfortunately, only 3 percent of apps are still actively used after 30 days past initial download. So, it is critical to build the right app for customers. The real measure of mobile CRM success is not initial downloads but how many people remain engaged 30 to 60 days after initial engagement. To be successful, companies need specific metrics to measure progress and success. How many customers opt in and download the app, how long customers remain engaged, what events motivate interaction, when push notifications convert to sales, and various other factors must be tracked to learn and sharpen the organization's strategy. Mobile CRM is much more than a replication of a traditional CRM strategy. The company must put the customer first and design an app that helps to increase customer engagement and loyalty.

Based on:

Anonymous. (2015, December 7). How many apps do smartphone owners use? *eMarketer.* Retrieved May 8, 2016, from http://www.emarketer.com/Article/How-Many-Apps-Do-Smartphone-Owners-Use/1013309

Turner, N. (2016, April 16). Mobile CRM—the six metrics that matter. *PerformanceIN.* Retrieved on May 8, 2016, from http://performancein.com/news/2016/04/11/mobile-crm-six-metrics-matter

(see Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics") to initiate conversations and gain preliminary information from the user in order to route the user to the relevant human customer service representative. Successful customer service and support systems enable faster response times, increased first-contact resolution rates, and improved productivity of service and support personnel. Managers can utilize digital dashboards to monitor key metrics such as first-contact resolution and service personnel utilization, which allows for improved management of the service and support functions.

Enterprise Marketing Management The third component of an operational CRM system is **enterprise marketing management**. Enterprise marketing management tools help a company in the execution of the CRM strategy by improving the management of promotional campaigns (Figure 8.18). Today, many companies use a variety of channels (such as e-mail,

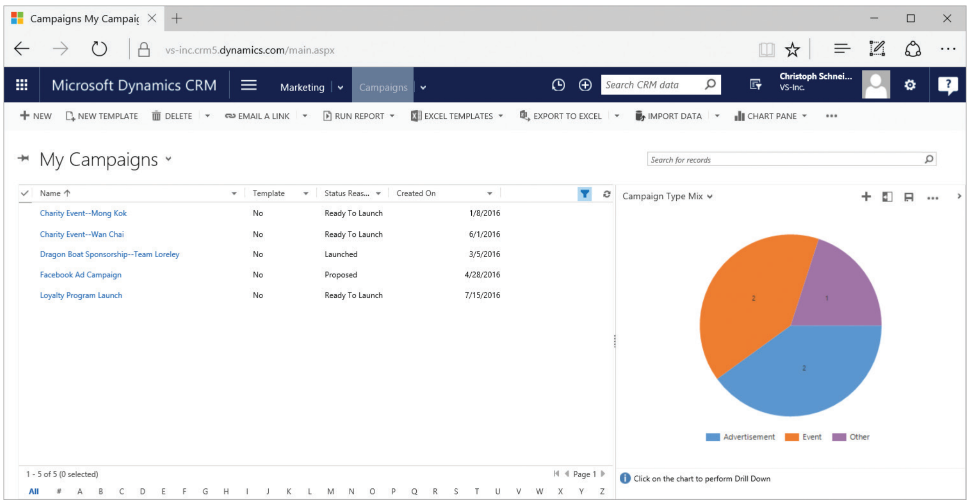


FIGURE 8.18

CRM systems allow for managing various types of promotional campaigns.

Source: Dynamics CRM 2016, Windows 10, Microsoft Corporation.

telephone, direct mail, Facebook pages and YouTube channels, Twitter status updates, and so on; see Chapter 4, "Enabling Business-to-Consumer Electronic Commerce," and Chapter 5, "Enhancing Organizational Communication and Collaboration Using Social Media") to reach potential customers and drive them to web pages customized for their target market (based on demographics and lifestyle). Using enterprise marketing management tools can help integrate those campaigns such that the right messages are sent to the right people through the right channels. This necessitates that customer lists are managed carefully to be able to personalize messages that can deliver individualized attention to each potential or existing customer (or to avoid targeting people who have opted out of receiving marketing communication). At the same time, enterprise marketing management tools provide extensive analytical capabilities that can help to analyze the effectiveness of marketing campaigns and can help to efficiently route sales leads to the right salespeople, leading to higher conversion rates.

ANALYTICAL CRM. **Analytical CRM** focuses on analyzing customer behavior and perceptions in order to provide the business intelligence necessary to identify new opportunities and to provide superior customer service. Organizations that effectively utilize analytical CRM can more easily customize marketing campaigns from the segment level to even the individual customer. Such customized campaigns help to increase cross- or up-selling (i.e., selling more profitable products or identifying popular bundles of products and services tailored to different market segments) as well as retain customers by having accurate, timely, and personalized information. Analytical CRM systems are also used to spot sales trends by ZIP code, state, and region as well as specific target markets within those areas.

Key technologies within analytical CRM systems include Big Data analytics and other business intelligence technologies that attempt to create predictive models of various customer attributes (see Chapter 6). These analyses can focus on enhancing a broad range of customer-focused business processes; for example, marketing campaign analysis can help organizations to optimize campaigns by improving customer segmentation and sales coverage as well as by optimizing the use of each customer's preferred communication channels. Similarly, analytical CRM tools can help in analyzing customer acquisition and retention. In addition, analytical CRM tools help in pricing optimization by building models of customer demand, taking into consideration not only factors such as product usage and customer satisfaction but also price, quality, and satisfaction of competitors' products or services.

Once these predictive models are created, they can be delivered to marketing and sales managers using a variety of visualization methods, including digital dashboards and other reporting methods (Figure 8.19). To gain the greatest value from analytical CRM applications, data

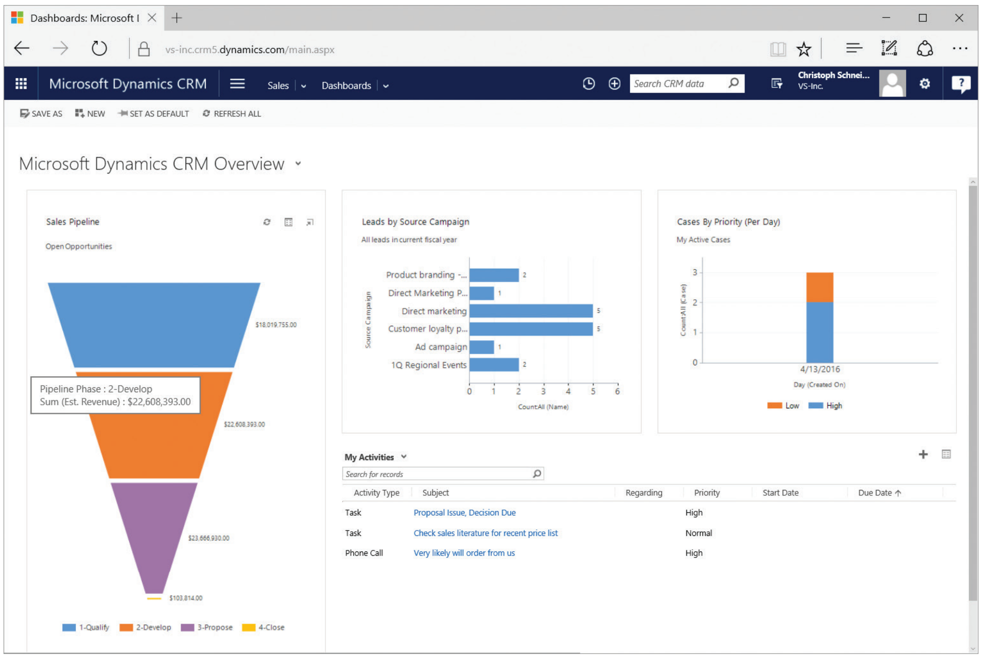


FIGURE 8.19

Digital dashboards help to visualize key CRM performance metrics.

Source: Dynamics CRM 2016, Windows 10, Microsoft Corporation.

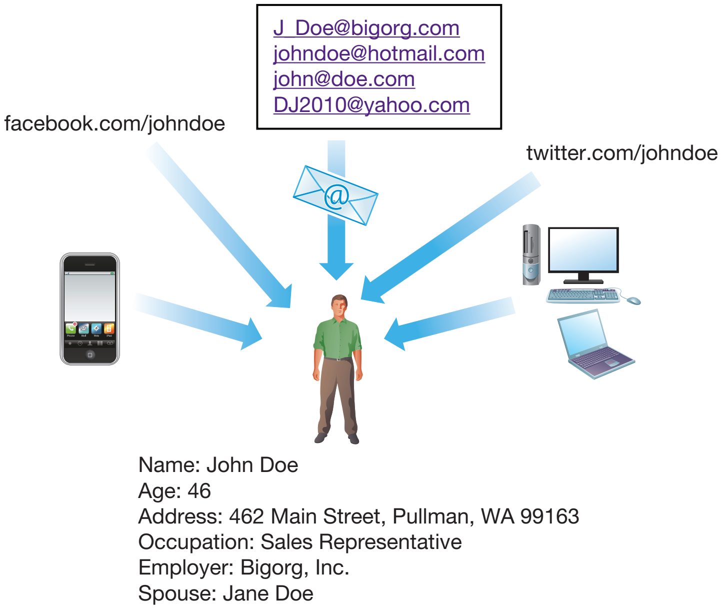


FIGURE 8.20

Many people interact with a company in many different ways using various online identities.

collection and analysis must be continuous so that all decision making reflects the most accurate, comprehensive, and up-to-date information.

One goal that customer-focused organizations are constantly striving for is to get a 360-degree view of the customer so as to be able to maximize the outcomes of sales and marketing campaigns and to identify the most profitable customers. In order to get the most complete picture of a sales prospect or a customer, marketers have to tie together data from various sources, such as demographic data provided when signing up for a loyalty card program, the customer's address, purchase and contact history, clickstream data on the company's website, and so on. In addition to the data captured when interacting with a person, marketers can complete the picture with publicly available information posted on the person's Facebook or LinkedIn profile or the person's Twitter updates. Unfortunately, many people have various different online identities (e.g., for different social networks), use multiple e-mail addresses, and access websites from different computers (Figure 8.20). Analytical CRM systems can help merge different identities by using fuzzy logic–based algorithms (see Chapter 6) to identify multiple records belonging to the same person.

Social CRM Social media applications enable companies to engage with their customers using a variety of social media channels. For example, many companies directly react to customer enquiries on their Facebook pages or on Twitter. This allows companies to quickly react to customers' concerns and provide a level of customer service that was typically not possible in offline environments. This use of social media for customer relationship management is often referred to as **social CRM**. As companies are using various social media channels, customers use various social media channels to quickly share both positive and negative experiences with a product or service. Monitoring such conversations can help organizations to better measure public perceptions, and by participating in such conversations, organizations can more effectively manage customer satisfaction and maintain a positive brand image.

Social Media Monitoring **Social media monitoring** is the process of identifying and assessing the volume and sentiment of what is being said about a company, individual, product, or brand. For example, monitoring online conversations can help to assess customer sentiments, find out what people really think about a product, and discover ways for improving a product: Whereas most customers do not bother to fill out a survey about a product, they are likely to voice their thoughts on Facebook or Twitter if they are very satisfied or very dissatisfied with a product. Similarly, many people participate in online discussion forums related to a product or company, and the company should monitor the conversation and step in when needed (e.g., when customers have questions about a product but no other customer answers within a certain time frame). To collect this information, organizations utilize a variety of tools to track

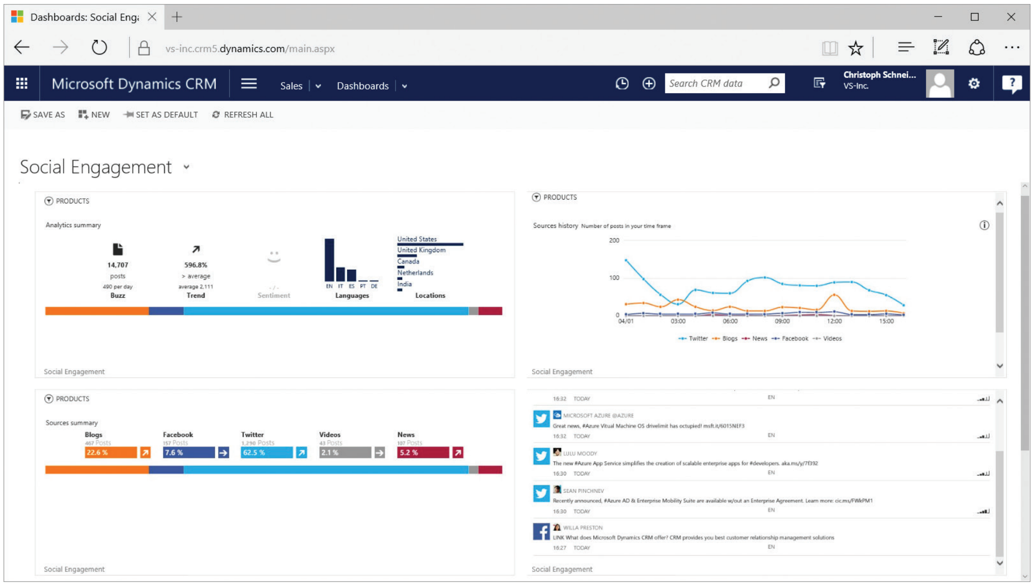


FIGURE 8.21

Many CRM applications include various tools to help in monitoring and analyzing ongoing conversations on social media sites.

Source: Dynamics CRM 2016, Windows 10, Microsoft Corporation.

and aggregate social media content from blogs, wikis, news sites, microblogs such as Twitter, social networking sites like Facebook, video- and photo-sharing websites like YouTube and Flickr, forums, message boards, blogs, and user-generated content in general. Depending on the goal of the social media monitoring program, a simple tool like Google Alerts might be adequate; alternatively, specialized applications that provide sophisticated analyses and full integration with existing CRM systems help to gain timely understanding of evolving customer sentiment. For example, Hootsuite, a popular tool for social media monitoring (and there are many), allows a company to keep track of chatter in real time on social media platforms such as Facebook, Twitter, LinkedIn, and many others. Using such tools, companies are not only able to listen to what people are saying about their brand or products, they can also consolidate and analyze trends and other summary information to improve strategy and decision making. Many CRM systems such as Microsoft Dynamics CRM now include various tools to help in monitoring and analyzing ongoing conversations on social media sites, helping to spot potential perception issues or to discover trends in customer sentiment (see Figure 8.21). Needless to say, an organization should have an appropriate social CRM strategy in place and should have clear policies, such as when to step into an online discussion, which (or how many) tweets to reply to, or how to strike a balance between grassroots marketing and deceiving people by posing as casual conversation partners.

Given the rise in importance of social media for reaching out to and communicating with customers, many organizations are creating a formal organizational group to engage in social media monitoring.

With the increasing use of social media, social media monitoring has become a central part of analyzing and understanding evolving market trends and customer sentiments. In addition, social media monitoring helps in identifying the "influencers" who are most likely to share their views through social media. Even though social media allow anybody to voice opinions, not everyone does so. For example, while many people regularly read blogs, only a few people write their own blogs; yet these blogs can be influential in swaying others' opinions. The importance of social media monitoring is exemplified by large companies such as Dell, which established a Social Media Listening Command Center, where a number of full-time staff monitor more than 22,000 daily posts made about the company on various social media. Having a dedicated team helps Dell to quickly react to customer complaints or changes in public sentiment about the company, enabling near-real-time communication with the customers through social media.

COLLABORATIVE CRM. **Collaborative CRM** refers to systems for providing effective and efficient communication with the customer from the entire organization. Collaborative CRM systems facilitate the sharing of information across the various departments of an organization in order to increase customer satisfaction and loyalty. Sharing useful customer information

ETHICAL DILEMMA

When Algorithms Discriminate

Promising companies the ability to get to know their customers and maximize the benefit gained from each one, CRM systems could be called a marketer's dream. CRM software allows companies to look closely at customer behavior, drilling down to smaller and smaller market segments. Once so segmented, customers can be targeted with specific promotions. For the company, this process reaps the greatest returns from marketing efforts because only those customers are targeted who are likely to respond to the marketing campaign.

From a customer's perspective, CRM systems seem like a great idea. You finally stop receiving advertisements for things that don't interest you. But what if a company uses its CRM software in a more discriminating way? Where do companies draw the line between using CRM data to offer certain clients customized deals and unethically discriminating against other customers? For example, lenders, which often segment their customers according to their creditworthiness, might use this credit risk data to target customers having a low credit rating with underhanded payday or subprime loans. Although these customers are riskier for the lender, the higher fees and interest charged for credit make these customers especially lucrative.

CRM and all software contain countless algorithms for manipulating, aggregating, and summarizing data. Algorithms reflect a set of rules to be followed in calculations and other problem-solving operations. While there is a widespread belief that such algorithms must be objective and fair, CRM software, and the underlying algorithms, is not free of human bias. Instances of bias reported in the popular press include a report that Google's online advertising system displayed an advertisement for high-income jobs for men more often than for women. Similarly, ads for accessing arrest records were significantly more likely to show up on searches for distinctively black names. In a similar way, CRM systems based on biased or discriminatory algorithms can potentially do more harm than good, destroying rather than building customer relationships.

Questions

1. Whose responsibility is it to ensure that algorithms are not discriminatory? Explain.
2. Google, Facebook, and many other widely used software platforms have been accused of using algorithms that present biased search results or news feeds. Should such platforms be bias free (at least as much as possible), or is it acceptable for platforms to reflect the biases of the developers? Explain.

Based on:

Jourdier, A. (2002, May 1). Privacy & ethics: Is CRM too close for comfort? *CIO.com.* Retrieved May 8, 2016, from http://www.cio.com/article/31062/Privacy_Ethics_Is_CRM_Too_Close_for_Comfort_

Miller, C.C. (2015, July 9). When algorithms discriminate. *The New York Times.* Retrieved on May 8, 2016, from http://www.nytimes.com/2015/07/10/upshot/when-algorithms-discriminate.html

Miller, C.C. (2015, August 10). Algorithms and bias: Q. and A. with Cynthia Dwork. *The New York Times.* Retrieved on May 19, 2016, from http://www.nytimes.com/2015/08/11/upshot/algorithms-and-bias-q-and-a-with-cynthia-dwork.html

Sydell, L. (2016, March 14). Can computers be racist? The human-like bias of algorithms. *National Public Radio.* Retrieved on May 19, 2016, from http://www.npr.org/2016/03/14/470427605/can-computers-be-racist-the-human-like-bias-of-algorithms

on a company-wide basis helps improve information quality and can be used to identify products or services a customer may be interested in. A collaborative CRM system supports customer communication and collaboration with the entire organization, thus providing more streamlined customer service with fewer handoffs. The customer engagement center (as described previously) enables customers to utilize the communication method they prefer when interacting with the organization. In other words, collaborative CRM integrates the communication related to all aspects of the marketing, sales, and support processes in order to better serve and retain customers. Collaborative CRM enhances communication in the following ways:

- ***Greater Customer Focus.*** Understanding customer history and current needs helps to focus the communication on issues important to the customer.
- ***Lower Communication Barriers.*** Customers are more likely to communicate with the organization when personnel have complete information and when they utilize the communication methods and preferences of the customer.
- ***Increased Information Integration.*** All information about the customer as well as all prior and ongoing communication is given to all organizational personnel interacting with the customer; customers can get status updates from any organizational touch point.

In addition to these benefits, collaborative CRM environments are flexible such that they can support both routine and nonroutine events.

Ethical Concerns with CRM

Although CRM has become a strategic enabler for developing and maintaining customer relationships, it is not viewed positively by those who feel that it invades customer privacy and facilitates coercive sales practices. Proponents of CRM warn that relying too much on the "systems" profiles of customers, based on statistical analysis of past behavior, may categorize customers in a way that they will take exception to. Additionally, given that a goal of CRM is to better meet the needs of customers by providing highly *personalized* communication and service (such as Amazon.com's recommendations), at what point does the communication get *too* personal? It is intuitive to conclude that when customers feel that the system knows too much about them, personalization could backfire on a company. Clearly, CRM raises several ethical concerns in the digital world (see Chapter 1, "Managing in the Digital World," for a comprehensive discussion of information privacy). Nevertheless, as competition continues to increase in the digital world, CRM will remain a key technology for attracting and retaining customers.

INDUSTRY ANALYSIS

Manufacturing

Regardless of whether you're thinking about a new computer, TV, automobile, or toy for your baby brother, most of today's consumer products have undergone an elaborate design and manufacturing process, and few companies do not make heavy use of information systems in the process. Traditionally, designers and engineers used large drawing boards to sketch detailed drawings of each component of a product. Today, designers use computer-aided design (CAD) software for this task, allowing them to create drawings faster and more accurately, thus cutting down cycle time (i.e., the time from inception to the shipment of the first product) tremendously. Further, CAD allows easier sharing of designs and can be used to produce 3D drawings of a new product. However, while you can create realistic 3D drawings of a new product, people often still prefer holding a physical model in their hands to evaluate it. 3D printing, sometimes known as "fabbing," can greatly speed up the creation of prototypes as well as an increasing range of finished products. In essence, 3D printers add successive layers of material onto a surface, thus building a 3D model out of myriad individual slices. In fact, some 3D printers even use materials such as titanium, allowing battleships to produce spare parts on an as-needed basis rather than carrying warehouses full of parts. 3D printing is rapidly evolving. Another implication of 3D printing relates to where products are manufactured. In the past decades, product manufacturing was often moved to parts of the world where labor was ample and wages were low. Countries such as China, Mexico, and Taiwan have become global heavyweights, manufacturing products for Apple, Nike, and countless other leading brands. 3D printing is potentially a global disrupter for manufacturing products. Many believe that the "workers" with the lowest wages and unlimited capacity will ultimately be 3D printers, which would result in moving the manufacturing of many products close to the location of final sale. While 3D printing is not a suitable manufacturing method for all products, and it may take many years before it emerges as the dominant manufacturing method, it clearly will have global implications for employment and trade balances.

The use of technology doesn't stop there. Inventory planning, job scheduling, or warehouse management are all supported by information systems, often in the form of ERP and SCM systems. Using RFID and other IoT sensors, new data can be integrated into various systems. With such highly granular data, companies will have enhanced information throughout the entire manufacturing value chain. From inventory management to production to logistics, all steps will be more transparent and efficient; complete information on the status of raw materials, production, and delivery will allow for improved inventory management, production scheduling, and delivery. Once a product leaves the manufacturer, IoT will be used throughout the distribution of the product to the final customer. Clearly, information systems will continue to transform the process of designing, manufacturing, and shipping products to you.

Based on:

3D printing. (2016, May 9). In *Wikipedia, The Free Encyclopedia*. Retrieved May 9, 2016, from https://en.wikipedia.org/w/index.php?title=3D_printing&oldid=719412123

D'Aveni, R.A. (2013, March). 3-D printing will change the world. *Harvard Business Review*. Retrieved May 9, 2016, from https://hbr.org/2013/03/3-d-printing-will-change-the-world

Macaulay, J., Buckalew, L., & Chung, G. (2015). Internet of Things in logistics. *DHL*. Retrieved on May 9, 2016, from http://www.dhl.com/en/about_us/logistics_insights/dhl_trend_research/internet_of_things.html

Key Points Review

1. ***Describe supply chain management systems and how they help to improve business-to-business processes.*** SCM focuses on improving interorganizational business processes in B2B relationships and has two main objectives: to accelerate product development and to reduce costs associated with procuring raw materials, components, and services from suppliers. Supplier and customer portals provide secure access points for established business partners. Smaller organizations often use B2B marketplaces for sourcing supplies. Organizations must match their overall supply chain strategy to their overall competitive strategy to reap the greatest benefits. SCM systems consist of supply chain planning, supply chain execution, and supply chain visibility and analytics components. Supply chain planning involves the development of various resource plans to support the efficient and effective production of goods and services. Supply chain execution involves the management of product flows, information flows, and financial flows. Supply chain visibility and analytics help in foreseeing the impacts of external events and monitoring the performance of the supply chain.

2. ***Describe customer relationship management systems and how they help to improve the activities involved in promoting and selling products to customers as well as providing customer service and nourishing long-term relationships.*** CRM is a corporate-level strategy to create and maintain lasting relationships with customers by concentrating on downstream information flows, to attract potential customers, to create customer loyalty, and to portray a positive corporate image. To develop a successful CRM strategy, organizations must make changes to policies and business processes, customer service, employee training, and data utilization. A CRM system consists of operational CRM, analytical CRM, and collaborative CRM. Operational CRM focuses on activities that deal directly with customers. Analytical CRM focuses on activities that aid managers in analyzing the sales and marketing functions as well as monitoring ongoing conversations in social media. Finally, collaborative CRM provides effective communication capabilities within the organization and externally with customers.

Key Terms

analytical CRM 331
bullwhip effect 313
business-to-business marketplace 310
collaborative CRM 333
customer engagement center 329
customer portal 310
customer relationship management (CRM) system 324
customer service and support 328
Electronic Data Interchange (EDI) 308
enterprise marketing management 330
Extensible Business Reporting Language (XBRL) 320
Extensible Markup Language (XML) 319
financial flow 320
first-call resolution 323
information flow 319
just-in-time (JIT) 313
operational CRM 326
portal 309
product flow 318
reverse logistics 318
sales force automation (SFA) 327
social CRM 332
social media monitoring 332
supplier portal 310
supply chain 308
supply chain analytics 321
supply chain effectiveness 316
supply chain efficiency 316
supply chain execution 318
supply chain management (SCM) system 314
supply chain planning 317
supply chain visibility 321
supply network 308
vendor-managed inventory (VMI) 313
vertical market 310
XML tag 319

MyMISLab™

Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

8-1. Describe supply chains and explain why *supply network* may be a more accurate term.

8-2. Contrast B2B portals with B2B marketplaces.

8-3. What are two process innovations enabled by effective collaboration within supply networks?

8-4. How does supply chain planning differ from supply chain execution?

MyMISLab **8-5.** How does supply chain visibility help an organization react to external events?

MyMISLab **8-6.** Contrast supply chain effectiveness and supply chain efficiency.

8-7. What is XML, and what is its role in SCM?

8-8. What is RFID's role in SCM?

8-9. How does CRM differ from SCM?

8-10. What is a CRM system, and what are its primary components?

8-11. Contrast operational and analytical CRM.

MyMISLab **8-12.** How does analytical CRM help in monitoring social conversations?

Self-Study Questions

8-13. Which of the following is commonly used to refer to the producers of supplies that a company uses?
A. procurement
B. sales force
C. supply network
D. customers

8-14. Under a VMI model, ______________.
A. a manufacturer has to signal restocking quantities to the supplier
B. the suppliers to a manufacturer manage the manufacturer's inventory levels based on negotiated service levels
C. the vendor has access only to stock levels
D. stockout situations are more likely to occur

8-15. The bullwhip effect refers to ______________.
A. contract penalties resulting from a supplier's inability to deliver raw materials on time
B. small forecasting errors at the end of the supply chain causing massive forecasting errors farther up the supply chain
C. pressure to use a specific SCM system by a company in a supply chain
D. rising stock values due to effective SCM practices

8-16. Which type of flow does supply chain execution not focus on?
A. procurement flow
B. product flow
C. information flow
D. financial flow

8-17. During supply chain planning, which four plans are created?
A. demand forecast, logistics plan, production plan, supplier plan
B. needs analysis, logistics plan, production plan, sourcing plan
C. needs analysis, transportation plan, outsourcing plan, partnership plan
D. demand forecast, transportation plan, production plan, sourcing plan

8-18. A comprehensive CRM system includes all but which of the following components?
A. operational CRM
B. analytical CRM
C. cooperative CRM
D. collaborative CRM

8-19. SFA is most closely associated with what?
A. operational CRM
B. analytical CRM
C. cooperative CRM
D. collaborative CRM

8-20. All the following are channels used for promotional campaigns except ______________.
A. Twitter
B. telephone
C. direct mail
D. all of the above are used

8-21. A metric for being able to quickly resolve customers' issues is called ______________.
A. customer satisfaction and complaint management
B. customer communication optimization
C. virtual-hold technology
D. first-call resolution

8-22. Categorizing customers based on statistical analysis of past behavior is ______________.
A. illegal
B. a sometimes ethically questionable business practice
C. ethical and a common business practice
D. technically impossible

Answers are on page 339.

Problems and Exercises

8-23. Match the following terms with the appropriate definitions:

i. JIT
ii. Supply chain efficiency
iii. Supply chain
iv. Supply chain visibility
v. CRM systems
vi. Customer engagement center
vii. SCM systems
viii. VMI
ix. Vertical market
x. First-call resolution

a. The ability not only to track products as they move through the supply chain but also to foresee external events
b. A market composed of firms within a specific industry sector
c. Addressing the customers' issues during the first call
d. The extent to which a company's supply chain is focusing on minimizing procurement, production, and transportation costs
e. An SCM innovation that optimizes ordering quantities such that parts or raw materials arrive just when they are needed for production
f. Applications that help to create and maintain lasting relationships with customers by concentrating on the downstream information flows
g. Commonly used to refer to the collection of producers of supplies that a company uses
h. A business model in which the suppliers to a manufacturer (or retailer) manage the manufacturer's (or retailer's) inventory levels based on negotiated service levels
i. A part of operational CRM that provides a central point of contact for an organization's customers
j. Applications that help to improve interorganizational business processes to accelerate product development and innovation and to reduce costs

8-24. Find an organization that you are familiar with and determine how it manages its supply chain. Is the company effective in managing the supply chain, or does it need closer integration and collaboration with its suppliers?

8-25. Search the web for a recent product recall. How did the company affected handle the recall? Were the actions appropriate, or could increased supply chain visibility have helped?

8-26. Search the web for companies using sustainable SCM practices. Are those attempts convincing? Why or why not? Under what circumstances would such practices influence your purchasing decisions?

8-27. Analyze the supply chain of your favorite electronic gadget and compare this with the supply chain of your favorite pair of jeans. How do the supply chains differ? What are potential reasons for this?

8-28. When purchasing a product on the web, how important is the visibility of *your* supply chain for this product? Why? Does the importance differ for different products?

8-29. Choose a company you are familiar with and examine how efficiently or effectively it has designed the procurement, production, and transportation aspects of its business.

8-30. Assume you are a sales manager. What sales performance measures would you want the CRM system to provide you in order to better manage your sales force? For each measure, describe how you would use it and at what interval you would need to update this information.

8-31. Find an organization that is utilizing CRM (visit vendor websites for case studies or industry journals such as *CIO Magazine* or *Computerworld*). Who within the organization is most involved in this process, and who benefits?

8-32. When you last contacted a company with a product or service request, which contact options did you have? Which option did you choose, and why?

8-33. Search the web for recent articles on social CRM. What is the current state-of-the-art application for managing customer relationships in social media?

8-34. Visit the web sites of three companies offering CRM systems. Do these companies sell only CRM systems? What do they have in common? What does each have that is unique?

8-35. Search on Facebook for your favorite company's page. How does this company present itself in the social media? How does it handle customer conversations? Is the organization's strategy effective?

8-36. Discuss the ethical trade-offs involved when using large databases that profile and categorize customers so that companies can more effectively market their products. Think about products that are "good" for the consumer versus those that are not.

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Tracking Website Visits at Campus Travel

8-37. Campus Travel has recently started selling products on the Internet; the managers are eager to know how the company's website is accepted by the customers. The file CampusTravel.csv contains transaction information for the past 3 days, generated from the company's web server, including IP addresses of the visitors, whether a transaction was completed, and the transaction amount. You are asked to present the current status of the e-commerce initiative. Use your spreadsheet program to prepare the following graphs:

- A graph highlighting the total number of site visits and the total number of transactions per day
- A graph highlighting the total sales per day

Make sure to format the graphs in a professional manner, including headers, footers, and the appropriate labels. (Hint: To calculate the total number of site visits and the total number of transactions, use the "countif" function to count the number.)

Database Application: Managing Customer Relations at Campus Travel

8-38. Not all frequent fliers accumulate large amounts of miles. There are many who never travel for years but have frequent-flier accounts. As manager of sales and marketing, you want to find out how to target these individuals with promotions and special offers. To accomplish this task, you will need to create the following reports:

- A report displaying all frequent fliers, sorted by distance traveled
- A report displaying all frequent fliers, sorted by the total amount spent on air travel

In the file InfrequentFliers.mdb, you will find travel data on the members of a frequent-flier program for the previous year. Professionally format all reports, including headers, footers, dates, and so on. (Hint: Use the report wizard to create the reports; use queries to sum up the fares and distances for each traveler before creating the respective reports.)

Team Work Exercise

Net Stats: RFID in the Supply Chain

The market for RFID tags, those high-tech devices that let businesses keep track of certain products via radio frequency readers and tags, has been steadily increasing for the past few years. According to a recent research report, the global RFID market in 2015 was worth US$10.1 billion and is expected to grow to US$13.2 billion by 2020. RFID can provide many benefits for managing supply chains, including a better understanding of materials and products inventories, employee theft, supply chain errors, and point-of-sale productivity. As RFID becomes central to managing supply chains, the software and services segment of this industry will play an increasingly larger role to help companies better utilize the data provided by using these devices. While the adoption of RFID technology may require a large startup investment for organizations, it provides a strong long-term return on investment.

Questions and Exercises

8-39. Search the web for the most up-to-date statistics and forecasts on the use of RFID technology in SCM.

8-40. As a team, interpret these numbers (or stories). What is striking/important about these findings?

8-41. As a team, discuss what these findings will look like in 5 years and 10 years. How are things in the U.S. market the same or different across the world? Where are things moving faster/slower? Why?

8-42. Using your presentation software of choice, create a brief presentation about the findings you consider most important.

Based on:

Das, R., & Harrop, P. (2015, October). RFID forecasts, players, and opportunities 2016–2026. *IDTechEx*. Retrieved May 4, 2016, from http://www.idtechex.com/research/reports/rfid-forecasts-players-and-opportunities-2016-2026-000451.asp

Nuce, M. (2015, July 23). The upstream and downstream benefits of RFID. *Apparel*. Retrieved May 4, 2016, from http://apparel.edgl.com/tech-insights/The-Upstream-and-Downstream-Benefits-of-RFID101523

Answers to the Self-Study Questions

8-13. C, p. 308	**8-14.** B, p. 313	**8-15.** B, p. 313	**8-16.** A, p. 318	**8-17.** D, p. 317
8-18. C, p. 326	**8-19.** A, p. 326	**8-20.** D, p. 331	**8-21.** D, p. 323	**8-22.** B, p. 335

CASE 1 | Supply Chain Havoc

Information systems have assisted in the creation of global supply networks that allow for the worldwide procurement of raw materials and components needed as inputs into production processes. For the purpose of achieving an optimal balance between quality and costs, manufacturers often have had to rely on complicated and fragile supply chains. Imagine that you are the manufacturer of a trendy new gadget that is gaining popularity worldwide. Also imagine that a tsunami just rolled over the factory of a key manufacturer of a certain critical component in your device. At best, you may encounter long shipment delays and lost sales; at worst, your opportunity in the marketplace fades and you go out of business. Thus, shielding the delicate supply chain from negative impacts arising from external events is a tremendous challenge for many organizations, especially in a reality where disruptions can rarely be forecast and the results can be devastating.

There are a variety of events that can put a supply chain in havoc. In addition to extreme weather events, other events such as cargo crime and terrorism can lead to disruptions. For instance, in 2015, the British Standards Institute (BSI) estimated that global supply chains incurred a combined US$56 billion in extra costs from these and other factors.

While it's not something most people think about, cargo crime is a significant factor influencing the efficiency and effectiveness of a global supply chain. The BSI estimated that US$23 billion were lost globally due to cargo crime in 2015, reporting a 30 percent increase in truck theft in South Africa alone. Much of this theft was ruthless, "with thieves using high levels of violence and switching from targeting only high-value goods to also targeting low-value items." In China, there were alarming increases in aggressive robbery from trucks traveling along major highways. In addition to increased violence, there was more sophistication in many of the attacks. In India, for example, criminal gangs found ways to remove the contents of large shipping containers without breaking customs seals in order to avoid detection.

Terrorism is also increasingly wreaking havoc on supply chains. In particular, in 2015, Europe suffered severe supply chain disruptions due to both terror attacks in France and Belgium and the influx of migrants into Europe to avoid the fighting in Syria and other parts of the Middle East. In the European Union, the so-called Schengen Agreement allows European citizens to cross borders without checks and greatly facilitates the movement of goods across Europe. After the terrorist attacks of 2015, many countries reestablished border controls, at least temporarily. It was estimated that permanently reestablishing controls in Germany alone would cost its economy US$25 billion.

Often highlighted for disrupting supply chains, natural disasters and extreme weather also were significant disrupters, resulting in more than US$33 billion in losses. In 2015, natural disasters disrupting supply chains included forest fires in Indonesia, earthquakes in Nepal, typhoons in China and the Philippines, and floods in the United States and India.

Other incidents are even more unexpected, such as the series of explosions in Tianjin (China) that killed more than 170 people and injured hundreds of others was highly disruptive. The blasts began on August 12, 2015, at the busy Port of Tianjin, the largest port in Northern China and the main maritime gateway to Beijing. Annually, this port handles more than 500 million tons of cargo and more than 13 million containers, making it the largest manmade port in mainland China and one of the largest in the world. The first blast was caused by an overheated container of dry nitrocellulose. The second was far larger and involved the detonation of about 800 tons of ammonium nitrate. The fires caused by the initial explosions burned uncontrolled for days, causing many secondary explosions. Ultimately, the BSI report estimated the supply chain losses to be US$3.3 billion.

Lastly, social unrest in many developing countries led to additional supply chain losses. Factory strikes in China in 2015, for example, increased by nearly 60 percent over the prior year. Other threats that might play a role in future disruptions include infectious diseases such as the Zika virus and Ebola. Concerns with climate change and El Niño may also result in increased extreme weather events. Clearly, many factors can create supply chain havoc. And because it is impossible to elude disruptions within today's global supply networks, organizations must carefully plan for disasters because they simply cannot be avoided.

Questions

8-43. What are various ways a supply chain can be disrupted?

8-44. What can companies do to make sure they are less vulnerable to supply chain disruptions?

8-45. What do you see as the greatest event currently (as of reading this chapter) disrupting supply chains? Why?

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CASE 2 | Efficiently Delivering Products Over the "Last Mile"

In the delivery business, the industry is aggressively working to improve the efficiency of the "last mile," which reflects the delivery of a product to the end consumer. Such delivery historically has been performed by a postal service or package delivery company like UPS, FedEx, or DHL. With the growth of e-commerce, there has been a huge reduction in traditional shopping where customers go to a physical store, purchase products, and then carry those products home. Likewise, with the rapid growth of e-commerce, the last mile of delivery has grown in importance. Delivering a 5-pound package for same-day delivery within the same city using a traditional delivery method, costs anywhere from US$5 to US$13. Amazon Prime Now is about US$8 for orders under US$35 (free for those over that amount). If such costs are added onto a lower-priced product, same-day delivery becomes uneconomical for many customers. Thus, creating ways to deliver products fast and cheaply to the end consumers can provide an incredible competitive advantage.

With such high stakes in mind, Amazon.com's CEO Jeff Bezos announced plans for Amazon Prime Air (APA) in late 2013. APA's plan is to use small, unmanned aerial vehicles (UAVs, commonly known as drones) to transport packages to customers. The goal is to deliver packages in under 30 minutes for locations within 10 miles of a warehouse. Not all items will be suitable for APA delivery, however, as they must be small enough to fit within the cargo box of the UAV and cannot exceed a weight of 5 pounds (which applies to 86 percent of Amazon's packages, according to official documents). In early 2016, the biggest hurdle for getting APA off the ground was not a technical problem but regulations concerning the use of UAVs for commercial delivery. While the U.S. Federal Aviation Administration (FAA) granted Amazon permission to begin testing prototypes of the delivery vehicle, the approval for making widespread deliveries has not yet been finalized. During testing, APA's flights were limited to a maximum height of 400 feet and a speed of 100 mph. The UAV planned for use by Amazon is 55 pounds in weight and flies at speeds up to 55 mph. A report by ARK Invest estimates that APA would cost Amazon about 88 cents per delivery. Thus, if Amazon offered 30-minute delivery for $1, it would significantly undercut other options for same-day delivery, further strengthening its online dominance; some experts estimate that even at those prices, Amazon would still be able to make a comfortable 50 percent return on its investment in the drone infrastructure. Needless to say, given the importance of solving the last mile problem, many other companies are exploring UAVs for product delivery, including Google, USPS, DHL, and many others as well as many governments around the world.

In addition to UAV delivery, there is tremendous innovation occurring around ground-based autonomous delivery. In February 2016, for example, Google was granted a U.S. patent for an autonomous delivery truck. Google plans to leverage its driverless vehicle technology, delivering anything from online purchases to your Saturday night pizza. Google emphasized the importance of the last mile problem in its patent application, stating that the "two largest delivery services in the US operate over 100,000 last mile vehicles—each of which requires a human operator." Google is not the only one thinking of autonomous delivery. In early 2016, Domino's built and tested an autonomous pizza delivery robot in Australia. When the delivery arrives at a customer's door, the customer needs to enter a mobile code to open the vehicle's insulated storage area, which can keep items both hot or cold. While e-commerce has transformed how most of us shop for goods and services, UAVs and autonomous delivery will further transform the digital world.

Questions

8-46. What is meant by the *last mile*, and why would retailers and delivery services want UAV and driverless vehicle delivery?

8-47. What are some of the drawbacks and challenges to overcome to make UAV and driverless vehicle delivery a reality?

8-48. If you were the chief executive officer at Amazon.com, would you be comfortable using UAV or driverless vehicle delivery? What are some of the potential risks of using either of these approaches? Explain.

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Wang, D. (n.d.). The economics of drone delivery. *Flexport*. Retrieved on May 9, 2016, from https://www.flexport.com/blog/drone-delivery-economics

MyMISLab™ | Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

8-49. Explain how effectively managing the supply chain can help an organization be a responsible social citizen.

8-50. Describe the enterprise-wide changes necessary for realizing a successful CRM strategy.

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9 Developing and Acquiring Information Systems

Preview

As you have read throughout this book and have experienced in your own life, information systems and technologies are of many different types, including high-speed web servers to rapidly process customer requests, business intelligence systems to aid managerial decision making, and customer relationship management systems to provide improved customer service. Given this variety, when we refer to "systems" in this chapter, we are talking about a broad range of technologies, including hardware, software, and services. Just as there are different types of systems, there are different approaches for developing and acquiring them. If you are a business student majoring in areas such as marketing, finance, accounting, or management, you might be wondering why we have a discussion about developing and acquiring information systems. The answer is simple: No matter what area of an organization you are in, you will be involved in systems development or technology acquisition processes. In fact, research indicates that spending on systems in many organizations is controlled by the specific business functions rather than by the information systems (IS) department. What this means is that even if your career interests are in something other than information systems, it is very likely that you will be involved in the development and acquisition of systems, technologies, or services. Understanding these processes is important to your future success.

MANAGING IN THE DIGITAL WORLD:

The Maker Movement

To build and deliver a product used to require a substantial support infrastructure. Physical products required machine tools, injection molding machines, and substantial space for manufacturing, inventory, and fulfillment. The digital components required large teams of developers with highly specialized skills. Recent innovations have led to a dramatic shift in these requirements. Today, individuals and small groups can participate in the full cycle of product innovation much more readily. This trend toward an increase in do-it-yourself (DIY) and do-it-with-others (DIWO) is often referred to as the "maker movement" and participants as "makers." Key technologies that have enabled the maker movement are inexpensive and small computing devices, rapid prototyping machinery, and streamlined software development platforms.

Small, inexpensive computing devices like the Raspberry Pi—a device costing as little as $5 that can perform all the functions of a full-scale computer—have made processing power more available and flexible. The low cost allows more people access—for example, schools can now afford to supply their students with their own computers. The small size and flexibility allow for many more possible uses—the Raspberry Pi Zero is about the size of a credit card and can be integrated into everything from school projects to Internet of Things (IoT) devices to designer clothing. Low-cost rapid

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

1. **Describe how to formulate and present the business case for technology investments.**
2. **Describe the systems development life cycle and its various phases.**
3. **Explain how organizations acquire systems via external acquisition and outsourcing.**

prototyping machines have given makers the ability to bring their imagination to life. An object that may have previously required expensive custom machine tools to manufacture can be printed on a relatively affordable desktop 3D printer, which uses techniques like fused deposition modeling to directly create parts from computerized designs. 3D printers can even print other 3D printers!

The software side has seen a similar shift. The Raspberry Pi has a large community devoted to making coding easier and more accessible. Online retailer SparkFun designs various open source microcontroller boards and sensors that provide the basis for developing innovative software and products that utilize data from embedded sensors and other microelectronics. The use of open source hard- and software and standard interfaces makes it easy for anyone to learn and develop code to support their own devices.

Maker spaces are physical locations designed to facilitate such innovation. In addition to making resources such as 3D printers available to individuals and teams, maker spaces provide access to other innovators and makers. Someone with a great IoT idea and a hardware design but without coding skills can get connected with someone to fill in the gaps. These collaborative environments are enabling innovation on a scale never seen before, such that today, anyone can be a software and hardware engineer.

FIGURE 9.1

3D printing is an enabler of the maker movement.
Source: Alexei Sysoev/Fotolia.

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

1. How can makers formulate and present the business case for selecting various hardware and software platforms?
2. How can makers ensure that they successfully complete their development projects?
3. How can makers decide which components to create themselves and which to obtain externally?

Based on:
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Maker movement. (n.d.). *Techopedia.* Retrieved May 20, 2016, from https://www.techopedia.com/definition/28408/maker-movement

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Making the Business Case

Before people are willing to spend money to acquire or develop a new system or spend more money on an existing one, they want to be convinced that this will be a good investment. **Making the business case** refers to the process of identifying, quantifying, and presenting the value provided by a system.

Business Case Objectives

What does *making the business case* mean? Think for a moment about what defense lawyers do in court trials. They carefully build a strong, integrated set of arguments and evidence to prove that their clients are innocent to those who will pass judgment on their clients. In much the same way, a manager has to build a strong, integrated set of arguments and evidence to prove that an information system (or any type of investment) is adding value to the organization or its constituents. This is, in business lingo, "making the business case" for a system.

As a business professional, you will be called on to make the business case for systems and other capital investments, you will have to make the case for a new system or application you may need for your work to improve certain business processes, or you will be involved in evaluating the business case for a proposed system. Thus, as a finance, accounting, marketing, or management professional, you are likely to be involved in these processes and will therefore need to know how to effectively make or evaluate the business case for a system (or other capital expenditures) and need to understand the relevant organizational issues involved. It will be in the organization's best interest—and in your own—to ferret out systems that are not adding value. In these cases, you will need to either improve the systems or replace them. Traditionally, business units turned to IS departments for new systems or applications. Today, business units often directly purchase applications from outside vendors and expect these applications to function in the infrastructure provided by the IS departments. As more and more applications are purchased from external vendors, organizations have to make sure to go through a proper process in selecting the right applications.

Making the business case is as important for proposed systems as it is for the continued investment in an existing system. For a proposed system, the case will be used to determine whether the new system is a "go" or a "no-go." For an existing system, the case will be used to determine whether the company will continue to fund the system. Whether a new system or an existing one is being considered, your goal is to make sure that the investment adds value, that it helps the firm achieve its strategy and competitive advantage over its rivals, and that money is being spent wisely.

The Productivity Paradox

Unfortunately, while it is easy to quantify the costs associated with developing an information system, it is often difficult to quantify tangible productivity gains from its use. Over the past several years, the press has given a lot of attention to the impact of IS investments on worker productivity. In many cases, IS expenditures, salaries, and the number of people on the IS staff have all been rising, but results from these investments have often been disappointing. For instance, the information and technology research firm Gartner (2016) reports that worldwide spending on systems and technologies will surpass US$3.6 trillion in 2016. American and Canadian companies are spending, on average, about 4 percent of company revenues on system-related investments. As a result, justifying the costs for IS investments has been a hot topic among senior managers at many firms. In particular, "white-collar" productivity, especially in the service sector, has not increased at the rate one might expect, given the trillions of dollars spent.

Why has it been difficult to show that these vast expenditures on technologies have led to productivity gains? Have information systems somehow failed us, promising increases in performance and productivity and then failing to deliver on that promise? Determining the answer is not easy. Information systems may have increased productivity, but other forces may have simultaneously worked to reduce it, the end results being difficult to identify. Factors such as government regulations, more complex tax codes, stricter financial reporting requirements (such as the Sarbanes–Oxley Act; see Chapter 10, "Securing Information Systems"), and more complex products can all have major impacts on a firm's productivity.

It is also true that information systems introduced with the best intentions may have had unintended consequences. A paramount example is giving employees access to e-mail and the

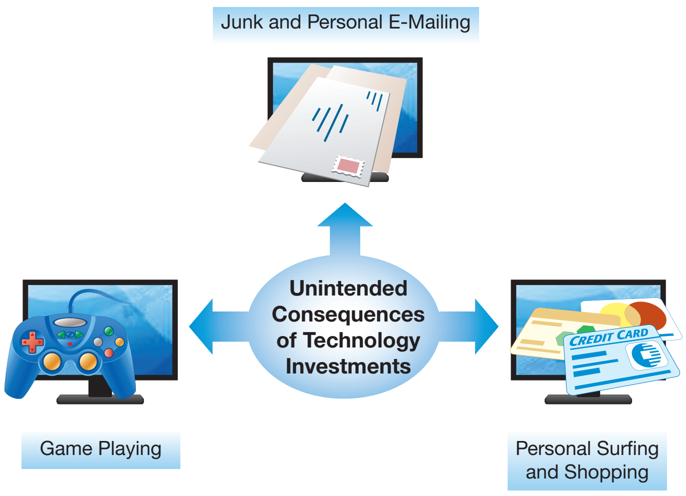


FIGURE 9.2

Unintended consequences can limit the productivity gains from IS investments.

Internet—now employees are spending excessive amounts of time surfing the web to check sports scores on ESPN.com, read volumes of electronic junk mail received from Internet marketing companies or from personal friends, post status updates on social networking sites, or use company PCs to download and play software games (Figure 9.2). Recently, it was reported that 89 percent of surveyed employees admitted "wasting time" at work; most wasted an hour or less, but 4 percent admitted wasting more than half the workday on non-work-related activities including doing personal work as well as visiting social networking sites such as Facebook and Twitter. The cost for this time wasting is billions of dollars in lost productivity every year. In such situations, information systems can result in less efficient and less effective communication among employees and less productive uses of employee time than before the systems were implemented. Nevertheless, sound technology investments should increase organizational productivity. If this is so, why have organizations not been able to show larger productivity gains? A number of reasons have been given for the apparent **productivity paradox** of technology investments (Figure 9.3). The four most prominent factors are examined next.

MEASUREMENT PROBLEMS. In many cases, the benefits of information systems are difficult to pinpoint because firms may be measuring the wrong things. Often, the biggest increases in productivity result from increased effectiveness (i.e., the extent to which goals or tasks are

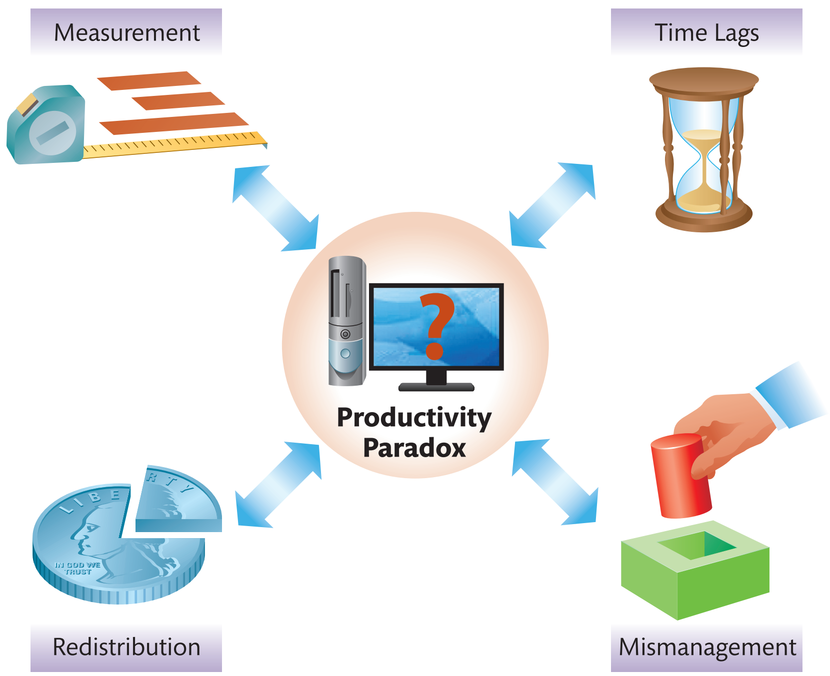


FIGURE 9.3

Factors leading to the IS productivity paradox.

accomplished well). Unfortunately, many business metrics focus on efficiency (i.e., the extent to which goals are accomplished faster, at lower cost, or with relatively little time and effort).

A good example of measurement problems associated with a technology investment is the use of online banking. How much has online banking contributed to banking productivity? Traditional statistics might look at the adoption rate of the service and associated reductions in branch-based services and locations. While informative, such statistics may not work well for evaluating online banking, at least at this point in time. For instance, some older customers may not want to bank online, so a reduction in the number of traditional branches could threaten a potentially large number of very good customers while at the same time inflating the percentage of online banking users (i.e., if the number of traditional banking customers leave the bank because of a reduction of branches, the adoption rate of online customers as a percentage will be increased). So, investing in online banking may be unimportant for an important segment of customers while essential for others. Nevertheless, can you imagine a bank staying competitive without offering online services? Deploying technologies such as online banking has become a *strategic necessity*—something an organization must do in order to survive (see Chapter 2, "Gaining Competitive Advantage Through Information Systems"). The value of necessary investments is often difficult to quantify.

TIME LAGS. A second explanation for why productivity is sometimes difficult to demonstrate for some technology investments is that there may be significant time lags between a company making an investment and observable impacts on the bottom line. Let us return to our online banking example. In some markets, it may take years from the first implementation of this new system before the magnitude of benefits may be felt by the organization.

REDISTRIBUTION. A third possible explanation for why IS productivity figures are not always easy to define is that a new type of system may be beneficial for individual firms but not for a particular industry or the economy as a whole. Particularly in competitive situations, new innovations may be used to redistribute the pieces of the pie rather than making the whole pie bigger. The result for the industry or economy as a whole is a wash—that is, the same number of products are being sold, and the same number of dollars are being spread across all the firms.

MISMANAGEMENT. A fourth explanation is that the new system has not been implemented and managed well. Some believe that people often simply build bad systems, implement them poorly, and rely on technology fixes when the organization has problems that require a joint technology/process solution. Rather than increasing outputs or profits, IS investments might merely be a temporary bandage and may serve to mask or even increase organizational inefficiency. Also, as we mentioned in Chapter 2, an information system can be only as effective as the business model that it serves. Bad business models can't be overcome by good information systems.

If it is so difficult to quantify the benefits of information systems for individual firms and for entire industries, why do managers continue to invest in information systems? The answer is that competitive pressures force managers to invest in information systems whether they like it or not. Also, for many organizations, information systems are an important source of competitive advantage. You might ask, then, so why waste time making the business case for a system? Why not just acquire or develop it? The answer: Given limited resources on the one hand and the vast number of potential systems and technologies that could be selected on the other hand, a strong business case aids the decision-making process and helps direct resources in more strategic ways.

Making a Successful Business Case

People make a variety of arguments in their business cases for information systems. When managers make the business case for an information system, they typically base their arguments on faith, fear, and/or facts (Wheeler & Marakas, 1999). (Wheeler also adds a fourth *F* for *fiction* and notes that, unfortunately, managers sometimes base their arguments on pure fiction, which is not only bad for their careers but also not at all healthy for their firms.) Table 9.1 shows examples of these three types of arguments.

Do not assume that you must base your business case on facts only. It is entirely appropriate to base the business case on faith, fear, or facts (Figure 9.4). Indeed, the strongest and most convincing business case will include a little of each type of argument. In the following sections, we talk about each of these types of arguments for the business case.

TABLE 9.1 Three Types of Arguments Commonly Made in the Business Case for an Information System

Type of Argument	Description	Example
Faith	Arguments based on beliefs about organizational strategy, competitive advantage, industry forces, customer perceptions, market share, and so on	"I know I don't have good data to back this up, but I'm convinced that having this customer relationship management system will enable us to serve our customers significantly better than our competitors do and, as a result, we'll beat the competition… You just have to take it on faith."
Fear	Arguments based on the notion that if the system is not implemented, the firm will lose out to the competition or, worse, go out of business	"If we don't implement this enterprise resource planning system, we'll get killed by our competitors because they're all implementing these kinds of systems … We either do this or we die."
Facts	Arguments based on data, quantitative analysis, and/or indisputable factors	"This analysis shows that implementing the inventory control system will help us reduce errors by 50 percent, reduce operating costs by 15 percent a year, and increase production by 5 percent a year and will pay for itself within 18 months."

BUSINESS CASE ARGUMENTS BASED ON FAITH. In some situations, arguments based on faith (or fear) can be the most compelling and can drive the decision to invest in an information system despite the lack of any hard data on system costs or even in the face of some data that say that the dollar cost for the system will be high. Arguments based on faith often hold that an information system must be implemented in order to achieve the organization's strategy effectively and to gain or sustain a competitive advantage over rivals.

For example, a firm has set as its strategy that it will be the dominant global force in its industry. As a result, this firm must adopt a variety of collaboration technologies in order to enable employees from different parts of the globe to work together effectively and efficiently. Similarly, a firm that has set as its strategy a broad scope—producing products and services across a wide range of consumer needs—may need to adopt some form of an enterprise resource planning system to better coordinate business activities across its diverse product lines.

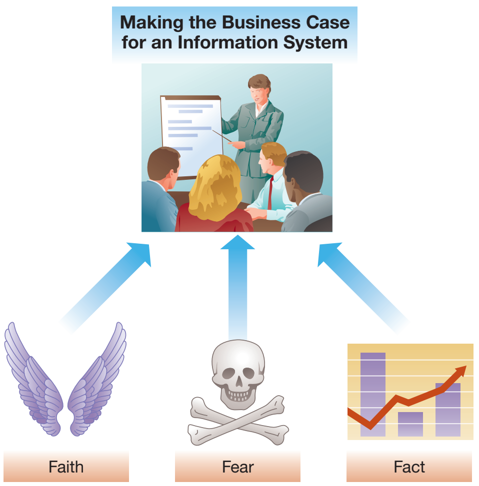


FIGURE 9.4

A successful business case will be based on faith, fear, and facts.

GREEN IT

Project Natick—Microsoft's Underwater Data Centers

A data center is a specially designed facility to house computer systems and associated components, such as telecommunication and data storage systems. Data centers are typically huge facilities, with countless data centers around the world being larger than 1 million square feet. In 2016, the Range International Information Hub in Langfang, China, was the largest data center in the world with a floor size of 6.3 million square feet. Because of their massive size, data centers are often located in remote locations.

Each data center can provide computer processing and storage for billions of individuals and millions of companies. Some of the biggest data centers are the backbone for the largest tech companies such as Facebook, Google, Microsoft, and Apple. These data centers, with millions of computers, produce a tremendous amount of heat and require an equal amount of cooling to keep machines and equipment from overheating. Many centers are located near fresh water, such as the Columbia River in the Pacific Northwest of the United States, where Google, Microsoft, and Facebook have massive facilities. These centers use millions of gallons of water from the river to keep the facility cool and the computers from overheating; massive pumps are used to cycle the water from the river into the facility and then to outdoor cooling ponds before moving the water back into the river.

Microsoft recently extended this idea of using natural ways to cool a data center by developing a standalone data center—called Project Natick—that can reside hundreds of feet underwater in the oceans around the world. Much of the world's population lives in urban centers off the coasts of the world's oceans. Placing the data centers underwater closer to most of the world's users will speed up data access and virtually reduce cooling costs to zero. Because an ocean is so huge, there is literally no heat impact from the data center on the surrounding environment. However, building a self-contained data center that can resist the corrosive elements of the sea as well as operate for up to 5 years without maintenance remains the most challenging aspect of this project. Nevertheless, Project Natick may be the future of how data centers are constructed to both reduce the massive footprint of current data centers and help to reduce the energy requirements and environmental impacts of the digital world.

Based on:

Anonymous. (2016). The 5 largest data centers in the world. *Forbes*. Retrieved March 11, 2016, from http://www.forbes.com/pictures/gikh45hdm/range-international-info

Data center. (2016, March 1). In *Wikipedia, The Free Encyclopedia*. Retrieved March 12, 2016, from https://en.wikipedia.org/w/index.php?title=Data_center&oldid=707775130

Markoff, J. (2016, January 31). Microsoft plumbs ocean's depths to test underwater data center. *The New York Times*. Retrieved March 11, 2016, from http://www.nytimes.com/2016/02/01/technology/microsoft-plumbs-oceans-depths-to-test-underwater-data-center.html

Vincent, J. (2016, February 1). Microsoft is experiment with underwater data centers. *The Verge*. Retrieved March 11, 2016, from http://www.theverge.com/2016/2/1/10883866/microsoft-underwater-data-centers

In short, successful business case arguments based on faith should clearly describe the firm's mission and objectives, the strategy for achieving them, and the types of information systems that are needed in order to enact the strategy. A word of caution is warranted here. In today's business environment, cases based solely on strategic arguments, with no hard numbers demonstrating the value of the information system under consideration, are not likely to be funded.

BUSINESS CASE ARGUMENTS BASED ON FEAR. There are several different factors to take into account when making a business case containing arguments based on fear. These include a number of factors involving competition and other characteristics of the industry in which the firm operates. For example, a mature industry, such as the automotive industry, may need systems simply to maintain the current pace of operations. While having the newest systems and technologies available may be nice, they may not be essential to stay in business. However, a company in a newer, expanding industry, such as the green technology industry, may find it more important to be on the leading edge of technology in order to compete effectively in the marketplace. Likewise, some industries are more highly regulated than others. In these cases, companies can use technology investments to better control processes and ensure compliance with appropriate regulations. The argument for the business case here would be something like "If we do not implement this system, we run the risk of being sued or, worse, being thrown in jail" (see Chapter 10).

Probably the most important industry factor that can affect technology investments is the nature of competition or rivalry in the industry. For example, when competition in an industry is high and use of the newest technologies is rampant, as it is in the mobile phone industry, strategic necessity, more than anything else, forces firms to adopt new systems. Given how tight profit margins are in this industry, Apple, Samsung, and other manufacturers must use inventory control systems, business intelligence systems, and a host of other systems that help them to be more effective and efficient. If they do not adopt these systems, they will likely go out of business. As introduced in Chapter 2, a common way for assessing the level of competition within an industry is the five forces model (Porter, 1979). By assessing the various competitive forces, you can determine which specific technologies may be more or less useful. For instance, in a highly price-competitive market, where buyers have strong bargaining power, investments to reduce production costs might be advantageous. Business case arguments formulated this way sound something like "If we do not implement this system, our competitors are going to beat us on price, we will lose market share, and we will go out of business."

BUSINESS CASE ARGUMENTS BASED ON FACTS. Many people, including most chief financial officers, want to see the business case for an information system based on a convincing, quantitative analysis that proves beyond the shadow of a doubt that the benefits of the system will outweigh the costs. The most common way to prove this is to provide a detailed cost–benefit analysis of the information system. Although this step is critical, the manager must remember that there are inherent difficulties in and limits to cost–benefit analyses for information systems. To illustrate how a cost–benefit analysis could be used to build a fact-based business case, let us consider the development of a web-based order entry system for a relatively small firm.

Identifying Costs One goal of a cost–benefit analysis is to accurately determine the **total cost of ownership (TCO)** for an investment. TCO is focused on understanding not only the total cost of *acquisition* but also all costs associated with ongoing *use and maintenance* of a system. Consequently, costs can usually be divided into two categories: **non-recurring costs** and **recurring costs**. Non-recurring costs are one-time costs that are not expected to continue after the system is implemented. These include costs for things such as site preparation and technology purchases. These one-time costs may also include the costs of attracting and training a webmaster or renovating some office space for new personnel or for hosting the web servers. Non-recurring costs such as for the acquisition or upgrade of long-term physical assets such as equipment and buildings are often classified as a **capital expenditure**.

Recurring costs are ongoing costs that occur throughout the life of the system. Recurring costs include the salary and benefits of the webmaster and any other personnel assigned to maintain the system, electricity, upgrades and maintenance of the system components, monthly fees paid to a local Internet service provider, and the continuing costs for the space in which the webmaster works or the data center where the servers reside. Such recurring costs are typically classified as a **non-capital expenditure** (or **operational expenditure**). Personnel costs are usually the largest recurring costs, and the web-based system is no exception in this regard. These recurring expenses can go well beyond the webmaster to include expenses for customer support, content management, ongoing maintenance, and more.

The sample costs described thus far are **tangible costs** that are relatively easy to quantify. Some **intangible costs** ought to be accounted for as well, even though they will not fit neatly into the quantitative analysis. These might include the costs of reduced traditional sales, losing some customers that are not "web ready," or losing customers if the web application is poorly designed or not on par with competitors' sites. You can choose to either quantify these in some way (i.e., determine the cost of losing a customer) or simply reserve these as important costs to consider outside of—but along with—the quantitative cost–benefit analysis.

Identifying Benefits Next, you determine both **tangible benefits** and **intangible benefits**. Some tangible benefits are relatively easy to determine. For example, you can estimate that the increased customer reach of the new web-based system will result in at least a modest increase in sales. Based on evidence from similar projects, you might estimate, say, a 5 percent increase in sales the first year, a 10 percent increase the second year, and a 15 percent increase the third year. In addition, you might also include as tangible benefits the reduction of order entry errors because orders will now be tracked electronically and shipped automatically. You could calculate the money previously lost on faulty and lost orders along with the salaries and wages of personnel assigned to find and fix these orders and then consider the reduction of these costs as a quantifiable benefit of the new system. Cost avoidance is a legitimate, quantifiable

COMING ATTRACTIONS

Harvesting Human Energy

If you have a smartwatch or a fitness tracker, it is frustrating that you can deplete your battery within a few days or less; likewise, you probably have to recharge your phone at least once a day. For any electric or electronic device, be it a mobile phone, a laptop computer, or an electric vehicle, battery life continues to be the Achilles' heel. To overcome this problem, MIT researchers are exploring how to power our gadgets, such as our smartwatches and fitness trackers, by our body movements. The idea of generating energy from human body movements is not new; already at the beginning of the 20th century, watchmakers developed self-winding (mechanical) watches, which used natural body movements to wind the watch. What is new is the idea of translating *bending* movements into electrical energy in order to charge electronic gadgets. The researchers at MIT have developed a "sandwich" of metal and polymer, not unlike inside lithium ion batteries. If this material is bent, electrochemical processes create an electrical current, thus translating mechanical into electrical energy. Integrating such a device into, for example, the sole of a shoe could translate human movement into enough energy to power many types of wearable devices, most of which require relatively low amounts of power. For devices that require more energy, such as devices connected to smartphones via Bluetooth, this approach could greatly extend the device's need for recharge by days or even weeks. While there are many challenges, one that is particularly difficult to forecast is the reliability of our movements. Those who are fitness fanatics will have no problem keeping their gadgets charged. For couch potatoes, this approach will have limited value. Nevertheless, powering your gadgets by your movements is on the horizon. Want to IM your friends on Facebook? Take a walk!

Based on:

Wang, U. (2016, February 4). The scientists harvesting energy from humans to power our wearables. *The Guardian*. Retrieved March 11, 2016, from http://www.theguardian.com/sustainable-business/2016/feb/04/harvesting-energy-humans-walking-charge-wearables-bending-mit

benefit of many systems. Similarly, the new system may enable the company to use fewer order entry clerks or redeploy these personnel to other, more important functions within the company. You could consider these cost reductions as benefits of the new system.

A web-based system may have intangible benefits as well. Some intangible benefits of this new system might include improvements in customer service resulting from faster turnaround on fulfilling orders. These are real benefits, but they might be hard to quantify with confidence. Perhaps an even more intangible benefit would be the overall improved perception of the firm. Customers might consider it more progressive and customer service–oriented than its rivals; in addition to attracting new customers, this might increase the value of the firm's stock if it is a publicly traded firm. Another intangible benefit might be simply that it was a strategic necessity to offer customers web-based ordering to keep pace with rivals. While these intangibles are difficult to quantify, they must be considered along with the more quantitative analysis of benefits. In fact, the intangible benefits of this web-based system might be so important that they could carry the day despite an inconclusive or even negative cost–benefit analysis.

Performing Cost–Benefit Analyses An example of a simplified **cost–benefit analysis** that contrasts the total expected tangible costs versus the tangible benefits is presented in Figure 9.5. Notice the fairly large investment up front, with another significant outlay in the fifth year for a system upgrade. You could now use the net costs/benefits for each year as the basis of your conclusion about this system. Alternatively, you could perform a **break-even analysis**—a type of cost–benefit analysis used to identify at what point (if ever) tangible benefits equal tangible costs (note that break-even occurs early in the second year of the system's life in this example)—or a more formal **net-present-value analysis** of the relevant cash flow streams associated with the system at the organization's **discount rate** (i.e., the rate of return used by an organization to compute the present value of future cash flows). In any event, these cost–benefit analyses help you make the business case for this proposed web-based order fulfillment system. It clearly shows that the investment for this system is relatively small, and the company can fairly quickly recapture the investment. In addition, there appear to be intangible strategic benefits to deploying this system. These analyses—and the accompanying arguments and evidence—go a long way toward convincing senior managers in the firm that this new system makes sense. For more on cost–benefit analyses, see any introductory finance or managerial accounting textbook.

		2018	2019	2020	2021	2022
Costs						
Non-recurring						
Hardware		$ 20,000				
Software		$ 7,500				
Networking		$ 4,500				
Infrastructure		$ 7,500				
Personnel		$100,000				
Recurring						
Hardware			$ 500	$ 1,000	$ 2,500	$ 15,000
Software			$ 500	$ 500	$ 1,000	$ 2,500
Networking			$ 250	$ 250	$ 500	$ 1,000
Service fees			$ 250	$ 250	$ 250	$ 500
Infrastructure				$ 250	$ 500	$ 1,500
Personnel			$ 60,000	$ 62,500	$ 70,000	$ 90,000
Total costs		$139,500	$ 61,500	$ 64,750	$ 74,750	$110,500
Benefits						
Increased sales		$ 20,000	$ 50,000	$ 80,000	$115,000	$175,000
Error reduction		$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Cost reduction		$100,000	$100,000	$100,000	$100,000	$100,000
Total benefits		$135,000	$165,000	$195,000	$230,000	$290,000
Net costs/benefits		$ (4,500)	$103,500	$130,250	$155,250	$179,500

FIGURE 9.5

Worksheet showing a simplified cost–benefit analysis for a web-based order fulfillment system.

Comparing Competing Investments One method for deciding among different IS investments or when considering alternative designs for a given system is **weighted multicriteria analysis**, as illustrated in Figure 9.6. For example, suppose that for a given application being considered for purchase, there are three alternatives that could be pursued—A, B, or C. Let's also suppose that early planning meetings identified three key system requirements and four key constraints that could be used to help make a decision on which alternative to pursue. In the left column of

Criteria	Weight	Alternative A		Alternative B		Alternative C	
		Rating	Score	Rating	Score	Rating	Score
Requirements							
Web-based Interface	18	5	90	5	90	5	90
Security capabilities	18	1	18	5	90	5	90
BI capabilities	14	1	14	5	70	5	70
	50		122		250		250
Constraints							
Software Costs	15	4	60	5	75	3	45
Hardware Costs	15	4	60	4	60	3	45
Operating Costs	15	5	75	1	15	5	75
Ease of Training	5	5	25	3	15	3	15
	50		220		165		180
Total	100		342		415		430

FIGURE 9.6

Decisions about alternative projects or system design approaches can be assisted using a weighted multicriteria analysis.

Figure 9.6, three system requirements and four constraints are listed. Because not all requirements and constraints are of equal importance, they are weighted on the basis of their relative importance. In other words, you do not have to weight requirements and constraints equally; it is certainly possible to make requirements more or less important than constraints. Weights are arrived at in discussions among the analysis team, users, and managers. Weights tend to be fairly subjective and, for that reason, should be determined through a process of open discussion to reveal underlying assumptions followed by an attempt to reach consensus among stakeholders. Notice that the total of the weights for both the requirements and constraints is 100 percent.

Next, each requirement and constraint is rated on a scale of 1 to 5. A rating of 1 indicates that the alternative does not meet the requirement very well or that the alternative violates the constraint. A rating of 5 indicates that the alternative meets or exceeds the requirement or clearly abides by the constraint. Ratings are even more subjective than weights and should also be determined through open discussion among users, analysts, and managers. For each requirement and constraint, a score is calculated by multiplying the rating for each requirement and each constraint by its weight. The final step is to add up the weighted scores for each alternative. Notice that we have included three sets of totals: for requirements, for constraints, and for overall totals. If you look at the totals for requirements, alternative B or C is the best choice because each meets or exceeds all requirements. However, if you look only at constraints, alternative A is the best choice because it does not violate any constraints. When we combine the totals for requirements and constraints, we see that the best choice is alternative C. Whether alternative C is actually chosen for development, however, is another issue. The decision makers may choose alternative A because it has the lowest cost, knowing that it does not meet two key requirements. In short, what may appear to be the best choice for a systems development project may not always be the one that ends up being developed or acquired. By conducting a thorough analysis, organizations can greatly improve their decision-making outcomes.

Presenting the Business Case

Up to this point, we have discussed the key issues to consider as you prepare to make the business case for a system. We have also shown you some tools for determining the value that a system adds to an organization. Now you are actually ready to make the case—to present your arguments and evidence to the decision makers in the firm.

KNOW THE AUDIENCE. Depending on the firm, a number of people from various areas of the firm might be involved in the decision-making process. People from different areas of the firm typically hold very different perspectives about what investments should be made and how those investments should be managed (Table 9.2). Consequently, presenting the business case for a

TABLE 9.2 Characteristics of Different Stakeholders Involved in Making IS Investment Decisions

Stakeholder	Perspective	Focus/Project Characteristics
Management	Representatives or managers from each of the functional areas within the firm	Greater strategic focus; largest project sizes; longest project durations
Steering committee	Representatives from various interest groups within the organization (they may have their own agendas at stake when making investment decisions)	Cross-functional focus; greater organizational change; formal cost–benefit analysis; larger and riskier projects
User department	Representatives of the intended users of the system	Narrow, nonstrategic focus; faster development
IS executive	Has overall responsibility for managing IS development, implementation, and maintenance of selected systems	Focus on integration with existing systems; fewer development delays; less concern with cost–benefit analysis

Source: Based on Valacich and George (2017) and McKeen, Guimaraes, and Wetherbe (1994).

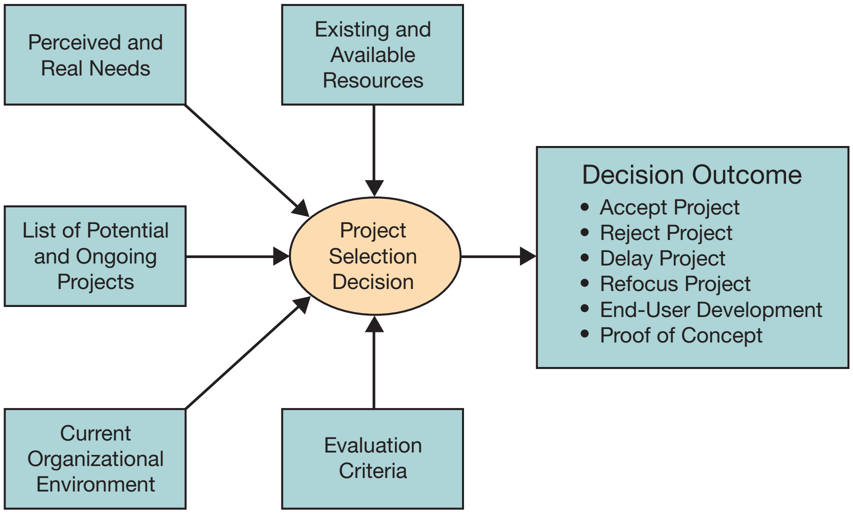


FIGURE 9.7

Investment selection decisions must consider numerous factors and can have numerous outcomes.

new system investment can be quite challenging. Ultimately, a number of factors come into play in making investment decisions, and numerous outcomes can occur (Figure 9.7). For instance, decisions and choices are driven by perceived needs, resource availability, evaluation criteria, and so on. Numerous outcomes can occur from this decision process. Of course, the project can be accepted or rejected; often, projects can be conditionally accepted or flagged for revision in order to more carefully consider resource, time, or other constraints. Understanding the audience and the issues important to them is a first step in making an effective presentation. Various ways to improve the development of a business case are examined next.

CONVERT BENEFITS TO MONETARY TERMS. When making the case for an IS investment, it is desirable to translate all potential benefits into monetary terms. For example, if a new system saves department managers an hour per day, try to quantify that savings in terms of dollars. Figure 9.8 shows how you might convert time savings into dollar figures. While merely explaining this benefit as "saving managers' time" makes it sound useful, managers may not consider it a significant enough inducement to warrant spending a significant amount of money. Justifying a US$50,000 system because it will "save time" may not be persuasive enough. However, an annual savings of US$90,000 is more likely to capture the attention of decision makers and is more likely to result in project approval. Senior managers can easily rationalize a US$50,000 expense for a US$90,000 savings and can easily see why they should approve such a request. They can also more easily rationalize their decision later on if something goes wrong with the system.

DEVISE PROXY VARIABLES. The situation presented in Figure 9.8 is fairly straightforward. Anyone can see that a US$50,000 investment is a good idea because the return on that investment is US$90,000 the first year. Unfortunately, not all cases are this clear-cut. In cases in which it is not as easy to quantify the impact of an investment, you can come up with **proxy variables** (i.e., alternative measures of outcomes) to help clarify what the impact on the firm will be. Proxy variables can be used to measure changes in terms of their perceived value to the organization.

Benefit:

New system saves at least one hour per day for 12 mid-level managers.

Quantified as:

Manager's salary (per hour)	$30.00
Number of managers affected	12
Daily savings (one hour saved × 12 managers)	$360.00
Weekly savings (daily savings × 5)	$1,800.00
Annual savings (weekly savings × 50)	$90,000.00

FIGURE 9.8

Converting time savings into dollar figures.

ETHICAL DILEMMA

Ethical App Development

In the past, systems development was in the hands of large software companies, with large development teams and legal departments that would scrutinize new functionalities for legal and ethical compliance. With the advent of the smartphone and social media came the promise of getting rich quick by developing the next Facebook, WhatsApp, Pinterest, or some other killer app. Nowadays, it's not only large companies building those apps but individuals with a creative idea aided by easy-to-use development tools.

However, with the hope of developing the next killer app, ethical implications are often overlooked or outright ignored, as evidenced by uKnow, the Arlington, Virginia, provider of the world's first "Parental Intelligence System." While uKnow was designed to help parents track their children, lack of proper security resulted in the app leaking a huge database of nearly 7 million text messages, 2 million images (many depicting children), and 1,700 in-depth child profiles.

In addition to sloppy app development, mobile devices offer various tempting ways of collecting user data, with many apps requesting access to functionalities such as your phone book, location, camera, microphone, and so on. Given these vulnerabilities, a new code of conduct for app development is needed. Just because you can collect certain types of data, should you? Many argue that an app should only be allowed to collect and utilize data it needs to provide its functionality, nothing more. Developers should also carefully consider the consequences of personal data being compromised. Who would be affected, and how serious might the consequences be? Given the high value of your personal data, the maxim of the app development industry should be: "Even though you can, don't collect data unless absolutely necessary!"

Questions

1. Mobile phones provide the possibility to collect various data about the user. Assume that you are developing a new weather app and are considering collecting user data that you don't need right away but may need in the future to build a different app. Is this practice ethical? What types of data would you be comfortable collecting? Which would you not consider collecting? Why?
2. You know that your competitors' apps are collecting much more data than you do, potentially giving them an advantage today or at least some time in the future. Should you follow their lead and collect more data about your customers? Why or why not?

Based on:

Allamsetty, T. (2013, March 19). User privacy and the ethics of app data collection. *[X]Cubelabs*. Retrieved March 13, 2016, from http://www.xcubelabs.com/blog/user-privacy-and-the-ethics-of-app-data-collection

Fox-Brewster, T. (2016, February 22). Child track app "leaks 6.8 million texts, 1.8 million photos" from kids' phones. *Forbes*. Retrieved March 13, 2016, from http://www.forbes.com/sites/thomasbrewster/2016/02/22/kids-texts-and-photos-leaked-by-uknow

Green, C. (2015, October 16). Where does the responsibility for "ethical" apps lie? *Information Age*. Retrieved March 13, 2016, from http://www.information-age.com/technology/applications-and-development/123460349/where-does-responsibility-ethical-apps-lie

Kotorov, R. (2015, June 12). Why ethics matters when building an app. *Business 2 Community*. Retrieved March 13, 2016, from http://www.business2community.com/mobile-apps/ethics-matters-building-app-01248104

For example, if mundane administrative tasks are seen as low-value activities (perhaps a 1 on a 5-point scale) but direct contact with customers is seen as a high-value activity (a rating of 5), you can use these perceptions to indicate how new systems will add value to the organization. In this example, you can show that a new system will allow personnel to have more contact with customers while at the same time reducing the administrative workload. Senior managers can quickly see that individual workload is being shifted from low-value to high-value activities.

You can communicate these differences using percentages, increases or decreases, and so on—whatever best conveys the idea that the new system is creating changes in work, in performance, and in the way people think about their work. This gives decision makers some relatively solid data on which to base their decision.

MEASURE WHAT IS IMPORTANT TO MANAGEMENT. One of the most important things you can do to show the benefits of a system is one of the simplest: Measure what senior managers think is important. You may think this is trivial advice, but you would be surprised how often people calculate impressive-looking statistics in terms of downtime, reliability, and so on, only to find that senior managers disregard or only briefly skim over those figures. You should concentrate on the issues senior business managers care about. The "hot-button" issues with senior managers should be easy to discover, and they are not always financial reports. Hot issues with senior managers could include cycle time (how long it takes to process an order), regulatory or compliance issues, customer feedback, and employee morale. By focusing on what senior business managers believe to be important, you can make the business case for systems in a way that is more meaningful for those managers, which makes selling systems to decision makers much easier. Managers are more likely to buy in to the importance of systems if they can see the impact on areas that are important to them. Now that you understand how to make the business case for new information systems, we next examine the development process.

The Systems Development Process

No matter if a software company such as Microsoft is planning to build a new version of its popular Office software suite or if a company such as Netflix is trying to build a system to improve its movie recommendations, companies follow a standardized approach. This process of designing, building, and maintaining information systems is often referred to as **systems analysis and design**. Likewise, the individual who performs this task is referred to as a **systems analyst**. Because few organizations can survive without effectively utilizing information and computing technology, the demand for skilled systems analysts is very strong. In 2016, *U.S. News* named being a systems analyst one of the top jobs; in fact, it was ranked as number 3. Organizations want to hire systems analysts because they possess a unique blend of managerial and technical expertise—systems analysts are not just "techies." Systems analysts remain in demand precisely because of their unique blend of abilities.

Custom Versus Off-the-Shelf Software

When deciding to deploy new systems to support their operations in order to gain or sustain a competitive advantage, organizations can typically choose between custom and off-the-shelf software. For example, many types of application software (such as word processors, spreadsheet, or accounting software) can be used by a variety of businesses within and across industries. These types of general-purpose systems are typically purchased off the shelf. Often, however, organizations have very specific needs that cannot be met by generic technologies. This is especially true for companies trying to capitalize on a first-mover advantage and therefore unable to purchase a preexisting system to meet their specific needs. For example, pioneers in online retailing (such as Amazon.com) or budget air travel (such as Southwest Airlines) needed entirely new systems and technologies to support their revolutionary business models and had to develop (or have someone else develop) custom solutions. Likewise, mobile apps often need to be developed from scratch. The approaches to developing or acquiring custom and off-the-shelf software are quite different, but they also have many similarities. Before going into the details of developing or acquiring such systems, we'll first contrast these two types of systems.

CUSTOM SOFTWARE. Custom software is developed to meet the specifications of an organization (it is thus also sometimes called *tailor-made* or *bespoke software*). Such software may be developed (or configured) in-house by the company's own IS staff, or the development may be contracted, or outsourced, to a specialized vendor charged with developing the system to the company's contractual specifications. Custom software has two primary advantages over general purpose commercial technologies:

1. ***Customizability.*** The software can be tailored to meet unique organizational requirements. Such requirements, for example, can reflect a desire to achieve a competitive advantage through a specific type of system (e.g., Amazon.com's one-click ordering); to better fit business operations, characteristics of the organizational culture, or proprietary security requirements; or to better interface with existing systems. Further, company- or industry-specific terms or acronyms can be included in a new software application, as can unique types of required reports. Such specificity is not typically possible in off-the-shelf systems that are targeted at a more general audience.
2. ***Problem Specificity.*** The company pays only for the features specifically required for its users. In contrast to software packages such as Microsoft Office, which include a wide range of individual programs (some of which may never be used), only those components that are really needed can be implemented.

Today, building a complete system from scratch is quite rare; most information systems that are developed within an organization for its internal use typically include a large number of preprogrammed, reusable modules that are purchased from development organizations or consultants.

TABLE 9.3 Examples of Off-the-Shelf Application Software

Category	Application	Description	Examples
Business information systems	Payroll	Automation of payroll services, from the optical reading of time sheets to generating paychecks	ZPAY Intuit Payroll
	Inventory	Automation of inventory tracking, order processing, billing, and shipping	Intuit QuickBooks NetSuite
Office automation	Personal productivity	Support for a wide range of tasks from word processing to graphics to e-mail	OpenOffice Corel Office Microsoft Office

OFF-THE-SHELF SOFTWARE. Although custom software has advantages, it is not automatically the best choice for an organization. Off-the-shelf software (or packaged software) is typically used to support common business processes that do not require any specific tailoring. In general, off-the-shelf systems, whether hardware or software, are less costly, faster to procure, of higher quality, and less risky than custom systems. Table 9.3 summarizes examples of off-the-shelf application software.

Traditionally, the most common option for packaged software was so-called commercial off-the-shelf (COTS) software; this type of software is typically developed by software companies that spread the development costs over a large number of customers. An alternative to commercial off-the-shelf software is open source software.

Open Source Software

Open source is a philosophy that promotes developers' and users' access to the source of a product or idea. Particularly in the area of software development, the open source movement has taken off with the advent of the Internet; people around the world are contributing their time and expertise to develop or improve software, ranging from operating systems to application software. As the programs' source code is freely available for use and/or modification, this software is referred to as **open source software**. Open source software owes its success to the inputs from a large user base, helping to fix problems or improve the software. One of the great success stories of open source software is the Android operating system. In early 2016, Android's share of the global smartphone shipment market—led by Samsung products—was near 80 percent! Android is based on another open source operating system called Linux, developed as a hobby by the Finnish university student Linus Torvalds in 1991. Linux has since become the operating system of choice for web servers, embedded systems (such as set-top boxes and network routers), and supercomputers alike (as of June 2016, 99.4 percent of the world's 500 fastest supercomputers ran Linux operating systems [Top 500, 2016]). In addition to the Linux operating system, other open source software has been gaining increasing popularity because of its stability and low cost. For example, in early 2016, 33.6 percent of all websites were powered by the Apache web server, another open source project (Netcraft, 2016).

Open source projects have also become indispensable for Big Data initiatives ranging from storing and managing vast amounts of unstructured data to analyzing these data. Not only do open source applications provide the tools to deal with Big Data, the openness of the source code also helps instill confidence as to where the results come from. Today, many Big Data startups, but also established companies from Adobe to Yahoo!, use Hadoop, a framework for distributed processing of large-scale data sets. For example, recently, the oil company Chevron turned to the open source project Hadoop for storing and managing huge amounts of seismic data needed to locate oil or gas deposits on the ocean floor. Other popular examples of open source application software include the Firefox web browser and the office productivity suite Apache OpenOffice.

How do large open source projects such as Firefox work? Typically, contributors *suggest* modifications for changes; for example, they contribute to program code or provide new designs for the system's user interface; a small group of carefully selected "committers" can then test and implement these modifications into the official releases of the software so as to ensure the quality and stability of the software.

While there are many benefits to open source software, vendors of proprietary software are still highlighting "hidden" costs of running open source software, such as obtaining reliable customer support. On the other hand, however, commercial open source vendors are providing customer support, installation, training, and so on, to their paying customers. Men's Wearhouse, the State of Oregon, and many other large organizations are using a CRM system offered by SugarCRM, Inc., a commercial open source vendor that offers free "community editions" as well as other, more feature-rich paid editions of its software. Similarly, the popular MySQL database, which is used by Facebook, GitHub, Verizon Wireless, and many other companies, is provided under an open source license for personal use, but the company employs its own developers and offers commercial licenses (including dedicated 24/7 technical support, consulting, and indemnification clauses) to business users. Further, many open source projects are now backed by major information technology (IT) companies such as IBM, which give money and human resources to Linux projects, or Oracle, which donated the source code of the OpenOffice productivity suite to the Apache Software Foundation.

Systems Integration: Combining Custom, Open Source, and Off-the-Shelf Systems

The process of linking together different computing systems and software applications physically or functionally to act as a coordinated whole is referred to as **systems integration** (see Chapter 1, "Managing in the Digital World"). Organizations can perform this integration themselves or hire experts who are well versed in weaving together various technologies into an integrated solution. Systems integration is an important skill because it allows an organization to bring together cheaper, preconfigured components and off-the-shelf software to meet business needs rather than having to pursue the more expensive approach of building a customized system from scratch.

Through systems integration, it is possible to combine the unique advantages of custom, open source, and commercial off-the-shelf systems into an integrated solution. For example, an online retailer may want to purchase an off-the-shelf inventory management system and then add tailor-made modules it needs to conduct its day-to-day business. This system could be based on the open source database MySQL; further, the online retailer could use the open source Apache web server to power its online shopping site. In some cases, for example, with large ERP systems, companies selling off-the-shelf software make customized changes for a fee. Other vendors, however, may not allow their software to be modified (as is the case with generic, all-purpose software, such as Microsoft Office).

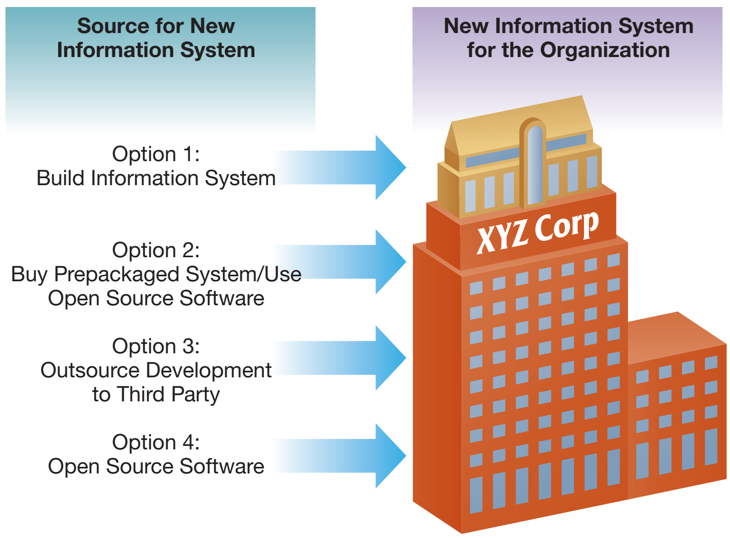
Commercial off-the-shelf systems are almost always acquired from an external vendor, whereas custom systems can be either developed in-house or developed by an outside vendor (Figure 9.9). Regardless of the source of the new system—custom, open source, or off-the-shelf—the primary role of managers and users in the organization is to make sure that it will meet the organization's business needs. This may be especially important in the case of end users developing systems. End users typically do not program elaborate systems but frequently use spreadsheet or database software to create solutions for accomplishing narrow, well-defined tasks; while such applications may be useful for accomplishing certain tasks, end user development may cause problems related to the adherence to standards, lack of documentation, security concerns, or a lack of continuity if the employee who built the spreadsheet or database leaves the organization.

IS Development in Action

The tools and techniques used to develop information systems are continually evolving with the rapid changes in IS hardware and software. As you will see, IS development is a fairly disciplined and structured process that moves from step to step. Systems analysts become adept at decomposing large, complex problems into many small, simple problems. The goal of the systems analyst is to design the final system by piecing together many small software modules and

FIGURE 9.9

There are a variety of sources for information systems.



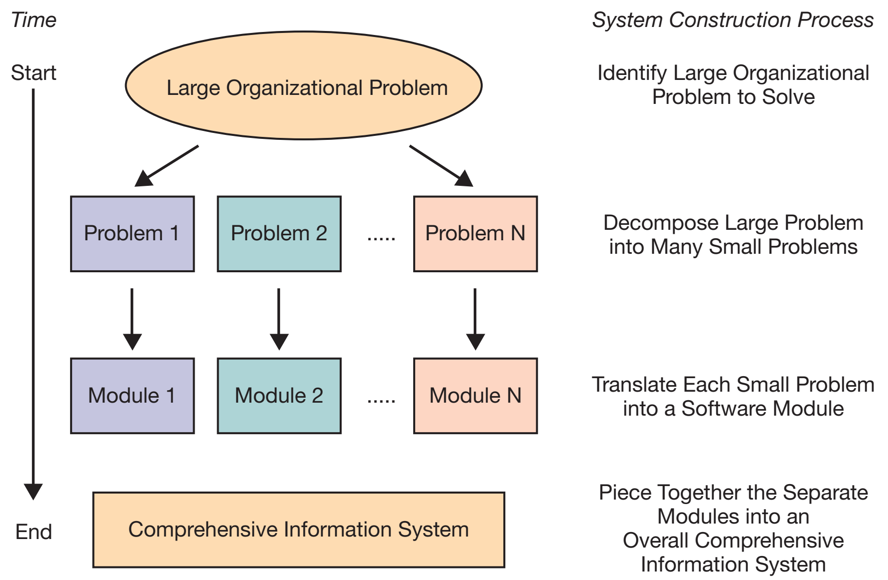
technologies into one comprehensive system (Figure 9.10). For example, think about using LEGO™ blocks for building a model of a space station. Each individual block is a small, simple piece that is nothing without the others. When put together, the blocks can create a large and very complex design (Google co-founder Larry Page had gained some notoriety for building a working printer out of LEGO™ bricks). When systems are built in this manner, they are much easier to design, build, and, most important, maintain.

Although many people in organizations, such as managers and users, are responsible and participate in a systems development project, the systems analyst has primary responsibility. Some projects may have one or several systems analysts working together, depending on the size and complexity of the project. The primary role of the systems analyst is to study the problems and needs of an organization in order to determine how people, methods, and information technology can best be combined to bring about improvements in the organization. A systems analyst helps systems users and other business managers define their requirements for new or enhanced information systems.

A systems analyst typically also *manages* the development project. As the **project manager**, the systems analyst needs a diverse set of management, leadership, technical, conflict management, and customer relationships skills. The project manager is the person most responsible for ensuring that a project is a success. The project manager must deal with continual change and problem solving. Successful projects require effective resource and task

FIGURE 9.10

Problem decomposition makes solving large, complex problems easier.



management as well as effective communication as the project moves through its various steps. Project management is an important aspect of the system development or acquisition process and a critical skill for successful systems analysts. The focus of project management is to ensure that projects meet customer expectations and are delivered within budget and time constraints. Clearly, a systems analyst is an agent of change and innovation in modern organizations.

The Role of Users in the Systems Development Process

Many organizations have a huge investment in transaction processing and management information systems. These systems are most often designed, constructed, and maintained by systems analysts within the organization using a variety of methods. When building and maintaining information systems, systems analysts rely on information provided by system users, who are involved in all phases of the system's development process. To effectively participate in the process, it is important for all members of the organization to understand what is meant by systems development and what activities occur. A close, mutually respectful working relationship between analysts and users is key to project success.

Systems Development Controls

In any systems development or acquisition process, it is key to ensure that all systems (including hardware and software) are properly developed, acquired, and maintained. Following a structured systems development process helps to minimize threats arising from software bugs, security holes, or other issues. A **software bug** is an error or flaw in a computer program or system that causes it to produce an incorrect or unexpected result or to behave in unintended ways. In general, **systems development controls** should ensure that the necessary security features are implemented and enabled and that proper change management processes are followed. When acquiring systems from outside vendors, organizations face risks not only from software bugs but also from backdoors (such as default administrator passwords) that may exist in the system. Thus, organizations should exercise due diligence to ensure that the software is trustworthy, for example, by reviewing the software's source code (if possible) and by performing background checks on the vendor's history and trustworthiness. In all cases, these processes should be properly documented to establish an audit trail that allows tracing back who reviewed, authorized, implemented, or tested the systems.

Steps in the Systems Development Process

Just as the products that a firm produces and sells follow a life cycle, so do organizational information systems. For example, a new type of tennis shoe follows a life cycle of being designed, introduced to the market, being accepted into the market, maturing, declining in popularity, and ultimately being retired. The term **systems development life cycle (SDLC)** describes the life of an information system from conception to retirement (Valacich & George, 2017). The SDLC has four primary phases:

1. Systems planning and selection
2. Systems analysis
3. Systems design
4. Systems implementation and operation

Figure 9.11 is a graphical representation of the SDLC containing four boxes connected by arrows. Within the SDLC, arrows flow from systems planning and selection, to systems analysis, to systems design, and, finally, to systems implementation and operation. Once a system is in operation, it moves into an ongoing maintenance phase that parallels the initial development process. For example, when new features are added to an existing system, analysts must first plan and select which new features to add, then analyze the possible impact of adding these features to the existing system, then design how the new features will work, and, finally, implement these new features into the existing system. While some consider maintenance another SDLC phase, it is really a repeated application of the core SDLC phases. In this way, the SDLC becomes an ongoing *cycle*. During ongoing systems maintenance, the entire SDLC is followed to implement system repairs and enhancements.

WHO'S GOING MOBILE

Creating Mobile Apps

With the rapid rise of smartphone usage, various useful and entertaining apps are rapidly being developed, greatly enhancing the phones' capabilities. In July 2015, both Google and Apple announced that they had more than 1.5 million apps in their app stores, with many more apps appearing every day. The primary reason there are so many apps is that anyone can build and try to sell apps, from software companies focused on translating their existing products (such as Adobe Reader) onto mobile platforms to individuals who have a clever idea for a game.

Owing to the intense competition between these apps, it is not surprising that only relatively few are highly successful. However, if you have the right idea, creating a winning app can be surprisingly easy. In fact, it is estimated that it took the maker of the widely successful game Flappy Bird a mere two to three days to create that game (alone, that is). At its peak, the game netted US$50,000 *per day* for the person who built the game. Given that games for popular consoles such as the PlayStation or the Xbox cost millions of dollars to develop, how did Flappy Bird's creator manage to pull that off?

In the past few years, a number of marketplaces have sprung up where anyone can purchase game templates for as low as US$49. These templates typically include certain game mechanics, which the buyer can modify to create a functioning game. Typically, there's not even a need to write a single line of code; all that is needed is a winning idea; coming up with a good story, game title, and key words; and the skills needed to create the graphics.

What if your idea is for an app other than a game, such as a productivity tool for students or a better way to keep track of your passwords? There are tools to help develop these as well. Once the app is created, all that is needed is uploading the app to the various marketplaces and watching the download count. Good luck!

Based on:

Anonymous. (2016). AppMachine. Retrieved March 13, 2016, from www.appmachine.com

Rigney, R. (2014, March 5). How to make a No. 1 app with $99 and three hours of work. *Wired*. Retrieved March 13, 2016, from http://www.wired.com/2014/03/flappy-bird-clones

Rubens, P. (February 18, 2014). Flap happy: How you too can become a mobile games mogul. *BBC*. Retrieved March 13, 2016, from http://www.bbc.com/news/business-26224428

Phase 1: Systems Planning and Selection

The first phase of the SDLC is **systems planning and selection** (see Figure 9.11). Understanding that it can work on only a limited number of projects at a given time because of limited resources, an organization must take care that only those projects that are critical to enabling the organization's mission, goals, and objectives are undertaken. Consequently, the goal of systems planning and selection is simply to identify, plan, and select a development project from all possible projects that could be performed. Organizations differ in how they identify, plan, and select projects. Some organizations have a formal **information systems planning** process whereby a senior manager, a business group, an IS manager, or a steering committee identifies and assesses all possible systems development projects that the organization could undertake. Project managers present the business case for the new system, and it is accepted or rejected. Others follow a more ad hoc process for identifying potential projects. Nonetheless, after all possible projects

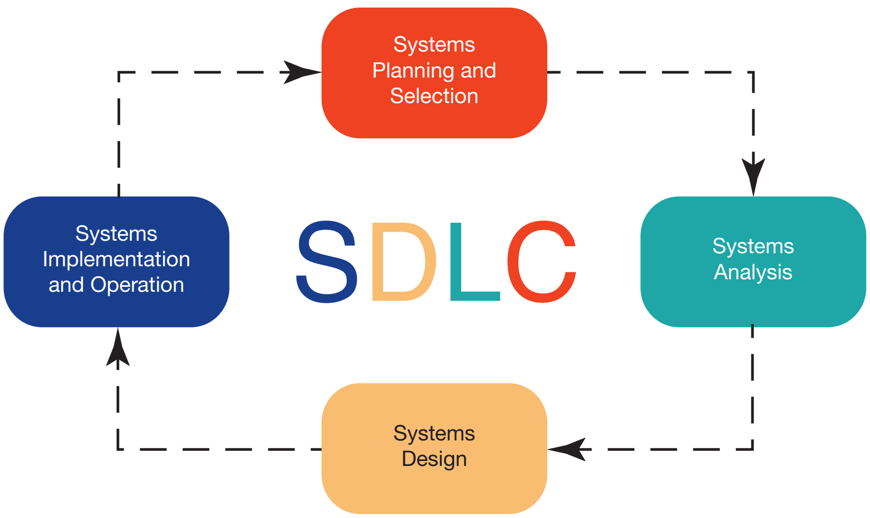


FIGURE 9.11

The SDLC defines the typical process for building systems.

are identified, those deemed most likely to yield significant organizational benefits, given available resources, are selected for subsequent development activities.

Just as there are often differences in the source of systems projects within organizations, there are often different evaluation criteria used within organizations when classifying and ranking potential projects, such as strategic alignment, costs and benefits, resource availability, project size and duration, or technical difficulties and risks. During project planning, the analyst works with the customers—the potential users of the system and their managers—to collect a broad range of information to gain an understanding of the project size, potential benefits and costs, and other relevant factors. After collecting and analyzing this information, the analyst builds the business case that can be reviewed and compared with other possible projects. If the organization accepts the project, systems analysis begins.

Phase 2: Systems Analysis

The second phase of the SDLC is called **systems analysis** (see Figure 9.11). One purpose of the systems analysis phase is for designers to gain a thorough understanding of an organization's current way of doing things in the area for which the new information system will be constructed. The process of conducting an analysis requires that many tasks, or subphases, be performed. The first subphase focuses on determining system requirements. To determine the requirements, an analyst works closely with users to determine what is needed from the proposed system. After collecting the requirements, analysts organize this information using data, process, and logic modeling tools.

COLLECTING REQUIREMENTS. The collection and structuring of requirements is arguably the most important activity in the systems development process because how well the IS requirements are defined influences all subsequent activities. The old saying "garbage in, garbage out" very much applies to the systems development process. **Requirements collection** is the process of gathering and organizing information from users, managers, customers, business processes, and documents to understand how a proposed information system should function. Systems analysts use a variety of techniques for collecting system requirements, including the following (Valacich & George, 2017):

- ***Interviews.*** Analysts interview people informed about the operation and issues of the current or proposed system.
- ***Questionnaires.*** Analysts design and administer surveys to gather opinions from people informed about the operation and issues of the current or proposed system.
- ***Observations.*** Analysts observe system users at selected times to see how data are handled and what information people need to do their jobs.
- ***Document Analysis.*** Analysts study business documents to discover issues, policies, and rules as well as concrete examples of the use of data and information in the organization.
- ***Joint Application Design.*** **Joint application design (JAD)** is a group meeting–based process for requirements collection (Figure 9.12). During this meeting, the users *jointly* define and agree on system requirements or designs. This process can result in dramatic reductions in the length of time needed to collect requirements or specify designs.

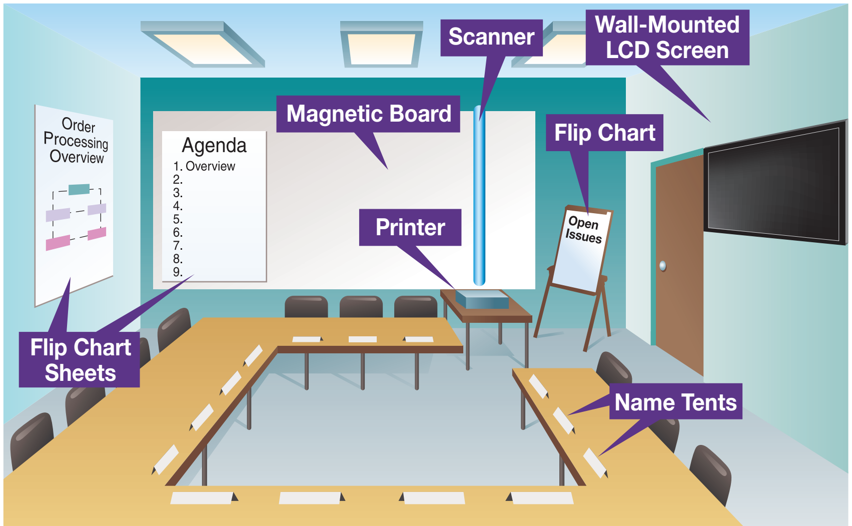


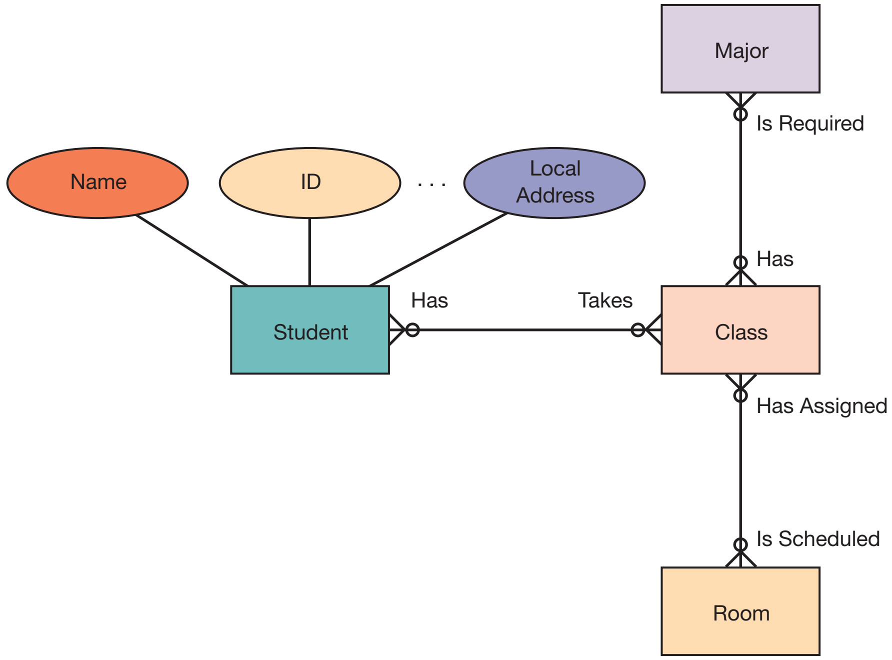
FIGURE 9.12

A JAD room.

Source: Based on *Joint Application Design: How to Design Quality Systems in 40% Less Time* by Jane Wood and Denise Silver. Published by John Wiley & Sons, Inc.

FIGURE 9.13

A sample entity-relationship diagram for students.



MODELING DATA. In organizations, data are used to describe people, objects, or events. A lot of different data can be used to describe a person: name, age, gender, race, and occupation, among others. To construct an information system, systems analysts must understand what data the information system needs in order to accomplish the intended tasks. To do this, they use data modeling tools to collect and describe the data to users to confirm that all needed data are known and presented to users as useful information. Figure 9.13 shows an *entity-relationship diagram,* a type of data model describing students, classes, majors, and classrooms at a university. Each box in the diagram is referred to as a data entity, and each entity is related to other entities. Data modeling tools enable the systems analyst to represent data in a form that is easy for users to understand and critique. For more information on databases and data modeling, see the Technology Briefing.

MODELING PROCESSES AND LOGIC. The next step in this phase is to model how data are being input, processed, and presented to the users. As the name implies, **data flows** represent the movement of data through an organization or within an information system. For example, your registration for a class may be captured in a registration form on paper or in an interactive form on the web. After it is filled out, this form probably flows through several processes to validate and record the class registration, shown as "Data Flows" in Figure 9.14. After all students have been registered, a repository of all registration information can be processed for developing class rosters or for generating student billing information, which is shown as "Data" in Figure 9.14. **Processing logic** represents the way in which data are transformed. Processing logic is often expressed in **pseudocode**, which is a representation of the program's internal functioning, independent of the actual programming language being used. As there are no standards for pseudocode, the level of detail can vary. For example, pseudocode to calculate students' grade-point averages at the conclusion of a term is shown in the "Processing Logic" section in Figure 9.14.

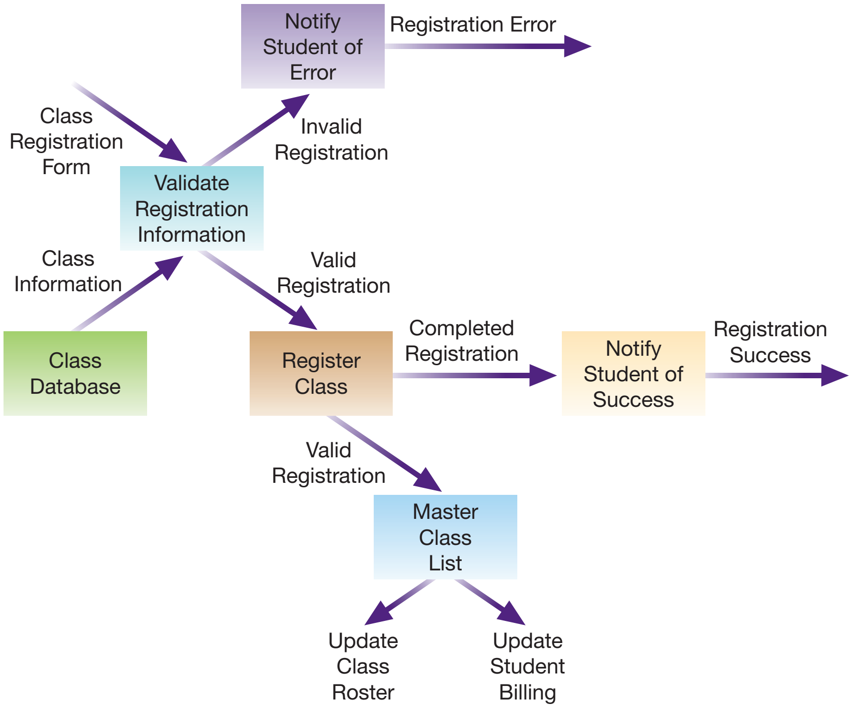
After the data, data flow, and processing logic requirements for the proposed system have been identified, analysts develop one or many possible overall approaches—sometimes called designs—for the information system. For example, one approach for the system may possess only basic functionality but has the advantage of being relatively easy and inexpensive to build. An analyst might also propose a more elaborate approach for the system, but it may be more difficult and costlier to build. Analysts evaluate alternative system design approaches with the knowledge that different solutions yield different benefits and different costs. After a system design approach is selected, details of that particular approach can be defined.

Requirements

Data

Name	Class	GPA
Patty Nicholls	Senior	3.7
Brett Williams	Grad	2.9
Mary Shide	Fresh	3.2

Data Flows



Processing Logic

```
i = read (number_of_classes)
total_hours = 0
total_grade = 0
total_gpa = 0
for j = 1 to i do
        begin
                read (course [ j ], hours [ j ], grade [ j ])
                total_hours = total_hours + hours [ j ]
                total_grade = total_grade + (hours [ j ] * grade [ j ])
        end
current_gpa = total_grade/total hours
```

FIGURE 9.14

Four key elements to the development of a system: requirements, data, data flows, and processing logic.

Phase 3: Systems Design

The third phase of the SDLC is **systems design** (see Figure 9.11). As its name implies, it is during this phase that the proposed system is designed; that is, the details of the chosen approach are elaborated. As with analysis, many different activities must occur during systems design. The elements that must be designed when building an information system include the following:

- Processing and logic
- Databases and files
- Human–computer interface

DESIGNING PROCESSING AND LOGIC. The processing and logic operations of an information system are the steps and procedures that transform raw data inputs into new or modified information. There are typically different ways to complete each process, with some being more efficient or effective than others. Modeling the processes thus includes specifying not only what is to be done but also the specific algorithms, which outline the steps, or set of rules, to be followed (that is, how a certain process is accomplished). For example, when calculating your grade-point average, your school needs to perform the following steps:

1. Obtain the prior grade-point average, credit hours earned, and list of prior courses
2. Obtain the list of each current course, final grade, and course credit hours
3. Combine the prior and current credit hours into aggregate sums
4. Calculate the new grade-point average

The logic and steps needed to make this calculation can be represented in many ways, including structure charts, decision trees, pseudocode, programming code, and so on (see Figure 9.14). Regardless of how the logic is represented, the process of converting pseudocode, structure charts, or decision trees into actual program code during system implementation is a relatively straightforward process.

DESIGNING DATABASES AND FILES. To design databases and files, a systems analyst must have a thorough understanding of an organization's data and informational needs. For example, Figure 9.15 shows the database design to keep track of student information in a Microsoft Access database. The database design is more complete (shows each attribute of the student) and more detailed (shows how the information is formatted) than a conceptual data model built during systems analysis (as was shown in Figure 9.14).

DESIGNING THE HUMAN–COMPUTER INTERFACE. Just as people have different ways of interacting with other people, information systems can have different ways of interacting with people. A **human–computer interface (HCI)** is the point of contact between a system and users. With people being used to interacting with easy-to-use systems and websites like Facebook, Twitter,

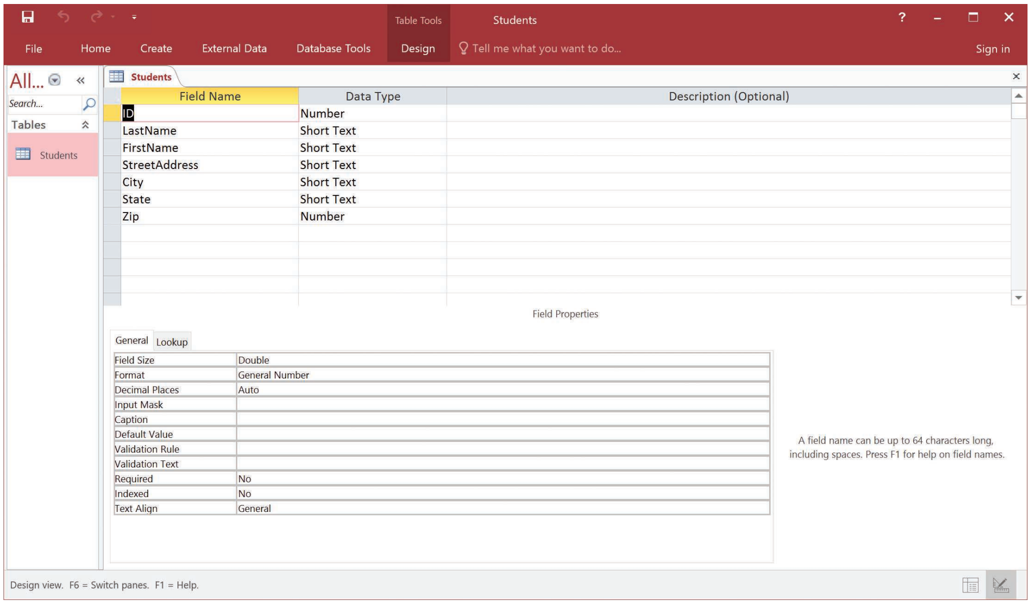


FIGURE 9.15

The database design for student information from an Access database.

Source: Access 2016, Windows 10, Microsoft Corporation.

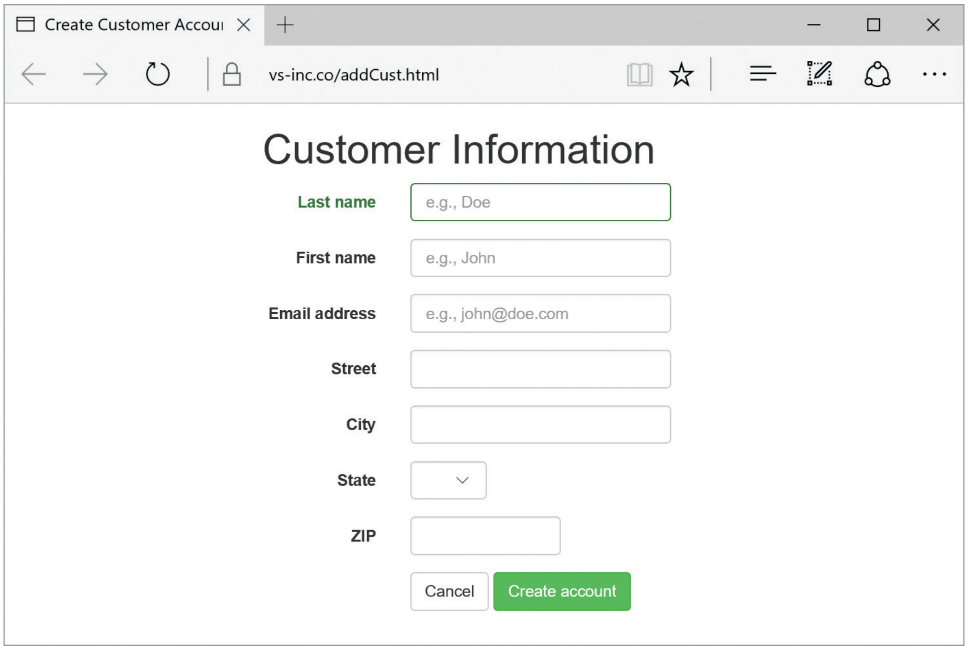


FIGURE 9.16

A data entry form.

and Amazon.com, their expectations in terms of ease of use are ever increasing. In addition, increasing a system's **usability**—that is, whether the system is easy to use and aesthetically pleasing—can lower error rates, increase efficiency, or increase customer satisfaction (in the case of customer-facing systems). Thus, analysts also take great care in designing data entry forms and management reports. A form is a business document containing some predefined data, often including some areas where additional data can be filled in (Figure 9.16). Similarly, a report is a business document containing only predefined data for online viewing or printing (Figure 9.17). For more on forms and reports, see Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics."

Phase 4: Systems Implementation and Operation

Many separate activities occur during **systems implementation**, the fourth phase of the SDLC (see Figure 9.11). One group of activities focuses on transforming the system design into a working information system. These activities include software programming and testing. A second group of activities focuses on preparing the organization for using the new information system. These activities include system conversion, documentation, user training, and support. This section briefly describes what occurs during systems implementation.

SOFTWARE PROGRAMMING AND TESTING. Programming is the process of transforming the system design into a working computer system. During this transformation, both programming and

Ascend Systems Incorporated
SALESPERSON ANNUAL SUMMARY REPORT 2018

			QUARTERLY ACTUAL SALES			
REGION	SALESPERSON	SSN	FIRST	SECOND	THIRD	FOURTH
Northwest and Mountain						
	Wachter	999-99-0001	16,500	18,600	24,300	18,000
	Mennecke	999-99-0002	22,000	15,500	17,300	19,800
	Wheeler	999-99-0003	19,000	12,500	22,000	28,000
Midwest and Mid-Atlantic						
	Spurrier	999-99-0004	14,000	16,000	19,000	21,000
	Powell	999-99-0005	7,500	16,600	10,000	8,000
	Topi	999-99-0006	12,000	19,800	17,000	19,000
New England						
	Speier	999-99-0007	18,000	18,000	20,000	27,000
	Wright	999-99-0008	28,000	29,000	19,000	31,000

FIGURE 9.17

A sales summary report.

TABLE 9.4 General Testing Types, Their Focus, and Who Performs Them

Testing Type	Focus	Performed by
Developmental	Testing the correctness of individual modules and the integration of multiple modules	Programmer
Alpha	Testing of overall system to see whether it meets design requirements	Software tester
Beta	Testing of the capabilities of the system in the user environment with actual data	Actual system users

testing should occur in parallel. As you might expect, a broad range of tests is conducted before a system is complete, including **developmental testing**, **alpha testing**, and **beta testing** (Table 9.4).

SYSTEM CONVERSION, DOCUMENTATION, TRAINING, AND SUPPORT. **System conversion** is the process of decommissioning the current way of doing things (automated or manual) and installing the new system in the organization. Effective conversion of a system requires not only that the new software be installed but also that users be effectively trained and supported. System conversion can be performed in at least four ways, as shown in Figure 9.18.

Many types of documentation must be produced for an information system. Programmers develop system documentation that details the inner workings of the system to ease future maintenance and to ensure reliability of the system. A second type of documentation is user-related documentation, which is typically written not by programmers or analysts but by users or professional technical writers. The range of documents can include the following:

- User and reference guides
- User training manuals and tutorials
- Installation procedures and troubleshooting suggestions

In addition to documentation, users may also need training and ongoing support to use a new system effectively. Different types of training and support require different levels of investment by the organization. Self-paced training and tutorials are the least expensive options, and one-on-one training is the most expensive. Table 9.5 summarizes various user training options.

Besides training, providing ongoing education and problem-solving assistance for users may also be necessary. This is commonly referred to as system support, which is often provided by a special group of people in the organization who make up an information center or help desk. Support personnel must have strong communication skills and be good problem solvers in addition to being expert users of the system. An alternative option for a system not developed internally is to outsource support activities to a vendor specializing in technical system support

FIGURE 9.18

Software conversion strategies.

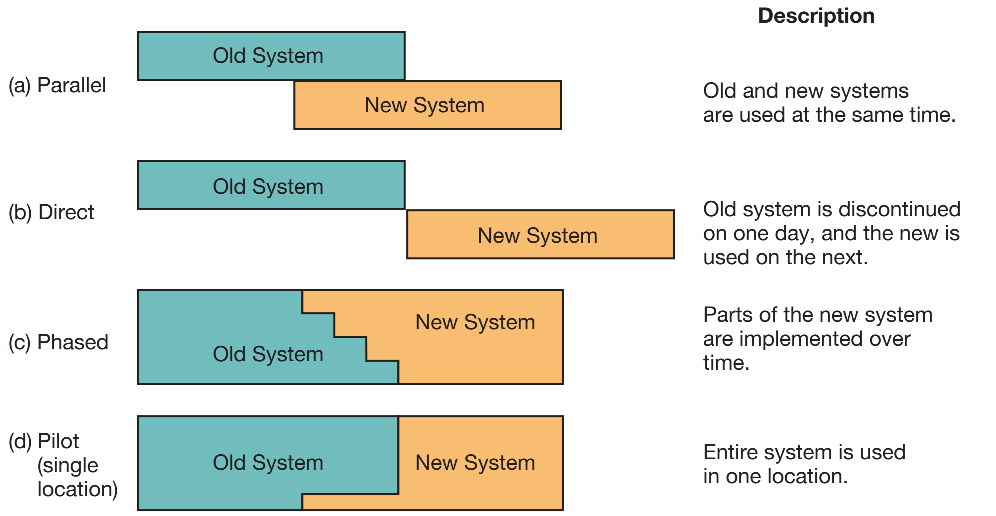


TABLE 9.5 User Training Options

Training Option	Description
Tutorial	One person taught at a time
Course	Several people taught at a time
Computer-aided instruction	One person taught at a time by the computer system
Interactive training manuals	Combination of tutorials and computer-aided instruction
Resident expert	Expert on call to assist users as needed
Software help components	Built-in system components designed to train users and troubleshoot problems
External sources	Vendors and training providers offering tutorials, courses, and other training activities

and training. Regardless of how support is provided, it is an ongoing issue that must be managed effectively for the company to realize the maximum benefits of a system.

Repeating the SDLC: Systems Maintenance

After an information system is installed, it is essentially in the **systems maintenance** phase. A system does not wear out in the physical manner that cars, buildings, or other physical objects do, but it must still be systematically repaired and/or improved. The types of maintenance are summarized in Table 9.6.

During systems maintenance, it is typical that one person within the systems development group is responsible for collecting maintenance requests from system users. Periodically, these requests are analyzed to evaluate how a proposed change might alter the system and what business benefits might result from such a change, and are prioritized accordingly (Figure 9.19). As with **adaptive maintenance**, both **perfective maintenance** and **preventive maintenance** are typically a much lower priority than **corrective maintenance**, which deals with repairing flaws in the system. Corrective maintenance is most likely to occur after initial system installation as well as over the life of a system after major system changes. This means that adaptive, perfective, and preventive maintenance activities can lead to corrective maintenance activities if they are not carefully designed and implemented.

As with developing or acquiring new systems, any changes to an existing system need to be carefully managed. Unmanaged changes can have a variety of negative consequences, including system malfunction, system failure, increasing unreliability (as errors tend to build up over time, making the system more fragile), or opening the door for fraud or deliberate misuse (e.g., if a "backdoor" is introduced during changes to a system). If a change request is approved, the

TABLE 9.6 Types of Systems Maintenance

Maintenance Type	Description
Corrective maintenance	Making changes to an information system to repair flaws in the design, coding, or implementation
Adaptive maintenance	Making changes to an information system to evolve its functionality, to accommodate changing business needs, or to migrate it to a different operating environment
Preventive maintenance	Making changes to a system to reduce the chance of future system failure
Perfective maintenance	Making enhancements to improve processing performance or interface usability or adding desired but not necessarily required system features (in other words, "bells and whistles")

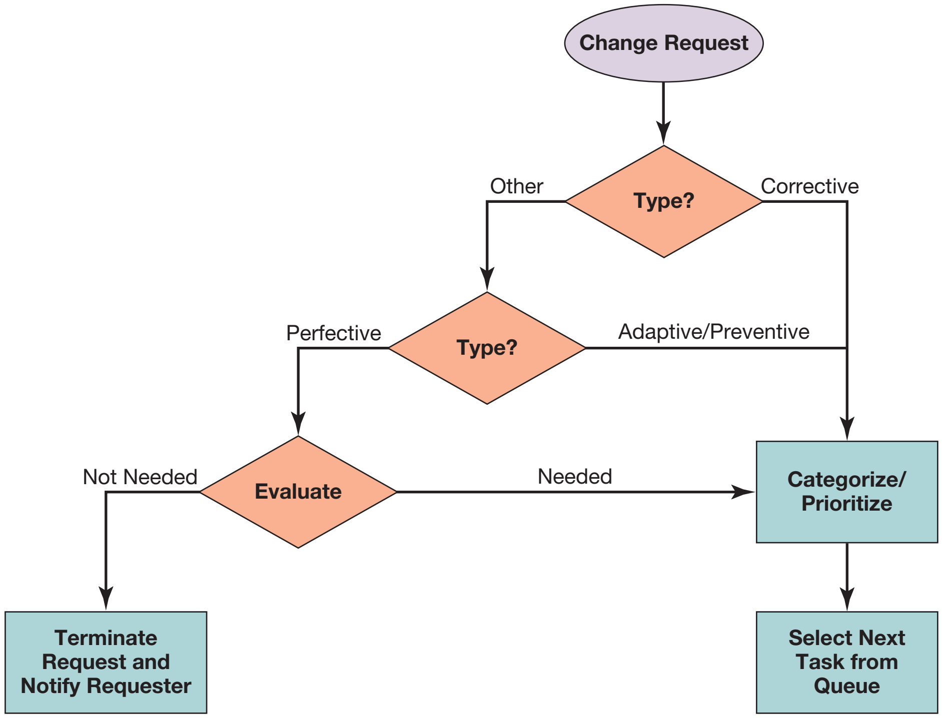


FIGURE 9.19

Change requests are prioritized based on business benefits.

system change is designed and then implemented. As with the initial development of the system, implemented changes need to be formally reviewed and tested before being installed into operational systems. Thus, **change request management** is a formal process that ensures that any proposed system changes are documented, reviewed for potential risks, appropriately authorized, prioritized, and carefully managed (to establish an audit trail that allows tracing back who reviewed, authorized, implemented, or tested the changes). In other words, the systems maintenance process parallels the process used for the initial development of the information system, as shown in Figure 9.20. Interestingly, it is often during system maintenance that the largest part of the system development effort occurs.

Today, vendors of commercial off-the-shelf software packages incorporate **patch management systems** to facilitate the different forms of systems maintenance for the user; patch

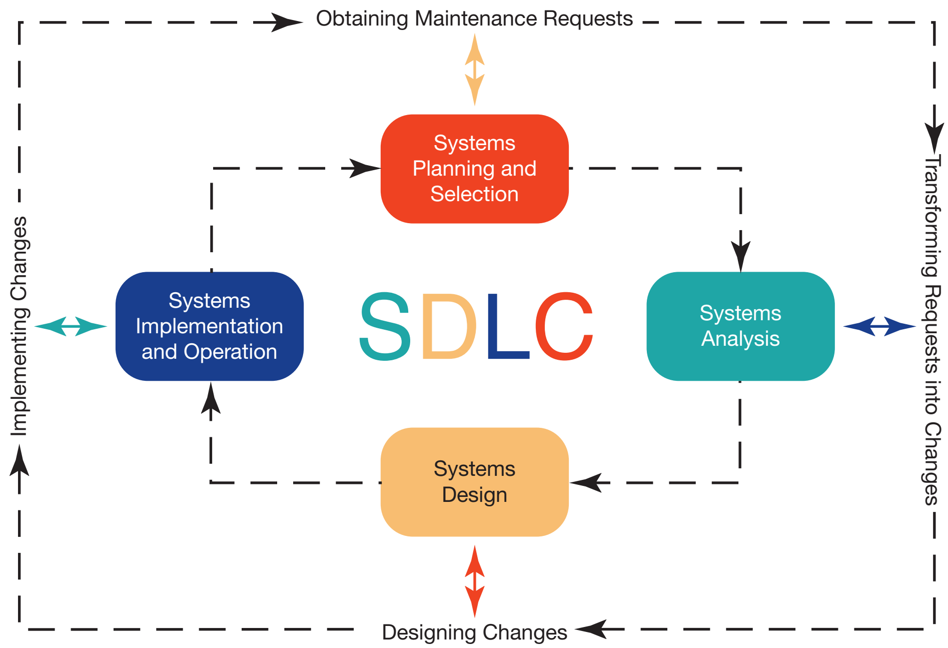


FIGURE 9.20

Mapping of system maintenance activities to the SDLC.

SECURITY MATTERS

Mobile Cybercrime

Whenever you look into your e-mail, you are likely to see malicious messages intended to trick you into giving away sensitive information—such as your bank account number or login credentials—or install malicious software on your computer (see Chapter 10). In many cases, sophisticated spam filters recognize the malicious intent, automatically route such messages into a spam folder, and disable hyperlinks to malicious websites, thus protecting the user. In other cases, there are telltale signs that signal something fishy: for example, phishing messages mimicking that of a bank may contain multiple spelling or grammatical errors, hyperlinks pointing to non-bank domains, or missing name or account numbers.

However, other types of malicious software may be more difficult to detect, especially with mobile devices now being ubiquitous. In particular, mobile users who install apps from untrusted sources (i.e., outside of trusted app stores that perform various security scans on listed apps) risk installing mobile malware. In 2016, security researchers at the Slovakian IT security company ESET discovered a type of mobile malware that was primarily targeted at Australian online banking users. The software was designed to trick users into giving away login credentials by presenting a fake login screen when the user opened the online banking application; the login credentials would then be sent to the criminals. What made this malware particularly dangerous was the fact that it was designed to circumvent two-factor authentication systems (where the user receives an SMS with a one-time code when accessing a legitimate banking app); the malware intercepted the SMS and automatically forwarded the one-time code to the criminals, potentially allowing them to access the victim's account.

In addition to targeting the apps of the largest banks in Australia, banking apps from New Zealand and Turkey were targeted as well. Further, the software could also provide fake login screens for other popular apps, including PayPal, Skype, eBay, and WhatsApp, thus putting potentially millions of users at risk. Thus, as a mobile user, you are not immune from security issues; one of the most basic ways to protect yourself is to install apps only from trusted sources.

Based on:

Taha, M. (2016, March 10). Android bank app users targeted in sophisticated cybercrime attack. *ABC Online*. Retrieved March 22, 2016, from http://www.abc.net.au/news/2016-03-10/cybercriminals-target-millions-of-bank-app-users/7237220

management systems use the Internet to check the software vendor's website for available patches and/or updates. If the software vendor offers a new patch, the application will download and install the patch in order to fix the software flaw. An example of a patch management system in wide use is the Windows Update Service, which automatically connects to a Microsoft web service to download critical operating system patches for corrective maintenance (e.g., to fix bugs in the Windows operating system) or preventive maintenance (e.g., to fix security holes that could be exploited by malicious hackers).

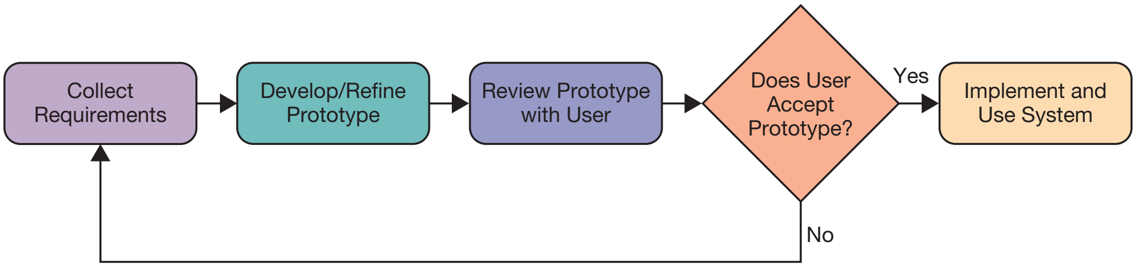
As you can see, there is more to systems maintenance than you might think. Lots of time, effort, and money are spent in this final phase of a system's development, and it is important to follow prescribed, structured steps. In fact, the approach to systems development described here—from the initial phase of identifying, selecting, and planning for systems to the final phase of systems maintenance—is a very structured and systematic process. Each phase is fairly well prescribed and requires active involvement by systems people, users, and managers.

Other Approaches to Designing and Building Systems

The SDLC is one approach to managing the development process, and it is a very good approach to follow when the requirements for the information system are highly structured and straightforward—for example, for a payroll or inventory system. Today, in addition to "standard" systems such as payroll and inventory systems, organizations need a broad variety of company-specific information systems, for which requirements either are very hard to specify in advance or are constantly changing. For example, an organization's website is likely to evolve over time to keep pace with changing business requirements. How many websites have you visited in which the content or layout seemed to change almost every week? For this type of system, the SDLC might work as a development approach, but it would not be optimal.

FIGURE 9.21

The prototyping process uses a trial-and-error approach to discovering how a system should operate.



PROTOTYPING. A commonly used alternative to the SDLC is **prototyping**, which uses a trial-and-error approach for discovering how a system should operate. You may think that this does not sound like a process at all; however, you probably use prototyping all the time in many of your day-to-day activities, but you just do not know it. For example, when you buy new clothes, you likely use prototyping—that is, trial and error—by trying on several shirts before making a selection.

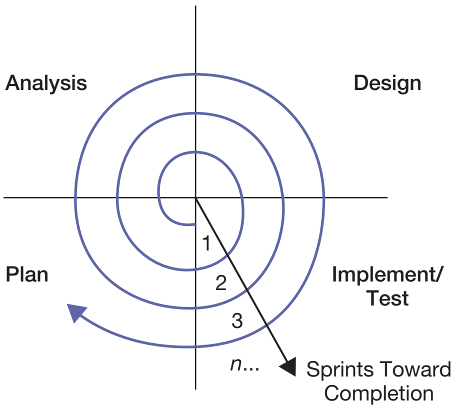
Figure 9.21 diagrams the prototyping process when applied to identifying/determining system requirements. To begin the process, the system designer interviews one or several users of the system, either individually or as a group, in a JAD session. After the designer gains a general understanding of what the users want, he or she develops a prototype of the new system as quickly as possible to share with the users. The users may like what they see or ask for changes. If the users request changes, the designer modifies the prototype and again shares it with them. This process of sharing and refinement continues until the users approve the functionality of the system.

AGILE METHODOLOGIES. The SDLC follows a fairly strict sequence and is very good for large projects with dozens or more developers as well as for problems where the system's requirements are well understood. An alternative to the SDLC are a variety of agile methodologies. An **agile methodology** utilizes an evolutionary systems development approach that focuses on creating small, client-approved parts of the system as the project progresses rather than delivering one large application at the end of the project. Agile methodologies can be thought of as following a "spiral" development approach, where the system quickly evolves and improves over a series of iterations, or *sprints,* that spiral through each of SDLC phases. Each sprint has its own planning, analysis, design and implementation activities that inform the subsequent sprint (see Figure 9.22).

Proponents of the agile methodology approach argue that methodologies adapted from engineering, like the SDLC, generally do not fit well with many real-world software development problems (Valacich & George, 2017). In engineering disciplines, such as civil engineering, requirements tend to be very well understood. Once the creative and difficult work of design is completed, construction becomes very predictable and may account for as much as 90 percent of the total project effort. For software, on the other hand, requirements are rarely well understood, and they typically change during software development process. With software, system construction may account for as little as 15 percent of the total project effort, with design

FIGURE 9.22

Agile methodologies evolve using an iterative development approach.



constituting as much as 50 percent. Techniques that work well for predictable, stable projects, such as bridge building, tend not to work as well for fluid, design-heavy projects such as writing new types of software. What is needed are methodologies that embrace change and that are able to deal with a lack of predictability. While agile methodologies are not for every project, they are highly recommended under the following conditions:

- Unpredictable or dynamic requirements
- Responsible and motivated developers
- Customers who understand the process and will get involved

An example of an agile methodology approach is eXtreme Programming. **eXtreme Programming (XP)** is a software development methodology that centers around fast software release to customers, small development teams (usually pairs), and extensive code reviews and testing. With XP, all phases of the SDLC converge into a series of activities based on the basic processes of coding, testing, listening to customers, and designing. In addition to XP, there are many more approaches for designing and constructing information systems, such as Rapid Application Development (RAD) or object-oriented analysis and design (see the Technology Briefing). Each alternative approach has its strengths and weaknesses, providing a skilled systems analyst with a variety of tools to best meet the needs of a situation (for more, see Valacich & George, 2017).

Acquiring Information Systems

We have now explained some of the general approaches that organizations follow when building systems in-house with their own IS staff. Many times, however, this is not a feasible solution. The following are four situations in which you might need to consider alternative development strategies.

- ***Situation 1: Limited IS Staff.*** Often, an organization does not have the capability to build a system itself. Perhaps its development staff is small or deployed on other activities and does not have the capability to take on an in-house development project.
- ***Situation 2: IS Staff Has Limited Skill Set.*** In other situations, the IS staff may not have the skills needed to develop a particular kind of system. This has been especially true with the explosive growth of the web and mobile devices; many organizations are having outside groups develop and manage their websites and mobile apps.
- ***Situation 3: IS Staff Is Overworked.*** In some organizations, the IS staff may simply not have the time to work on all the systems that the organization requires or wants.
- ***Situation 4: Problems with Performance of IS Staff.*** Earlier in this book, we discussed how and why systems development projects could sometimes be risky. Often, the efforts of IS departments are derailed because of staff turnover, changing requirements, shifts in technology, or budget constraints. Regardless of the reason, the result is the same: another failed (or flawed) system.

When it isn't possible or advantageous to develop a system in-house, organizations are pursuing two popular options:

1. External acquisition of a prepackaged system
2. Outsourcing systems development

These options are examined next.

External Acquisition

Purchasing an existing system from an outside vendor such as IBM, Oracle, or SAP is referred to as **external acquisition**. How does external acquisition of an information system work? Think about the process that you might use when buying a car. Do you simply walk into the first dealership you see, tell them you need a car, and see what they try to sell you? You had better not. Probably you have done some upfront analysis and know how much money you can afford to spend and what your needs are. If you have done your homework, you probably have an idea of what you want and which dealership can provide the type of car you desire.

WHEN THINGS GO WRONG

Top Security Threats

There seems to be a never-ending stream of security threats. Each year, new vulnerabilities and threats are created (see Table 9.7). Ransomware is holding people's data hostage. The Ashley Madison data breach has broken many hearts. Each leakage of nude photos of celebrities results in a near meltdown of the Internet. As individuals and organizations increasingly rely on information systems and gadgets, the stakes are increasingly higher. In 2015 alone, nearly 500 million records have been stolen by cyber thieves. Examples of such records include people's health data, details of subscribers to an adultery website, finance and banking accounts, detailed records of the background checks of virtually all U.S. governmental employees, and countless others.

How can this happen? Creators of legitimate as well as malicious software engage in systems development activities. Most (if not all) legitimate software contains vulnerabilities (or security holes). The reasons for this are manifold: increasing complexity of software makes it all but impossible to build a flawless system, developers may try to rush the product to market and neglect proper testing procedures, security holes are introduced if change management procedures are not properly followed, or inexperienced developers may not be aware of the need for proper security measures. Cybercriminals try to discover these vulnerabilities and engage in systems development activities to build malicious software (i.e., threats) that exploit the vulnerabilities. Typically, cybercriminals use sophisticated software tools to discover the vulnerabilities. Once a vulnerability is discovered, the process of creating the malware follows the systems development approaches discussed in this chapter; first, the criminals will need to analyze the requirements, then design and implement the software, and finally test its efficacy. The number of security incidents signals that in many cases, the criminals are successful. And what's truly troubling is there is no end in sight. Experts believe that things are going to get worse before they get better. Given this dismal forecast, everyone needs to remain vigilant to best secure their online digital lives.

Based on:

Jain, K. (2015, September 7). These top 7 brutal cyber attacks prove "no one is immune to hacking." *The Hacker News*. Retrieved March 10, 2016, from http://thehackernews.com/2015/09/top-cyber-attacks-1.html

Morgan, L. (2016, January 8). List of data breaches and cyber attacks in 2015—over 480 million leaked records. *IT Governance Blog*. Retrieved March 11, 2016, from http://www.itgovernance.co.uk/blog/list-of-data-breaches-and-cyber-attacks-in-2015-over-275-million-leaked-records

Osborne, C. (2015, November 10). The top security threats of 2016. *ZDNet*. Retrieved March 10, 2016, from http://www.zdnet.com/article/the-top-security-threats-of-2016

Szoldra, P. (2015, December 29). The 9 worst cyber attacks of 2015. *Tech Insider*. Retrieved March 10, 2016, from http://www.techinsider.io/cyberattacks-2015-12

TABLE 9.7 Existing and Emerging Security Threats

Issue	Description
Hardware/IoT	Hardware-based cyber attacks are on the rise as criminals are finding ways to infiltrate various devices and gadgets (e.g., industrial control systems and IoT devices) that cannot be protected with normal antivirus software.
Ransomware	A type of malware that restricts access to the infected computer system in some way, and demands that the user pay a ransom to the malware operators to remove the restriction.
Unknown vulnerabilities	These reflect unintended flaws in hardware and software that leave it open to various forms of exploitation including unauthorized access or malicious behavior.
Cloud services	Utilizing cloud services has allowed many companies to better manage IT costs and also provide individuals with incredible convenience; at the same time, this efficient model may come at a higher security price as malicious hackers increasingly focus on the cloud.
Wearables	Wearable technologies such as watches, fitness trackers, and smart clothing are typically connected to mobile device apps; poorly written apps can open backdoors to a cache of sensitive data.
Connected cars	Connected cars with onboard computers and applications are becoming mainstream; many of these technologies have inadequate security, potentially resulting in staggering safety concerns.
Warehouses of stolen data	The influx of widespread data breaches of patient, employee, and customer data has made available a treasure trove of data on the "dark web," putting individuals and organizations at tremendous risk.
Hacktivism	The act of hacking, or breaking into a computer system, for a politically or socially motivated purpose continues to concern businesses and governments.

This upfront analysis of your needs can be extremely helpful in narrowing your options and can save you a lot of time. Understanding your needs can also help you sift through the salespeople's hype that you are likely to encounter from one dealer to the next as each tries to sell you on why his or her model is perfect for you. After getting some information, you may want to take a couple of promising models for a test drive, actually getting behind the wheel to see how well the car fits you and your driving habits. You might even talk to other people who have owned this type of car to see how they feel about it. Ultimately, you are the one who has to evaluate all the different cars to see which one is best for you. They may all be good cars; however, one may fit your needs just a little better than the others.

The external acquisition of an information system is very similar to the purchase of a car. When you acquire a new system, you should do some analysis of your specific needs. For example, how much can you afford to spend, what basic functionality is required, and approximately how many people will use the system? Next, you can begin to "shop" for the new system by asking potential vendors to provide information about the systems that they have to offer. After you evaluate this information, it may become clear that several vendors have systems that are worth considering. You may ask those vendors to come to your organization and set up their systems so that you and your colleagues are able to "test-drive" them. Seeing how people react to the systems and seeing how each system performs in the organizational environment can help you "see" exactly what you are buying. By seeing the actual system and how it performs with real users, with real or simulated data, you can get a much clearer idea of whether that system fits your needs. When you take a car for a test drive, you learn how the car meets your needs. By seeing how the system meets your needs before you buy, you can greatly reduce the risk associated with acquiring that system.

STEPS IN EXTERNAL ACQUISITION. In many cases, your organization will use a competitive bid process for making an external acquisition. In the competitive bid process, vendors are given an opportunity to propose systems that meet the organization's needs. The goal of the competitive process is to help the organization ensure that it gets the best system at the lowest possible price. Most competitive external acquisition processes have at least five general steps (Figure 9.23):

1. Systems planning and selection
2. Systems analysis
3. Development of a request for proposal
4. Proposal evaluation
5. Vendor selection

You have already learned about the first two steps because they apply when you build a system yourself as well as when you purchase a system through an external vendor. Step 3, development of a request for proposal, is where the external acquisition process differs significantly from in-house development.

DEVELOPMENT OF A REQUEST FOR PROPOSAL. A **request for proposal (RFP)** is a document that is used to tell vendors what your requirements are and to invite them to provide information about how they might be able to meet those requirements. An RFP is sent to vendors who might potentially be interested in providing hardware and/or software for the system.

Among the areas that may be covered in an RFP are the following:

- A summary of existing systems and applications
- Requirements for system performance and features
- Reliability, backup, and service requirements
- The criteria that will be used to evaluate proposals
- Timetable and budget constraints (how much you can spend)

The RFP is then sent to prospective vendors along with an invitation to present their bids for the project. Eventually, you will likely receive a number of proposals to evaluate. If, on the other hand, you do not receive many proposals, it may be necessary to rethink the requirements—perhaps the requirements are greater than the budget limitations or the time frame is too short. In some

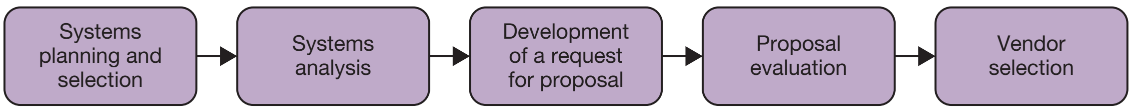
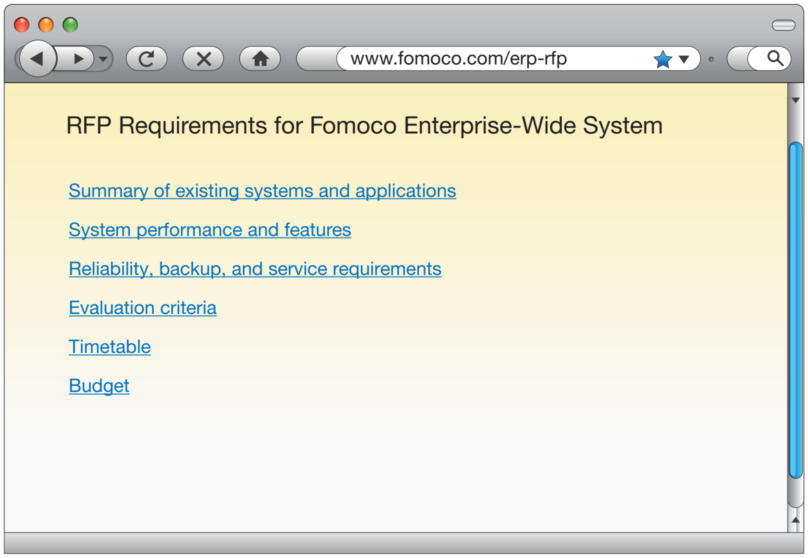


FIGURE 9.23

Steps in external acquisition.

FIGURE 9.24

Sample RFP website for an information systems project.



situations, you may first need to send out a preliminary request for information simply to gather information from prospective vendors. This will help you determine whether, indeed, the desired system is feasible or even possible. If you determine that it is, you can then send out an RFP. Often, rather than trying to identify all potential vendors and sending out RFPs, companies set up a project website, allowing potential bidders to find out more about the organization and its current and planned information systems (Figure 9.24).

PROPOSAL EVALUATION. The fourth step in external acquisition is to evaluate proposals received from vendors. This evaluation may include viewing system demonstrations, evaluating the performance of those systems, examining criteria important to the organization, and judging how the proposed systems "stack up" to those criteria. Demonstrations are a good way to get a feel for the different systems' capabilities. Just as you can go to the showroom to look at a new car and get a feel for whether it meets your needs, it is also possible to screen various systems through a demonstration from the vendor. During a demonstration, a sales team from the vendor gives an oral presentation about the system, its features, and its cost followed by a demonstration of the actual system. Although such demonstrations are often useful in helping you understand the features of different systems being proposed, they are rarely enough in and of themselves to warrant purchasing the system without further evaluation.

One of the methods you can use to evaluate a proposed system is **systems benchmarking**, which is the use of standardized performance tests to facilitate comparison between systems. Benchmark programs are sample programs or jobs that simulate a system's workload. You can have benchmarks designed to test portions of the system that are most critical to your needs, based on your systems analysis. A benchmark program might test how long it takes to calculate a set of numbers, how long it takes to access a set of records in a database, or how long it would take to access certain information given a certain number of concurrent users. Some common system benchmarks include the following:

- Response time given a specified number of users
- Time to sort records
- Time to retrieve a set of records
- Time to produce a given report
- Time to read in a set of data

In addition, vendors may also supply benchmarks that you can use, although you should not rely solely on vendor information. For popular systems, you may be able to rely on system benchmarks published in computer trade journals such as *PC Magazine* or on industry websites such as www.cnet.com. However, in most cases, demos and benchmarks alone do not provide all the information you need to make a purchase. The systems analysis phase should have revealed some specific requirements for the new system. These requirements may be listed as criteria that the organization can use to further evaluate vendor proposals. Depending on what you are

TABLE 9.8 Commonly Used Evaluation Criteria

Hardware Criteria	Software Criteria	Other Criteria
Brand/manufacturer	Business alignment	Installation/training
Speed/storage	Required/desired features	Vendor characteristics (years in business, flexibility, reputation, etc.)
Reliability	Reliability	Price
Scalability for growth	Operations integration	
Ease of installation	Scalability for growth	
Ease of integration	Support model	
Warranty	Usability	

purchasing—hardware, software, or both—the criteria you use will change. Table 9.8 provides examples of commonly used evaluation criteria.

VENDOR SELECTION. In most cases, more than one system will meet your needs, just as more than one car will usually meet your needs. However, some probably "fit" better than others. In these cases, you should have a way of prioritizing or ranking competing proposals. One way of doing this is by devising a scoring system for each of the criteria and benchmarking results as described when making the business case.

Companies may use other, less formalized approaches to evaluate vendors. Sometimes they use simple checklists; other times they use a more subjective process. Regardless of the mechanism, eventually a company completes the evaluation stage and selects a vendor, ending the external acquisition process.

MANAGING SOFTWARE LICENSING. When purchasing commercial, off-the-shelf software, companies usually have to agree to a license agreement. In general, software licenses can be classified based on their restrictiveness or the freedom they offer to use or modify the software. Software licensing has been a hot-button topic for software companies as they lose billions in piracy and mislicensed customers (see Chapter 10). Traditionally, software licensing is defined as the permissions and rights that are imposed on applications; the use of software without a proper license is illegal in most countries.

Most software licenses differ in terms of restrictiveness, ranging from no restrictions at all to completely restricted. Note that although freeware or shareware is freely available, the copyright owners often retain their rights and do not provide access to the program's source code. For organizations using proprietary software, two types of licenses are of special importance. The first type includes the **shrink-wrap licenses** and **click-wrap licenses** that accompany the software, which are used primarily for generic, off-the-shelf application and systems software. The shrink-wrapped contract has been named as such because the contract is activated when the shrink wrap on the packaging has been removed; similarly, a click-wrap license refers to a license primarily used for downloaded software that requires computer users to click on "I accept" before installing the software. The second type of license is an **enterprise license** (also known as a **volume license**). Enterprise licenses can vary greatly and are usually negotiated. In addition to rights and permissions, enterprise licenses usually contain limitations of liability and warranty disclaimers that protect the software vendor from being sued if its software does not operate as expected.

As shown in Table 9.9, there are a variety of software licenses. For different business needs, organizations often depend on a variety of software, each having different licenses, which can cause headaches for many organizations. For organizations, not knowing about the software installed can have a variety of consequences. For example, companies are not able to negotiate volume licensing options, unused licenses strain the organization's budget, or license violations can lead to fines or public embarrassment. **Software asset management** helps organizations to avoid such negative consequences. Usually, software asset management consists of a set of activities, such as performing a software inventory (either manually or using automated tools), matching the installed software with the licenses, reviewing software-related policies and procedures, and creating a software asset management plan. The results of these processes help organizations to better manage their software infrastructure by being able to consolidate and standardize their software titles, decide to retire unused software, or decide when to upgrade or replace software.

TABLE 9.9 Different Types of Software Licenses

Restrictiveness	Software Types	Rights	Restrictions	Examples
Full rights	Public domain software	Full rights	No restrictions; owner forsakes copyright	Different programs for outdated IBM mainframes
	Non-protective open source (e.g., Berkeley software development [BSD] license)	Freedom to copy, modify, and redistribute the software; can be incorporated into a commercial product	Creator retains copyright	Free BSD operating system; BSD components in (proprietary) Mac OS X operating system
	Protective open source (e.g., general public license [GPL])	Freedom to copy, modify, and redistribute the software	Modified or redistributed software must be made available under the same license; cannot be incorporated into commercial product	Linux operating system
	Proprietary software	Right to run the software (for licensed users)	Access to source code severely restricted; no rights to copy or modify software	Windows operating system
No rights	Trade secret	Software typically only used internally	Access to source code severely restricted; software is not distributed outside the organization	Google PageRank™ algorithm

EXTERNAL ACQUISITION THROUGH THE CLOUD. Undoubtedly, managing the software infrastructure is a complex task, often resulting in high operating costs for organizations; further, many systems are not scalable in response to large fluctuations in demand. To deal with these issues, business organizations increasingly use software as a service (SaaS)—that is, clients access applications in the cloud on an as-needed basis using standard web-enabled interfaces (see Chapter 3, "Managing the Information Systems Infrastructure and Services"). For organizations, using SaaS provides a variety of benefits, such as a reduced need to maintain or upgrade software, variable costs based on the actual use of the services (rather than fixed IS costs), and the ability to rely on a provider that has gained considerable expertise because of a large number of clients.

Outsourcing Systems Development

Outsourcing systems development is a way to acquire new systems that closely resembles the process of in-house development. However, in the case of outsourcing, the responsibility for some or all of an organization's information systems development (and potentially the day-to-day management of its operation) is turned over to an outside firm such as Infosys or Accenture. Information systems outsourcing includes a variety of working relationships. The outside firm, or service provider, may develop your information systems applications and house them within their organization, it may run your applications on its computers, or it may develop systems to run on existing computers within your organization. Anything is fair game in an outsourcing arrangement. Today, outsourcing has become a big business and is a very popular option for many organizations (see Chapter 1 for more information on outsourcing).

WHY OUTSOURCING? A firm might outsource some (or all) of its information systems services for varied reasons. Some of these are old reasons, but some are new to today's environment (Applegate, Austin, & Soule, 2009):

- ***Cost and Quality Concerns.*** In many cases it is possible to achieve higher-quality systems at a lower price through economies of scale, better management of hardware, lower labor costs, and better software licenses on the part of a service provider.
- ***Problems in IS Performance.*** IS departments may have problems meeting acceptable service standards because of cost overruns, delayed systems, underutilized systems, or poorly performing systems. In such cases, organizational management may attempt to increase reliability through outsourcing.

- ***Supplier Pressures.*** Perhaps not surprisingly, some of the largest service providers are also the largest suppliers of software or computer equipment (e.g., IBM or HP). In some cases, the aggressive sales forces of these suppliers are able to convince senior managers at other organizations to outsource their IS functions.
- ***Simplifying, Downsizing, and Reengineering.*** Organizations under competitive pressure often attempt to focus on only their "core competencies." In many cases, organizations simply decide that running information systems is not one of their core competencies and decide to outsource this function to companies such as Infosys, Accenture, or IBM whose primary competency is developing and maintaining information systems.
- ***Financial Factors.*** When firms turn over their information systems to a service provider, they can sometimes strengthen their balance sheets by liquidating their IT assets. Also, if users perceive that they are actually paying for their IT services rather than simply having them provided by an in-house staff, they may use those services more wisely and perceive them to be of greater value.
- ***Organizational Culture.*** Political or organizational problems are often difficult for an IS group to overcome. However, an external service provider often brings enough clout, devoid of any organizational or functional ties, to streamline IS operations as needed.
- ***Internal Irritants.*** Tensions between end users and the IS staff are sometimes difficult to eliminate. At times this tension can intrude on the daily operations of the organization, and the idea of a remote, external, relatively neutral IS group can be appealing. Whether the tensions between users and the IS staff (or service provider) are really eliminated is open to question; however, simply having the IS group external to the organization can remove a lingering thorn in management's side.

MANAGING THE IS OUTSOURCING RELATIONSHIP. The ongoing management of an outsourcing alliance is the single most important aspect of the outsourcing project's success. Some advice includes the following:

1. A strong, active chief information officer (CIO) and staff should continually manage the legal and professional relationship with the outsourcing firm.
2. Clear, realistic performance measurements of the systems and of the outsourcing arrangement, such as tangible and intangible costs and benefits, should be developed.
3. The interface between the customer and the outsourcer should have multiple levels (e.g., links to deal with policy and relationship issues and links to deal with operational and tactical issues).

Managing outsourcing alliances in this way has important implications for the success of the relationship. For example, in addition to making sure a firm has a strong CIO and staff, McFarlan and Nolan (1995) recommend that firms assign full-time relationship managers and coordinating groups lower in the organization to "manage" the project. The structure and nature of the internal system activities change from exclusively building and managing systems to also including managing relationships with outside firms that build and manage systems under legal contract.

USING OUTSOURCING STRATEGICALLY. Outsourcing can have many benefits to an organization, but it is important to know what and when outsource. Apple, for example, designs its new products internally but outsources product manufacturing. To Apple, quality and innovative design are central to its strategy—this strategic task cannot be outsourced! However, once the product is designed successfully, getting it reliably constructed is critical but not central to Apple's strategy. Apple simply needs a reliable partner to execute the manufacturing process. This suggests two key questions (Cohn, 2015):

1. What to outsource?
2. When to outsource?

To provide a product or service, a company must perform many different types of tasks. Understanding the difference between strategic, critical, and routine tasks is important when considering what to outsource. For example, imagine if you just launched an energy drink company. This energy drink is quite expensive, utilizing a proprietary formula and the finest ingredients. Given the importance of quality control, manufacturing of your drink is not likely the best candidate for outsourcing. However, how the product gets shipped to stores is critical but not strategic. So, a reliable outsourcing partner like UPS might be attractive. Likewise, many routine tasks, such as the printing of a new product flier or even janitorial services in your offices, can be easily outsourced without putting the company in jeopardy. Such nonstrategic tasks are strong candidates for outsourcing.

It is almost always a good time to consider outsourcing nonstrategic tasks. However, some tasks will change in importance over time, creating a cost versus time trade-off to consider. For example, for your new energy drink company, you need an attractive and informative website so that customers can read all about your product and company. Nevertheless, at this time, you are distributing your product exclusively through retail outlets and are not utilizing the web and social media as a key aspect of your marketing and distribution strategy. However, you believe that sometime in the future, you plan to pursue an aggressive online marketing and social media strategy. So, you could justify hiring an internal web development team today (because you will need them someday) or push this decision into the future, utilizing a local web developer to create your initial online identity. Hiring an internal team will be more expensive; outsourcing the development will be faster. Down the road, when you shift your strategy, you will likely be better off having your own development and social media marketing team. So, at one point in time, it may make sense to use outsourcing; however, at some other time, the situation may change and outsourcing may no longer be the best approach. Just as in your new energy drink company, many organizations are identifying strategic ways to utilize outsourcing.

It is likely that you will have numerous opportunities to participate in the acquisition or development of a new system for an organization for which you currently work or will work in the future. Now that you have an understanding of the process, you should be better equipped to make a positive contribution to the success of any systems development project.

INDUSTRY ANALYSIS

Broadcasting

Only a few years ago, radio and television were among the primary sources for satisfying the desire for both entertainment and up-to-date news and information. Over the past few years, this situation has changed dramatically, with many people turning to the Internet for both entertainment and information.

For many television news companies, the Internet has opened opportunities, as news features can be easily transmitted over the Internet, allowing easier connection between the newsrooms and the "action" in the field. At the same time, viewing habits have changed, and many viewers prefer to obtain their latest news via the Internet or while on the move. As a reaction, television stations (both focusing on news and entertainment) are increasingly using the Internet as a distribution medium for their content.

These changes force TV stations to adjust their revenue models. Whereas traditionally large revenues were derived from TV advertising, advertisers are now less willing to pay high advertising fees in light of dwindling viewership. On the other hand, TV stations can potentially charge more for advertising tied to online shows, as the Internet offers benefits such as advertising targeted at the individual viewer and provides detailed tracking metrics such as click-through rates, allowing the advertiser to directly assess the success of a campaign.

For radio stations, the situation is similar. With more and more people listening to various Internet radio stations, using music streaming services like Pandora or Spotify, listening to satellite radio, and downloading music or audiobooks, the number of listeners to traditional radio has dwindled and along with it advertising revenues. Online advertising now surpasses radio advertising spending. Facing competition from Internet radio, satellite radio, podcasting, and a plethora of other online diversions, many radio stations will have to find innovative ways to prosper in these times of profound change.

Questions

1. What is the effect of the Internet on the quality of television and radio content? With less advertising revenue, how can broadcasters continue to produce high-quality content?
2. Today, AM/FM stations are competing with thousands of Internet radio stations, music streaming, and downloading. Forecast their future and provide a strategy for retaining and gaining market share.

Based on:

Bennette, J. (2015, May 12). 4 trends shaping the future of television. *Adobe Primetime Blog.* Retrieved March 11, 2016, from http://blogs.adobe.com/primetime/2015/05/4-trends-shaping-future-of-tv

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Key Points Review

1. ***Describe how to formulate and present the business case for technology investments.*** Making the business case is the process of building and presenting the set of arguments that show that an information system investment is adding value to an organization. In order to make a convincing presentation, you should be specific about the benefits this investment will provide for the organization. Choosing the wrong measures can yield a negative decision about a beneficial system.
2. ***Describe the systems development life cycle and its various phases.*** The development of information systems follows a process called the systems development life cycle. The SDLC is a process that first identifies the need for a system and then defines the processes for designing, developing, and maintaining an information system. The process is very structured and formal and requires the active involvement of managers and users. The SDLC has four phases: systems planning and selection, systems analysis, systems design, and systems implementation and operation. After the implementation, a system moves into an ongoing maintenance phase. A variety of other approaches are available to enhance the development process for different types of systems and contexts.
3. ***Explain how organizations acquire systems via external acquisition and outsourcing.*** External acquisition is the process of purchasing an existing information system from an external organization or vendor. External acquisition is a five-step process. Steps 1 and 2 mirror the first two steps of the SDLC. Step 3 is the development of a request for proposal (RFP). Step 4 is proposal evaluation, which focuses on evaluating proposals received from vendors. Step 5 is vendor selection, which focuses on choosing the vendor to provide the system. Outsourcing refers to the turning over of partial or entire responsibility for information systems development and management to an outside organization.

Key Terms

MyMISLab™

Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

9-1. Describe the productivity paradox.

9-2. Describe how to make a successful business case, contrasting faith-, fear-, and fact-based arguments.

MyMISLab **9-3.** Compare and contrast tangible and intangible benefits and costs.

9-4. What are the four phases of the systems development life cycle (SDLC)?

MyMISLab **9-5.** List and describe five techniques used in requirements collection.

9-6. What are the three major components/tasks of the systems design phase of the SDLC?

9-7. What are the four options for system conversion? How do they differ from each other?

MyMISLab **9-8.** Compare and contrast the four types of systems maintenance.

9-9. Describe the two key questions related to outsourcing.

9-10. List and describe two main types of software licenses.

Self-Study Questions

9-11. Which of the following is not one of the four phases of the systems development life cycle?
A. systems analysis
B. systems implementation
C. systems design
D. systems acquisition

9-12. ______________ is the process of gathering and organizing information from users, managers, business processes, and documents to understand how a proposed information system should function.
A. Requirements collection
B. Systems collection
C. Systems analysis
D. Records archiving

9-13. Which of the following is the correct order of phases in the systems development life cycle?
A. analysis, planning, design, implementation
B. analysis, design, planning, implementation
C. planning, analysis, design, implementation
D. design, analysis, planning, implementation

9-14. In the systems design phase, the elements that must be designed when building an information system include all of the following except ______________.
A. the human–computer interface
B. questionnaires
C. databases and files
D. processing and logic

9-15. ______________ maintenance involves making enhancements to improve processing performance or interface usability or adding desired (but not necessarily required) system features (in other words, “bells and whistles”).
A. Preventive
B. Perfective
C. Corrective
D. Adaptive

9-16. Which of the following is not one of the three types of arguments commonly made in the business case for an information system?
A. fear
B. fact
C. faith
D. fiction

9-17. A ______________ is a document that an organization uses to tell vendors what its requirements are and to invite them to provide information about how they might be able to meet those requirements.
A. request letter
B. vendor request
C. request for proposal
D. requirements specification

9-18. A user of proprietary software has the right to ____________ the software.
A. copy
B. run
C. modify
D. redistribute

9-19. Which of the following factors is a good reason to outsource?
A. problems in IS performance
B. supplier pressures
C. financial factors
D. all of the above

9-20. Most competitive external acquisition processes have at least five general steps. Which of the following is not one of those steps?
A. vendor selection
B. proposal evaluation
C. development of a request for proposal
D. implementation

Answers are on page 385.

Problems and Exercises

9-21. Match the following terms with the appropriate definitions:

i. Request for proposal
ii. Systems benchmarking
iii. Alpha testing
iv. Systems development life cycle
v. Productivity paradox
vi. Prototyping
vii. Pilot conversion
viii. Systems analysis
ix. Outsourcing
x. External acquisition
xi. Data flows
xii. Requirements collection

a. The movement of data through an organization or within an information system
b. Term that describes the life of an information system from conception to retirement
c. The second phase of the systems development life cycle
d. The process of gathering and organizing information from users, managers, business processes, and documents to understand how a proposed information system should function
e. Testing performed by the development organization to assess whether the entire system meets the design requirements of the users
f. Using a new system in one location before rolling it out to the entire organization
g. A systems development methodology that uses a trial-and-error approach for discovering how a system should operate
h. The practice of turning over responsibility for some or all of an organization's information systems development and operations to an outside firm
i. The observation that productivity increases at a rate that is lower than expected when new technologies are introduced
j. The process of purchasing an existing system from an outside vendor
k. A way to evaluate a proposed system by testing a portion of it with the system workload
l. A document that is used to tell vendors what the requirements are and to invite them to provide information about how they might be able to meet those requirements

9-22. After reading this chapter, it should be fairly obvious why an IS professional should be able to make a business case for a given system. Why, however, is it just as important for non-IS professionals? How are they involved in this process? What is their role in making IS investment decisions?

9-23. Why can it be difficult to develop an accurate cost–benefit analysis? What factors may be difficult to quantify? How can this be handled? Is this something that should just be avoided altogether? What are the consequences of that approach?

9-24. Contrast the cost of acquisition versus the total cost of ownership for the purchase of a new car. Demonstrate how the type of car, year, make, model, and so on change the values of various types of costs and benefits.

9-25. Identify and describe three different situations where fear, faith, or fact arguments would be most compelling when making an information systems investment decision.

9-26. Contrast the differing perspectives of different stakeholders involved in making information systems investment decisions.

9-27. Explain the differences between data and data flows. How might systems analysts obtain the information they need to generate the data flows of a system? How are these data flows and the accompanying processing logic used in the system design phase of the life cycle? What happens when the data and data flows are modeled incorrectly?

9-28. When Mozilla posts a new version of the Firefox browser on its website and states that this is a beta version, what does it mean? Is this a final working version of the software, or is it still being tested? Who is doing the testing? Search the web to find other companies that have beta versions of their products available to the public. You might try Corel (www.corel.com) or Adobe (www.adobe.com). What other companies did you find?

9-29. Conduct a search on the web for "systems development life cycle." Check out some of the hits. Compare them with the SDLC outlined in this discussion. Do all these life cycles follow the same general path? How many phases do the ones you found on the web contain? Is the terminology the same or different? Prepare a 10-minute presentation to the class on your findings.

9-30. Choose an organization with which you are familiar that develops its own information systems. Does this organization follow an SDLC? If not, why not? If so, how many phases does it have? Who developed this life cycle? Was it someone within the company, or was the life cycle adopted from somewhere else?

9-31. Describe your experiences with information systems that were undergoing changes or updates. What kind of conversion procedure was being used? How did this affect your interaction with the system as a user? Who else was affected? If the system was down altogether, for how long was it down? Do you or any of your classmates have horror stories, or were the situations not that bad?

9-32. Find an organization on the Internet (e.g., at www.computerworld.com or www.infoworld.com) or a company you may want to work for in the future that outsources work. What are the managerial challenges of outsourcing, and why is this a popular alternative to hiring additional staff?

9-33. Imagine that you have just been hired by an organization and you have been tasked with purchasing 10 tablet computers. Compile a list of at least three criteria you will use to evaluate at least three alternatives using weighted multicriteria analysis. Make a purchase recommendation based on your analysis.

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Outsourcing Information Systems at Campus Travel

9-34. Campus Travel wants to increase its customer focus and wants to be able to better serve its most valued customers. Many members of the frequent-flier program have requested the ability to check on the status of their membership online; furthermore, the frequent fliers would welcome the opportunity to book reward flights online. As you know that there are a number of companies specializing in building such transactional systems, you have decided to outsource the development of such a system. The following weights are assigned to evaluate the different vendors' systems:

- Online booking capability: 20 percent
- User friendliness: 25 percent
- Maximum number of concurrent users: 20 percent
- Integration with current systems: 10 percent
- Vendor support: 10 percent
- Price: 15 percent

To evaluate the different offers, you need to calculate a weighted score for each vendor using the data provided in the Outsourcing.csv spreadsheet. To calculate the total points for each vendor, do the following:

- Open the file Outsourcing.csv.
- Use the SUMPRODUCT formula to multiply each vendor's scores with the respective weights and add the weighted scores.
- Use conditional formatting to highlight all vendors falling below a total of 60 percent and above a total of 85 percent to facilitate the vendor selection.

Database Application: Building a Special Needs Database for Campus Travel

9-35. In addition to international travel, travel reservations for people with special needs is an area of specialty of Campus Travel. However, to be able to recommend travel destinations and travel activities, you should know what facilities are available at each destination. Therefore, you have been asked to create a database of the destinations and the type of facilities that are available for people with special needs. In order to make the system as useful as possible for all, you need to design reports for the users to retrieve information about each destination. Your manager would like to have a system that contains the following information about the destinations:

- Location
- Availability of facilities for the physically handicapped
- Distance to medical facilities
- Pet friendliness

Each location may have one or more handicap facility (e.g., hearing, walking, sight, and so on). A type of handicap facility can be present at multiple locations. Also, each location has to have one pet-friendly accommodation/activity and may also have accommodation for different types of pets (dogs, cats, and so on). After designing the database, please design three professionally formatted reports that (1) list the locations in alphabetical order, (2) list all locations that have the handicap facilities for those that find it difficult to walk, and (3) list all locations that have a cat-friendly policy.

Hint: In Microsoft Access, you can create queries before preparing the reports. Enter a few sample data sets to populate the reports.

Team Work Exercise

Net Stats: Moore's Law and the Laggards

The technology industry, laboring under Moore's Law, depends on technology users to regularly adopt new hardware and software. Millions of users, however, accustomed to the tried and true, would rather stick with those products they know—at least as long as possible. Sometimes the reason for not rushing to replace the old with the new is familiarity with and an acquired expertise in using the older version of a product or service. Some recent examples of people not rushing to replace the old include the following:

- In December 2015, 67 percent of U.S. households had broadband Internet access, but 13 percent had no broadband at home.
- In the third quarter of 2015, Microsoft still earned more revenue from selling feature phones (a legacy from its Nokia acquisition) than from selling smartphones.
- In March 2016, worldwide, millions of users were still using Windows XP, released in 2001, with more than 11 percent market share, even though Microsoft officially ended support for this product.
- In March 2016, Windows 7 still had 52 percent of the desktop market share. Windows 10 had only 13 percent.

Individual computer users are free to opt to be tortoises or hares regarding the adoption of new technology. Information technology (IT) directors, however, must usually follow company culture and management preferences when deciding whether to adopt new technology. If management is comfortable with risk and likes to be on the cutting edge, for example, IT directors can probably feel safe in adopting new technology early on. A staid, risk-averse management attitude, however, would probably not appreciate an IT director who rushes to adopt the newest technologies. In any event, whether to adopt new technology immediately as it becomes available is a decision that will always be with us.

Questions and Exercises

9-36. Search the web for the most up-to-date statistics and forecasts on people lagging behind in their adoption of new technologies.

9-37. As a team, interpret the changes in numbers (or stories). What is striking/important about these findings?

9-38. As a team, discuss what these numbers will look like in 5 years and 10 years. How are things in the U.S. market the same or different compared with the world? Where are things moving faster/slower? Why?

9-39. Using your spreadsheet or presentation software of choice, create a graph/figure/presentation to effectively visualize the findings you consider most important.

Based on:

Gilbert, D. (2015, October 23). Microsoft is making more money from sales of feature phones than smartphones. *International Business Times*. Retrieved July 25, 2016, from http://www.ibtimes.com/microsoft-making-more-money-sales-feature-phones-smartphones-2154087

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Answers to the Self-Study Questions

9-11. D, p. 361	**9-12.** A, p. 363	**9-13.** C, p. 361	**9-14.** B, p. 364	**9-15.** B, p. 369
9-16. D, p. 348	**9-17.** C, p. 375	**9-18.** B, p. 378	**9-19.** D, p. 379	**9-20.** D, p. 375

CASE 1 | Next Generation Identification: FBI, ICE Databases Expand and Join Forces

As crime-solving aids, first there was fingerprinting; decades later came DNA analysis. Next is the US$1.2 billion Next Generation Identification (NGI) database of the Federal Bureau of Investigation (FBI), used to store biometric identification data ranging from palm prints to iris patterns, photos of scars and tattoos, and distinctive facial characteristics for criminal identification. In the past, fingerprints have been the most widely used means of uniquely identifying people, with the FBI keeping more than 100 million sets of fingerprints in its current database dubbed the Integrated Automated Fingerprint Identification System (IAFIS). The NGI system will be more flexible and modular and store additional biometric characteristics. Unfortunately, taken alone, many of those have been proven to be rather unreliable (facial recognition accuracy in public places can be as low as 10 to 20 percent, depending on lighting conditions), such that a real increase in identification accuracy can come only from combining the results of multiple biometrics. As of 2016, the NGI system contained approximately 547 million face photos; however, additional biometric features such as iris scans had yet to be added.

Similar to the FBI's IAFIS database, the Department of Homeland Security (DHS) maintains the massive Automated Biometric Identification System (IDENT) database. The Immigration and Customs Enforcement Agency (ICE), part of the DHS, uses this database in its Priority Enforcement Program (PEP) to aid in capturing criminal aliens. The PEP is a federal, state, and local government partnership that allows state and local law enforcement officials to quickly share data with ICE on captured suspects. The data forwarded to ICE are used to make immigration processing and removing more efficient if the suspect turns out to be a criminal alien. At the heart of PEP is the automatic integration of the IAFIS and IDENT databases. When someone is arrested, local law enforcement puts the suspect's fingerprints into the FBI's database. However, the fingerprints are checked not only against the FBI's IAFIS system but also against the DHS's IDENT database to see if the suspect is in the country legally. If the suspect isn't legal, ICE can immediately begin the deportation process. The system also prioritizes removal of criminal aliens based on their risk to national security and the local community. The prioritization helps ensure that serious criminals (aliens or otherwise) are not inadvertently released and cuts down on the time criminal aliens must be held in custody before being returned to their home country. Since its deployment (2009–2015), more than 47 million queries into the database have been made with 2.4 million matches leading to more than 400,000 deportations. The FBI's NGI database will take this a step further, as it will not only be based on data from both existing databases but will also include a host of other biometric identifiers.

Both the FBI and Secure Communities programs (the predecessor of the PEP) have been criticized by privacy advocates. Critics say that Secure Communities, for example, can lead to unnecessary or prolonged detention, make accessing a lawyer difficult, and prevent release on bail. There is also a fear that there is no complaint mechanism associated with the systems. Opponents believe that victims of system errors will have little redress if they are erroneously identified as a criminal or illegal alien. In addition, opponents to the Secure Communities program argue that the integration of databases undermines the trust between immigrant communities and local law enforcement agencies. Fearing that illegal immigrants may be dissuaded from reporting crimes or may not be willing to serve as witnesses, Washington, D.C., Mayor Vincent Gray announced in June 2012 that law enforcement officers would be prohibited from asking about people's immigration status.

While the FBI and ICE maintain that their programs are strictly limited to criminals and those in the country illegally, privacy and civil rights activists are watching the developments to ensure that the government respects the rights of its citizens.

Questions

9-40. List a set of tangible and intangible benefits as well as tangible and intangible costs for the FBI database system.

9-41. Develop a set of faith-, fear-, and fact-based arguments to support the continued and ongoing expansion of the FBI database. Which arguments do you think are the strongest? Why?

9-42. Some privacy advocates argue that biometric systems can become unreliable and single out innocent people, especially over time as these databases become less accurate because of a person's natural aging process, weight loss, weight gain, injury, or permanent disability. Discuss the problems associated with having these systems single out innocent people.

Based on:

American Immigration Council. (2011, November 29). Secure Communities: A fact sheet. *Immigrationpolicy.org*. Retrieved June 3, 2016, from http://www.immigrationpolicy.org/just-facts/secure-communities-fact-sheet

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CASE 2 | Big Data, Hadoop, Map Reduce

It may seem obvious that the amount of data in the world keeps getting larger and larger, but what is really meant by *Big Data*? Physical size of the storage device? Number of records? How do we effectively store it, and how do we approach doing useful things with it?

Big Data can be defined using three attributes: volume, velocity, and variety. Volume refers to traditional measures of size—how many bytes. A byte is an encoding of information using 8 bits—on or off states, like 1s and 0s. Large numbers of bytes are quantified using the same prefixes as metric units. *Kilo-* means "a thousand," *mega-* "a million," *giga-* "a billion," and so on. A single e-mail may be a few kilobytes of data including the message itself and the associated address information. A word processor document may be anywhere from a few kilobytes to a few megabytes depending on how long the contents are and if there are any embedded images. A high-definition movie takes up around 5 gigabytes when encoded and stored on a Blu-ray disc. An example of the high velocity of Big Data is the amount of video submitted to YouTube—every minute more than 300 additional hours of video are uploaded. The variety aspect of Big Data represents all the different types of digital data we encounter—everything from e-mails, to homework assignments, to fitness tracker data, to photos, status updates, and VR videos. As the Internet of Things expands and more and more devices are connected all the time, the volume, velocity, and variety of data will only continue to increase.

So, how do we store and do something useful with this much data being generated so fast? Traditional mechanisms for storing and searching large data sets don't scale well. In the early 2000s, Google started utilizing a new approach that allowed for cheap hardware to be used to easily store and process large data sets. The key to the approach is to expect failure of any given component of the system and to design the system such that it can easily and rapidly recover when such failures do occur. The Google File System (GFS) spreads data across multiple servers and incorporates redundancy such that if any one server goes down, the others can pick up where it left off and no data get lost. To do something useful with this much data, however, requires even more ingenuity. Google developed an approach to split queries into multiple steps that can be distributed across multiple servers, much as the data files themselves get split up in GFS. First, the input data files are filtered and sorted into chunks (referred to as "mapping"). Then these chunks are distributed across multiple servers for processing. Each chunk gets processed into a smaller output set (the "reduce" step). The algorithm is designed in such a way that these steps can be performed simultaneously on each chunk on different servers at the same time. Just like GFS, if any given server fails, the others can smoothly recover and keep processing. These smaller output sets are then combined back together, and the process is repeated until a solution is reached. These steps lead to the algorithm's name: *MapReduce*.

MapReduce was a proprietary technology that belonged to Google and was a key part of its competitive advantage in the early 2000s. However, the underlying computer science research was published openly and known outside Google. As a result, many other projects implemented a similar approach. One of these projects, an open source effort, became very popular and widely used. The project was named *Hadoop* after a stuffed elephant belonging to the primary developer's son. Hadoop implements the core functions of GFS as the Hadoop Distributed File System (HDFS) and MapReduce as Hadoop MapReduce. Because it is open source technology and can be freely incorporated into anyone's software system, it has been widely deployed. In keeping with the elephant name and logo, the suite of tools that grew up around Hadoop is called *Mahout* (a term for an elephant handler). Mahout and Hadoop were incorporated into the Apache Software Foundation suite of open source technologies.

Google has moved past MapReduce as its primary Big Data processing model, and Mahout has also moved on to more capable processing models that are enabled by or improvements on Hadoop and MapReduce. Apache Pig is a high-level language for developing and implementing Hadoop programs. Hive is a data warehouse platform built on top of Hadoop and HDFS. New approaches to distributed processing beyond MapReduce that are being pursued by the Apache Foundation include Spark and Flink—both provide resilient distributed data set functionality and implement modern programming architectures using languages like Java and Scala. These technologies are a key part of the behind-the-scenes infrastructure that makes our modern world work. Any platform, like an app store, a fitness app, or a social network, must deal with the challenges of volume, velocity, and variety. Technologies like Hadoop, Mahout, and their kin are what make it all possible.

Questions

9-43. How much data do you generate on a daily, weekly, monthly, and annual basis? Think about every digital encounter you have and what gets stored.

9-44. What advantages are there to storing and processing Big Data? How can companies and individuals benefit?

9-45. What skills might help you to pursue opportunities in the area of Big Data?

Based on:

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MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

9-46. Contrast the perspectives of different stakeholders involved in making information systems investment decisions.

9-47. What are the advantages and disadvantages of prototyping?

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10 Securing Information Systems

Preview

With the proliferation of computing technologies in every corner of the world, most people and organizations have become completely dependent upon their smartphones, tablets, or other information systems (IS) to support communication and commerce. With this increasing dependency on technology to work flawlessly, we have never been more vulnerable to catastrophic security disasters. Because of this, individuals and organizations are focusing more of their attention on information systems security. Here, we first examine computer crime and other threats to information systems security, followed by a discussion of various approaches for securing information systems and the critical data they hold.

Managing in the digital world requires careful attention to IS security. Having thorough plans and approaches for dealing with IS security attacks and natural disasters is critical for effectively managing IS resources within organizations and your personal life.

MANAGING IN THE DIGITAL WORLD:

Not So "Anonymous"—Activists, Hacktivists, or Just Plain Criminals?

File-sharing sites like Megaupload.com, best known for its massive size and volume of downloaded content, are hotbeds of online piracy. After being shut down by U.S. authorities, Megaupload.com formally bade goodbye in 2012 as New Zealand police raided several homes and businesses linked to its founder Kim Dotcom (a name he took on after making a fortune during the dotcom bubble). With only a slight warning from a tweet reading, "One thing is certain: EXPECT US!," a hacktivist group called Anonymous launched "Operation Payback" (Figure 10.1); utilizing 5,635 *zombie computers* distributed throughout the Internet, Anonymous delivered a retaliatory attack resulting in a string of highly coordinated takedowns of websites managed by the U.S. Department of Justice and a number of other organizations that have publicly supported anti-piracy legislation, including the Recording Industry Association of America, the Motion Picture Association of America, and Universal Music.

Who is Anonymous? Having no formal organization and no formal leadership, Anonymous is often considered to be a loose collective of hacktivists—Internet users practicing civil disobedience by taking part in cyberattacks on websites. The group has participated in several cyberattacks; the best known concerned a vigilante

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

1. Define computer crime and describe several types of computer crime.
2. Describe and explain differences between cyberwar and cyberterrorism.
3. Discuss the process of managing IS security and describe various IS controls that can help in ensuring IS security.

FIGURE 10.1

The symbol of the Anonymous group is a mask depicting the historical figure Guy Fawkes.
Source: dny3d/Shutterstock.

movement against Visa, MasterCard, and PayPal as a protest for their freezing the accounts of the whistleblower site WikiLeaks. Anonymous is also politically active, launching attacks on Israeli government websites in response to Israeli military actions in the Gaza Strip. In late 2015, Anonymous launched sustained operations against the ISIS terrorist group in retaliation for the Paris attacks that killed more than 100 people. And, in early 2016, Anonymous targeted the U.S. presidential campaign of Donald Trump for his "hateful campaign."

Not all of Anonymous's actions are controversial. Anonymous garnered much public sympathy with the 2011 "Operation Darknet," its attempt to battle child pornography. In 2012, Anonymous members defended a teen victim of cyberbullying. Following the devastation of Hurricane Sandy in 2012 and massive tornado damage in Oklahoma in 2013, Anonymous mobilized its online influence to support relief efforts. These efforts were considered by many to be more effective than those of government relief agencies. Although Anonymous claims to have good intentions, what the group does is sometimes illegal, and Anonymous and its supporters face a dilemma of having to choose between pursuing (sometimes worthwhile) ideological goals and crossing the boundaries of legality.

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

1. What is the difference between hacktivists, cyberterrorists, and other computer criminals?
2. What tools can hacktivists and other computer criminals use to conduct cyberwar or cyberterrorist attacks?
3. How can organizations and individuals protect themselves from attacks by hacktivists and other computer criminals?

Based on:

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Computer Crime

We continue to hear and read about cases where a breach of computer security was catastrophic and/or had potentially dire consequences. For example, in 2014, retail giant Home Depot had a data breach of more than 56 million customers. In 2015, the U.S. Office of Personnel Management (OPM) was hacked, exposing the personnel records of more than 4 million employees. In 2016, the computers at Hollywood Presbyterian Medical Center were held by ransomware for more than a week until the ransom was paid. It seems like there is an announcement of a major cyberattack or data breach virtually every week. It is becoming clear that no one is immune from computer crime and that information systems security strategies are often lacking. As computer criminals won't become complacent anytime soon, organizations need to guard against attacks. **Computer crime** is defined as the use of a computer to commit an illegal act. This broad definition of computer crime includes the following:

- Targeting a computer while committing an offense. For example, someone gains unauthorized entry to a computer system in order to cause damage to the computer system or to the data it contains.
- Using a computer to commit an offense. In such cases, computer criminals may steal credit card numbers from websites or a company's database, skim money from bank accounts, or make unauthorized electronic fund transfers from financial institutions.
- Using computers to support a criminal activity despite the fact that computers are not actually targeted. For example, drug dealers and other professional criminals may use computers to store records of their illegal transactions.

The global economic impact of computer crime and cyber-espionage is estimated to be about US$400 billion (McAfee, 2014). While this is a fraction of the estimated US$80 trillion global gross domestic product (GDP) (Statista, 2016), its greater impact is its effect on trade, technology development, and competitiveness. Additionally, as many cyberattacks are so visible to customers and investors through 24-hour global news reporting, reports of an attack on a company can have a tremendously negatively effect on the company's valuation and stock price, and many organizations do not report incidents of computer crime because of fear that negative publicity could hurt stock value or provide advantages to competitors. Thus, experts believe that many incidents are never reported and that real losses exceed these estimates. It is clear, however, that computer crime is a fact of life, and for organizations, computer crime has become a strategic and board of directors–level issue, with many of the more than 500 U.S. respondents to the 2015 U.S. State of Cybercrime Survey feeling that their organizations are now focusing much more on computer crime than ever before. In this section, we briefly introduce this topic of growing importance.

Hacking and Cracking

Those individuals who are knowledgeable enough to gain access to computer systems without authorization have long been referred to as **hackers**. The name was first used in the 1960s to describe expert computer users and programmers who were students at the Massachusetts Institute of Technology. Based on curiosity and the desire to learn as much as possible about computers, they wrote programs for the mainframes they used that allowed them to roam freely through computer systems and freely exchanged information about their "hacks"; however, they followed unwritten rules against damaging or stealing data belonging to others.

As computer crime became more prevalent and damaging, true hackers—those motivated by curiosity and not by a desire to do harm (sometimes referred to as "white hats")—objected to use of the term to describe computer criminals (Figure 10.2). Today, those who break into computer systems with the intention of doing damage or committing a crime are usually called **crackers** or "black hats." Some computer criminals attempt to break into systems or deface websites to promote political or ideological goals (such as free speech, human rights, and antiwar campaigns); these web vandals are referred to as **hacktivists**.

Types of Computer Criminals and Crimes

Computer crimes are almost as varied as the users who commit them. Some involve the use of a computer to steal money or other assets or to perpetrate a deception for money, such as advertising merchandise for sale on a web auction site, collecting orders and payment, and then sending

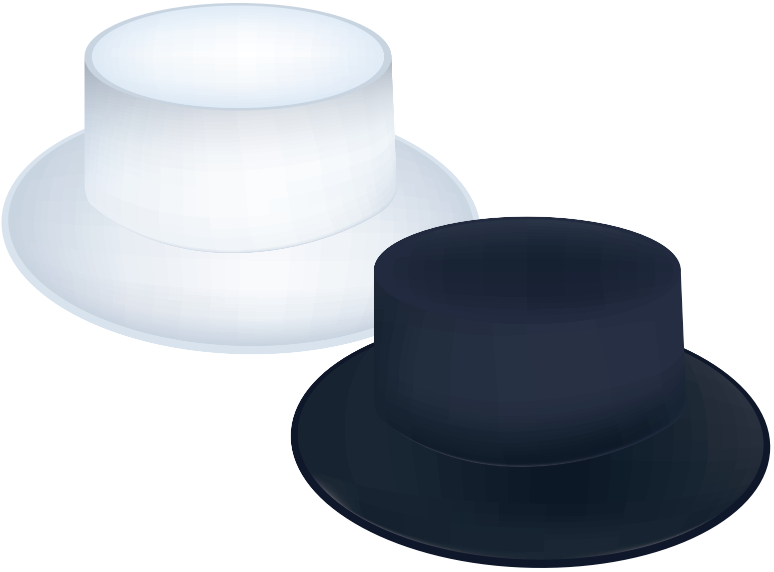


FIGURE 10.2

Malicious hackers are referred to as black hats, and those not motivated to do harm are referred to as white hats.

either inferior merchandise or no merchandise at all. Other computer crimes involve stealing or altering data. Some of those thieves who steal data or disrupt a computer system have demanded a ransom from victims in exchange for returning the data or repairing the damage. Cyberterrorists have planted destructive programs in computer systems and then threatened to activate them if a ransom is not paid (see the upcoming discussion on cyberterrorism). Crimes in the form of electronic vandalism cause damage when offenders plant viruses, cause computer systems to crash, or deny service on a website.

Another type of crime that increasingly is using computers is industrial espionage. **Industrial espionage** describes covert activities, such as the theft of trade secrets, bribery, blackmail, and technological surveillance to gain an advantage over rivals. Many notable companies have been victims of industrial espionage, including Procter & Gamble, IBM, DuPont, Gillette, Kodak, Starwood, and Microsoft. Industrial espionage is most commonly associated with technology-heavy industries, such as the computer hardware and software industries, but also with any other industry in which a significant amount of money is spent on research and development, such as the defense, automobile, and pharmaceutical industries. Often, competitors attempt to steal prototypes to gain access to new technological developments. Industrial espionage is also often carried out by compromising someone who works for a targeted company through bribery, coercion, or blackmail.

The proliferation of the Internet and mobile devices is providing additional avenues for industrial espionage. Cracking into a company's computer system has become a fairly common practice, where criminals steal confidential data and trade secrets that could be sold to others. Laptops, mobile devices, and USB drives can be stolen or accessed while left unattended in hotel rooms or can be stolen while in transit (e.g., stolen out of checked baggage when traveling). In the digital world, critical data is always vulnerable to attacks, and the loss of strategic data may give an organization's rivals a competitive advantage and can have devastating impacts on the company's bottom line.

Use of the Internet has fostered other types of criminal activity, such as the stalking of minors by sexual predators through newsgroups and chat rooms.

WHO COMMITS COMPUTER CRIMES? When you hear the term *cracker* or *computer criminal*, you might imagine a techno-geek, someone who sits in front of his or her computer all day and night, attempting to break the ultra-super-secret security code of one of the most sophisticated computer systems in the world, perhaps a computer for the U.S. military, a Swiss bank, or the Central Intelligence Agency (CIA). While this fits the traditional profile for a computer criminal, there is no clear profile today. More and more people have the skills, the tools, and the motives to hack into a computer system. A modern-day computer criminal could be a disgruntled, middle-aged, white-collar worker sitting at a nice desk on the 14th floor of the headquarters building of a billion-dollar software manufacturer. Computer criminals have been around for decades. For the most part, we associate hackers and crackers with their pranks and crimes involving computer break-ins, virus distribution, and other malicious acts. Nevertheless, hackers and crackers have caused the loss of billions of dollars' worth of stolen goods, repair bills, and lost goodwill with customers.

Studies attempting to categorize computer criminals show that they generally fall into one of four groups. These groups are listed next, from those who commit the most infractions to those who commit the fewest infractions:

1. Current or former employees who are in a position to steal or otherwise do damage to employers; most organizations report insider abuses as their most common crime
2. People with technical knowledge who commit business or information sabotage for personal gain
3. Career criminals who use computers to assist in crimes
4. Outside crackers simply snooping or hoping to find data of value—crackers commit millions of intrusions per year, but most cause no harm (Estimates are that only about 10 percent of cracker attacks cause damage.)

Some crackers probe others' computer systems, electronically stored data, or websites for fun, for curiosity, or just to prove they can. Others have malicious or financial motives and intend to steal for gain or do other harm. Whatever the motives, discovery, prosecution, fines, and jail terms can result.

How do computer criminals gain access to computer systems? Frequently, computer criminals use sophisticated software such as **vulnerability scanners** to automatically test targeted systems for weaknesses; **packet sniffers** to analyze network traffic and capture unencrypted passwords; **keyloggers** to capture every keystroke and thus gather data such as e-mail addresses, passwords, and credit card numbers; or tools to break passwords using a brute-force approach (note that vulnerability scanners and packet sniffers can also be used by organizations to test the effectiveness of controls, and keyloggers may be installed on companies' computers to monitor employees; see the upcoming discussion of IS controls). Alternatively, crackers try to exploit human weaknesses by using methods such as phishing attacks (to be discussed), **social engineering** (misrepresenting oneself to trick others into revealing information), **shoulder surfing** (looking over someone's shoulder while the person is keying in access credentials), or **dumpster diving** (scouring wastebaskets for potentially useful information).

UNAUTHORIZED ACCESS. **Unauthorized access** occurs whenever people who are not authorized to see, manipulate, or otherwise handle data search systems for interesting or useful data, peek at monitors displaying proprietary or confidential data, or intercept electronic messages on the way to their destination. Unauthorized access can include seemingly unproblematic actions such as an employee stealing time on company computers to do personal business, but also thieves stealing credit card numbers and Social Security numbers from electronic databases and then using the stolen information to charge thousands of dollars in merchandise to victims or competitors' employees posing as interns steal proprietary information about products or corporate strategies (i.e., engaging in industrial espionage).

When electronic data are shared by several users, as in an organization, in-house system administrators can prevent casual snooping or theft of data by requiring correct permissions. Further, administrators can log attempts of unauthorized individuals trying to obtain access. Determined attackers, however, will try to gain access by giving themselves system administrator status or otherwise elevating their permission level—sometimes by stealing passwords and logging on to a system as authorized users (Figure 10.3). Today, malicious *insiders*, referred to as insider threats, are a top concern for government and corporate agencies.

The term **insider threats** refers to "trusted adversaries" or "malicious insiders" who operate within an organization's boundaries and are a significant danger to both private and public sectors. Insider threats include disgruntled employees or ex-employees, potential employees, contractors, business partners, or auditors. The damage caused by an insider threat can take many forms, including workplace violence; the introduction of malware into corporate networks; the theft of data, corporate secrets, or money; the corruption or deletion of data; and so on. Especially in very large organizations, identifying insider threats can be extremely difficult. For instance, identifying a small number of potential insider threats within an organization with thousands of employees is a "needle in the haystack" problem. In fact, in January 2014, James R. Clapper, director of National Intelligence, cited the malicious insider as the greatest threat to the United States, exceeding terrorism.

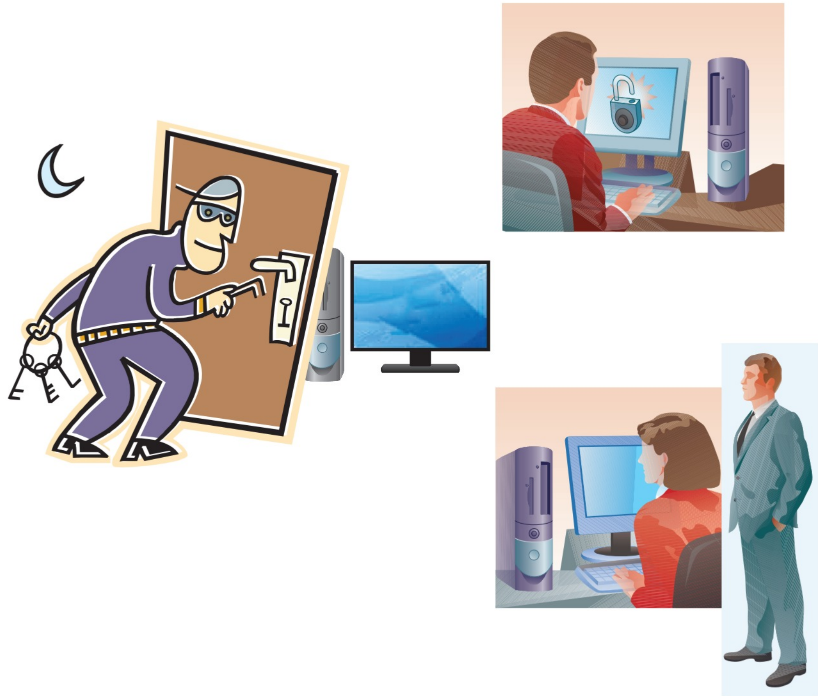


FIGURE 10.3

Unauthorized access can occur in many ways.

The most famous insider threat in recent history is Edward Snowden, an American computer professional who once worked for the CIA and was a contract worker for the National Security Agency (NSA). He came to international attention when he disclosed thousands of classified documents—which he had acquired while working for the American consulting firm Booz Allen Hamilton—to several media outlets. Similarly, the whistleblower site **Wikileaks** frequently publishes information (mostly related to political relations) obtained from insiders. Insider threats may also take the form of **backdoors** (i.e., hidden access points allowing for unauthorized access), which are (intentionally or unintentionally) built into systems by software developers. Such backdoors might be exploited by malicious crackers, intelligence agencies, or one's competitors (for industrial espionage). An unintended backdoor is often referred to as a zero-day vulnerability. A **zero-day** is an undisclosed hardware or software vulnerability that crackers can exploit to adversely affect computer programs, data, other computers, or networks. Such vulnerabilities are referred to as a "zero-day" because once the flaw becomes known, the hardware or software vendor has zero days to mitigate the flaw.

UNAUTHORIZED DATA MODIFICATION. Often related to unauthorized access, **unauthorized data modification** occurs when someone accesses electronic data and then changes it in some way, such as when crackers hack into government websites and change content or when employees give themselves electronic raises and bonuses (Figure 10.4).

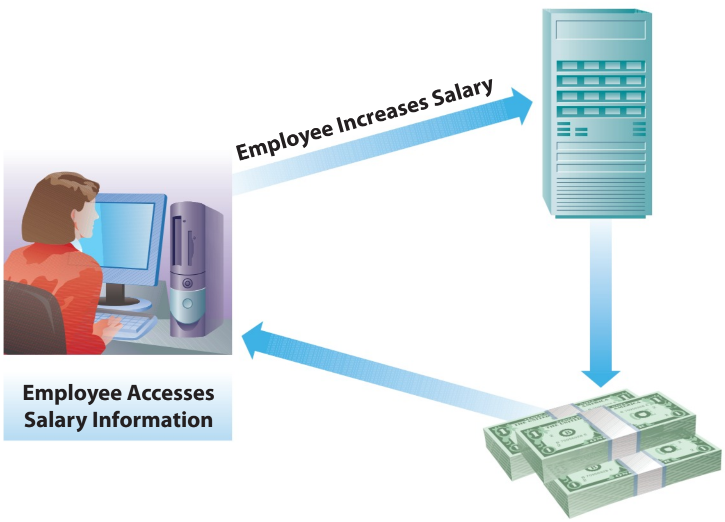


FIGURE 10.4

Unauthorized data modification.

GREEN IT

Anonymous Protests the Killing of Dolphins and Whales in Japan

As defined in Chapter 3, "Managing the Information Systems Infrastructure and Services," green computing is defined as "attempts to use computing resources more efficiently to reduce environmental impacts as well as the use of information systems to reduce negative environmental impacts." In addition to its various other activities, the hacking group Anonymous (see the chapter-opening case) seems to use its computer prowess for its own "green computing." In the Japanese city of Taiji, every year between September and March, hundreds of dolphins are captured for display in dolphinariums and thousands are slaughtered for consumption.

Although this hunt, depicted in the Oscar-winning documentary *The Cove*, has been criticized by environmentalists for years (and dolphin meat is potentially hazardous due to high mercury levels), there seems to be no end in sight. In early 2016, Anonymous decided to launch its own actions to spread awareness about the annual killing spree and targeted hundreds of Japanese websites in defense of wales and dolphins as part of its "OpWhales" campaign. One of the most prominent targets was Japanese automaker Nissan. Although Nissan itself has no connections with the killings, its position as a major Japanese company made it a prime target for the hacking group. In a concerted denial-of-service attack, Anonymous launched attacks on Nissan's global websites, which crashed after being bombarded with traffic from bogus computer-generated visitors, but stressed that it did not intend to steal or harm customer or system data. Anonymous believes it is acting in the best interests of the public and is supported by those who say that the secretive organization is justified in protesting against inequality, injustice, and other threats around the world. Critics, however, say that the group is a vigilante acting in its own interest and engaging in illegal activity.

Based on:

Kumar, N. (2016, January 14). Anonymous hackers protest the killing of dolphins in Japan with Nissan DDoS cyberattack. *Computer Business Review.* Retrieved March 20, 2016, from http://www.cbronline.com/news/cybersecurity/business/annonymous-hackers-protest-the-killing-of-dolphins-in-japan-with-nissan-ddos-cyberattack-4784712

Reisinger, D. (2016, January 14). Anonymous hacks Nissan site to support whales. *Fortune.* Retrieved March 20, 2016, from http://fortune.com/2016/01/14/anonymous-nissan-whales-hack

OTHER THREATS TO IS SECURITY. Many times, IS security is breached simply because organizations and individuals do not exercise proper care in safeguarding information systems. Some examples follow:

- Employees keep passwords or access codes on slips of paper in plain sight.
- Individuals have never bothered to install antivirus software, or they install the software but fail to keep it up to date.
- Computer users within an organization continue to use default network passwords after a network is set up instead of passwords that are more difficult to break.
- Employees are careless about letting outsiders view computer monitors, or they carelessly give out information over the telephone.
- Organizations fail to limit access to company files and system resources.
- Organizations fail to install effective firewalls or intrusion detection systems, or they install an intrusion detection system but fail to monitor it regularly.
- Organizations fail to conduct proper background checks on new hires.
- Fired employees are resentful and install harmful code, such as computer viruses, when they leave the company.

With the increasing popularity of mobile devices like smartphones and tablets, many additional security threats have emerged, including:

- Individuals lose their mobile devices and don't have capabilities to remotely wipe data from the device.
- Individuals keep sensitive data on mobile devices and do not use passcodes.
- Individuals "jailbreak" their mobile phone. **Jailbreaking**—that is, modifying the operating system to remove manufacturer or carrier restrictions in order to run applications other than those from the official app store—can allow unsecure applications to run on devices or make it difficult to upgrade devices that have been modified.
- Individuals use poorly designed mobile applications that can have security vulnerabilities.

- Individuals use unsecure wireless networks, leaving their devices vulnerable to different types of attacks.

While there are many threats to IS security, there are also ways to combat those threats. Later, we discuss safeguards organizations can use to improve IS security.

Computer Viruses and Other Destructive Code

Malware—short for "malicious software" such as viruses, worms, and Trojan horses—continues to have a tremendous economic impact on the world, costing organizations more than US$114 billion to respond to and to enact countermeasures (Brown, 2013). Accurate estimates of real costs to organizations and society are difficult to obtain, as many organizations choose not to report major incidents; most organizations do not want to alarm customers and shareholders of malware and other security breaches. Increasingly, malware targets not only traditional computers, but Internet of Things (IoT) devices as well.

COMPUTER VIRUSES. A **virus** is a destructive program that disrupts the normal functioning of information systems. Viruses differ from other types of malicious code in that they can reproduce themselves. Some viruses are intended to be harmless pranks, but more often they do damage to a computer system by erasing files on the hard drive or by slowing computer processing or otherwise compromising the system. Viruses infect a single computer only, potentially spreading to other computers if infected files are shared. Viruses are planted in host computers in a number of ways (Figure 10.5) but are most often spread through malicious e-mail attachments, the sharing of removable media (such as USB sticks), or file downloads from malicious websites.

WORMS, TROJAN HORSES, AND OTHER SINISTER PROGRAMS. Viruses are among the most virulent forms of computer infections, but other destructive code can also be damaging. A **worm**, a variation of a virus that is targeted at networks, is designed to spread by itself without the need for an infected host file to be shared. Worms take advantage of security holes in operating systems and other software to replicate endlessly across the Internet, thus causing servers to crash, which denies service to Internet users.

Another category of destructive programs is called **Trojan horses**. Like the Trojan horse in Greek mythology, Trojan horses appear to be legitimate, benign programs but carry a destructive payload. Unlike viruses, Trojan horses typically do not replicate themselves but, like viruses, can do much damage, such as by giving the creator unauthorized access to a system. When a Trojan

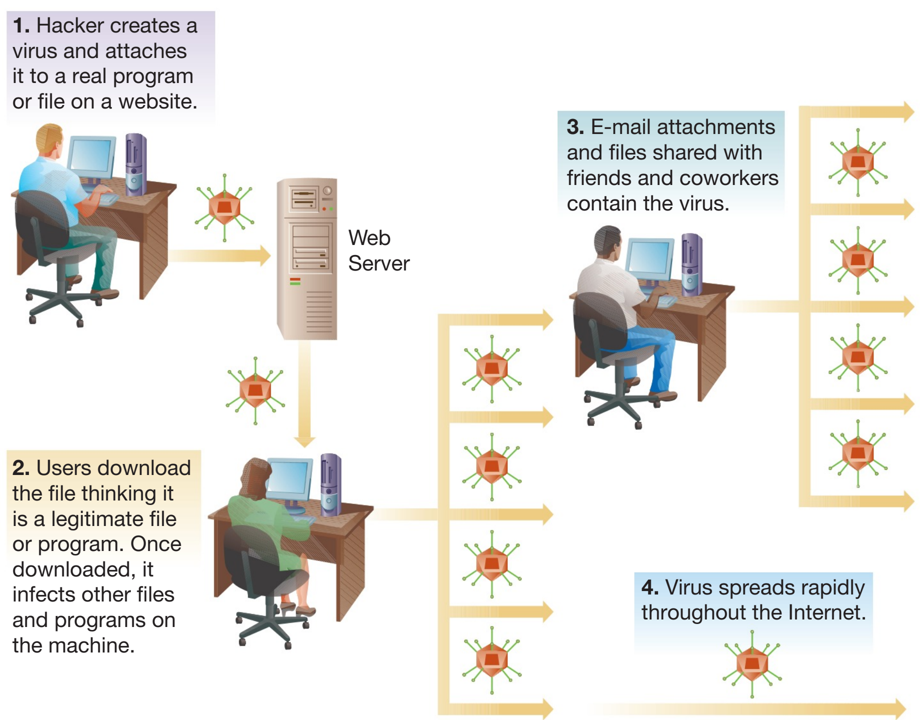


FIGURE 10.5

How a computer virus is spread.

horse is planted in a computer, its instructions remain hidden. The computer appears to function normally, but in fact it is performing underlying functions dictated by the intrusive code. For example, under the pretext of playing chess with an unsuspecting systems operator, a cracker group installed a Trojan horse in a Canadian mainframe. While the game appeared to be proceeding normally, the Trojan horse program was sneakily establishing a powerful administrator account for the future use of the intruders.

Logic bombs or **time bombs** are variations of Trojan horses. They also do not reproduce themselves and are designed to operate without disrupting normal computer function. Instead, they lie in wait for unsuspecting computer users to perform a triggering operation. Logic bombs are set off by certain types of operations, such as entering a specific password or adding or deleting names and other data to and from certain databases. Time bombs are set off by specific dates, such as the birthday of a famous person. Disgruntled employees have planted logic and time bombs on being fired, intending for the program to activate after they have left the company. In at least one instance in recent history, a former employee in Minnesota demanded money to deactivate the time bomb he had planted in company computers before it destroyed employee payroll records.

Recently, a new type of malware called **ransomware** has emerged. In 2016, security giant McAfee Labs predicted a dramatic increase in the use of ransomware on all types of users. Ransomware holds a user's computer hostage by locking or taking control of the user's computer or encrypting files or documents. Once infected, the scammers demand a ransom to be paid by a certain deadline in order to unlock the computers or decrypt the files. Alternatively, an official-looking message from a law enforcement agency (typically, the Federal Bureau of Investigation [FBI]) is displayed (complete with logos) that demands the payment of a fine to avoid being prosecuted for illegal activity/content detected on the computer. In either case, paying the ransom does not guarantee getting access to the files again, and having backups is the best safeguard against ransomware (see the upcoming discussion about controls).

DENIAL OF SERVICE. **Denial-of-service (DoS) attacks** occur when electronic intruders deliberately attempt to prevent legitimate users of a service (e.g., customers accessing a website) from using that service, often by using up all of a system's resources. To execute such attacks, intruders often create armies of **zombie computers** by infecting computers that are located in homes, schools, and businesses with viruses or worms. Any computer connected to the Internet can be infected if it is not protected by firewalls and antivirus software and is, therefore, open to attacks and to being used as a zombie computer (in fact, some security experts believe that more than 10 percent of all computers connected to the Internet are used as zombies, unbeknownst to the owners). The zombie computers, without users' knowledge or consent, are used to spread the malware to other computers and to launch attacks on their targets. The computers under attack crash under the barrage of bogus computer-generated visitors, causing a denial of service to legitimate users (Figure 10.6). For example, in late 2016, the Mirai botnet used millions of IoT devices (such as Internet-connected CCTV cameras) to attack the DNS system, a critical part of the Internet infrastructure responsible for translating domain names into IP addresses (see the Technology Briefing). As a result, large parts of the U.S. experienced Internet blackouts, with major sites from Twitter to PayPal being unreachable for hours at a time.

SPYWARE, SPAM, AND COOKIES. Three additional ways in which information systems can be threatened are by spyware, spam, and cookies.

Spyware **Spyware** is any software that covertly gathers data about a user through an Internet connection without the user's knowledge. Spyware is sometimes hidden within freeware or shareware programs. In other instances, it is embedded within a website and is downloaded to the user's computer, without the user's knowledge, in order to track data about the user for marketing and advertisement purposes. Spyware can monitor your activity (such as website visits) and secretly transmit that data to someone else or may include keyloggers that capture sensitive data as it is typed. Spyware presents problems because it uses your computer's memory resources; eats network bandwidth as it sends data back to the spyware's home base via your Internet connection; causes system instability or, worse, system crashes; and exposes users to identity theft, credit card fraud, and other types of crime. **Adware** (free software paid for by advertisements appearing during the use of the software) sometimes contains spyware that collects data about a person's web surfing behavior in order to customize website banner

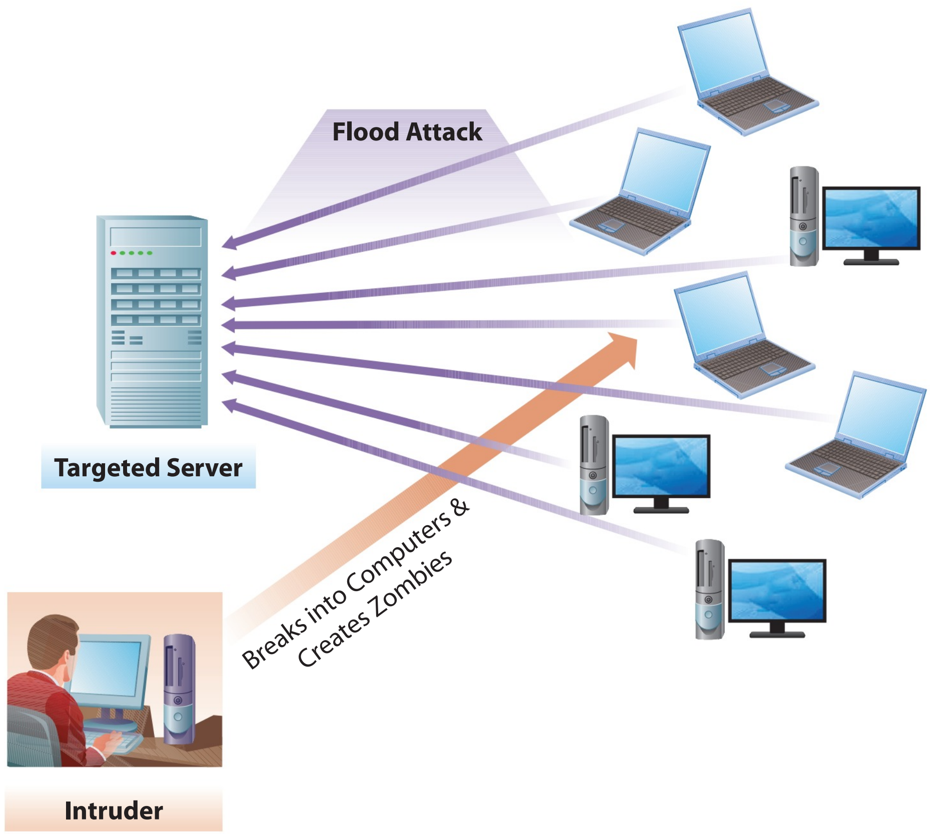


FIGURE 10.6

Denial-of-service attack.

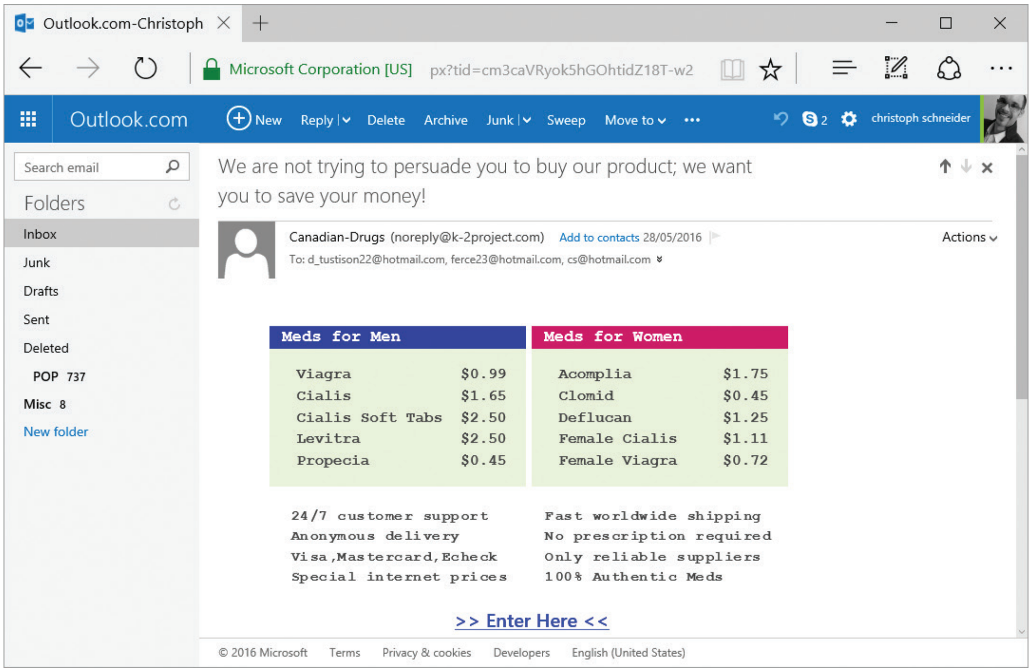
advertisements. It is important to note that spyware is not currently illegal, although there is ongoing legislative hype about regulating it in some way. Fortunately, firewalls and spyware protection software can be used to scan for and block spyware.

Spam Another prevalent form of network traffic that invades our e-mail is spam. **Spam** is electronic junk mail or junk newsgroup postings, usually for the purpose of advertising for some product and/or service (Figure 10.7). In addition to being a nuisance and wasting our time, spam also eats up huge amounts of storage space and network bandwidth, with about 50 percent of all e-mail being spam! Globally, there were an estimated 4.6 billion e-mail accounts in 2016, with more than 215 billion messages being sent per day. That equates to trillions of spam messages clogging up inboxes each year. Spammers commonly use zombie computers to send out millions of e-mail messages, unbeknownst to the computer users. Some spam consists of hoaxes, asking you to donate money to nonexistent causes or warning you of viruses and other Internet dangers that do not exist. Other times, spam includes attachments that carry destructive computer viruses. As a result, Internet service providers and those who manage e-mail within organizations often use **spam filters** to fight spam. Typical spam filters use multiple defense layers—consisting of dedicated hardware and software—to help reduce the amount of spam processed by the central e-mail servers and delivered to users' inboxes. Using techniques such as sophisticated machine learning algorithms (see Chapter 6, "Enhancing Business Intelligence Using Big Data and Analytics"), spam filters have gotten better over the years, and fight not only spam but also other e-mail threats, such as directory harvest attacks (i.e., attempts to determine valid e-mail addresses for building spam databases), phishing attacks (discussed below), viruses, and more. Increasingly, spammers use instant messaging, cell phone text messaging (SMS), or other messaging services (such as WhatsApp) to spread their annoying (and sometimes malicious) messages.

In addition to advertisement, computer criminals use spam e-mails to spread hoaxes, encouraging the recipients to forward them to their friends. An **Internet hoax** is a false message circulated online about new viruses, funds for alleged victims of a global catastrophe, kids in trouble, cancer causes and cures, or any other topic of public interest. In most cases, the consequences of passing on a hoax will be small, and your friends will just ridicule you; in other

FIGURE 10.7

Spam is rampant and consumes an enormous amount of human and technology resources.
Source: Outlook 2016, Windows 10, Microsoft Corporation.

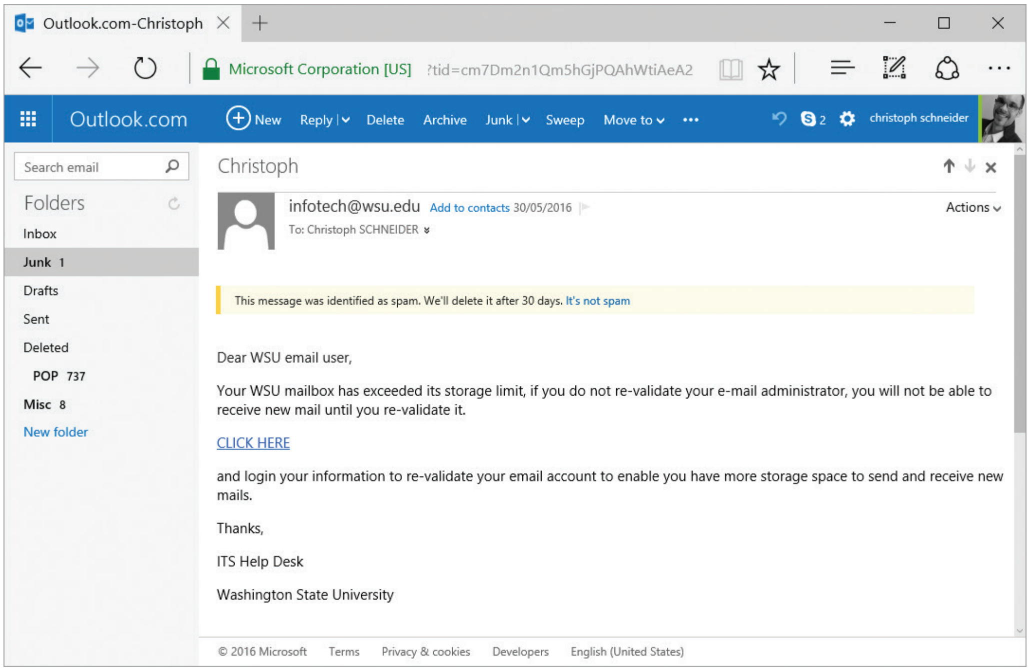


cases, spammers use such hoaxes to "harvest" e-mail addresses to identify future targets. Several websites, such as Snopes (www.snopes.com), Symantec, and McAfee, publish lists of known hoaxes, and you should always check to see if a message is a hoax before you forward it to others.

In its worst form, spam is used for **phishing** (or spoofing), which is attempts to trick financial account and credit card holders into giving away their authentication credentials, usually by sending spam messages to millions of e-mail accounts (i.e., attackers are "phishing" [fishing] for victims). These phony messages contain links to websites that duplicate legitimate sites to capture login credentials. For example, most e-mail users regularly receive phishing attempts from eBay, PayPal, various spoofed banks, or fake system administrators (Figure 10.8). As people learn that generically addressed e-mail from a bank is not likely legitimate, criminals have turned to spear phishing. **Spear phishing** is a more sophisticated fraudulent e-mail attack that targets a

FIGURE 10.8

A phishing e-mail message.
Source: Outlook 2016, Windows 10, Microsoft Corporation.



specific person or organization by personalizing the message (phishing with a spear rather than a broad net) in order to make the message appear as if it is from a trusted source such as an individual within the recipient's company (often someone in a position of authority), a government entity, or a well-known company. While spear phishing can be very effective, the attacker needs some basic information in order to optimally target the phishing message. Many fear that social media sites like Facebook will increasingly provide valuable information about potential victims to criminals designing spear phishing attacks.

Often, spammers post their spam messages in online forums, blogs, or wikis or create thousands of e-mail accounts at free providers such as Yahoo! or Oulook.com to send out their messages. Rather than manually going through such tedious tasks to set up these accounts or post thousands of messages, spammers use bots (i.e., software robots that work in the background to provide services to their owners; see Chapter 6) to do this. Faced with this problem, e-mail providers and managers of online forums are attempting to prevent spammers from using bots to automatically submit online forms. One commonly used approach for preventing bots from submitting forms is the use of CAPTCHAs. A **CAPTCHA** (Completely Automated Public Turing Test to Tell Computers and Humans Apart) typically consists of a distorted image displaying a combination of letters and/or numbers that a user has to input into a form (in addition to other required information) before submitting it (Figure 10.9). As the image is distorted, (currently) only humans can interpret the letters/numbers, preventing the use of automated bots for creating accounts or posting spam to forums, blogs, or wikis. CAPTCHAs are also used to prevent crackers from trying to break passwords using a brute force approach, where a bot submits thousands or millions of possible passwords (usually from a list of common passwords) until the correct password is found.

However, trying to stop spammers is a cat-and-mouse game, and increasingly, webmasters are using a combination of multiple techniques to stop spammers, such as detecting mouse movements (as automated agents do not use a mouse), detecting the rate at which text is entered into forms, or incorporating invisible fields (which would be "seen" and filled out by an automated agent but not a human user) together with CAPTCHAs in order to distinguish between malicious bots and legitimate users.

Cookies Another potential nuisance in Internet usage is cookies. A **cookie** is a small text file passed to a web browser on a user's computer by a web server. The browser then stores the message in a text file, and the message is sent back to the server each time the user's browser requests a page from that server.

Cookies are normally used for legitimate purposes, such as identifying a user in order to present a customized web page or for authentication purposes. Although you can choose to not accept the storage of cookies, you may not be able to visit the site, or it may not function

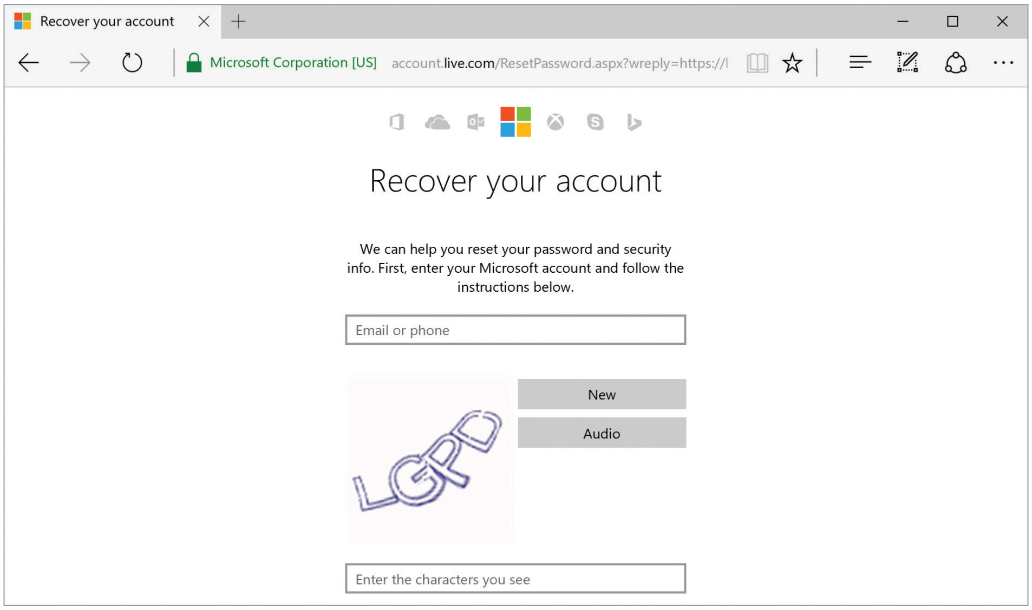


FIGURE 10.9

A CAPTCHA is used to prevent bots from submitting an online form.

Source: Windows 10, Microsoft Corporation.

WHEN THINGS GO WRONG

The Bug That Almost Killed the Internet

On December 31, 2011, Stephen Henson reviewed a new section of code for inclusion into the OpenSSL Project. OpenSSL is a popular encryption framework used to secure many Internet-based transactions. Dr. Henson, one of the core developers of the software, apparently failed to notice a flaw in the code, and the bug was adopted into widespread use across the Internet, where it remained undetected for more than 2 years. When a fix for the flaw was completed in April 2014, an estimated 17 percent (about half a million) of web servers were believed to have been vulnerable to attack. *Forbes* magazine labeled the bug the worst since commercial traffic began to flow on the Internet.

The security bug—popularly known as Heartbleed—allowed an attacker to read the active memory of systems with the vulnerability. This compromised various types of potentially sensitive data, including encryption keys, user names and passwords, and the actual data that those encryption and authentication technologies were intended to protect.

Though many companies were quick to update their sever software, it was reported that a vast majority of large organizations had yet to fully remediate the security bug one year after the fix was released (early 2015); 2 years after the fix was released (early 2016), Heartbleed was still affecting web server security as the original bug was appearing in new variations. The vulnerability thus continues to have repercussions for thousands of companies and millions of users. It serves as a cogent reminder of the potential dangers associated with conducting transactions via the Internet.

Based on:

Hackett, R. (2015, April 7). On Heartbleed's anniversary, 3 of 4 big companies are still vulnerable. *Fortune*. Retrieved March 18, 2016, from http://fortune.com/2015/04/07/heartbleed-anniversary-vulnerable

Heartbleed. (2016, February 20). In *Wikipedia, The Free Encyclopedia*. Retrieved March 18, 2016, from https://en.wikipedia.org/w/index.php?title=Heartbleed&oldid=706004410

Leyden, J. (2016, March 2). SSL's DROWN not as bad as Heartbleed, still a security ship wreck. *The Register*. Retrieved March 18, 2016, from http://www.theregister.co.uk/2016/03/02/drown_exploitability_analysis

McMillan, R. (2014, April 11). How Heartbleed broke the Internet—and why it can happen again. *Wired*. Retrieved March 18, 2016, from http://www.wired.com/2014/04/heartbleedslesson

Steinberg, J. (2014, April 10). Massive Internet security vulnerability—here's what you need to do. *Forbes*. Retrieved March 18, 2016, from http://www.forbes.com/sites/josephsteinberg/2014/04/10/massive-internet-security-vulnerability-you-are-at-risk-what-you-need-to-do

properly. For example, to read the *New York Times* online, you must register by entering your name and other information. When you go through the registration process, cookies are stored on your machine. If you don't accept cookies or you delete the stored cookies, you are not allowed to access the online newspaper without reregistering. Similarly, you will have to accept cookies when purchasing from many e-tailers, as most online shopping carts require cookies to function properly. In some cases, cookies may contain sensitive data (such as credit card numbers) and thus pose a security risk in case unauthorized persons gain access to the computer. Many countries as well as the European Union now require websites to inform users about the use of cookies (except for cookies that are necessary to ensure the site's functionality, such as for shopping carts or login information).

Specific cookie management or cookie killer software can be used to manage cookies, but an even simpler way to manage cookies is through the settings in your web browser. In the settings for the Firefox web browser, for example, you can set levels of restrictions on the use of cookies, you can block them altogether, and, if you do allow them, you can go in periodically and delete them from your computer.

THE RISE OF BOTNETS AND THE CYBERATTACK SUPPLY CHAIN. Destructive software robots called bots (see Chapter 6), working together on a collection of zombie computers via the Internet, called **botnets**, have become the standard method of operation for professional cybercriminals. For example, about 85 percent of all e-mail spam is sent out by only six major botnets. Attacks using botnets are utilizing a global supply chain of highly specialized criminals. For instance, a phishing attack can involve the following:

1. A *programmer* writes a phishing attack template and makes this available for purchase.
2. A *phisher* who wants to run an attack purchases the template and designs an attack (e.g., ask recipients of a spam e-mail to update their login credentials at the Wells Fargo Bank).
3. The *phisher* contracts with a *cracker* to provide hosting space for the phishing websites.

4. The *phisher* contacts a *bot herder*—a criminal who has a botnet residing on a collection of zombie computers—to send out the spam e-mail that carries the attack to unsuspecting people.
5. After launching the attack and collecting data from those who responded to the phishing attack, the *phisher* provides the stolen credentials to a *collector* who specializes in removing funds from the affected financial institutions.
6. The *collector* works with a criminal called a *mule herder* who has a network of people (called *mules*) who carry out the withdrawals from affected banks.

Each member of the supply chain has very specialized skills and can be located anywhere in the world. In fact, one of the difficulties in stopping this global crime syndicate is the difficulty of not only tracking the locations of these villains but also prosecuting criminals across international borders. Today, anonymization tools and cryptocurrencies (such as Bitcoin; see Chapter 4, "Managing Business-to-Consumer Electronic Commerce") have lowered the entry barriers for cybercriminals, enabling various "cybercrime-as-a-service" offerings. Similar to service models used in cloud computing (see Chapter 3), crime-as-a-service offerings include not only crimeware as a service, hacking as a service, or cybercrime infrastructure as a service but also research as a service, selling things such as stolen credentials (Paganini, 2013). For example, a would-be cybercriminal can easily "rent" space on a botnet (including technical support, tremendous resources, and bandwidth) such as the Mirai botnet (which brought down large parts of the U.S. Internet infrastructure in late 2016), with weekly access costs of just US$7,500 for 100,000 bots.

IDENTITY THEFT. One of the fastest-growing cybercrimes in recent years has been **identity theft** (Figure 10.10). Identity theft is the stealing of another person's Social Security number, credit card number, and other personal data for the purpose of using the victim's credit rating to borrow money, buy merchandise, and otherwise run up debts that are never repaid. In some cases, thieves even withdraw money directly from victims' bank accounts. Because many government and private organizations keep data about individuals in accessible databases, opportunities abound for thieves to steal data. Reclaiming one's identity and restoring a good credit rating can be frustrating and time-consuming for victims.

The solution to identity theft lies in the government and private sector working together to change practices used to verify a person's identity. For example, a mother's maiden name and an individual's Social Security number are too easily obtained. Other methods of authentication, such as biometrics and encryption, may need to be used if the problem is to be solved. Methods of information security, including biometrics and encryption, are presented later in our discussion.

FIGURE 10.10

Identity theft is one of the fastest-growing cybercrimes.
Source: Henrik5000/Getty Images.

Cyberharassment, Cyberstalking, and Cyberbullying

The anonymity provided by the Internet is increasingly used to harass, stalk, and bully others. As defined in Chapter 5, "Enhancing Organizational Communication and Collaboration Using Social Media," an Internet troll is a person who creates discord on the Internet by starting arguments or upsetting people by posting inflammatory content on social media sites with the deliberate intent of provoking readers into an emotional response, often for their own amusement. In contrast, **cyberharassment**, a crime in many states and countries, broadly refers to the use of a computer to communicate obscene, vulgar, or threatening content about a person with the intent of harming or harassing that person. A single offensive message can be considered cyberharassment.

Intentionally following, threatening and/or intimidating someone using electronic means and causing that person to fear for his or her safety is referred to as **cyberstalking**. While cyberstalking can take many forms and can go undetected by the victim, the intent of **cyberbullying** is to *deliberately* cause emotional distress in the victim, often by manipulating, discrediting, or humiliating the victim. Cyberharassment, cyberstalking, and cyberbullying are typically targeted at a particular person or group as a means of taking revenge or expressing hatred. The widespread and increasing use of mobile devices has led to increases in these incidents. Cyberharassment, cyberstalking, and cyberbullying can take many forms, including the following:

- Making false accusations that damage the reputation of the victim on blogs, websites, chat rooms, or e-commerce sites (e.g., eBay)
- Gaining information about the victim by monitoring online activities, accessing databases, and so on
- Researching and broadcasting personally identifiable information about the victim (a practice known as **doxing**).
- Encouraging others to harass a victim by posting personal information about the victim on websites, chat rooms or social networking sites
- Attacking data and equipment of the victim by sending e-mail viruses and other destructive code
- Using the Internet to place false orders for goods and services, such as magazines, pornography, and other embarrassing items, as well as having such items delivered to work addresses
- Posting incriminating pictures on social networking sites

Many states, the U.S. government, and many countries have laws against cyberharassment and cyberstalking. Unfortunately, law enforcement has a difficult time catching most cyberstalkers.

Online predators typically target vulnerable people, usually the young or old, for sexual or financial purposes. While traditionally online chat rooms and instant messaging systems have been the primary playground for online predators, these villains are increasingly targeting many social networking sites like Facebook. To combat these online predators, parents must educate their children not to share personal information and possibly must use monitoring software to track online activity. Fortunately, most social networking and online chat sites also provide ways to report abuse by these predators. Nevertheless, with the increase in cyberharassment, cyberstalking, cyberbullying, and online predators, it is increasingly important to carefully manage one's privacy in social networks, and to be aware of the potential consequences of any activities in social media.

Software Piracy

Software developers and marketers want you to buy as many copies of their products as you want, of course. But commercial software vendors do not want you or anyone else to buy one copy and then bootleg additional copies to sell or to give to others. Vendors also take a dim view of companies that buy one copy of a software application and then make many copies to distribute to employees. In fact, these practices are called **software piracy** and are illegal.

Both patent and copyright laws can apply to software, which is a form of intellectual property—creations of the mind (e.g., music, software, and so on), inventions, names, images, designs, and other works used in commerce. Patents and copyrights are recognized and enforced by most countries, giving the creator exclusive rights to benefit from the creation for a limited period of time. **Patents** typically refer to process, machine, or material inventions. For example, Amazon.com's "one-click buying" process is protected by patent law, and Apple has patented its multitouch technology (including the "pinch" for shrinking and expanding items) used in the iPhone and iPad. **Copyrights** generally refer to creations of the mind such as music, literature, or software.

When you buy commercial software, it is typically legal for you to make one copy for your own use for backup purposes (although the software vendor can make it very difficult to copy the software). It is also legal to offer shareware or public domain software for free on a website. But **warez** peddling—offering stolen proprietary software for free or for sale over the Internet—is a crime. (*Warez* is the slang term for such stolen software.)

Software piracy has become a problem because it is so widespread, costing the commercial software industry and the entire economy billions of dollars a year: A study conducted by the Business Software Alliance suggested that the worldwide value of unlicensed software in 2015 was US$52 billion (BSA, 2016). The crime is difficult to trace, but many individuals and even companies have been successfully prosecuted for pirating software.

Many software vendors are trying to limit software piracy by requiring the users to enter license keys or verifying the key before allowing the customer to register or update the software. To discover and understand protection mechanisms (such as registration or license keys) built into the software by its original developer, computer criminals typically disassemble the software, a practice referred to as **reverse engineering**. Once the crackers understand the inner workings of the protection mechanism, they can build a **key generator** that can be used to generate fake license keys to circumvent the protection mechanism. (Reverse engineering is not always destructive and may be legally used to improve a program, but use of the term here implies using the process for gaining unauthorized access to a program's internal structure.)

SOFTWARE PIRACY IS A GLOBAL BUSINESS. A major international issue that businesses deal with is the willingness (or unwillingness) of governments and individuals to recognize and enforce the ownership of intellectual property—in particular, software copyrights. Piracy of software and other technologies is widespread internationally (Figure 10.11). The BSA (2016) estimates that about 39 percent of all installed software is unlicensed. The BSA points to countries such as Armenia (86 percent), Moldova (86 percent), Libya (90 percent), and Zimbabwe (90 percent) as those with the highest percentages of illegal software. Countries with the lowest piracy rates include the United States (17 percent), Japan (18 percent), New Zealand (18 percent), and Luxembourg (19 percent). Because technology usage varies significantly by region, average piracy levels and dollar losses greatly differ across regions (Table 10.1). For instance, even though the United States has the lowest piracy rate, it also is the country where the greatest losses occur (more than US$9.1 billion) because of its high level of computer usage.

In addition to being a crime, software piracy can lead to fines or public embarrassment and make users vulnerable to attacks. According to the Business Software Alliance, there is a strong correlation (a correlation coefficient of .78) between unlicensed software and malware. In other words, it is clear that by using pirated software, organizations expose themselves to a high risk of

FIGURE 10.11

In many parts of the world, using pirated software is a common practice.

Source: Courtesy of Christoph Schneider.

TABLE 10.1 Software Piracy Levels and Dollar Losses by Region

Region	Piracy Level	Dollar Loss (in US$ billions)
North America	17%	10.0
Western Europe	28%	10.5
Asia/Pacific	61%	19.1
Latin America	55%	5.8
Middle East and Africa	57%	3.7
Central and Eastern Europe	58%	3.1
Worldwide	39%	52.2

Source: Based on Business Software Alliance (2016).

contracting malware. However, ethical questions surrounding the use of pirated software are often debated. While software piracy is often considered an ethical problem, businesspeople must acknowledge and deal with other perspectives as well. In part, the problem stems from other countries' differing concepts of ownership. Many of the ideas about intellectual property ownership stem from long-standing cultural traditions. For example, the concept of individual ownership of knowledge is traditionally a strange one in many Middle Eastern countries, where knowledge is meant to be shared. Plagiarism does not exist in a culture where words belong to everyone. By the same token, piracy does not exist either. This view is gradually changing; the Saudi Arabia Patent Office granted its first patents several years ago, and its piracy rates have plummeted from 79 percent in 1996 to 49 percent in 2015. Other factors leading to piracy or infringement of intellectual property agreements throughout the world include lack of public awareness about the issue and the increasingly high demand for computers and other technology products.

In other cases, there are political, social, and economic reasons for piracy. In many countries, software publishers are not catering to the needs of those consumers who simply may not have the funds to purchase software legitimately. This is true in many areas of South America, Africa, and other regions with low per capita income. It is particularly true of students and other members of university communities whose needs are critical in some areas. Recognizing these issues, many software manufacturers offer educational versions or use differential pricing for different regions.

Cybersquatting

Another form of piracy is **cybersquatting**, the dubious practice of registering a domain name and then trying to sell the name for big bucks to the person, company, or organization most likely to want it. Domain names are one of the few scarce resources on the Internet, and victims of cybersquatting include Panasonic, Hertz, Avon, and numerous other companies and individuals. Fortunately, the U.S. government passed the Anti-Cybersquatting Consumer Protection Act in 1999, which made it a crime to register, traffic in, or use a domain name to profit from the goodwill of a trademark belonging to someone else. Fines for cybersquatting can reach as high as US$100,000, in addition to the forfeiture of the disputed domain name, and courts have not been kind to cybersquatters. Many feel, however, that it is often much easier simply to pay the cybersquatter because that will likely be much faster and cheaper than to hire a lawyer and go through a lengthy legal process. No matter how companies or individuals deal with this problem, valuable resources of time and money are wasted resolving these disputes.

Laws Against Computer Crime

In the United States, there are two main federal laws against computer crime: the Computer Fraud and Abuse Act of 1986 and the Electronic Communications Privacy Act of 1986. The Computer Fraud and Abuse Act of 1986 prohibits the following:

- Stealing or compromising data about national defense, foreign relations, atomic energy, or other restricted information

- Gaining unauthorized access to computers owned by any agency or department of the U.S. government
- Violating data belonging to banks or other financial institutions
- Intercepting or otherwise intruding on communications between states or foreign countries
- Threatening to damage computer systems in order to extort money or other valuables from persons, businesses, or institutions
- Threatening the U.S. president, vice president, members of Congress, and other administrative members (even if it's just in a critical e-mail)

In 1996, the Computer Abuse Amendments Act expanded the Computer Fraud and Abuse Act of 1986 to prohibit the dissemination of computer viruses and other harmful code. These and other relevant US laws are listed in Table 10.2. Throughout the world, most countries have some combination of laws to protect data, privacy, and security.

As computer capabilities continue to evolve, so do the crimes that new capabilities enable. Some critics argue that laws do not go far enough to prosecute computer crimes, while others believe that they should not be invoked when systems are breached but no damage is done. Even the definition of "damage" is debatable. For instance, has damage occurred if someone gains unauthorized access to a computer system but does not steal or change data?

There are additional difficulties in legislating and enforcing laws that affect global networks. Because many countries can be involved when break-ins and other crimes occur, who has jurisdiction? Should e-mail messages be monitored for libelous or other illegal content, and, if so, who should have monitoring responsibility? Should e-mail be subject to the same laws as mail delivered by the U.S. Postal Service, or should it be more akin to telephone conversations and the laws that apply to them?

Cyberwar and Cyberterrorism

Over the past several years, individual computer criminals have caused billions of dollars in losses by spreading malware or through unauthorized access to computers. In the future, many believe that coordinated efforts by national governments or terrorist groups have the potential to cause hundreds of billions of dollars in damage as well as put the lives of countless people at risk (Bremmer, 2015). Most experts believe that cyberwar and cyberterrorism are imminent threats to the United States and other technologically advanced countries. A major attack that cripples a country's information infrastructure or power grid or even the global Internet could have

TABLE 10.2 Examples of Several U.S. Federal Laws Related to Computer Crime

Law	Focus
Computer Fraud and Abuse Act	Legislation making it a federal crime to access a protected computer without proper authorization.
Electronic Communications Privacy Act	Law related to various types of communication, including wiretaps and stored communication.
USA Patriot Act	Law passed shortly after the September 11, 2001, terrorist attacks in the United States giving law enforcement agencies increased, broad powers to bring terrorists to justice.
CAN-SPAM Act	Law that provides recipients of commercial e-mail messages with the right to opt out of these messages and have their opt-out (or unsubscribe) request be acted upon.
Telephone Consumer Protection Act	Law that restricts telephone solicitations and the use of automated telephone equipment such as automated dialing systems, prerecorded messages, and text messages and fax machine spam.
Right to Financial Privacy Act	Law that provides customers of financial institutions the right to some level of privacy from government searches; searches could only be performed if it could be demonstrated that the person was a foreign power.
U.S. Copyright Act	Law that protects the creator of a literary, artistic, musical, or other creative work, including software, providing the sole right to publish and sell that work.

WHO'S GOING MOBILE

Backdoors in Every Mobile Phone?

In late 2015, Syed Rizwan Farook and his wife Tashfeen Malik killed 14 people and seriously injured 22 in a terrorist attack in San Bernardino, California. Following the attack, the FBI obtained Farook's work iPhone. However, as the iPhone was locked with an access code, the contents of the phone would be erased if more than 10 failed login attempts occurred, so the FBI asked Apple to provide a backdoor into Farook's iPhone in order to access the phone's contents. After Apple refused to unlock the phone, arguing that it would violate trust with its customers, the FBI sued Apple to provide a new operating system that would essentially provide a backdoor into the phone. In late March 2016, the FBI dropped the suit against Apple after finding another method for unlocking the phone.

The event has sparked a strong debate about the balance between security and privacy. Privacy advocates say that Apple should never be compelled to unlock one of its phones, as providing a backdoor can result in an unreasonable "search and seizure" of protected data; when a government accesses electronic devices through such backdoor, it is conducting an electronic version of such banned searches. Security advocates argue that security is a common good that is promised to all, and the most important job of government is to "secure the general welfare" of its citizens; thus, security must outweigh any personal concerns about privacy, and it is necessary to unlock some phones when it is important to protect society. This debate between privacy and security is not new. Over the millennia, there have been debates about the trade-offs between security and privacy, and the Apple versus FBI case will not end this debate.

Based on:

2015 San Bernardino attack. (2016, March 26). In *Wikipedia, The Free Encyclopedia*. Retrieved March 29, 2016, from https://en.wikipedia.org/w/index.php?title=2015_San_Bernardino_attack&oldid=712033195

Anonymous. (n.d.). Privacy vs security. *debatewise*. Retrieved March 28, 2016, from http://debatewise.org/debates/3040-privacy-vs-security

Corvitz, L. G. (2016, March 27). FBI vs. Apple isn't over. *The Wall Street Journal*. Retrieved March 28, 2016, from http://www.wsj.com/articles/fbi-vs-apple-isnt-over-1459116064

Johnson, K., Swartz, J., & della Cava, M. (2016, March 28). FBI hacks into terrorist's iPhone without Apple. *USA Today*. Retrieved March 28, 2016, from http://www.usatoday.com/story/news/nation/2016/03/28/apple-justice-department-farook/82354040

devastating implications for a country's (or the world's) economic system and make transportation systems, medical capabilities, and other key infrastructure extremely vulnerable to disaster, especially given the proliferation of cloud computing for many personal, commercial, and governmental applications.

Cyberwar

Cyberwar refers to an organized attempt by a country's military to disrupt or destroy the information and communication systems of another country. Cyberwar is often executed simultaneously with traditional methods to quickly dissipate the capabilities of an enemy, and intelligence agencies from countries around the world are secretly probing networks and looking for weaknesses in their potential enemies' computer systems. For example, during the 78-day Serbia/Kosovo war in 1999, the United States reportedly conducted its first cyberwar campaign using a team of information warriors to support its bombing campaign against Serbia. The U.S. information operation cell electronically attacked Serbia's critical networks and command-and-control systems. However, given that the United States and NATO alliance is the most technologically sophisticated war machine in the world—and also the most dependent on its networking and computing infrastructure—it is also the most vulnerable to cyberwar (or cyberterrorism) attacks.

CYBERWAR VULNERABILITIES. The goal of cyberwar is to turn the balance of power—through information and knowledge—in one's favor in order to enhance one's capabilities while diminishing those of an opponent. Cyberwar utilizes a diverse range of technologies, including software, hardware, and networking technologies, to gain an information advantage over an opponent. These technologies can be used to electronically blind, jam, deceive, overload, and intrude into an enemy's information systems infrastructure in order to diminish various capabilities, including the following:

- Command-and-control systems
- Intelligence collection, processing, and distribution systems
- Tactical communication systems and methods

- Troop and weapon positioning systems
- Friend-or-foe identification systems
- Smart weapons systems

Additionally, controlling the content and distribution of propaganda and information to an opponent's civilians, troops, and government is a key part of a cyberwar strategy. At the simplest level, **web vandalism** can occur by defacing an opponent's websites. Likewise, cyberpropaganda can be quickly and easily distributed through websites, social media, and e-mail. Espionage—stealing of secrets or modifying information—can occur if data and systems are not adequately protected and secure.

While there are several known attacks, most governments deny involvement. Typically, governments accused of cyberwar activities blame uncontrolled **patriot hackers**—independent citizens or supporters of a country that perpetrate attacks on perceived or real enemies. A recent example of such an attack was discovered in June 2010 when a Belarus-based computer security company discovered a computer worm called **Stuxnet** on a computer system belonging to an Iranian client. Stuxnet is a computer worm designed to find and infect a particular piece of industrial hardware inside Iranian nuclear plants. Once Stuxnet found its intended target—centrifuges within Iran's nuclear enrichment program—it was programmed to manipulate their motor speeds. The manipulation of the motor speeds beyond normal operating tolerances would ultimately destroy the equipment, slowing and degrading the nuclear program. Since its discovery, computer security experts around the globe have studied its design. Stuxnet is a very sophisticated and unprecedented method for attacking an adversary. While most experts agreed that Stuxnet was most likely designed by a nation-state, from the time of its discovery, no country had come forward to admit involvement in its creation. This suspicion ended in June 2012, when it was revealed that Israel and the United States worked together to design Stuxnet. It is one of the first examples where cyberwarfare was used to inflict physical damage to critical infrastructures of a nation-state. Another (admittedly less damaging attack) on the Iranian nuclear program happened in 2012, when malware introduced into Iranian nuclear facilities caused computers to play AC/DC's "Thunderstruck" at full volume in the middle of the night.

It is also often difficult to differentiate cyberattacks by known terrorist groups from those of legitimate governments. Many governments such as Iran, Syria, North Korea, and others have been suspected of supporting the activities of terrorist organizations. For example, in 2016, Pakistani intelligence agents used an app called SmeshApp to spy on Indian army personnel who were tricked into installing the app on their smartphones. SmeshApp provided similar capabilities as the popular messaging apps WhatsApp and Telegram. After being downloaded, the app gained access to contacts, photos, and other personal data as well as captured the phone's contact list, messaging data, e-mail, browsing history, and so on. Ultimately, data gained from the app were sent to a database in Germany that was allegedly controlled by Pakistani intelligence. Data captured from this activity were provided to Pakistani-based terrorists who launched an attack on India's Pathankot Air Force Station that killed several people.

In traditional war, destroying equipment by dropping a bomb is an act of war. Time will tell how nation-states will respond to cyberattacks that ultimately cause similar damage, and regardless of the source of these attacks, it is clear that one of the big challenges for governments moving forward will be to fully integrate a cyberwar strategy into their overall plans and capabilities.

Cyberterrorism

Unlike cyberwar, **cyberterrorism** is launched not by governments but by individuals and organized groups. Cyberterrorism is the use of computer and networking technologies against persons or property to intimidate or coerce governments, civilians, or any segment of society in order to attain political, religious, or ideological goals. One of the great fears about cyberterrorism is that an attack can be launched from a computer anywhere in the world—no borders have to be crossed, no bombs smuggled and placed, and no cyberterrorists' lives are lost in carrying out the attack. Because computers and networking systems control power plants, telephone systems, and transportation systems as well as water and oil pipelines, any disruption of these systems could cause loss of life or widespread chaos. Just as physical terrorist attacks have physical and psychological effects, so also do cyberattacks. Dealing with the unknown—where, when, and how—of an indiscriminant terrorist attack is what leads to "terror."

TABLE 10.3 Categories of Potential Cyberterrorist Attacks

Category	Description
Coordinated bomb attacks	To distribute a number of devices—from small explosive devices to large weapons of mass destruction—that communicate with each other through the Internet or cellular phone networks and are made to simultaneously detonate if one device stops communicating with the others
Manipulation of financial and banking information	To disrupt the flow of financial information with the objective of causing fear and lack of confidence in a country's or the world's financial system
Manipulation of the pharmaceutical industry	To make hard-to-detect changes in the formulas of medications in order to cause fear and lack of confidence in this important industry
Manipulation of transportation control systems	To disrupt airline and railroad transportation systems, possibly leading to disastrous collisions
Manipulation of the broader civilian infrastructures	To compromise the communication, broadcast media, gas lines, water systems, and electrical grids in order to cause panic and fear within the population
Manipulation of nuclear power plants	To disrupt cooling systems in order to cause a meltdown that would disperse radiation

WHAT KINDS OF ATTACKS ARE CONSIDERED CYBERTERRORISM? Cyberterrorism could involve physical destruction of computer systems or acts that destroy economic stability or infrastructure. Cyberterrorist acts could likely damage the machines that control traffic lights, power plants, dams, or airline traffic in order to create fear and panic. Attacks launched in cyberspace could take many forms, such as viruses, denial of service, destruction of government computers, stealing classified files, altering web page content, deleting or corrupting vital information, disrupting media broadcasts, and otherwise interrupting the flow of information. Table 10.3 summarizes several categories of attacks that experts believe cyberterrorists could try to deliver.

The goal of cyberterrorists is to cause fear, panic, and destruction. Through the power of computer technology and global networks, terrorists can gain access to critical parts of the world's infrastructure to produce both physical and virtual terror. Given the great potential for cyberterrorism, many experts believe that it will, unfortunately, become the weapon of choice for the world's most sophisticated terrorists.

HOW THE INTERNET IS CHANGING THE BUSINESS PROCESSES OF TERRORISTS. Just as the Internet has fueled globalization for organizations and societies, it too has fueled global terrorism, and virtually all modern terrorist groups utilize the Internet. Beyond using the Internet to wage cyberattacks, the Internet is a powerful tool for improving and streamlining the business processes of the modern terrorist (Table 10.4).

ASSESSING THE CYBERTERRORISM THREAT. Some experts claim that because of the general openness of access, the Internet infrastructure is extremely vulnerable to cyberterrorism. Each year, cyberattacks on critical infrastructure such as nuclear power plants, dams, and power grids are increasing. While the majority of such attacks have not done damage at this point, a few have been alarmingly successful and concerning:

- In May 2003, Romanian crackers compromised systems that housed life-support control for 58 scientists and contractors in Antarctica. FBI agents assisted in the arrest of the crackers, who attempted to extort money from the research station.
- In May 2007, government networks and commercial banks within Estonia came under a very sophisticated cyberattack by cyberterrorists in retaliation for the removal of a Soviet-era memorial to fallen soldiers.
- In 2010–2013, "The Jester," believed to be a former U.S. soldier, claimed responsibility for attacks on WikiLeaks, Islamists' websites, and even the website of Iranian President Mahmoud Ahmadinejad. After a successful attack, The Jester broadcast "TANGO DOWN"—a military term that means a target has been injured or killed—on Twitter.
- In 2015, a group called CyberCaliphate attacked TV5, a French media outlet, taking control of its website and social media accounts and incapacitating its broadcasting for hours.

It also published the names and family members, along with various threats, of French military personnel.

While cyberterrorism obviously remains a threat to computer and network security, some experts point out that there are disadvantages to using acts of cyberterrorism as a weapon, including the following:

1. Computer systems and networks are complex, so cyberattacks are difficult to control and may not achieve the desired destruction as effectively as physical weapons.
2. Computer systems and networks change and security measures improve, so an ever-increasing level of knowledge and expertise on the part of intruders is required for cyberattacks to be effective. This means that perpetrators will be required to continuously study and hone their skills as older methods of attack no longer work.
3. Cyberattacks rarely cause physical harm to victims; therefore, there is less drama and emotional appeal than for perpetrators using conventional weapons.

Some experts believe that the likelihood of a devastating attack that causes significant disruption in the major U.S. infrastructure systems is quite low because of the resources and intelligence needed carry out a sophisticated attack. Nevertheless, small attacks have been occurring for years and are likely to increase in frequency and severity—even a "small" attack, like an individual suicide bomber, can cause tremendous chaos in a society. While cyberterrorism and cyberwar may be methods of choice for future generations with advanced computer knowledge, experts are hopeful that the increasing sophistication of computer security measures will help reduce the number of such incidents.

RESPONDING TO GLOBAL CYBERTERRORISM THREATS. With the proliferation of and dependence on technology increasing at an astronomical rate, the threat of cyberterrorism will continue to increase. As has been true with virtually all governments and business organizations, fueled by the digitization of information and the Internet, terrorism has become a global business. To be adequately prepared, national governments along with industry partners must design coordinated

TABLE 10.4 How Terrorists Are Using the Internet

Use	Description
Information dissemination	The use of websites and social media to disseminate propaganda to current and potential supporters, to influence international public opinion, and to notify potential enemies of pending plans
Data mining	The use of advanced analytics to collect and analyze the vast amount of structured and unstructured data available on the Internet regarding virtually any topic for planning, recruitment, and numerous other endeavors
Fundraising	The use of websites for bogus charities and nongovernmental organizations to raise funds and transfer currencies around the world
Recruiting and mobilization	The use of websites to provide information for recruiting new members as well as roaming online chat rooms, social media, and cybercafés for receptive individuals
Networking	The use of the Internet to enable a less hierarchical, cell-based organizational structure that is difficult to combat; networking capabilities also allow different groups with common enemies to better share and coordinate information
Information sharing	The use of the Internet as a powerful tool for announcing events as well as sharing best practices
Training	The use of the Internet to disseminate training materials. For example, the official Hamas website details how to make homemade poisons and gases, and Syrian rebels use YouTube to disseminate weapons training videos.
Planning and coordinating	The use of communication and information dissemination capabilities to facilitate designing and executing plans
Information gathering	The use of mapping software such as Google Earth to locate potential targets for terrorist attacks
Location monitoring	The use of public webcams to monitor and study potential attack sites (e.g., public places or civil infrastructure such as tunnels or power generation facilities)

ETHICAL DILEMMA

Ethics and Cyberwar: Just Because We Can, Should We?

One of the realities of the digital world is constant and unrelenting change. The exponential increase in performance of computers has helped to usher in new gadgets and technologies that can do new things that were once unimaginable. All this change has resulted in many positive advances, from the promise of commercial space travel to self-driving cars. What often doesn't keep pace with all this innovation and change are the laws and ethical standards for what should or should not be legal or ethical to do. For example, because it is technically possible for the government to listen to any of your phone calls, read any of your e-mail messages, or monitor your online activity, what legal and ethical bounds should be enforced?

Just as technology is transforming how we work and live, it is also transforming how war can be conducted. By now, we are familiar with airstrikes conducted by drones, controlled by personnel located in a safe facility at a remote airbase. These drone strikes effectively enable the killing of people without putting oneself into harm's way. Likewise, cyberwar raises many serious issues for societies, issues that need to be addressed by policies and agreements. Cyber-weapons are difficult to precisely target, given the interdependence of most modern computer systems. As such, collateral damage to civilian targets is a major concern (e.g., a nasty computer virus targeting military computers might simultaneously take out civilian computers). Avoiding disproportionate damage to civilians is a key part of the Geneva Conventions and the law of war (i.e., a series of international agreements related to the humane treatment of war prisoners, acceptable justification to engage in war, acceptable wartime conduct, and so on). In less technologically advanced societies, repairing the damage caused by a massive cyberattack may be especially difficult, resulting in excessive and long-term impacts on civilians and society. Crippling a country's power grid, telephone, and banking systems may provide a strong strategic advantage in a war but may have equally damaging effects on its citizens and society.

Questions

1. What are the ethical implications of drone strikes?
2. Should cyberwar attacks be prosecutable as war crimes? If so, under which circumstances?

Based on:

Geneva Conventions. (2016, March 22). In *Wikipedia, The Free Encyclopedia*. Retrieved March 28, 2016, from https://en.wikipedia.org/w/index.php?title=Geneva_Conventions&oldid=711345522

Law of war. (2016, March 21). In *Wikipedia, The Free Encyclopedia*. Retrieved March 28, 2016, from https://en.wikipedia.org/w/index.php?title=Law_of_war&oldid=711123158

Tucker, P. (2015, April 20). NSA chief: Rules of war apply to cyberwar, too. *Defense One*. Retrieved March 29, 2016, from http://www.defenseone.com/technology/2015/04/nsa-chief-rules-war-apply-cyberwar-too/110572

responses to various attack scenarios. In addition to greater cooperation and preparedness, governments must improve their intelligence-gathering capabilities so that potential attacks are thwarted before they begin. Industry must also be given incentives to secure their information resources so that losses and disruptions in operations are minimized. International laws and treaties must rapidly evolve to reflect the realities of cyberterrorism, where attacks can be launched from anywhere in the world to anywhere in the world. Clearly, there are great challenges ahead.

Managing Information Systems Security

Everyone who uses an information system (IS) knows that disasters can happen to stored data or to entire systems. Some disasters are unintentional, such as accidents caused by power outages, inexperienced computer users, or mistakes, while others are deliberate, caused on purpose by malicious crackers. The primary threats to the security of information systems include the following (Figure 10.12):

- ***Natural Disasters:*** power outages, hurricanes, floods, and so on
- ***Accidents:*** inexperienced or careless computer operators (or cats walking across keyboards!)
- ***Employees and Consultants:*** people within an organization who have access to electronic data
- ***Links to Outside Business Contacts:*** electronic data that can be at risk when it travels between or among business affiliates as part of doing business
- ***Outsiders:*** hackers and crackers who penetrate networks and computer systems to snoop or to cause damage (Viruses, perpetually rampant on the Internet, are included in this category.)

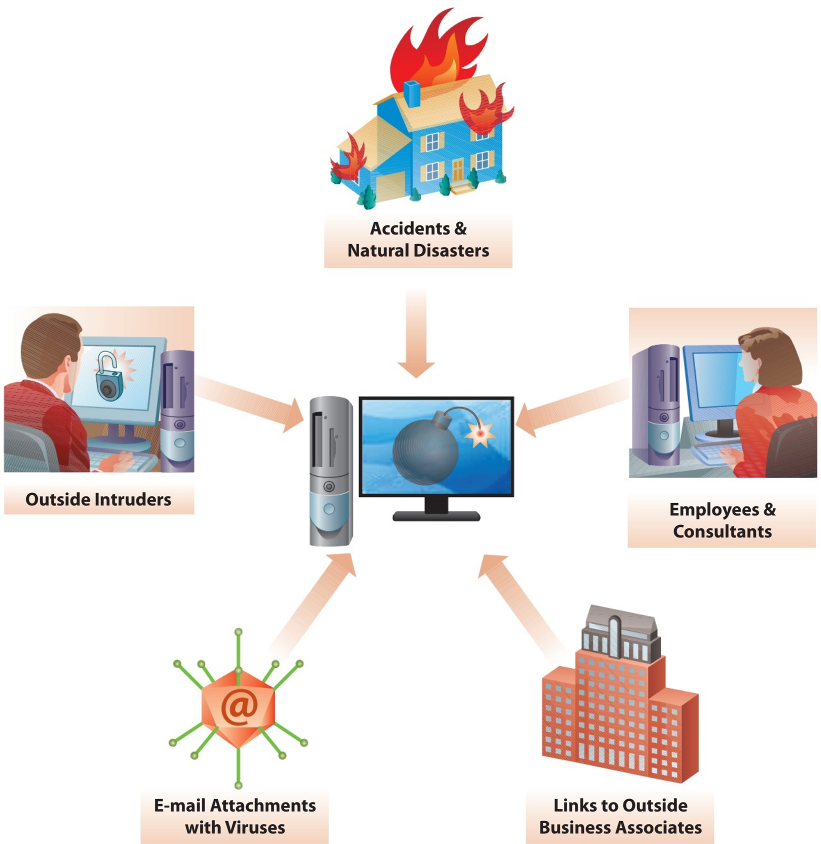


FIGURE 10.12

Threats to IS security.

For individuals as well as organizations, trying to recover from disasters carries high costs in terms of time and money; in addition, organizations can lose much goodwill if their systems are unavailable (no matter what the reason is), their systems are compromised by malicious crackers, or customer data are stolen. How do you secure information systems from such dangers? How do you know what systems are at risk of being compromised? The rule of thumb for deciding whether an information system is at risk is simple: All systems connected to networks are vulnerable to security violations from both insiders and outsiders as well as to virus infections and other forms of computer crime. Further, no information system is immune to intentional or unintentional physical harm. In short, threats to information systems can come from a variety of places internal and external to an organization.

Information systems security refers to precautions taken to keep all aspects of information systems (e.g., all hardware, software, network equipment, and data) safe from destruction, manipulation, or unauthorized access or use while providing the intended functionality to legitimate users. Specifically, organizations have to consider the following:

- ***Availability:*** ensuring that legitimate users can access the system
- ***Integrity:*** ensuring that unauthorized manipulations of data and systems (that may compromise accuracy, completeness, or reliability of data) are prevented
- ***Confidentiality:*** ensuring that data are protected from unauthorized access
- ***Accountability:*** ensuring that actions can be traced

Hence, for organizations, it is essential to carefully manage IS risk and to ensure business continuity by securing their IS infrastructure. As use of the Internet and related telecommunications technologies and systems has become pervasive, use of these networks now creates various dangerous vulnerabilities for organizations. These networks can be infiltrated and/or subverted in a number of ways. As a result, the need for tight computer and network security has increased dramatically. Fortunately, there are a variety of managerial methods and security technologies that can be used to manage IS security effectively. However, as threats to information systems constantly evolve, information systems security is an ongoing process, consisting of (Figure 10.13):

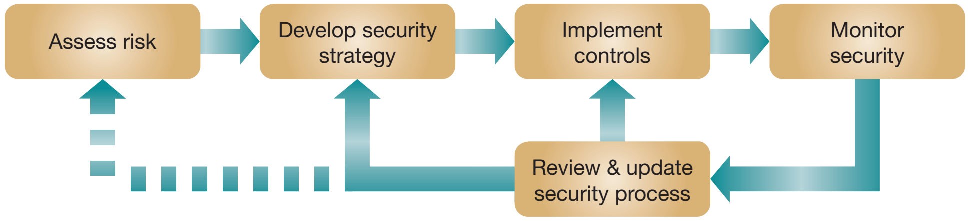


FIGURE 10.13

Information systems security is an ongoing process.

1. Assessing risks
2. Developing a security strategy
3. Implementing controls and training
4. Monitoring security

In addition, organizations should continuously watch for emerging threats and vulnerabilities as well as attacks (including attacks on other organizations) so as to update risk assessments and strategies and implement additional controls.

Assessing Risks

Maintaining customer confidence is essential for any organization, and any IS security-related incident can lead to reputation, operational, legal, and strategic risks. Consequently, any good approach to securing information systems begins first with a thorough **information systems risk assessment** to obtain an understanding of the risks to the availability, integrity, and confidentiality of data and systems. It would not make sense to spend literally millions of dollars a year to protect an asset the loss of which would cost the organization only a few thousand dollars. As a result, organizations attempt to identify and rank the risks in order to develop the most effective strategies. In other words, organizations assess the value of the assets being protected, determine their probability of being compromised, and compare the probable costs of their being compromised with the estimated costs of whatever protections they might have to take. Protecting an asset only makes economic sense if the cost of protecting the asset is less than (or equal to) the value of the asset (and the associated data that can be lost or damage that can be done) multiplied by the probability of a disaster. Thus, organizations perform risk assessments for their systems to ensure that IS security programs make sense economically (Stallings & Brown, 2017).

Such assessment should encompass all of an organization's systems, including hardware, software, data, networks, and any business processes that involve them, so as to identify threats and vulnerabilities, determine the probabilities of vulnerabilities being exploited, and assess the potential impact (i.e., the severity of the consequences if a threat indeed causes damage by exploiting a vulnerability) (Figure 10.14). **Threats** are typically defined as undesirable events that can cause harm and can arise from actions performed by agents internal or external to an organization. In other words, threats can come from current or former insiders (such as employees, contractors, etc.) as well as criminals, competitors, terrorists, or the elements. In contrast, **vulnerabilities** are defined as weaknesses in an organization's systems or security policies that can be exploited to cause damage and can encompass both known vulnerabilities (such as vulnerabilities discovered during audits) and expected vulnerabilities (such as unpatched software, new attack methodologies, or staff turnover).

FIGURE 10.14

Organizations have to understand the interplay between threats, vulnerabilities, and impacts to plan and implement effective IS controls.

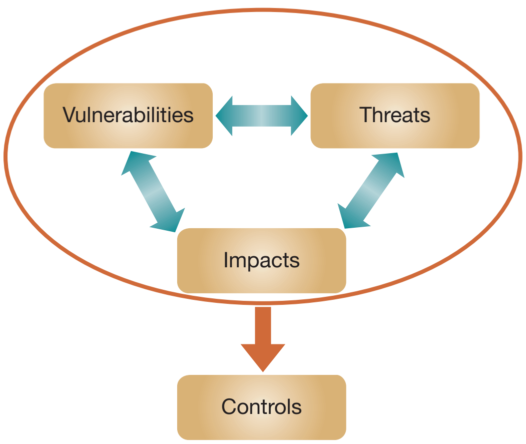


TABLE 10.5 Sample Risk Rating Matrix for a Customer Database

Risk Category	Impact	Likelihood	Risk Level (Impact × Likelihood)
Confidentiality	3	2	6
Integrity	2	3	6
Availability	3	1	3
Overall	***8***	***6***	***15***

By understanding and evaluating these factors, organizations can then design and implement a security strategy that makes the best use of the available resources in order to eliminate vulnerabilities or reduce impacts. In addition to an information systems risk assessment, organizations then periodically perform security audits to determine the effectiveness of the implemented measures. People within the IS department are usually responsible for implementing the security measures chosen, though people from throughout the organization should participate in the risk assessment.

In order to get a thorough understanding of risks, organizations need to consider both technical information (such as information about databases, hardware and software, and networks) and nontechnical information (such as information about processes and procedures related to physical or personnel security) to determine and assess the threats and vulnerabilities. Typically, a thorough information systems risk assessment uses both quantitative data (such as value of the asset or implementation costs of security measures) and qualitative data (e.g., results from interviews or walkthroughs) to arrive at a risk rating that reflects the possible impact, likelihood, and ultimate risk level for each particular function or asset (Table 10.5).

This risk rating then enables the organization to determine what steps, if any, to take to secure systems. Large organizations typically use a balance of different approaches, taking steps in **risk reduction** for some systems, accepting risk and living with it in other cases (i.e., **risk acceptance**), and also insuring all or most of their systems activities (i.e., **risk transference**). A fourth category—**risk avoidance** (e.g., by not engaging in e-commerce, not having a website, or not using e-mail)—can often be impractical or even infeasible in today's networked environment. See Table 10.6 for a summary of these options.

For organizations, the IT megatrends (see Chapter 1, "Managing in the Digital World") have led to the need to a far more wide-reaching risk assessment. For example, data on mobile devices are often particularly vulnerable to being compromised, and organizations using cloud computing often place their data and applications in the hands of third parties, which may or may not have appropriate security measures in place (note that using reliable cloud service providers is a common risk transference strategy). Likewise, the Internet of Things can expose organizations

TABLE 10.6 Options for Addressing IS Risks

Option	Description	Condition
Risk reduction	Taking active countermeasures to protect your systems	■ High risk cannot be accepted
Risk acceptance	Implementing no countermeasures and simply absorbing any damages that occur	■ There exists a low likelihood/impact ■ Other factors are more important than security
Risk transference	Having someone else absorb the risk	■ Other parties may be better equipped to manage the risk
Risk avoidance	Using alternate means or not performing tasks that would cause risk	■ Risk is unmanageable ■ Risk is too high

to a multitude of vulnerabilities: Data generated by various sensors may open the door to identity theft or hacking, and criminals may attempt gain control over smart objects to use them for nefarious purposes; thus, risk assessment and management should cover *all* devices that companies use to interact with their customers (EY, 2016).

Developing a Security Strategy

Once risks are assessed, a strategy should be formulated that details what **information systems controls** (in terms of technology, people, and policies) should be implemented. By ensuring the availability, integrity, and confidentiality of information, the controls help an organization to control costs, gain and protect trust, remain competitive, and comply with internal or external governance mandates (e.g., the Sarbanes–Oxley Act, discussed later in this section). Such controls can consist of a variety of different measures; to be most effective, an IS security strategy should focus on the following:

- **Preventive controls:** to prevent any potentially negative event from occurring, such as by preventing outside intruders from accessing a facility
- **Detective controls:** to assess whether anything went wrong, such as unauthorized access attempts, and to limit damage
- **Corrective controls:** to mitigate the impact of any problem after it has arisen, such as restoring compromised data

Whereas most efforts should focus on prevention, detection and correction are important to compensate for any weaknesses in preventive measures, and organizations have to strike the balance between implementing preventive measures and providing functionality for the users. Thus, organizations use the principles of *least permissions* and *least privileges*, meaning that users should only be given access to the systems, data, or resources that are needed to perform their duties and should be restricted from accessing other resources (Figure 10.15). Typically, information systems controls comprise multiple layers such that a potential attacker has to break several layers to conduct a successful attack; using multiple defense layers not only helps in thwarting the attack but also increases the chances of detecting the attacker.

POLICIES AND PROCEDURES. Very often some of the best things that people can do to secure their information systems are not necessarily technical in nature. Instead, they may involve changes within the organization and/or better management of people's use of information systems. For example, one of the outcomes of the risk assessment described here may well be a

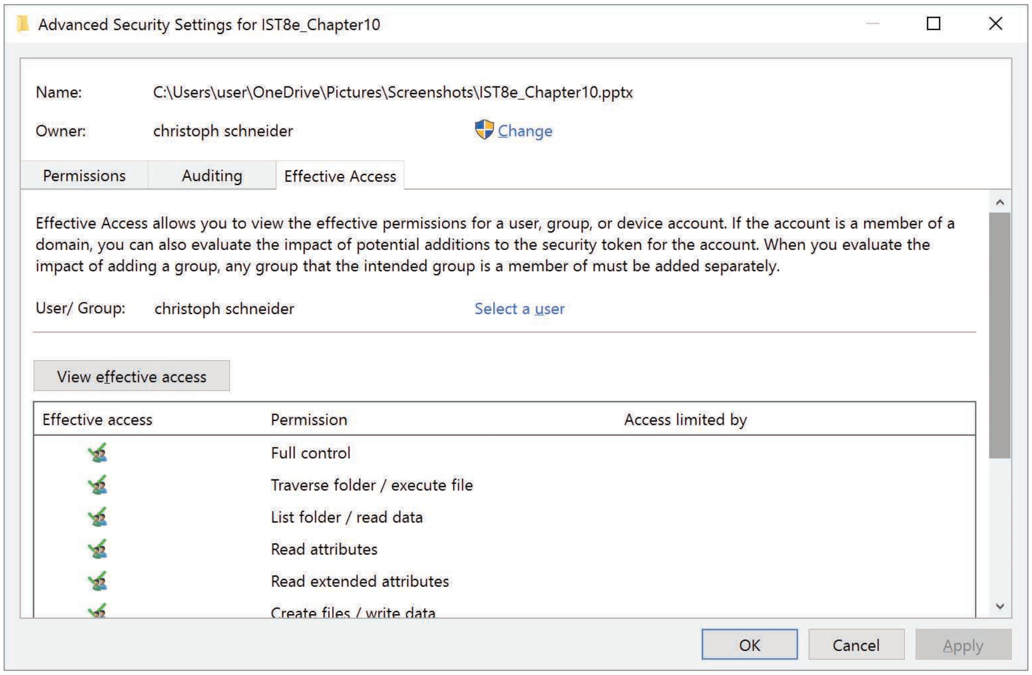
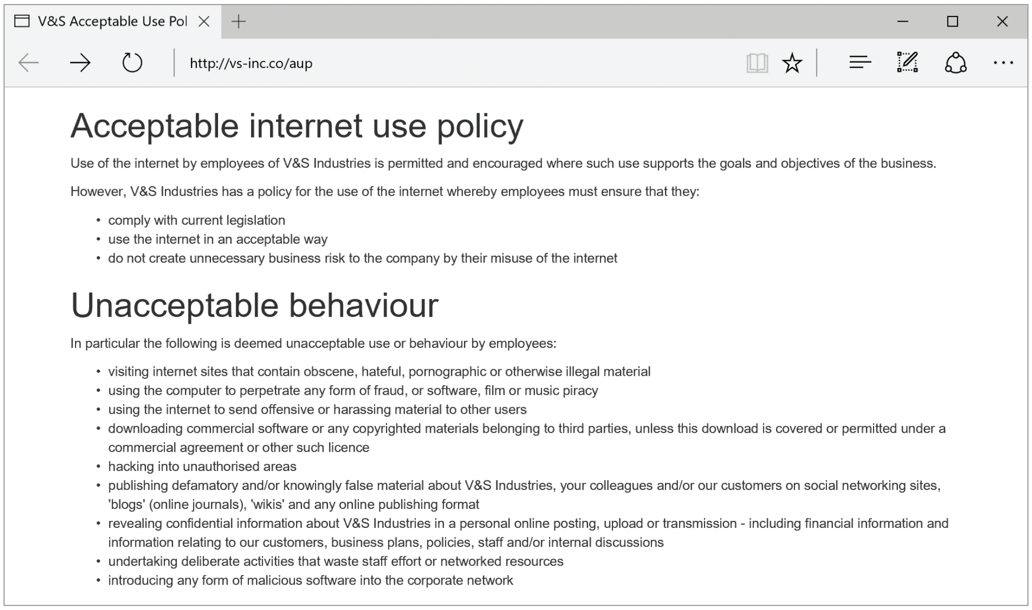


FIGURE 10.15

Following the principles of least permissions and least privileges, users should only be given access to the systems, data, or resources that are needed to perform their duties.

Source: Windows 10, Microsoft Corporation.



Acceptable internet use policy

Use of the internet by employees of V&S Industries is permitted and encouraged where such use supports the goals and objectives of the business.

However, V&S Industries has a policy for the use of the internet whereby employees must ensure that they:

- comply with current legislation
- use the internet in an acceptable way
- do not create unnecessary business risk to the company by their misuse of the internet

Unacceptable behaviour

In particular the following is deemed unacceptable use or behaviour by employees:

- visiting internet sites that contain obscene, hateful, pornographic or otherwise illegal material
- using the computer to perpetrate any form of fraud, or software, film or music piracy
- using the internet to send offensive or harassing material to other users
- downloading commercial software or any copyrighted materials belonging to third parties, unless this download is covered or permitted under a commercial agreement or other such licence
- hacking into unauthorised areas
- publishing defamatory and/or knowingly false material about V&S Industries, your colleagues and/or our customers on social networking sites, 'blogs' (online journals), 'wikis' and any online publishing format
- revealing confidential information about V&S Industries in a personal online posting, upload or transmission - including financial information and information relating to our customers, business plans, policies, staff and/or internal discussions
- undertaking deliberate activities that waste staff effort or networked resources
- introducing any form of malicious software into the corporate network

FIGURE 10.16

Most organizations provide employees or customers with an acceptable use policy.

set of computer and/or Internet use policies (sometimes referred to as **acceptable use policies**) for people within the organization, with clearly spelled-out penalties for noncompliance (Figure 10.16).

In general, policies and procedures that guide users' decisions and establish responsibilities include the following:

- ***Confidential Information Policy:*** outlines how sensitive information will be handled, stored, transmitted, and destroyed
- ***Security Policy:*** explains technical controls on all organizational computer systems, such as access limitations, audit-control software, firewalls, and so on
- ***Use Policy:*** outlines the organization's policy regarding appropriate use of in-house computer systems; may mandate no Internet surfing, use of company computer systems only for employment-related purposes, restricted use of social networking and e-mail, and so on
- ***Backup Policy:*** explains requirements for backing up data so that critical data can be restored in case of data loss
- ***Account Management Policy:*** lists procedures for adding new users to systems and removing users who have left the organization
- ***Incident Handling Procedures:*** lists procedures to follow when handling a security breach
- ***Disaster Recovery Plan:*** lists all the steps an organization will take to restore computer operations in case of a natural or deliberate disaster (Each department within the organization generally has its own disaster recovery plan; see the following discussion.)

While establishing such policies and procedures is crucial, they need to be clearly communicated; organizations often require employees to acknowledge the acceptance of policies in order to mitigate risks arising from employee noncompliance, and mechanisms should be in place for enforcing these. Needless to say, such policies and procedures need to be continually reviewed and updated to account for environmental changes. More fundamental to security than management techniques such as these is that you make every effort to hire trustworthy employees and treat them well. Trustworthy employees who are treated well are less likely to commit offenses affecting the organization's information systems.

DISASTER PLANNING. In some cases, all attempts to provide a reliable and secure IS infrastructure are in vain, and disasters cannot be avoided. Thus, organizations need to be prepared for potential impacts. A **business continuity plan** describes how a business continues operating after a disaster before normal operations have been restored; relatedly, a **disaster recovery plan** spells out detailed procedures for recovering from systems-related disasters, such as virus infections and other disasters that might cripple the IS infrastructure. This way, even under the worst-case scenario, people will be able to replace or reconstruct critical files or data, or they will at least have a plan readily available to begin the recovery process. A typical disaster recovery plan includes information that answers the following questions:

- What events are considered a disaster?
- What should be done to prepare the backup site?
- What is the chain of command, and who can declare a disaster?
- What hardware and software are needed to recover from a disaster?
- Which personnel are needed for staffing the backup sites?
- What is the sequence for moving back to the original location after recovery?
- Which providers can be drawn on to aid in the disaster recovery process?

Backup sites are critical for business continuity in the event a disaster strikes; in other words, backup sites can be thought of as a company's office in a temporary location. In addition, organizations should have **backups** of important data in place. Typically, such backups use media such as external hard drives, CDs, or tapes, or data are backed up to online backup service providers at regular intervals. No matter what the medium is, backed-up data should be encrypted so that in the event computer criminals gain access to the backup media, the data are useless to them.

Commonly, a distinction is made between cold and hot backup sites. A **cold backup site** is nothing more than an empty warehouse with all necessary connections for power and communication but nothing else. In the case of a disaster, a company has to first set up all necessary equipment, ranging from office furniture to web servers. While this is the least expensive option, it also takes a relatively longer time before a company can resume working after a disaster. A **hot backup site**, in contrast, is a fully equipped backup facility, having everything from office chairs to a one-to-one replication of the most current data. In the event of a disaster, all that has to be done is to relocate the employees to the backup site to continue working. Obviously, this is a very expensive option, as the backup site has to be kept fully equipped and all the IS infrastructure duplicated.

DESIGNING THE RECOVERY PLAN. When planning for disaster, two primary objectives should be considered by an organization: recovery time and recovery point objectives. **Recovery time objectives** specify the maximum time allowed to recover from a catastrophic event. For example, should the organization be able to resume operations in minutes, hours, or days after the disaster? Companies using cloud-based backup services often forget that restoring large quantities of data from the cloud can take a long time; having completely redundant systems helps to minimize the recovery time and might be best suited for mission-critical applications, such as e-commerce transaction servers. For other applications, such as data mining, while important, the recovery time can be longer without disrupting primary business processes.

Recovery point objectives specify how current the backup data should be. Imagine that your computer's hard drive crashes while you are working on a term paper. Luckily, you recently backed up your data. Would you prefer the last backup to be a few days old, or would you rather have the last backup include your most recent changes to the term paper? Hot backup sites typically have a redundant backup of the data so that the business processes are interrupted as little as possible and data loss is minimized (or even avoided) in the event of a catastrophic failure. To achieve this redundancy, all data are **mirrored** on separate servers (i.e., everything is stored synchronously on two independent systems). This might seem expensive, but for a critical business application involving customers, it may be less expensive to run a redundant backup system in parallel than it would be to disrupt business or lose customers in the event of catastrophic system failure.

Often, companies choose to replicate their data centers in multiple locations. Thinking about the location of redundant systems is an important aspect of disaster planning. If a company relies on redundant systems, all of which are located within the same building, a single event can incapacitate all the systems. Similarly, events such as a hurricane can damage systems that are located across town from each other. Thus, even if the primary infrastructure is located in-house, it pays to have a backup located in a different geographic area to minimize the risk of a disaster happening to both systems.

Implementing Controls and Training

Once a comprehensive strategy has been formulated, organizations can decide which controls to implement and train personnel regarding security policies and measures. Such controls can encompass different measures, such as systems security policies and their physical implementation,

SECURITY MATTERS

Back to the Future: Analog May Be the Future of Securing Critical Infrastructure

Over the past 50 years, the world has evolved from the analog to the modern digital world. Analog devices represent data as continuous variable quantities, such as length, width, voltage, sound, or pressure. In an old car, for example, an analog speedometer would indicate the rate of travel in miles (or kilometers) per hour by a dial that might range from 0 to 120 MPH. As the car's speed changed, so too would a center-mounted needle to indicate the current speed. Other analog devices include classic record players and tube amplifiers that many top musicians like to use. One major drawback of analog data is that they cannot be easily and quickly shared or transmitted over networks. In the modern digital world, however, we have embraced the power of precisely controlled computer-based devices, leveraging databases, and sharing data across networks throughout the world; digital recordings of music are shared with millions of customers around the world using networked platforms like iTunes, companies use the Internet to interconnect their global supply chains to better serve their customers, and various devices or even entire factories can be controlled remotely.

While the use of digital computers has led to a tidal wave of positive change throughout the world, cyberterrorism expert Ralph Langner, a foremost expert on the security of critical infrastructure components such as nuclear power plants, power grid substations, and water treatment plants, is wondering whether the old, analog approach might be more secure than a fully digital infrastructure. A digitally networked control infrastructure provides many benefits, such as remote monitoring and greater flexibility. However, virtually every system that is connected to a network can be remotely hacked, while old-school analog systems require a human operator to turn a dial or flip a switch. In other words, analog equipment cannot be infected by malware and commandeered by hackers. Langner cautions against the wholesale replacement of digital with analog devices, as digital provides many benefits. However, he suggests that some key components should remain analog in order to isolate critical parts of a plant so that catastrophic damage cannot be remotely initiated by cyberterrorists.

Based on:

Roberts, P. (2014, March 17). Is analog the answer to cyber terrorism? *The Security Ledger*. Retrieved March 28, 2016, from https://securityledger.com/2014/03/is-analog-the-answer-to-our-digital-insecurity-dilemma

Sax, D. (2016, March 10). The best insurance may be analog. *Bloomberg Business*. Retrieved March 28, 2016, from http://www.bloomberg.com/news/articles/2016-03-10/cybersecurity-the-best-insurance-may-be-analog

access restrictions, or record keeping, to be able to trace actions and transactions and who is responsible for these. IS controls thus need to be applied throughout the entire IS infrastructure. There are two broad categories of approaches for reducing risk—technological- and human-based approaches—and any comprehensive security strategy will include both. Commonly used controls to safeguard information systems include:

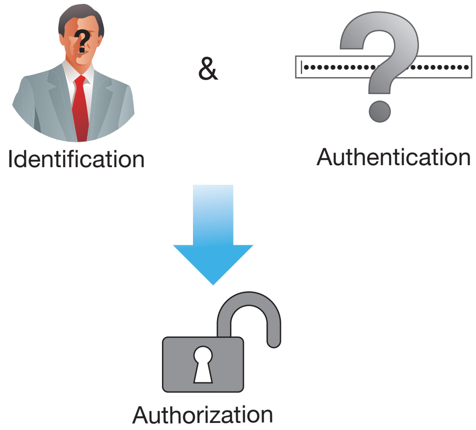
- Physical access restrictions
- Firewalls
- Encryption
- Virus monitoring and prevention
- Secure data centers
- Mobile device management
- Systems development controls
- Human controls

Within any type of control, there are a variety of ways in which it can be deployed. Next, we briefly review each of these methods.

PHYSICAL ACCESS RESTRICTIONS. Organizations can prevent unauthorized access to information systems by keeping stored data safe and allowing access only to those employees who need it to do their jobs. Of course, organizations can protect computers and data resources by physically securing computers to desks or requiring users to lock hard drives with keys when leaving a computer unattended. However, most organizations don't go to such lengths and control access only by requiring some form of identification and authentication to authorize the access of resources by a user (Figure 10.17). Typically, **identification** is a user's claim or declaration of being someone. A user's identity is normally established using publicly available information,

FIGURE 10.17

Users need to assert and prove their identity to get access to a system.



such as a user name (or even bank account number); the identifying information is typically unique (within the context of a certain system). **Authentication** is the process of confirming the identity of a user who is attempting to access a restricted system or web site. In contrast to identification, authentication is private, such as a PIN or a password, but not necessarily unique. Passwords are effective only if chosen carefully and changed frequently. Likewise, organizations must take care to securely store the users' passwords at the organizations' end; if the passwords stored on the e-commerce server are not secure, determined crackers can easily get access to the users' passwords. Thus, systems such as e-commerce websites typically do no store a user's password but an encrypted version called a hash value (which is extremely difficult to decrypt), which is then compared to a hashed version of the password the user enters. Even if crackers are successful in breaking into the organization's systems, they will be unable to gain access to users' passwords.

Besides passwords, users may be asked to provide an ID combination, a security code sequence, or personal data, such as their mother's maiden name. Employees may also be issued keys to physically unlock a computer, photo ID cards, smart cards with digital ID, and other physical devices allowing computer access. Based on the combination of identification and authentication, **authorization** is provided by the system and grants access to particular resources. In sum, authorization can be granted dependent on one or more of the following:

- ***Something You Have:*** keys, picture identification cards, smart cards, or smart badges that contain memory chips with authentication data on them (Figure 10.18)

FIGURE 10.18

A smart card.
Source: al62/Fotolia.

FIGURE 10.19

Biometric devices are used to verify a person's identity.
Source: Grzegorz Kula/123RF GB Ltd.

- ***Something You Know:*** passwords, code numbers, PINs, lock combinations, or answers to secret questions (your pet's name, your mother's maiden name, and so on)
- ***Something You Are:*** unique attributes, such as fingerprints, voice patterns, facial characteristics, or retinal patterns (collectively called *biometrics*)

Biometrics **Biometrics** is one of the most sophisticated forms of governing access to systems, data, and/or facilities. With biometrics, employees may be identified and/or authenticated by fingerprints, retinal patterns in the eye, facial features, or other bodily characteristics before being granted access to use a computer or to enter a facility (Figure 10.19). Biometrics has the promise of providing very high security while at the same time authenticating people extremely efficiently, so many governments and companies are investigating how best to use this technology. For example, many laptops and computer keyboards now incorporate fingerprint readers. Likewise, many smartphones now let you log in by using your fingerprint or looking into the phone's camera (facial recognition software then matches the user's face with a stored profile); MasterCard, Amazon, and others are introducing pay-by-selfie, allowing customers to authorize transactions by using their device's camera (with other companies using different biometrics, such as voice recognition).

Two-Factor Authentication Some measures that limit access to systems are more secure than others. For example, smart cards and smart badges, passwords, lock combinations, and code numbers can be stolen. Biometric devices are difficult to fool, but determined intruders may sometimes devise ways to bypass them; further, in contrast to passwords, biometric information cannot be hashed, and any cracker breaking into an organization could obtain the users' actual biometric data (such as fingerprints, which are often relatively easy to obtain). If compromised, passwords can be easily changed; however, biometrics cannot be revoked if they are compromised (e.g., you can't change your retinal patterns or fingerprints). Likewise, the use of biometrics for both identification and authorization may be problematic from a security standpoint. Thus, while any of the previously mentioned single items can be used, it is safer to use combinations of safeguards, such as a password *and* a smart card. The use of two types of credentials to gain access to a system is referred to as **two-factor authentication**. Today, two-factor authentication is often used for banking transactions, where the user has to enter not only a password but also a one-time token provided by the bank (such as provided by a key fob or sent to the user's registered e-mail address or mobile phone number); similarly, residents of Hong Kong can quickly pass through immigration checkpoints by using a smart card and their thumbprints. No matter what safeguards are used, organizations should have formal processes in place for enrolling new users, authorizing specific users to access systems or data, identifying and authenticating the users, and monitoring the access of resources. Needless to say, policies should be in place to revoke access for employees who are leaving the company or who are taking on different roles or responsibilities. Next, we examine various methods for implementing physical access control.

Access-Control Software Following the principles of least permissions and least privileges, access should only be granted to the resources needed to perform the work; anything beyond that can be a potential vulnerability. **Access-control software** can reduce such vulnerabilities by

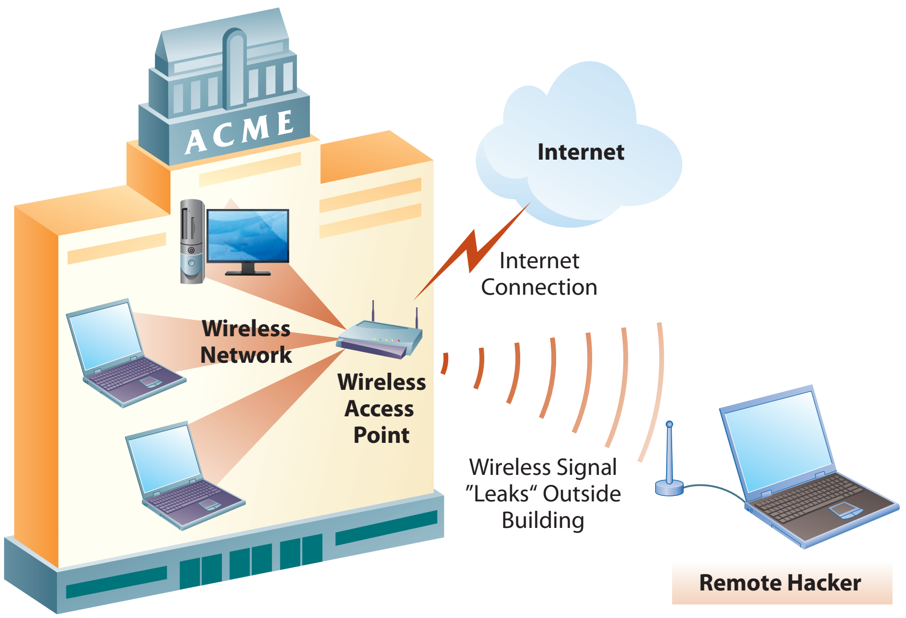


FIGURE 10.20

Drive-by hacking is on the rise given the proliferation of unsecured wireless LANs.

allowing computer users access only to those files related to their work. The user might even be restricted to these resources only at certain times or for specified periods of time, and, depending on the access level, the user can be restricted to being able to only read a file, to read and edit the file, to add to the file, and/or to delete the file. Many common business systems applications now build in these kinds of security features so that you do not have to have additional, separate access-control software running on top of your applications software.

Wireless LAN Control Given how easy and inexpensive wireless local area networks (WLANs) are to install and use, their use has skyrocketed, leaving many systems open to attack. On an unsecured network, for instance, unauthorized people can thus easily "steal" company resources (e.g., by surfing the web for free, which is illegal in many countries) or do considerable damage to the network. A new form of attack known as **drive-by hacking** has arisen, where an attacker accesses the network, intercepts data from it, and even uses network services and/or sends attack instructions to it without having to enter the home, office, or organization that owns the network (Figure 10.20). **Wireless LAN control** refers to methods of configuring the WLAN so that only authorized users can gain access.

Virtual Private Networks A **virtual private network (VPN)** is a network connection that is constructed dynamically within an existing network—often called a secure tunnel—in order to connect users or nodes (Figure 10.21). For example, a number of companies and software solutions enable you to create VPNs within the Internet as the medium for transporting data. These systems use authentication and encryption (discussed later) and other security mechanisms to ensure that only authorized users can access the VPN and that the data cannot be intercepted and compromised; this practice of creating an encrypted "tunnel" to send secure (private) data over the (public) Internet is known as **tunneling**. For example, the University of Arizona requires VPN software to be used when accessing some critical resources from remote (off-campus) locations.

FIREWALLS. A **firewall** is a part of a computer system designed to detect intrusion and prevent unauthorized access to or from a private network (Figure 10.22). Think of a firewall essentially as a security fence around the perimeter of an organization's networks that spots any intruders that try to penetrate the organization's outer defenses. Firewalls can be implemented in hardware, in software, or in a combination of both. Firewalls are frequently used to prevent unauthorized Internet users from accessing private networks connected to the Internet, especially private corporate intranets (see Chapter 3). All data packets entering or leaving the intranet pass through the firewall, which examines each message and blocks those that do not meet the specified security criteria.

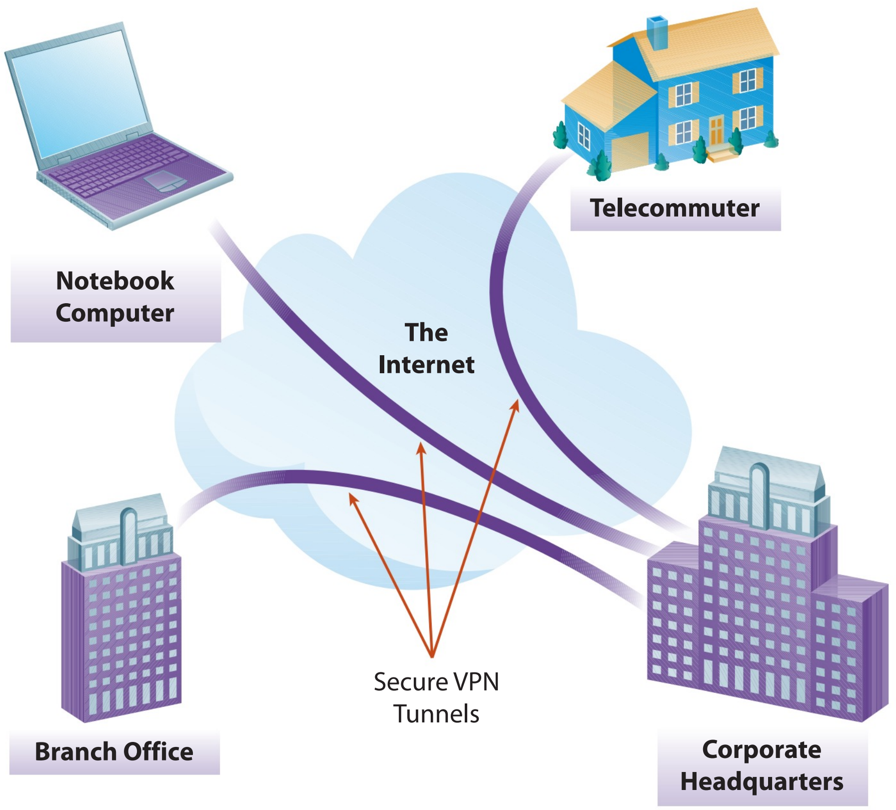


FIGURE 10.21

A virtual private network (VPN) allows remote sites and users to connect to organizational network resources using a secure tunnel.

ENCRYPTION. When you do not have access to a secure channel for transmitting messages over a wired or wireless network, encryption is the best bet for keeping snoopers out. **Encryption** is the process of encoding messages using an encryption key before they enter the network or airwaves, then decoding them using a matching key at the receiving end of the transmission so that the intended recipients can read or hear them (Figure 10.23). Scrambling messages before you send using a key—the code that scrambles and then decodes messages—prevents eavesdroppers who might intercept them from deciphering them without the decoding key. (The science of encryption is called *cryptography*.) Encryption can be used to protect data that are transmitted over the Internet (e.g., your new purchase at Amazon.com), calls on your mobile phone, or files or folders containing sensitive data or for various other scenarios requiring confidentiality of data. Some chatting and instant messaging platforms like WhatsApp and

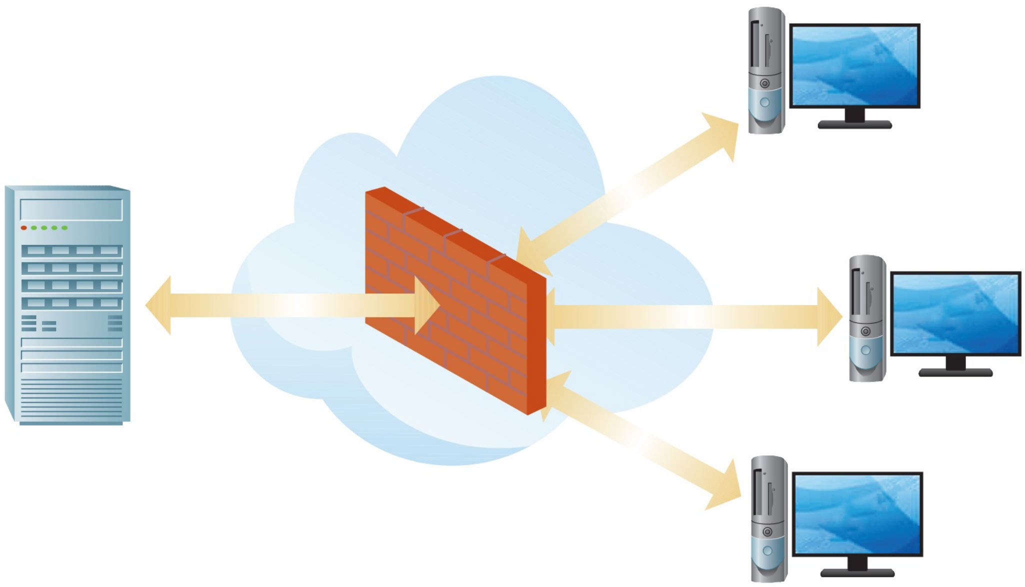


FIGURE 10.22

A firewall blocks unauthorized access to organizational systems and data, while permitting authorized communication to flow in and out of the organization to the broader Internet.

FIGURE 10.23

Encryption is used to encode data so that unauthorized people cannot understand it.

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Ciphertext letters:
JOGPSNBUJPO TZTUFNT UPEBZ
Equivalent plaintext letters:
INFORMATION SYSTEMS TODAY
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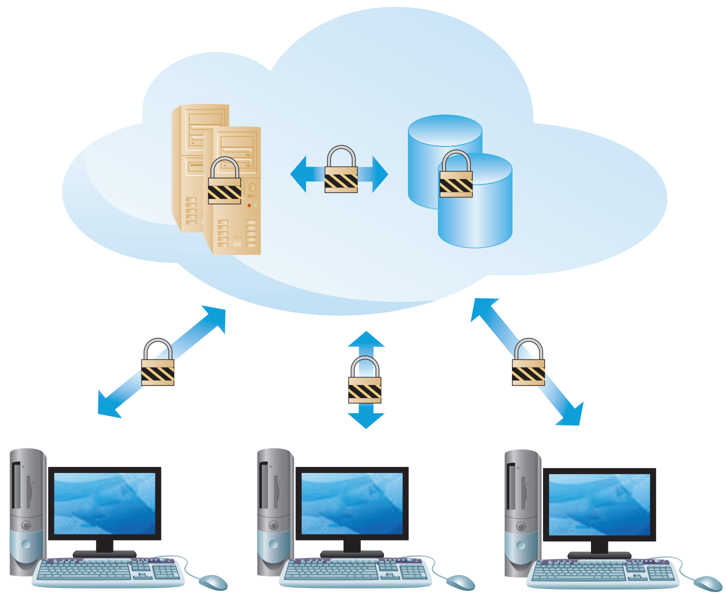
Telegram use **end-to-end encryption**, making it impossible for eavesdroppers (criminals as well as governmental organizations) to gain access to the communication. Such end-to-end encrypted communication is controversial because it is alleged that many terrorist groups and criminals utilize end-to-end encryption to obscure their communications.

There are many different encryption approaches for different types of data transmission. Traditional encryption methods require the sending and receiving party to have the same key to encode and decode the message (these methods are referred to as **symmetric encryption**); however, such methods require a secure channel to share the encryption key between the two parties before messages can be securely transmitted. **Public key encryption**, in contrast, is a form of **asymmetric encryption** that uses a pair of keys—a public and a private key. Using public key encryption (such as PGP, or Pretty Good Privacy), a message can be encoded using the recipient's public key, and the recipient can then use his or her private key to decode the message. As anyone can access the public key, anyone can encrypt a message; however, as only the recipient has access to the private key, no one else is able to decrypt the message. Implementing such encryption on a large scale, such as on a busy website, requires a third party, called a **certificate authority**, to help manage the distribution of keys. The certificate authority acts as a trusted middleman between computers and verifies that a website is a trusted site. The certificate authority knows that each computer is who it says it is and provides the encryption/decryption keys to each computer. **Secure Sockets Layer (SSL)**, developed by Netscape, is a popular public key encryption method used on the Internet.

Cloud Security With more and more data and applications being moved to the cloud, **cloud security** is becoming increasingly important; specifically, organizations not only need to secure data at rest (e.g., files or folders stored on a physical medium) and data in transit (i.e., data traveling across a network) but also data in use (i.e., data being processed by a computer) (Figure 10.24). Regular encryption approaches can be utilized to secure data at rest and data in transit; securing data in use is more problematic, as encrypted data typically need to be decrypted before being processed, even for simple manipulations such as summing up a range of numbers. However, in such cases, the cloud service provider would be able to access the decrypted data, potentially being able to compromise the availability, integrity, and confidentiality of the data. Recently, researchers have developed new algorithms that allow for "encryption in use," such that the encrypted data can be processed without being accessible to a cloud service provider.

FIGURE 10.24

Cloud security is concerned with the need to secure data at rest, data in transit, and data in use.



COMING ATTRACTIONS

Can You Become Your Password?

Have you ever had a tough time remembering one of your passwords? If you are like most of us, this has happened more than once. Luckily, many new smartphones, laptops, and computer keyboards sport fingerprint scanners, enabling users to log in without having to remember the password. Likewise, other advanced security devices scan a person's retina to grant access to systems or facilities. Yet, as you probably have seen in the movies, such security measures can be foiled. For example, you may have seen someone taking the fingerprints a person left on a drinking glass to produce a fake fingerprint; given that the surface of your phone is likely covered with fingerprints, the scanner could be easily foiled. In more gruesome movie scenes, you may have seen the villain mutilate someone's thumb to obtain access to a secure facility. In addition, once criminals have gained access to a person's fingerprint or retina data, the data will remain compromised forever, as, unlike a password, a person's fingerprint or retina can't be changed. Researchers at Binghamton University believe they have found a way to overcome these problems. They found that each person's brain responds differently when reading a particular word. Their approach, called "Brainprint," found that when people read a list of acronyms, such as *FBI* and *DVD*, the part of the brain associated with reading and recognizing words reacted differently for each person. The researchers were able to use the brainwave signals generated to uniquely identify people at 94 percent accuracy. The Brainprint approach suggests that brainwaves could be used by security systems to verify a person's identity by simply reading a standard sentence. On the one hand, one's brainwaves leave no traces anywhere, can't be stolen, and promise to be an effective way of confirming a person's identity. On the other hand, even if someone's Brainprints were compromised (e.g., due to someone cracking a database), a new sentence could be used to reset the Brainprint. While it might be some time before we use Brainprints to unlock our phones, this could be a valuable method for authenticating a person's identity in many voice-activated systems of the future.

Based on:

Anonymous. (2015, June 22). Brain's reaction to certain words could replace passwords. Retrieved March 20, 2016, from https://www.binghamton.edu/inside/index.php/inside/story/brains-reaction-to-certain-words-could-replace-passwords

VIRUS MONITORING AND PREVENTION. **Virus prevention**, which is a set of activities for detecting and preventing computer viruses, has become a full-time, important task for IS departments within organizations and for all of us with our personal computers. While viruses often have colorful names—Melissa, I Love You, Naked Wife—they can be catastrophic from a computing perspective. Here we describe some precautions you can take to ensure that your computer is protected:

- Install antivirus software, then update frequently to be sure you are protected against new viruses.
- Do not use flash drives or shareware from unknown or suspect sources and be equally careful when downloading material from the Internet, making sure that the source is reputable.
- Delete without opening any e-mail message received from an unknown source. Be especially wary of opening attachments. It is better to delete a legitimate message than to infect your computer system with a destructive virus.
- Do not blindly open e-mail attachments, even if they come from a known source (such as a friend or coworker). Many viruses are spread without the sender's knowledge, so it is better to check with the sender before opening a potentially unsafe attachment.
- If your computer system contracts a virus, report the infection to your school or company's IS department so that appropriate measures can be taken.

SECURE DATA CENTERS. Specialized facilities are an important component of creating a reliable and secure IS infrastructure. Data and the ability to process the data are the lifeblood for many of today's large organizations, such as Amazon.com, Travelocity.com, or Facebook. Consequently, organizations need to protect important equipment from outside intruders and from the elements, such as water or fire. The most prominent threats to an organization's IS facilities come from floods, seismic activity, rolling blackouts, hurricanes, and the potential of criminal activities (Figure 10.25). How can an organization reliably protect its facilities from such threats?

FIGURE 10.25

Potential threats to IS facilities include floods, hurricanes, criminal activities, power outages, and seismic activity.

Ensuring Business Continuity As many potential causes of disasters cannot be avoided (there's no way to stop a hurricane), organizations should attempt to plan for the worst and implement necessary controls in their data centers. For companies operating in the digital world, the IS infrastructure is often critical for most business processes, so special care has to be taken to secure it. Whereas some applications can tolerate some downtime in case something malfunctions or disaster strikes, other applications (such as UPS's package routing systems) can't tolerate any downtime—these companies need 24/7/365 reliability (Figure 10.26).

Securing the Facilities Infrastructure An organization's data centers always need to be secured and protected from outside intruders. Absolute protection against security breaches remains out of reach, but here are a few safeguards organizations can employ:

- ***Site Selection.*** Organizations should ensure that data centers are not built in areas that are prone to earthquakes, floods, hurricanes, or other damaging natural forces.
- ***Physical Access Restrictions.*** As with any valuable asset, data centers should be protected from intruders using measures such as fences, barriers, and security guards. Organizations should also strive to maintain information about data center locations confidential.
- ***Intrusion Detection.*** Closed-circuit television (CCTV) systems should monitor the physical interior and/or exterior of a facility for physical intruders, allowing in-house security personnel or an outside security service to detect and immediately report suspicious activity. In addition, security alarm systems using motion, sound, and/or vibration detectors should be installed. Recording CCTV footage as well as all events from the security alarm systems can help investigate the causes of an intrusion.
- ***Uninterruptible Power and Cooling.*** To ensure uninterrupted service, the data centers should be self-sufficient and be able to operate for a pre-specified time period on self-generated power. In addition to implementing an uninterruptible power supply for powering the computers, the data center should provide for continuous cooling in case of a power interruption (some data centers store chilled water for such purposes).
- ***Protection from Environmental Threats.*** To protect the data centers from the elements, data centers should be built to withstand strong winds (depending on the location). Other measures include raised floors (to protect from floods) as well as heat sensors, smoke detectors, and fire suppression systems.

FIGURE 10.26

The UPS servers handle more than 18 million packages per day.
Source: Alejandro Mendoza R/Shutterstock.

For reasons of business continuity, companies such as UPS maintain large data centers in different geographic areas. Many (especially smaller) organizations do not need facilities the size of one of the UPS data centers; instead, they may just need space for a few servers. For such needs, companies can turn to **collocation facilities**. Organizations can rent space (usually in the form of cabinets or shares of a cabinet) for their servers in such collocation facilities, and the organizations managing collocation facilities provide the necessary infrastructure in terms of power, backups, connectivity, and security. Alternatively, organizations increasingly attempt to transfer risk by using cloud computing services.

MOBILE DEVICE MANAGEMENT. With mobile devices being used by large numbers of organizational users, protecting mobile devices and the data stored thereon is of crucial importance. **Mobile device management (MDM)** is the administration of an organization's mobile devices to enforce authorization policies, prevent the downloading or installing of non-approved apps, or remotely lock the devices or wipe data. Often, third-party software is used for MDM; such software solutions can also be used to prevent jailbreaking, perform security scans, or preconfigure approved Wi-Fi hotspots or VPN services.

SYSTEMS DEVELOPMENT CONTROLS. As outlined in Chapter 9, "Developing and Acquiring Information Systems," system development and acquisition processes must also be carefully controlled and managed. When systems are designed or purchased, care must be taken that all security features are implemented, enabled, and managed and that any changes are properly managed and documented so as to prevent risks from software bugs or hidden backdoors.

HUMAN CONTROLS. In addition to the technological controls, various human safeguards can help to protect information systems, specifically ethics, laws, and effective management (Figure 10.27). *IS ethics*, discussed in Chapter 1, relates to a broad range of standards of appropriate conduct by users. Educating potential users as to what constitutes appropriate behavior can help, but unethical users will undoubtedly always remain a problem for those wanting to maintain IS security. Additionally, there are numerous federal and state laws against unauthorized use of networks and computer systems. Unfortunately, individuals who want unauthorized access to networks and computer systems usually find a way to exploit them; often, after the fact, laws are enacted to prohibit that activity in the future. Finally, effective management that defines appropriate oversight and control over what information and activities employees can and cannot perform is critical for having strong and robust information systems security.

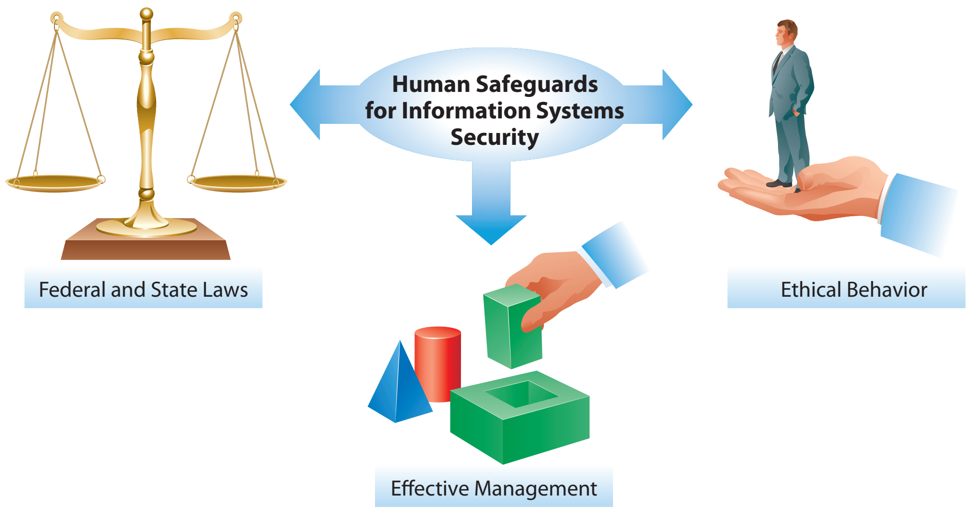


FIGURE 10.27

Human safeguards for IS security.

DEPLOYMENT AND TRAINING. Once the organization has decided on the necessary controls, network security mechanisms such as firewalls are deployed, as are intrusion detection systems, antivirus software, manual and automated log examination software, and host- and network-based intrusion detection software. Passwords, smart cards, and smart badges are also disseminated and explained during this phase. The IS department is usually responsible for implementing these controls. At the same time, personnel throughout the organization should receive training about the security policies and plans for disaster recovery and be prepared to perform assigned tasks in that regard—both routinely on a daily basis and disaster related.

Monitoring Security

To minimize risk, organizations should continuously monitor the effectiveness of the controls. Any user—authorized or unauthorized—leaves electronic footprints that can be traced. Automated log examination software and host- and network-based intrusion detection software is used to keep track of computer activity in order to spot suspicious activity and take action. Using such software helps creating an audit trail, which is a record showing who has used a computer system and how it was used. For the software to effectively protect security, of course, auditors within the organization—most often someone in the IS department or information security department—must monitor and interpret the results. Needless to say, the level of monitoring should be based on an assessment of the potential impact of a certain asset being compromised; in other words, the most monitoring efforts should be focused on high-risk systems. In addition to monitoring internal events, organizations should also monitor external events in order to obtain a full view of threats and vulnerabilities (Figure 10.28).

MONITORING EXTERNAL EVENTS. Several online organizations issue bulletins to alert organizations and individuals to possible software vulnerabilities or attacks based on reports from organizations that have experienced security breaches. Further, Information Sharing and Analysis Centers (ISAC, www.isaccouncil.org) representing various industry sectors and the

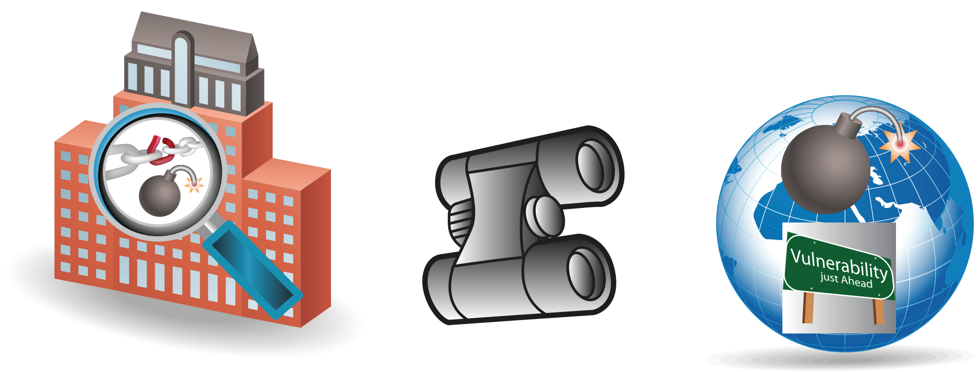


FIGURE 10.28

Organizations should monitor internal and external threats and vulnerabilities to ensure the effectiveness of their IS controls.

United States Computer Emergency Readiness Team (www.us-cert.gov) provide additional resources for organizations by publishing security alerts or conducting and publishing research related to IS security.

IS AUDITING. Monitoring internal and external vulnerability information should be an ongoing process for organizations. However, it can also be beneficial for organizations to periodically have an external entity review the controls so as to uncover any potential problems. An **information systems audit**, often performed by external auditors, can help organizations assess the state of their IS controls to determine necessary changes and to help ensure the information systems' availability, integrity, and confidentiality. The response to the strengths and weaknesses identified in the IS audit is often determined by the potential risks an organization faces. In other words, the IS audit has to assess whether the IS controls in place are sufficient to address the potential risks. Thus, a major component of the IS audit is a risk assessment (discussed in prior sections), which aims to determine what type of risks the organization's IS infrastructure faces, the criticality of those risks to the infrastructure, and the level of risks the organization is willing to tolerate.

Once the risk has been assessed, auditors have to evaluate the organization's internal controls, trying to answer questions such as: Can the intrusion detection system detect attacks? Are incident response procedures effective? Can the network be penetrated? Is physical security adequate? Do employees know security policies and procedures? In other words, auditors assess aspects such as policy adherence, the security of new projects, and whether the organization's defense layers can be penetrated. During such audits, the auditor tries to gather evidence regarding the effectiveness of the controls. However, testing all controls under all possible conditions is very inefficient and often infeasible. Thus, auditors frequently rely on **computer-assisted audit tools** to test applications and data using test data or simulations, or tools such as vulnerability scanners or packet sniffers. In addition to using specific auditing tools, auditors use audit sampling procedures to assess the controls, enabling the audit to be conducted in the most cost-effective manner. Further, penetration tests are conducted in-house and/or by an outside contractor to see how well the organization's computer security measures are working. Once the audit has been performed and sufficient evidence has been gathered, reports are issued to the organization. Usually, such reports are followed up with a discussion of the results and potential courses of action.

THE SARBANES–OXLEY ACT. Performing an IS audit can help an organization reduce costs or remain competitive by identifying areas where IS controls are lacking and need improvement. Another major factor that has contributed to a high demand for IS auditors is the need to comply with government regulations, most notably the **Sarbanes–Oxley Act** of 2002 (hereafter S-OX). Formed as a reaction to large-scale accounting scandals that led to the downfall of corporations such as WorldCom and Enron and to protect investors from fraudulent practices by organizations, S-OX mandates companies to demonstrate compliance with accounting standards and to establish controls and sound corporate governance. Commonly used controls include limiting a single employee's influence over transactions, such as by segregation of duties and establishing proper checks and balances. For example, if the employee who creates a purchase order also has the authority to approve the purchase order, this opens up a possibility for creating fraudulent orders; similarly, if the same employee is responsible for disbursing cash, recording the disbursements, and reconciling the related accounts, the employee can devise schemes to embezzle money. Implementing proper controls not only helps to reduce the potential for fraud but also helps to prevent unintentional errors. To demonstrate S-OX compliance, public companies are required, among other things, to have external auditors assess the effectiveness of their internal controls as well as audit their financial statements. While S-OX addresses primarily the accounting side of organizations, it is of major importance to include IS controls in compliance reviews, given the importance of an IS infrastructure and IS controls for an organization's financial applications.

According to S-OX, companies have to demonstrate that there are controls in place to prevent misuse or fraud, controls to detect any potential problems, and effective measures to correct any problems; S-OX goes so far that corporate executives face jail time and heavy fines if the appropriate controls are not in place or are ineffective. The IS architecture plays a key role in S-OX compliance, given that many controls are IS based, providing capabilities to detect exceptions and providing an audit trail for tracing these. However, S-OX itself barely addresses IS controls specifically; rather, it addresses general processes and practices, leaving companies wondering how to comply with the guidelines put forth in the act. Further, it is often cumbersome and time-consuming for organizations to identify the relevant systems to be audited for S-OX compliance. Thus, many organizations find it easier to review their entire IS infrastructure, following objectives set forth in guidelines such as the **control objectives for information and related technology (COBIT)**—a set of best practices that helps organizations both maximize the benefits from their IS infrastructure and establish appropriate controls.

Another issue faced by organizations because of S-OX is the requirement to preserve evidence to document compliance and for potential lawsuits. Since the inception of S-OX, e-mails and even instant messages have achieved the same status as regular business documents and thus need to be preserved for a period of time, typically up to 7 years. Failure to present such documents in the case of litigious activity can lead to severe fines being imposed on companies and their executives, and courts usually will not accept the argument that a message could not be located. For example, the investment bank Morgan Stanley faced fines up to US$15 million for failing to retain e-mail messages. On the surface, it seems easiest for an organization to simply archive all the e-mail messages sent and received. However, such a "digital landfill," where everything is stored, can quickly grow to an unmanageable size, and companies cannot comply with the mandate to present evidence in a timely manner. Thus, many organizations turn to e-mail management software that archives and categorizes all incoming and outgoing e-mails based on key words. Even using such specialized software, finding e-mails related to a certain topic within the archive can pose a tremendous task: Some analysts estimate that a business with 25,000 employees generates more than 4 billion e-mail messages over the course of 7 years (not counting any increase in e-mail activity), which would be hard to handle for even the most sophisticated programs.

RESPONDING TO SECURITY INCIDENTS. Organizations that have developed a comprehensive IS security plan will have the ability to rapidly respond to any type of security breach to their IS resources or to a natural disaster. Typically, incident handling policies detail how the incident is classified in terms of severity, who has the authority to escalate the incident, and what incidents need to be internally or externally reported. Responses to a security breach include containing the security breach, restoring systems, and notifying or assisting customers (if needed). Further, when intruders are discovered, organizations can contact local law enforcement agencies and the FBI for assistance in locating and prosecuting the intruders. In addition, common responses to a security breach include performing a new risk audit and implementing a combination of additional (more secure) controls (as described previously).

COMPUTER FORENSICS. As computer crime has gone mainstream, law enforcement has had to become much more sophisticated in their computer crime investigations. **Computer forensics** is the use of formal investigative techniques to evaluate digital information for judicial review. Most often, computer forensics experts evaluate various types of storage devices to find traces of illegal activity or to gain evidence in related non-computer crimes. In fact, in most missing-person or murder cases today, investigators immediately want to examine the victim's computer for clues or evidence.

Organizations and governments are increasingly utilizing *honeypots* to proactively gather intelligence to improve their defenses or to catch cybercriminals. A **honeypot** is a computer, data, or network site that is designed to be enticing to crackers so as to detect, deflect, or counteract illegal activity. Many law enforcement agencies operate honeypots in the dark web as a way to gather intelligence and find criminals (Murdock, 2016). The **dark web** refers to web content that is used for various nefarious purposes. Content on the dark web is not indexed by popular search engines like Google and Bing and is typically only accessible using specialized browsers that anonymize the user and hide traces (the underlying infrastructure, which directs Internet traffic through a worldwide volunteer network of relays and virtual tunnels—rather than the usual direct connections to Internet sites—is often referred to as dark net). Illegal content on the dark web includes everything from child pornography to black markets and hacker forums for sharing tools and information.

Although computer forensics experts are extremely skilled in investigating prior and ongoing computer crime, many computer criminals are also experts, making the forensics process extremely difficult in some cases. Some criminals, for example, have special "booby-trap" programs running on computers to destroy evidence if someone other than the criminal uses the machine. Using special software tools, computer forensics experts can often restore data that have been deleted from a computer's hard drive. Additionally, given the proliferation of computer crime, there is a growing backlog of cases where computer forensics experts are needed. Backlogs in analyzing computers, smartphones, online activities, and communications are leading to long delays in the criminal justice system, resulting in some cases being dropped and others being inadequately investigated. Further, growing sizes of people's hard drives, or, in the case of companies, databases containing tens or hundreds of terabytes of Big Data, cause additional challenges for forensic experts. Clearly, computer forensics will continue to evolve as criminals utilize more sophisticated computer-based methods for committing and aiding criminal activities.

As you can see, securing information systems consists of various activities, with protection against computer crime being the most visible—but not the only—aspect. Given the ubiquity and increasing complexity of information systems, securing information systems will remain a hot topic for organizations and individuals alike, and we need to continue to implement vigilant approaches to better manage information systems security in the digital world.

INDUSTRY ANALYSIS

Cybercops Track Cybercriminals

The *CSI* (*Crime Scene Investigation*) television shows have made "DNA testing" a household phrase. Virtually everyone knows that a criminal who leaves body cells or fluids—hair and skin cells, saliva, blood, semen, and so on—at the scene of a crime can be linked to the crime through DNA analysis. (DNA, or deoxyribonucleic acid, is present in all living tissue—plant or animal.) Just as a criminal leaves DNA traces, cybercriminals are leaving digital footprints. However, using computer forensics to track down cybercriminals requires sophisticated tools and methods.

Because technological advancement has been rapid, law enforcement has lagged behind cybercriminals but is catching up. In the United States, the Computer Crime and Intellectual Property Section within the Department of Justice is devoted to combating computer crime. In addition, the FBI has created cyber-squads in 56 field offices around the country specifically to investigate computer crime in addition to a cyber-division at the FBI headquarters. Each federal judicial district has at least one assistant U.S. attorney who has received special training in how to investigate and prosecute computer crime. Every state now has a computer crime investigation unit available as a resource to local law enforcement agencies, and many municipal police departments have their own computer crime investigative units.

Software tools available to law enforcement agencies have improved greatly in recent years. Programs to conduct forensic analyses of computer hard drives or smartphones have become standard practice. Photo databases of known criminals, including any distinctive features such as scars and tattoos, go way beyond fingerprint identification of yesteryear. Similarly, advanced tools using data mining and machine learning are helping detectives find patterns that can connect related crimes.

In addition to these advances, 3D technology is now widely used for re-creating crime scenes, from comparing footprints to testing crime theories. For example, modern 3D forensic ballistics technologies help to re-create a crime scene for understanding the shooter's location and the path of bullets. These technologies are also capable of creating a 3D image of a bullet that has been fired and then finding a match from previous criminal cases. Data can be shared across the country and around the world, allowing law enforcement to also benefit from the Internet age.

While these advances have greatly helped law enforcement solve a broad range of crimes, the prevalence of sophisticated tools on entertainment programs like *CSI* has created the so-called "CSI effect." The CSI effect refers to the tendency of jurors to demand more forensic evidence in criminal trials due to advances in forensic and investigative technology that are learned by watching modern police shows, thereby raising the effective standard of proof for prosecutors. It is unfortunate that criminals use the Internet and other technologies to their advantage. Clearly, however, law enforcement is keeping pace with them; officers use technological advances to track, arrest, and prosecute online and offline criminals.

Questions

1. Today, is it harder or easier to be a criminal? Why?
2. Provide an argument as to whether law enforcement can or cannot get ahead of criminals technologically.

Based on:

CSI effect. (2016, March 14). In *Wikipedia, The Free Encyclopedia*. Retrieved March 21, 2016, from https://en.wikipedia.org/w/index.php?title=CSI_effect&oldid=710029554

DeGood, J. (2014, April 10). WPD uses 3D scanner to document police involved shooting. *KWCH.com*. Retrieved March 20, 2016, from http://www.kwch.com/news/local-news/wpd-uses-3d-scanner-to-document-police-involved-shooting/25421540

FBI Cyber Crime Division. (n.d.). Retrieved March 20, 2016, from http://www.fbi.gov/about-us/investigate/cyber

Justice Technology Information Network. (n.d.). Retrieved March 20, 2016, from https://www.justnet.org

Key Points Review

1. ***Define computer crime and describe several types of computer crime.*** Computer crime is defined as the use of a computer to commit an illegal act, such as targeting a computer while committing an offense, using a computer to commit an offense, or using computers in the course of a criminal activity. Those who break into computer systems with the intention of doing damage or committing a crime are usually called crackers. Crackers are associated with creating and distributing computer viruses and other destructive codes. People are increasingly using information systems to aid in crimes against individuals, including identity theft, cyberharassment, cyberstalking, and cyberbullying. Finally, making illegal copies of software, a worldwide computer crime, is called software piracy.
2. ***Describe and explain differences between cyberwar and cyberterrorism.*** Cyberwar refers to an organized attempt by a country's military to disrupt or destroy the information and communication systems of another country. The goal of cyberwar is to turn the balance of information and knowledge in one's favor in order to diminish an opponent's capabilities and also to enhance those of the attacker. Cyberterrorism is the use of computer and networking technologies by individuals and organized groups against persons or property to intimidate or coerce governments, civilians, or any segment of society to attain political, religious, or ideological goals. Now that terrorist groups are increasingly using the Internet for their purposes, one of the great fears about cyberterrorism is that an attack can be launched from a computer anywhere in the world.
3. ***Discuss the process of managing IS security and describe various IS controls that can help in ensuring IS security.*** Information systems security refers to precautions taken to keep all aspects of information systems (e.g., all hardware, software, network equipment, and data) safe from unauthorized use or access, to ensure availability, integrity, confidentiality, and accountability. IS security is an ongoing process, consisting of assessing risks, developing a security strategy, implementing controls and training, and monitoring security. An information systems risk assessment is performed to identify threats and vulnerabilities, determine their probabilities of being exploited, and assess the potential impact. An IS security strategy details what controls should be implemented as well as security-related policies and procedures. General categories of controls include: physical access restrictions, firewalls, encryption, virus monitoring and protection, secure data centers, systems development controls, and human controls. To ensure the effectiveness of the controls, organizations should continuously monitor internal and external events and periodically perform IS audits.

Key Terms

packet sniffer 394
patent 404
patriot hacker 409
phishing 400
preventive controls 416
public key encryption 424
ransomware 398
recovery point objective 418
recovery time objective 418
reverse engineering 405
risk acceptance 415
risk avoidance 415
risk reduction 415
risk transference 415
Sarbanes–Oxley Act 429
Secure Sockets Layer (SSL) 424
shoulder surfing 394
social engineering 394
software piracy 404
spam 399
spam filter 399
spear phishing 400
spyware 398
Stuxnet 409
symmetric encryption 424
threat 414
time bomb 398
two-factor authentication 421
Trojan horse 397
tunneling 422
unauthorized access 394
unauthorized data modification 395
virtual private network (VPN) 422
virus 397
virus prevention 425
vulnerability 414
vulnerability scanners 394
warez 405
web vandalism 409
WikiLeaks 395
wireless LAN control 422
worm 397
zero-day 395
zombie computer 398

MyMISLab™ | Go to **mymislab.com** to complete the problems marked with this icon MyMISLab.

Review Questions

10-1. List and describe the primary threats to IS security.
MyMISLab **10-2.** Define computer crime and list several examples of computer crime.
10-3. Explain the purpose of the Computer Fraud and Abuse Act of 1986 and the Electronic Communications Privacy Act of 1986.
10-4. Contrast hackers versus crackers.
MyMISLab **10-5.** Why are insider threats particularly dangerous for organizations?
10-6. Define malware and give several examples.
10-7. Define and contrast cyberharassment, cyberstalking, and cyberbullying.
10-8. Define and contrast cyberwar and cyberterrorism.
10-9. What are physical access restrictions, and how do they make an information system more secure?
10-10. Describe several methods for preventing and/or managing the spread of computer viruses.
10-11. Describe three human-based controls for safeguarding information systems.
MyMISLab **10-12.** Describe the process of managing IS security.
10-13. Describe how the Sarbanes–Oxley Act affects the IS security of an organization.

Self-Study Questions

10-14. What is the common rule for deciding if an information system faces a security risk?
A. Only desktop computers are at risk.
B. Only network servers are at risk.
C. All systems connected to networks are vulnerable to security violations.
D. Networks have nothing to do with computer security.

10-15. Those individuals who break into computer systems with the intention of doing damage or committing a crime are usually called _______________.
A. hackers
B. crackers
C. computer geniuses
D. computer operatives

10-16. Which of the following does not pose a threat to electronic data?
A. unauthorized access
B. jailbreaking one's mobile phone
C. unauthorized data modification
D. all of the above can compromise data

10-17. Unauthorized data modification includes _______________.
A. an authorized user changing a website address
B. a website crashing
C. an unauthorized user viewing confidential data
D. someone who is not authorized to do so changing electronic data

10-18. Technological controls used to protect information include ______________.
A. laws
B. effective management
C. firewalls and physical access restrictions
D. ethics

10-19. Limiting access to electronic data can involve ______________.
A. something you have
B. something you know
C. something you are
D. all of the above

10-20. Which of the following is the process of determining the true, accurate identity of a user of an information system?
A. identity audit
B. authentication
C. authorization audit
D. authorization assessment

10-21. The use of computer and networking technologies by individuals and organized groups against persons or property to intimidate or coerce governments, civilians, or any segment of society in order to attain political, religious, or ideological goals is known as ______________.
A. cyberwar
B. cybercrime
C. cyberterrorism
D. none of the above

10-22. A(n) ______________ is a system composed of hardware, software, or both that is designed to detect intrusion and prevent unauthorized access to or from a private network.
A. encryption
B. firewall
C. alarm
D. logic bomb

10-23. ______________ is the process of encoding messages before they enter the network or airwaves, then decoding them at the receiving end of the transmission so that recipients can read or hear them.
A. Encryption
B. Transmission security
C. Authentication
D. Cloud security

Answers are on page 437.

Problems and Exercises

10-24. Match the following terms to the appropriate definitions:

i. Acceptable use policy
ii. Authentication
iii. Cyberwar
iv. Biometrics
v. Firewall
vi. Phishing
vii. Information systems audit
viii. Spyware
ix. Unauthorized access
x. Zombie computer

a. Body characteristics such as fingerprints, retinal patterns in the eye, or facial characteristics that allow the unique identification of a person
b. Hardware or software designed to keep unauthorized users out of network systems
c. An organized attempt by a country's military to disrupt or destroy the information and communication systems of another country
d. The process of confirming the identity of a user who is attempting to access a restricted system or website
e. Computer and/or Internet use policy for people within an organization, with clearly spelled-out penalties for noncompliance
f. An assessment of the state of an organization's information systems controls to determine necessary changes and to help ensure the information systems' availability, integrity, and confidentiality
g. Attempts to trick financial account and credit card holders into giving away their authorization information
h. A virus-infected computer that can be used to launch attacks on websites without the knowledge of the owner
i. Software that covertly gathers information about a user through an Internet connection without the user's knowledge
j. An IS security breach where an unauthorized individual sees, manipulates, or otherwise handles electronically stored data

10-25. Take a poll of classmates to determine who has had personal experience with computer virus infections, identity theft, or other computer/information system intrusions. How did victims handle the situation? What are classmates who have not been victimized doing to secure computers and personal information?

10-26. Research the statistics for the number of unauthorized intrusions into computer systems last year. Which type was most prevalent? Which groups committed the highest number of intrusions—hackers, employees, and so on?

10-27. Visit the website for the U.S. Computer Emergency Readiness Team at www.us-cert.gov/ncas/tips/ST04-015 and answer the following:

a. What is a distributed denial-of-service attack?
b. How can you spot a denial-of-service attack?
c. What devices or activities within an organization might be impacted by denial-of-service attacks?
d. Name three steps organizations might take to prevent denial-of-service attacks.

If the previously given URL is no longer active, conduct a web search for "denial-of-service attacks." Other active links can provide answers to the questions.

10-28. Do you feel the media generate too much hype regarding hackers and crackers? Since prominent companies such as Microsoft are often hacked into, are you concerned about your bank account or other sensitive information?

10-29. Visit www.fraud.org to find ways to protect yourself from identity theft. Search the Internet for additional sources that provide information on identity theft and make a list of other ways to safeguard against it. What are some of the losses in addition to stolen documents and additional bills to pay that may result from identity theft?

10-30. Search the Internet for information about the damaging effects of software piracy and/or look at the following websites: www.bsa.org and www.microsoft.com/piracy. Is software piracy a global problem? What can you do to mitigate the problem? Prepare a short presentation for the class.

10-31. Check one or more of the following websites to see which hoaxes are currently circulating online: www.hoax-slayer.com, www.truthorfiction.com, or www.snopes.com/info/top25uls.asp. What are five popular hoaxes now circulating online?

10-32. What laws should be enacted to combat cyberterrorism? How could such laws be enforced?

10-33. Contrast cyberharassment, cyberstalking, and cyberbullying using real-world examples found from recent news stories.

10-34. There are many brands of software firewalls, with ZoneAlarm, Norton 360, and Comodo Firewall being three popular choices. Search for these products on the web and learn more about how a firewall works and what it costs to give you this needed protection; prepare a one-page report that outlines what you have learned.

10-35. Search for further information on encryption. What is the difference between 128-bit and 40-bit encryption? What level of encryption is used in your web browser? Why has the U.S. government been reluctant to release software with higher levels of encryption to other countries?

10-36. What levels of user authentication are used at your school and/or place of work? Do they seem to be effective? What if a higher level of authentication were necessary? Would it be worth it, or would the added steps cause you to be less productive?

10-37. Should the encryption issue be subject to ethical judgments? For instance, if an absolutely unbreakable code becomes feasible, should we use it with the knowledge that it may help terrorists and other criminals evade the law? Should governments regulate which encryption technology can be used so that government law enforcement agents can always read material generated by terrorists and other criminals? Explain your answer. Should the government continue to regulate the exportation of encryption technology to foreign countries, excluding those that support terrorism as it does now? Why or why not?

10-38. Assess and compare the security of the computers you use regularly at home, work, and/or school. What measures do you use at home to protect your computer? What measures are taken at work or school to protect computers? (If possible, interview IT/IS personnel at work and/or at school to determine how systems are protected in the workplace and in classrooms.) Describe any security vulnerabilities you find and explain how they might be patched.

10-39. In some cases, individuals engage in cybersquatting in the hope of being able to sell the domain names to companies at a high price; in other cases, companies engage in cybersquatting by registering domain names that are very similar to their competitors' product names in order to generate traffic from people misspelling web addresses. Would you differentiate between these practices? Why or why not? If so, where would you draw the boundaries?

10-40. Find your school's guidelines for ethical computer use on the Internet and answer the following questions: Are there limitations as to the type of websites and material that can be viewed (e.g., pornography)? Are students allowed to change the programs on the hard drives of the lab computers or download software for their own use? Are there rules governing personal use of computers and e-mail?

10-41. To learn more about protecting your privacy, visit https://www.usa.gov/privacy and www.privacyrights.org. Did you learn something that will help protect your privacy? Why is privacy more important now than ever?

10-42. Should tougher laws be passed to make spam a crime? If so, how should lawmakers deal with First Amendment rights? How would such laws be enforced?

10-43. Insider threats are not new. Use the web to find two examples of insider threats throughout history that have had a big negative impact on their organization or government.

10-44. Microsoft and other software producers make free upgrades available to legitimate buyers of applications when security risks are exposed, but those using pirated copies are not eligible to receive security updates. Should security patches for popular software be given for free to everyone, no questions asked? Why or why not?

Application Exercises

Note: The existing data files referenced in these exercises are available on the book's website: www.pearsonhighered.com/valacich.

Spreadsheet Application: Analyzing Ethical Concerns at Campus Travel

10-45. Because of the employees' increased use of IS resources for private purposes at Campus Travel, you have announced that a new acceptable use policy will be implemented. You have set up a website for the employees to provide feedback to the proposed changes; the results of this survey are stored in the file EthicsSurvey.csv. Your boss wants to use the survey results to find out what the greatest concerns in terms of ethical implications are for the employees, so you are asked to do the following:

- Complete the spreadsheet to include descriptive statistics (mean, standard deviation, mode, minimum, maximum, and range) for each survey item. Use formulas to calculate all statistics for the responses to the individual questions.

(Hint: In Microsoft Excel, you can look up the necessary formulas in the category "Statistical"; you will have to calculate the ranges yourself.)

- Format the means using color scales to highlight the items needing attention.
- Make sure to professionally format the pages before submitting them to your instructor.

Database Application: Tracking Software Licenses at Campus Travel

10-46. Recently, you have taken on the position of IS manager at Campus Travel. In your second week at work, you realize that many of the software licenses are about to expire or have already expired. As you know about the legal and ethical implications of unlicensed software, you have decided to set up a software asset management system that lets you keep track of the software licenses. You have already set up a database and stored some of the information, but you want to make the system more user friendly. Using the SWLicenses.mdb database, design a form to input the following information for new software products:

- Software title
- Installation location (office)
- License number
- Expiration date

Furthermore, design a report displaying all software licenses and expiration dates (sorted by expiration dates). (Hint: In Microsoft Access, use the form and report wizards to create the forms and reports; you will find the wizards under the "Create" tab.)

Team Work Exercise

Top Cyberthreats

Robert Morris's worm, a bug that crashed a record 6,000 computers (a statistic compiled from an estimate that there were 60,000 computers connected to the Internet at the time and the worm affected 10 percent of them), now seems as antiquated as the 1911 Stutz Bearcat automobile. In 1998, when Morris was a student at Cornell University, he devised a program that he later insisted was intended simply to gauge how many computers were connected to the Internet. Errors in Morris's program turned it into a self-replicating monster that overloaded computers and threatened frightened Internet users. Dubbed simply the Internet Worm, Morris's program was the precursor for today's multitude of malevolent codes.

According to Kaspersky Lab, a leading developer of content management security solutions, attackers are having to continuously change their methods in response to the growing competition among the IT security companies that investigate and protect against targeted attacks. Increased public attention to security lapses will also force the attackers to search for new instruments. For example, conventional methods of attack involving e-mail attachments will gradually become less effective, while browser attacks will gain in popularity. For 2016 and beyond, they expected to see the following:

- Mobile threats will continue to rise.
- Maintaining privacy will become increasingly difficult.
- Attacks on cloud storage facilities will increase.
- Attacks on software developers will increase.
- Cyber-mercenaries will be on the rise.
- Ransomware will continue to be a major threat.

In addition to these various trends, an old favorite, the Windows operating system, will continue to be a popular target. Nevertheless, many experts believe some major security improvements within Windows 10 were driving criminals to other targets.

Questions and Exercises

10-47. Search the web for the most up-to-date statistics and events related to IS security.

10-48. As a team, interpret these numbers (or stories). What is striking/important about these findings?

10-49. As a team, discuss what these findings will look like in 5 years and 10 years. What will the changes mean for cloud computing and mobility? What issues/opportunities do you see arising?

10-50. Using your spreadsheet software of choice, create a graph/figure to visualize the findings you consider most important.

Based on:

Garnaeva, M., van der Wiel, J., Makrushin, D., Ivanov, A., & Namestnikov, Y (2015, December 15). Kaspersky security bulletin 2015. *Secure-List.* Retrieved March 20, 2016, from https://securelist.com/files/2015/12/KSB_2015_Statistics_FINAL_EN.pdf

Markoff, J. (1990, May 5). Computer intruder is put on probation and fined $10,000. *The New York Times.* Retrieved March 20, 2016, from http://www.nytimes.com/1990/05/05/us/computer-intruder-is-put-on-probation-and-fined-10000.html

Answers to the Self-Study Questions

10-14. C, p. 413	**10-15.** B, p. 392	**10-16.** D, p. 394	**10-17.** D, p. 395	**10-18.** C, p. 419
10-19. D, p. 420	**10-20.** B, p. 420	**10-21.** C, p. 409	**10-22.** B, p. 422	**10-23.** A, p. 423

CASE 1 | Stopping Insider Threats: Edward Snowden and the NSA

Insider threats—trusted adversaries who operate within an organization's boundaries—are a significant danger to both private and public sectors and are often cited as the greatest threat to an organization. Although insider threats such as disgruntled employees or ex-employees, contractors, business partners, or auditors can cause various threats to organizations, insider threats in the right places may even have serious diplomatic consequences.

In June 2013, major news agencies—including *The Guardian, The Washington Post,* and *The New York Times*—began publishing news articles about a global surveillance program being orchestrated by the U.S. National Security Agency (NSA) in cooperation with intelligence agencies from several other countries. The source of information for these news stories was Edward Snowden, a former employee of the Central Intelligence Agency (CIA) and former contractor for the NSA. Snowden provided these news agencies with hundreds of thousands of classified documents that he acquired during his contract work with the NSA. His motivation for leaking these documents was to reveal to the public the nature and extent of government surveillance of the everyday electronic activities of its citizens.

The leaked documents revealed a staggering amount of surveillance being executed. Individuals' personal e-mail and instant message contact lists were being harvested, e-mail content was being routinely searched, certain cell phone call records and location information was being tracked, and even users of online games such as World of Warcraft were being monitored and analyzed. Snowden claimed that the NSA's surveillance activities were not limited to protecting national security but instead consisted of gratuitous surveillance of everyday citizens and businesses. In a 2013 letter, Snowden wrote, "there is a huge difference between legal programs, legitimate spying … and these programs of dragnet mass surveillance that put entire populations under an all-seeing eye and save copies forever … These programs were never about terrorism: they're about economic spying, social control, and diplomatic manipulation. They're about power."

The Snowden leaks, which reveal a great many U.S. intelligence secrets beyond the NSA's surveillance activities, have been called the most damaging breach of national security in history. The U.S. Department of Justice charged Snowden with espionage, and he will face trial if he returns to the United States. Snowden currently resides in Russia, where he has been granted temporary political asylum. Snowden is variously called a hero, a whistleblower, a dissident, a traitor, and a patriot. In early 2016, he said he was willing to return to the United States for trial if he was "guaranteed a fair trial and is allowed to mount a public interest defense of his actions."

Regardless of whether you support the NSA's surveillance activities and regardless of whether you agree with Snowden's actions, the events described here were clearly the result of an insider threat who exploited vulnerabilities in a system. Edward Snowden was a trusted contractor for the NSA and was granted wide access to classified data because of his role as a security administrator and analyst. While the Snowden revelations initiated widespread debate on the legality and morality of government electronic surveillance policies, these events have also sparked renewed interest from governments and companies regarding effective means of reducing insider threats.

Questions

10-51. Choose a large company that many people are familiar with. How could this company be damaged by insider threats?

10-52. How can companies reduce insider threats?

10-53. Research the Snowden leaks on the web. How was Snowden able to gain access to so many classified documents?

Based on:

Edward Snowden. (2016, March 18). In *Wikipedia, The Free Encyclopedia*. Retrieved March 20, 2016, from https://en.wikipedia.org/w/index.php?title=Edward_Snowden&oldid=710692315

Grierson, J. (2016, February 21). Edward Snowden would be willing to return to US for fair trial. *The Guardian*. Retrieved March 20, 2016, from https://www.theguardian.com/us-news/2016/feb/21/edward-snowden-willing-to-return-to-us-fair-trial

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CASE 2 | China's Great (Fire) Wall

Welcome to modern-day China, where the government blocks website access to the country's 721 million Internet users on such subjects as democracy, Tibet, Taiwan, health, education, news, entertainment, religion, and revolution. Various chat rooms, blogs, photo- and video-sharing sites, gaming and podcasting sites, and bulletin boards are also forbidden stops on the web, and don't even think about searching for "Tiananmen Square massacre" or anything remotely considered pornographic.

Building censorship into China's Internet infrastructure is the first step for the country's government in controlling access to politically sensitive material. To accomplish this, the Chinese government prevents Internet service providers (ISPs)—many of them privately held businesses, some with foreign investments—from hosting any material the government calls politically objectionable by holding the ISPs liable for content and imposing severe penalties for violations, including imprisonment.

In addition, the Chinese government targets Internet content providers (ICPs—organizations and individuals who have a web presence in China, both nonprofit and for profit), who are required to register for and post a license to operate legally and like ISPs are held liable for politically incorrect content. To keep a license, ICPs must police sites for objectionable content and must take down those sites that violate regulations governing content. Yahoo!, Microsoft's MSN, and Google all act as ICPs in China and have been criticized for complying with China's strict Internet censorship policy. Likewise, posts on various chat rooms or Weibo—China's equivalent to Twitter—are removed if they contain terms deemed to be "disturbing social order," "undermining social stability," or "spreading rumors," among other offenses. Certain terms are often blocked after notable events. For example, the term "Kunming Train Station" was blocked after a knife attack at the station; at times, even posts containing rumors about a price increase of the Beijing subway were blocked.

Managing ISPs and ICPs is not the only tool China has for controlling what content its citizens can access. Beginning operations in 2003, China instituted the Golden Shield Project. More popularly known as "The Great Firewall of China," the system can automatically filter and block content that the government deems inappropriate. Through IP tracking, blocking, DNS/URL filtering, and redirection, the Golden Shield not only blocks and filters content but acts as a surveillance system as well. The Great Firewall also creates a sluggish and congested network infrastructure, though some believe this is intentional to discourage Internet use.

In September 2015, a reported 3,000 popular websites were blocked in China, including Facebook, Twitter, Gmail, and YouTube. This heavy censorship made China's Internet (sometimes referred to as "China's Intranet") one of the most heavily censored in the world, similar to countries such as Belarus, Iran, or North Korea.

Historically, many foreign ICPs have cooperated with the Chinese government by censoring information in order to operate in the country. Yahoo!, the only non-Chinese company providing e-mail service in China, has even turned over e-mail content to the authorities, resulting in the prosecution and conviction of at least four persons for criticizing the government. In 2010, however, Google took a different course with China.

In late 2009, Google was hit with a sophisticated attack on its Gmail servers and some of its other corporate networks. Google believed that the attack was an attempt to access the Gmail accounts of human rights activists. Up until then, Google had been censoring content like other ICPs, tailoring results to remove topics deemed subversive or pornographic. However, after the network attack, tensions began to rise between Google and China, as it was widely believed that the attacks came from the Chinese government or were at least sponsored by it in an effort to root out political dissidents. As a result, Google threatened to end its practice of censoring search results or even completely pull its business out of China.

Early in 2010, Google made the decision to redirect all its search traffic in China to servers in Hong Kong, where greater civil liberties remain, effectively ending its practice of censoring results and opening unrestricted searches to the Chinese public. Within days of the move, China began filtering and blocking searches directed to the Hong Kong servers using the Golden Shield system and even pulled out of lucrative agreements to use Google's Android operating system on a number of mobile platforms. In March 2010, Google's annual license to be an ICP in China expired. In summer 2010, China renewed Google's license, but it remains to be seen how this standoff between the search giant and China will end; several Google applications including Docs, Drive, and Photos remain blocked, with academics even being unable to access Google Scholar, Google's search engine dedicated to academic articles.

As is true of most attempts to censor the Internet, tech-savvy users in China find ways to circumvent the government's firewall. One group of Chinese dissidents created Greatfire.org, which includes mirror duplicates of several blocked websites. The group also created Freeweibo.com, which collects and publishes posts deleted from China's popular social media service Sina Weibo. Another example is an iPhone app called FireChat, a mobile messaging app designed to allow anonymous group messaging through the iPhone's peer-to-peer and Bluetooth connections. The app was recently used as a part of a political protest in Taiwan, and protesters in Taiwan and China were able to communicate and encourage each other without censorship from the Chinese government.

Questions

10-54. Should foreign companies provide their technologies to China knowing that the technologies are used to limit the individual freedom of Chinese citizens? Why or why not?

10-55. Given that China has the largest number of Internet users, do you think it can ultimately succeed in controlling information? Why or why not?

10-56. Should the rest of the world care if China limits information access within China? Why or why not? Now that Google has moved against censorship, do you think other companies will follow suit? Why or why not?

Based on:

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MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions:

10-57. Describe information systems risk assessment and explain four ways to approach systems security risk.
10-58. Define and contrast spyware, spam, and cookies.

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TECHNOLOGY BRIEFING

Foundations of Information Systems Infrastructure

After reading this briefing, you will be able to do the following

1. Discuss foundational information systems (IS) hardware concepts.
2. Describe foundational topics related to system software, programming languages, and application development environments.
3. Describe foundational networking and Internet concepts.
4. Explain foundational database management concepts.

Preview

In Chapter 3, "Managing the Information Systems Infrastructure and Services," you learned about the key components of a comprehensive information systems (IS) infrastructure and why its careful management is necessary. This Technology Briefing will expand that discussion, providing you with a deeper understanding of those topics. Each of the major sections within this briefing provides optional material that stands alone from the other sections as well as the entire book. Likewise, the end-of-chapter material is presented in separate sections to facilitate this independence.

Foundational Topics in IS Hardware

IS hardware is an integral part of the IS infrastructure and is broadly classified into three types: input, processing, and output technologies. In this section, we examine foundational topics related to IS hardware.

Input Technologies

Input technologies are used to enter data into a computer, laptop, tablet, or smartphone (see Figure TB1). Well-known input devices include various types of keyboards or pointing devices like track pads and mice. Other, more specialized input devices include biometric fingerprint readers to identify or authenticate people (for access control, such as for secure laboratories, or for border controls; see Chapter 10, "Securing Information Systems"), radio frequency identification (RFID) scanners to track valuable inventory in a warehouse (see Chapter 8, "Strengthening Business-to-Business Relationships via Supply Chain and Customer Relationship Management"), and eye-tracking devices, used primarily by the disabled for help with operating computers as well as for usability studies and scientific research studies.

ENTERING BATCH DATA. Large amounts of routine data, referred to as **batch data**, are often entered into the computer using scanners that convert printed or handwritten text and images into digital data. Scanners range from small handheld devices to large desktop boxes that resemble personal photocopiers. Rather than duplicating the image on another piece of paper, the computer translates the image into digital data that can be stored or manipulated by the computer. Insurance companies, universities, and other organizations that routinely process large numbers of forms and documents are typically using scanner technology to increase employee productivity; entering a large number of separate forms or documents into a computer system and then manipulating these data at a single time is referred to as **batch processing**.

Once a document is converted into digital format, **text recognition software** uses **optical character recognition** to convert typed, printed, or handwritten text into the computer-based characters that form the original letters and words. Other special-purpose scanning technologies include **optical mark recognition** devices, **bar code readers**, and **magnetic ink character recognition**, as summarized in Table TB1.

FIGURE TB1

All computing devices utilize input technologies.

Sources: (a) Nikolai Sorokin/Fotolia; (b) Aaron Amat/Fotolia; (c) Jan Engel/Fotolia

TABLE TB1 Specialized Scanners for Inputting Data

Scanner	Description
Optical mark recognition	Used to scan questionnaires and test answer forms ("bubble sheets") where answer choices are marked by filling in circles using pencil or pen
Optical character recognition	Used to read and digitize typewritten, computer-printed, and even handwritten characters such as product specifications on sales tags on department store merchandise, patient data in hospitals, or addresses on postal mail
Bar code reader	Used mostly in grocery stores and other retail businesses to read bar code data at the checkout counter; also used by libraries, banks, hospitals, utility companies, and so on
Magnetic ink character recognition	Used by the banking industry to read data, account numbers, bank codes, and check numbers on preprinted checks
Biometric scanner	Used to scan human body characteristics of users to enable everything from access control to payment authorization

Other Input Technologies **Smart cards** are special credit card–sized cards containing a microprocessor chip, memory circuits, and often a magnetic stripe. Smart cards can be used for various applications, including identification, providing building access, or making payments (e.g., at vending machines or checkout counters). Some smart cards allow for contactless transmission of data using RFID technology (e.g., MasterCard Contactless or Visa payWave). Biometric devices, discussed in more detail in Chapter 10, are being used primarily for identification and authentication purposes. These devices read certain body features, including irises, fingerprints, and hand or face geometry, and compare them with stored profiles. Biometric devices are now also being included in consumer products such as laptops, computer keyboards, or mobile devices, allowing users to log on to the device by scanning their fingerprints rather than typing their user names and passwords. Further, most modern smartphones use various sensors to obtain data about the device's location (global positioning system [GPS] sensor), orientation (compass and gyroscope), acceleration (accelerometer), altitude (barometer), proximity to the user's body, or ambient light. As introduced in Chapter 1, the various Internet of Things (IoT) devices have become another important input technology. Entrepreneurs and established companies around the globe are using a variety of sensors to collect diverse types of data to automate processes or provide innovative services to customers, from monitoring newborn babies, to providing reminders for taking medication, to fitness tracking, to home automation, and countless other uses.

ENTERING AUDIO AND VIDEO. When entering **audio** (i.e., sound) or **video** (i.e., still and moving images) data into a computer, the data have to be digitized before they can be manipulated, stored, and played or displayed. In addition to the manipulation of music, audio input is helpful for operating a computer when a user's hands need to be free to do other tasks. Video input is used for assisting in security-related applications, such as room monitoring and employee verification, as well as for videoconferencing and chatting on the Internet, using a PC and a webcam.

Voice Input Voice data are input into a computer system using microphones. A process called **speech recognition** also makes it possible for your computer or smartphone to understand speech. **Voice-to-text software** is an application that uses a microphone to monitor a person's speech and then converts the speech into text. Speech recognition technology can also be especially helpful for disabled computer users, physicians and other medical professionals, airplane pilots, factory workers whose hands get too dirty to use keyboards, mobile users who don't want to type while walking or driving, and computer users who cannot type and do not want to learn. Increasingly, **interactive voice response (IVR)**, based on speech recognition technology, is used for telephone surveys or to guide you through the various menu options when calling a company's customer service line.

Other Forms of Audio Input In addition to using a microphone, users can enter audio using electronic keyboards, or they can transfer audio from another device (such as an audio recorder, a digital media player, or a smartphone). The users can then analyze and manipulate the sounds via sound editing software, output the sounds to speakers, or store the digitized sounds to MP3 or other file formats.

Video Input Video data can be entered into a computer using digital cameras that record still images or video clips in digital form on small, removable memory cards. File size is primarily influenced by the resolution, compression, and file format you select for pictures or the length of the recording for video. As webcams (as well as cameras integrated into mobile devices) have become very popular with people wanting to use the Internet for chatting with friends and family using programs like Skype, Google Hangouts, or FaceTime, protocols to transmit data in a continuous fashion are used. In contrast to discrete audio or video files that have to be completely downloaded before they can be opened, **streaming audio** and **streaming video** (together referred to as **streaming media**) are data streams transmitted using specific protocols that are available for immediate playback on the recipient's device. Similarly, the video-sharing site YouTube, online radio stations, and Netflix use specific protocols to stream media content.

Processing: Transforming Inputs into Outputs

In this section we provide a brief overview of computer processing. **Processing technologies**, contained inside any computing device (including smartphones, tablets, or wireless routers), transform inputs into outputs.

HOW A COMPUTER WORKS. Inside any computing device, you will find the **motherboard**, a plastic or fiberglass circuit board that holds or connects to all of the computer's electronic components (see Figure TB2). The motherboard holds the **central processing unit (CPU)** or **microprocessor**, which is the main component of a computing device, and connects it to the power supply and primary and secondary storage as well as to various peripherals (such as input and output devices or expansion cards, such as dedicated sound or video cards). The CPU is often called the computer's brain, as it is responsible for performing all the operations of the computer (see Figure TB3). Its job includes loading the *operating system* (e.g., Windows 10, Mac OS X, or Ubuntu Linux) when the machine is first turned on and performing, coordinating, and managing all the calculations and instructions relayed to it while the computer is running. The CPU, a small device made of silicon, is composed of millions of tiny transistors arranged in complex patterns that allow it to interpret and manipulate data. In addition to the number of transistors on the CPU, three other factors greatly influence its speed—its system *clock speed* (the number of instructions

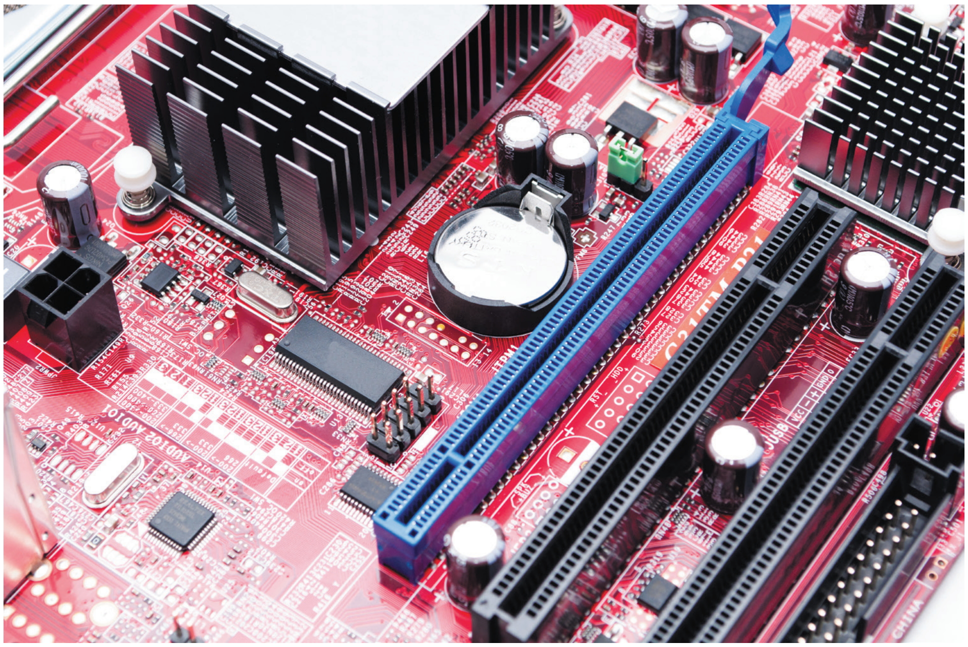


FIGURE TB2

A computer's motherboard holds or connects to all of the computer's electronic components.
Source: Bretislav Horak/Shutterstock.

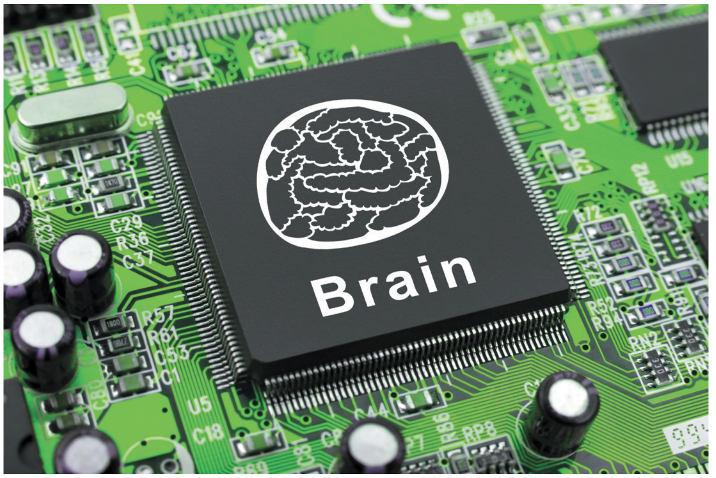


FIGURE TB3

A CPU performs all operations of a computer.

Source: Tatiana Popova/Shutterstock.

a CPU can execute in a fixed amount of time), registers, and *cache memory* (described later). The CPU consists of two main sections: the **arithmetic logic unit (ALU)** and the **control unit**, together often referred to as its *core*. The ALU performs calculations and logical operations, which involve comparing packets of data and then executing appropriate instructions. Combined in various ways, these functions allow the computer to perform complicated operations rapidly. The control unit works closely with the ALU, fetching and decoding instructions as well as retrieving and storing data. Many modern CPUs have more than one set of ALU and control units on a single chip and are referred to as **multi-core processors**. Multi-core processers can divide processing operations into independent streams that are performed in parallel by the separate cores, greatly speeding up the performance of the CPU.

Inside all computers, data are represented in the form of binary digits, or **bits** (i.e., the 0s and 1s a computer understands); a sequence of 8 bits is referred to as a **byte**. Different **binary codes** have been developed to represent characters or numbers as strings of bits. A widely used standard is the **American Standard Code for Information Interchange (ASCII)**, where, for example, the binary digits "01100001" represent the letter *a*. Due to limitations in the number of characters that can be represented, as well as for specialized applications, various other codes have been developed. For example, **Unicode** has gained widespread acceptance, as it allows for representing characters and scripts beyond the Latin alphabet, including Chinese, Cyrillic, Hebrew, and Arabic. Any input your computer receives (say, a keystroke or mouse movement) is **digitized**, or translated into binary code, and then processed by the CPU.

Within the computer, an electronic circuit generates pulses at a rapid rate, setting the pace for processing events to take place, just like a metronome marks time for a musician. This circuit is called the **system clock**. A single pulse is a **clock tick**, and a fixed number of clock ticks is required to execute a single instruction. In microcomputers, the processor's **clock speed** is measured in hertz (Hz) or multiples thereof. One megahertz (MHz) is 1 million clock ticks, or instruction cycles, per second. Personal computer speeds are most often indicated in gigahertz (GHz, or 1 billion hertz). Microprocessor speeds improve so quickly that faster chips are on the market about every 6 months. Today, most new PCs operate at more than 3 GHz. To give you an idea of how things have changed, the original IBM PC had a clock speed of 4.77 MHz.

As its inner workings are very complex, for most of us it is easiest to think of a CPU as being a "black box" where all the processing occurs. The CPU uses registers and cache memory (both located inside the CPU) and RAM (located outside the CPU) as *primary*, or temporary, storage space for data that are currently being processed. The CPU interacts with *secondary storage* (such as a *hard drive*, *optical disk*, or *flash drive*) for permanently storing data; as primary storage is considerably faster than secondary storage, the amount of primary storage greatly influences a computer's performance. The different types of storage are discussed next.

STORAGE. A computer has various different types of storage, each serving a specific purpose. The primary differences between different types of storage are capacity, volatility, and read/write speed (see Table TB2 for a comparison of different storage technologies).

TABLE TB2 Different Storage Technologies

Name	Volatility	Speed	Access	Capacity	Usage
Register	Volatile	Extremely fast	Random	32 or 64 bits per register	Data directly used by CPU
Cache	Volatile	Extremely fast	Random	Typically up to 20 MB	Data and instructions used by CPU
RAM	Volatile	Very fast	Random	Depends on configuration; typically up to 128 GB	Programs and data currently used
ROM	Nonvolatile	Fast	Random	Very low	Instructions used before the operating system is loaded
SSD	Nonvolatile	Fast	Random	High	Storage of programs and data
Hard drive	Nonvolatile	Relatively slow	Random	High	Storage of programs and data
Optical disks	Nonvolatile	Slow	Random	Medium	Backup and long-term storage; software distribution; music and movies
Tape	Nonvolatile	Very slow	Sequential	High	Archiving of data

Primary Storage **Primary storage** (such as **random-access memory [RAM]**), also called main memory, is located on the motherboard and is used to store the data and programs currently in use; primary storage uses memory chips (consisting of transistors and capacitators) to store data. Because instructions and data stored in RAM are lost when the power to the computer is turned off, it is referred to as **volatile memory**. Within the CPU itself, **registers** provide relatively small temporary storage locations where data must reside while being processed or manipulated. For example, if two numbers are to be added together, both must reside in registers, with the result placed in a register. Consequently, the number and size of the registers can also greatly influence the speed and power of a CPU.

A **cache** (pronounced "cash") is a small block of memory used by processors to store those instructions most recently or most often used. Just as you might keep file folders that you use most in a handy location on your desktop, cache memory is located within the CPU. Thanks to cache memory, before performing an operation, the processor does not have to go directly to main memory, which is slower and farther away from the microprocessor and takes longer to reach. Instead, it can check first to see if needed data are contained in the cache. Cache memory is another way computer engineers have increased processing speed.

Modern CPUs have a hierarchy of cache memory (level 1, level 2, or even level 3); the lower levels of cache memory are faster but also smaller and more expensive. The more cache available to a CPU, the better the overall system performs because more data are readily available (although at a certain size, factors such as heat emission and power consumption become prohibitive to increasing the CPU cache).

Read-only memory (ROM) is used to store programs and instructions that are automatically loaded when the computer is turned on (before the operating system is loaded), such as the **basic input/output system (BIOS)**. In contrast to other forms of primary storage, ROM is **nonvolatile memory**, which means that it retains the data when the power to the computer is shut off.

Secondary Storage **Secondary storage** refers to technologies for permanently storing data to a large-capacity, nonvolatile storage component, such as a **hard drive (hard disk drive)**. Most of the software runing on a computer, including the operating system, is stored on the hard drive. Hard drives are usually installed internally, but additional hard drives may be externally located and connected via cables.

The storage capacity of the hard drives for today's microcomputers is typically measured in gigabytes (GB, billions of bytes) or terabytes (TB, trillions of bytes). It is not unusual for PCs currently on the market to come equipped with hard drives with 1–2 TB storage capacities. Modern supercomputers can have millions of terabytes of storage. To make sure critical data are not lost, some computers employ **redundant array of independent disks (RAID)** technology to store redundant copies of data on two or more hard drives. RAID is not typically used on an individual's computer, but it is very common for web servers and many business systems. RAID is sometimes called a "redundant array of *inexpensive* disks" because it is typically less expensive to have multiple redundant disks than fewer highly reliable and expensive ones.

A traditional hard drive consists of several magnetic disks, or platters, used for data storage (see Figure TB4). Each disk within a disk pack has an access arm with two **read/write heads**—one positioned close to the top surface of the disk and another positioned close to the bottom surface of the disk—to inscribe or retrieve data. When reading from or writing to the disks, the read/write heads are constantly repositioned to the desired storage location for the data while the disks are spinning at speeds of 5,400 to 15,000 revolutions per minute. The read/write heads do not actually touch either surface of the disks. In fact, a **head crash** occurs if the read/write head for some reason touches the disk, leading to a loss of data. Because of the mechanical action needed to position the read/write heads, hard drives are comparably slow; it takes a permanent storage device such as a hard drive about 3–10 milliseconds to access data. Within a CPU, however, a single transistor can be changed from a 0 to a 1 in about 10 picoseconds (10-trillionths of a second). Changes inside the CPU occur about 1 billion times faster than they do in a hard drive because the CPU operates only on electronic impulses, whereas the hard drives perform both electronic and mechanical activities, such as spinning the disk and moving the read/write head. Mechanical activities are extremely slow relative to electronic activities; however, modern hard drives use cache memory to decrease the time needed to access frequently used data. A newer secondary storage technology called **solid-state drive (SSD)** uses nonvolatile memory chips (i.e., *flash memory*) to store data; as SSDs have no moving parts, they are typically faster (with access times of 0.1–0.5 millisecond), quieter, and more reliable but also more expensive than traditional hard disk drives. Solid-state drives have become increasingly popular due to the rise of smartphones and tablets. Given their performance, weight, and reliability, they are also increasingly used for laptops and even high-performance servers and supercomputers.

Removable Storage Media There are different types of removable storage: flash memory, optical disks, and tapes. **Flash memory** is a memory chip–based nonvolatile computer storage method that is used in USB flash drives, solid-state hard drives, and memory cards (such as

FIGURE TB4

A hard drive consists of several disks that are stacked on top of one another and read/write heads to read and write data.

Source: Alias Studiot Oy/Shutterstock.

SD cards) used for storing music and pictures in digital cameras and music players. A **flash drive** is a data storage device that includes flash memory with an integrated USB interface. Flash drives are relatively inexpensive storage devices typically having capacities of 16–128 GB; as of 2016, the highest-capacity flash drive could store 1 TB of data.

Optical disks (i.e., disks that are written/read using laser beam technology) are very inexpensive removable nonvolatile storage media used to store data (e.g., photos and videos) and distribute software, video games, and movies. Optical disks store binary data in the form of pits and flat areas on the disk's surface (where the pits and flats represent the 0s and 1s, respectively); an optical disk drive's laser beam can then read the data based on the reflection of the disk's surface. For many years, CD-ROMs (compact disc–read-only memory) were the standard for distributing data and software because of their low cost and their storage capacity of 700 MB. As CD-ROMs cannot be written to, most computers support other types of optical disks that data can be written to, such as the **CD-R (compact disc–recordable)**. Whereas a CD-R can be written onto only once, a **CD-RW (compact disc–rewritable)** can be written onto multiple times. The **DVD-ROM (digital versatile disc–read-only memory)** has more storage space than a CD-ROM because DVD-ROM (or typically referred to as simply DVD) drives use a shorter-wavelength laser beam that allows more optical pits to be deposited on the disk. Like compact discs, there are recordable (DVD-R) and rewritable (DVD-RW) versions of this storage technology. DVDs used for the distribution of movies are also called **digital video discs**. The increasing demand for high-definition video content led to the creation of Blu-ray, a DVD format that provides up to 50 GB of storage.

Tapes are removable, high-capacity secondary storage media; allowing only for sequential access, tapes are typically only used for archiving data and long-term storage. Tapes used for data storage consist of narrow plastic tape coated with a magnetic substance. Storage tapes are typically enclosed in a cartridge, similar to a music cassette, and must be inserted into a tape reader. As with other forms of magnetic storage, data are stored in tiny magnetic spots. The storage capacity of tapes is expressed as **density**, which equals the number of **characters per inch** or **bytes per inch (BPI)** that can be stored on the tape.

Having a life span of several decades, magnetic tape is still used for backing up or archiving large amounts of computer data, but it is gradually being replaced by high-capacity disk storage because disk storage is equally reliable. In fact, data stored on disks are easier and faster to locate because when using disks, computers do not have to scan an entire tape to find specific data.

PORTS AND POWER SUPPLY. To use the full functionality of a computer, you need to be able to connect various types of peripheral devices, such as mice, printers, and cameras, to the system unit. A **port** provides a hardware interface for connecting devices to computers. The characteristics of various types of ports are summarized in Table TB3. A final key component of any computing device is the **power supply**, which converts electricity from the wall socket to a lower voltage. Whereas typically power supplied by the utility companies can vary from 100 to 240 volts AC, depending on where you are in the world, a PC's components use lower voltages—3.3 to 12 volts DC. The power supply converts the power accordingly and also regulates the voltage to eliminate spikes and surges common in most electrical systems. For added protection against external power surges, many PC owners opt to connect their systems to a separately purchased voltage surge suppressor. The power supply includes one or several fans for air cooling the electronic components inside the system unit—that low humming noise you hear while the computer is running is the fan.

Now that you understand how data are input into a computer and how data can be processed and stored, we can turn our attention to the third category of hardware—output technologies.

Output Technologies

Output technologies, such as a computer monitor or printer, deliver information to you in a usable format. A **printer** is an output device that produces a paper copy of alphanumeric data or other content from a computer. Printers vary in price, performance, and capabilities (e.g., document size, color or black and white, technology, speed, resolution, quality). Ink-jet, LED, or laser technology is used in most personal printers.

Monitors are used to display information from a computer and, like printers, can vary in price, performance, and capabilities (e.g., screen size, color, technology, resolution, and so on). Monitors can be color, black and white, or monochrome (meaning all one color, usually green or amber). Today, monochrome monitors are used primarily in cash registers and other point-of-sale

TABLE TB3 Common Computer Ports, Applications, and Descriptions

Port Name	Used to Connect	Description
Serial	Modem, mouse, keyboard, terminal display, MIDI	■ Transfers one bit at a time ■ Slowest data transfer rates
USB	Printer, scanner, mouse, keyboard, digital camera and camcorders, external disk drives	■ Extremely high-speed data transfer method ■ Up to 10 Gbps using USB3.1 ■ Up to 127 devices simultaneously connected
IEEE 1394 ("Fire Wire")	Digital cameras and camcorders, external disk drives	■ Extremely high-speed data transfer method ■ Up to 3.2 Gbps ■ Up to 63 devices simultaneously connected
Thunderbolt	Simultaneous transmission of DisplayPort (video and audio), PCI Express (data), and power	■ Extremely high-speed data transfer method ■ Up to 40 Gbps ■ Up to 7 devices simultaneously connected to a single port
Ethernet	Network	■ Most common standard for local area networks
VGA (Video Graphics Array), DVI (Digital Visual Interface)	Monitors	■ VGA is designed for transmission of analog video signals ■ DVI allows for transmission of digital video signals
HDMI (High Definition Multimedia Interface), DisplayPort	Monitors, home theater	■ HDMI and DisplayPort allow for simultaneous transmission of digital audio and video signals

systems. Most modern monitors use **liquid crystal display (LCD)** technology because they are lighter and thinner than the bulky **cathode ray tubes (CRT)** used in old computer displays and televisions. Because display monitors are embedded into a broad range of products and devices, such as cell phones, digital cameras, and automobiles (e.g., to display route maps and other relevant information), they must be sturdy, reliable, lightweight, energy efficient, and low in cost. Recent developments in monitor technologies have thus focused on other display technologies, such as **organic light-emitting diodes (OLED)**, which require far less power and are much thinner than traditional LCD panels. Finally, projectors are often used for presentation to an audience (and by many as a way to project a large video image in a home theater).

In addition to traditional monitors, touch screen displays have become extremely popular with the development of smartphones, tablets, high-end laptops, and a variety of technology gadgets. A **touch screen** is a display screen that is also an input device; a user interacts with the device by touching pictures or words on the screen with a finger or a stylus. In addition to your smartphone or tablet, touch screens are used in ATMs, retail point-of-sale terminals, car navigation, and industrial control computers. Touch screens provide great flexibility in how an input device can look and operate.

Especially for mobile computing, monitor technology is still a challenge. In addition to screen size and power requirements of commonly used display technologies, glare is often an issue, and many laptop screens are hard to read in bright sunlight. Over the past decades, there has been a steady stream of enhancements related to improved resolution and reduced power consumption. It is forecasted that the next generation will be lightweight, thin, and flexible like paper, as well as be inexpensive and not require external power to retain an image. Recently, manufacturers have introduced flexible glass for touch screens, which has allowed for new form factors of mobile devices.

Now that you have learned more about IS hardware, we will focus on software, another key component of the IS infrastructure.

Foundational Topics in IS Software

Software refers to programs, or sets of instructions, that allow all the hardware components in your computer system to speak to each other and to perform the desired tasks. Throughout the book, we have discussed a variety of application software, from large business systems (e.g., an enterprise resource planning system) to office automation and personal productivity tools. Without software, the biggest, fastest, most powerful computer in the world is nothing more than a fancy paperweight. Software is intertwined with all types of products and services—toys, music, appliances, healthcare, and countless other products. Here, we provide some background on this critical component to all computer-based products.

System Software

In Chapter 3, you learned about one type of system software, the operating system, and its many different tasks. More specifically, common tasks of an operating system include the following:

- Booting (or starting) your computer
- Reading programs into memory and managing memory allocation
- Managing where programs and files are located in secondary storage
- Maintaining the structure of directories and subdirectories
- Formatting disks
- Controlling the computer monitor
- Sending documents to the printer

Just as there are many kinds of computers, there are many different kinds of operating systems (see Table TB4). In general, operating systems—whether for large mainframe computers, desktop computers, or smartphones—perform similar operations. Obviously, large multiuser mainframes are more complex than small desktop systems; therefore, the operating system must account for and manage that complexity. However, the basic purpose of all operating systems is the same.

A second type of system software, **utilities** (or **utility programs**), is designed to manage computer resources and files. Some utilities are included in operating systems, while others must be obtained separately and installed on your computer. Table TB5 provides a sample of a few utility programs that are considered essential.

Programming Languages and Development Environments

Each piece of software is developed using some programming language. A programming language is the computer language the software developer uses to write programs. For application software, such as spreadsheets, web browsers, or accounting software, the underlying programming language is invisible to the user. However, programmers in an organization's IS group, and in some instances end users, can use programming languages to develop their own specialized

TABLE TB4 Common Operating Systems

Operating System	Description
z/OS	A proprietary operating system developed specifically for large IBM mainframe systems.
Unix	A multiuser, multitasking operating system that is available for a wide variety of computer platforms. Commonly used because of its superior security.
Windows	Currently, the Windows desktop operating system is by far the most popular in the world. Variations are also used to operate large servers, tablets, and smartphones.
Mac OS	The first commercial graphical-based operating system, making its debut in 1984. The operating system of Apple computers.
Linux	An open source operating system designed in 1991 by a Finnish student. Known as a secure, low-cost, multiplatform operating system. Linux powers about one-third of all web servers. Linux users can choose between different "flavors" (or distributions) depending on their needs (such as the novice-friendly Ubuntu).
Android	Google's Linux-based operating system for mobile devices.
iOS	Apple's mobile operating system.

TABLE TB5 Common Types of Computer Software Utilities

Utility	Description
Backup	Archives files from the hard drive to tapes, flash drives, or other storage devices.
File defragmentation	Converts fragmented files (i.e., files not stored contiguously) on your hard drive into contiguous files that will load and be manipulated more rapidly.
Disk and data recovery	Allows the recovery of damaged or erased data from hard drives and flash drives.
Data compression	Compresses data by substituting a short code for frequently repeated patterns of data, much like the machine shorthand used by court reporters, allowing more data to be stored on a storage medium.
File conversion	Translates a file from one format to another so that it can be used by an application other than the one used to create it.
Antivirus	Scans files for viruses and removes or quarantines any virus found.
Device driver	Allows the computer to communicate with various different hardware devices.
Spyware detection and removal	Scans a computer for spyware and disables or removes any spyware found.
Media player	Allows listening to music or watching video on a computer.

applications. The **source code** (i.e., the program written in a programming language) must be translated into object code—called assembly or machine language—that the hardware can understand. Normally, the source code is translated into machine language using programs called *compilers* and *interpreters*.

COMPILERS AND INTERPRETERS. A **compiler** takes an entire program's source code written in a programming language and converts it into an **executable**, that is, a program in machine language that can be read and executed directly by the computer (see Figure TB5). Although the compilation process can take quite some time (especially for large programs), the resulting executables run very fast; thus, programs are usually compiled before they are sold as executables to the customers. The customers purchase only the executable but do not have access to the program's source code; thus, they can run the program but not make any modifications to it.

Some programming environments do not compile the entire program into machine language. Instead, each statement of the program is converted into machine language and executed "on the fly" (i.e., one statement at a time), as depicted in Figure TB6. The type of program that does the conversion and execution is called an **interpreter**. As the source code is translated each time the program is run, it is easy to quickly evaluate the effects of any changes made to the program's source code. However, this also causes interpreted programs to run much slower than compiled executables. Programming languages can be either compiled or interpreted.

PROGRAMMING LANGUAGES. Over the past few decades, software has evolved. As software has evolved, so have the programming languages. Each programming language has been designed at a particular time, for a particular use, and the first generations of programming languages were quite crude by today's standards. Some popular programming languages are listed in Table TB6.

Of course, programming languages continue to evolve, with object-oriented languages, visual programming languages, and web development languages having rapidly gained popularity. We discuss these next.

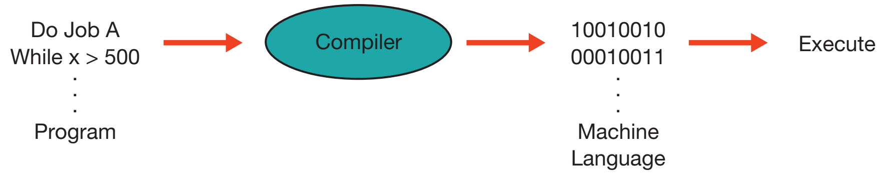


FIGURE TB5
A compiler translates the entire computer program into machine language, then the CPU executes the machine language program.

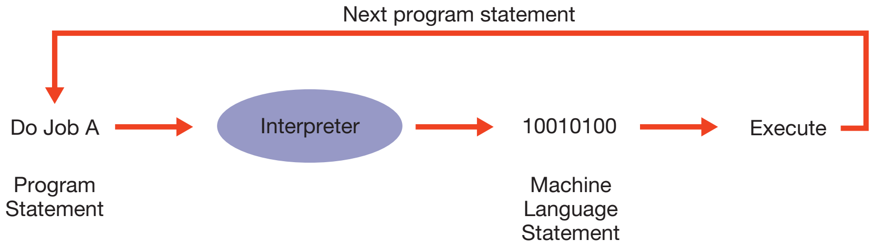


FIGURE TB6

Interpreters read, translate, and execute one line of source code at a time.

Object-Oriented Languages **Object-oriented languages** are the most recent in the progression of high-level programming languages and are extremely popular with application developers. Object-oriented languages use common modules (called objects), which combine properties and behaviors to define the relevant system components. An example of an object would be a specific student who has a name, an address, and a date of birth (i.e., the properties) but can also perform certain operations, such as register for a course (the behaviors). If an object-oriented programming language is being used, it enables the design and implementation of the objects to happen quickly and simultaneously, as oftentimes preexisting objects can be reused or adapted. For important concepts related to object-oriented languages, see Table TB7.

Visual Programming Languages Just as you may have found it easier to use a computer operating system with a **graphical user interface (GUI)**, such as Windows 10 or Mac OS X, programmers using **visual programming languages** may also take advantage of the GUI. For instance, programmers can easily add a command button to a screen with a few clicks of a mouse (see Figure TB7) instead of programming the button pixel by pixel and using many lines

TABLE TB6 Examples of Popular Programming Languages

Language	Application	Description
BASIC	General purpose	Beginner's All-Purpose Symbolic Interaction Code. An easy-to-learn language, BASIC works on almost all PCs.
C/C++	General purpose	C++ is a newer version of C. Developed at AT&T Bell Labs. Complex languages used for a wide range of applications.
COBOL	Business	COmmon Business-Oriented Language. Developed in the 1960s, it was the first language for developing business software. COBOL is still frequently used for many business transaction processing applications on mainframes.
FORTRAN	Scientific	FORmula TRANslator. The first commercial high-level language developed by IBM in the 1950s. Designed for scientific, mathematical, and engineering applications.
Java	World Wide Web	An object-oriented programming language developed by Sun Microsystems in the early 1990s. It is a popular programming language for the Internet because it is highly transportable from one computer to another. Java is also used for programing Android apps.
.NET Framework	World Wide Web	A variety of programming languages (e.g., ASP.NET and C#) offered by Microsoft that can easily be integrated into web applications.
LISP	Artificial Intelligence	LISt Processor. Dates from the late 1950s. One of the main languages used to develop applications in artificial intelligence and high-speed arcade graphics.
PERL	World Wide Web	A dynamic programming language commonly used for writing scripts for websites, as well as for batch processing of large amounts of data.
Python	General purpose	Popular object-oriented scripting language
Objective-C	App development	Evolved from C, Objective-C is used for developing apps for iPhones, iPads, and Apple computers.

TABLE TB7 Concepts Related to Object-Oriented Languages

Concept	Description	Example
Class	A set of objects having the same properties and behaviors (but the values of the properties can differ for each individual object). Classes can be reused for different programs.	A "student" has an address and a grade-point average (GPA) (properties) and can enroll in courses (behavior).
Object	Instantiation of a class.	Student Jeff Smith has a GPA of 3.94 and enrolls in MIS250.
Encapsulation	Data and behavior of a class are hidden from other classes and are thus protected from unexpected changes.	The registrar doesn't need to know how the GPA is calculated within the "student" class; the registrar cares only that it is updated.
Inheritance	More specific classes include the properties and behaviors of the more general class.	Both "distance degree student" and "on-campus student" inherit properties (such as address and GPA) and behaviors (such as enroll in a course) from the general class "student."
Event-driven program execution	The programmer does not determine the sequence of execution for the program; the flow is determined by user input (e.g., mouse clicks) or messages from other applications.	A word processor reacts to your typing and clicking.

of code. Visual Basic.NET and Visual C# (pronounced as "C-sharp") are two popular examples of visual programming languages.

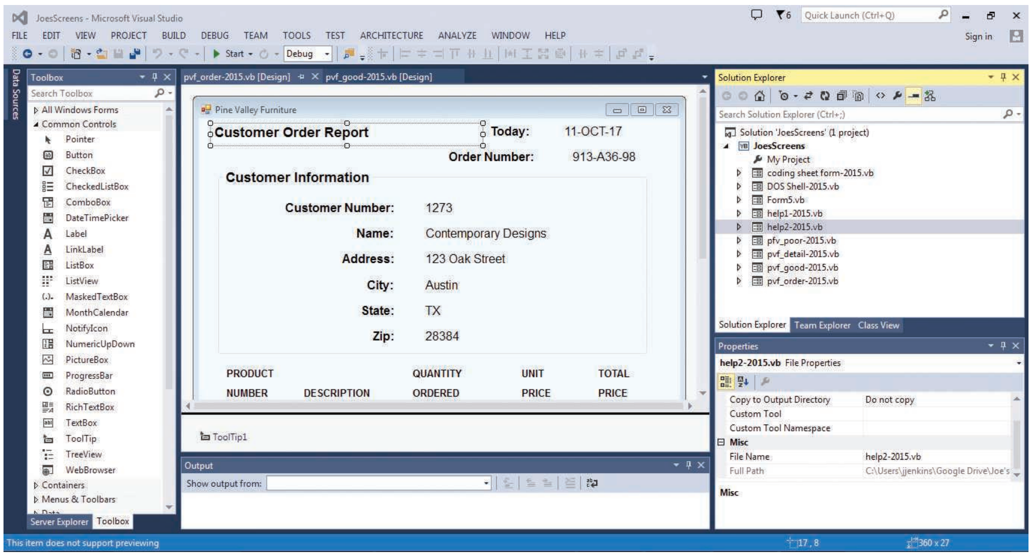
Web Development Languages You may have thought of creating a personal web page or already have one. In that event, you have some experience with using a markup language. The markup language you used to create your web page is called Hypertext Markup Language (HTML). HTML is a text-based file format that uses codes (i.e., tags) to specify the content and structure of a document; **HTML tags** are used to instruct the web browser on how a document should be presented to the user. Because many HTML editing programs are visually oriented and easy to use, you do not need to memorize the language to set up a web page. Programs for creating web pages (such as Brackets, Microsoft Visual Studio, and Adobe Dreamweaver CC) are called **web page builders** or **HTML editors**.

In HTML, the tags used to identify different elements on a page are set apart from the text with angle brackets (<>). Specific tags are used to mark the beginning and the ending of an element or a formatting command. For example, if you want text to appear in bold type, the HTML

FIGURE TB7

Visual Basic.Net, a visual programming language, is used to create standard business forms.

Source: Visual Studio 2016, Windows 10, Microsoft Corporation.



tag to begin bolding is . The tag to turn off bolding, at the end of the selected text, is . The "a href" command sets up a hyperlink from a word or image on the page to another HTML document. Tags can also be used to specify meaning, such as text to be used as the page title, levels of headings, the ends of paragraphs, emphasis, or importance, and to specify places to insert images or media (see Table TB8). The current HTML version is referred to as HTML5, which provides advanced markup for structuring and presenting content, such as the latest multimedia, on web pages. In addition to HTML, web developers use **cascading style sheets (CSS)** to specify the formatting and layout of elements on a web page (the current version, CSS3, provides greater flexibility for web page layouts, which allows for higher aesthetics and usability).

A good way to understand how HTML works is to find a web page you like, then use the "View Source" command on your browser to view the markup used to create the page (see Figure TB8). Once you have created your own web page and saved it to a disk, you can upload it to a web space you have created through your website's host.

Markup languages such as HTML are for specifying the content and structure of web pages. If you want to add dynamic content or have users interact with your web page other than by clicking on hypertext links, then you will need to use special purpose programming languages such as Java or use web services, scripting languages, and so on.

Java is a programming language that was developed by Sun Microsystems in the early 1990s to allow adding dynamic, interactive content to web pages. For example, the chat feature in the Blackboard learning environment uses Java. You can add Java applications to a web page in one of two ways: by learning Java or a similar language and programming the content you want or by downloading free general purpose **applets** from the web to provide the content you want on your web page. Applets are small programs that are executed within another application, such as a web page. When a user accesses your web page, the applets you inserted are downloaded from the server along with your web page to the user's browser, where they perform the desired action. Later, when the user leaves your web page, the web page and the applets disappear from his or her computer. Java is also frequently used to build Android apps.

Microsoft.NET is a programming platform that is used to develop applications that are highly interoperable across a variety of platforms and devices. For example, using the .NET framework, developers can create an application that runs on desktop computers, mobile computers, or smartphones. A suite of visual programming languages including Visual C#, ASP .NET, and Visual Basic.NET can be used to construct .NET applications.

Scripting languages can also be used to supply interactive components and dynamic content to a web page. These languages let you build programs or scripts directly into HTML page code. Web page designers frequently use them to check the accuracy of user-entered information, such as names, addresses, and credit card numbers. Two common scripting languages are Microsoft's VBScript and JavaScript.

TABLE TB8 Common HTML Tags

Tag	Description
<html>…</html>	Delineates an HTML document
<head>…</head>	Contains the title, scripts, styles, metadata and other elements that are not displayed on the web page itself
<body>…</body>	Contains the visible portion of the document
…	Creates bold text
…	Creates a hyperlink
…	Creates a link creating a new e-mail message
…	Creates a new paragraph
<table>…</table>	Creates a table

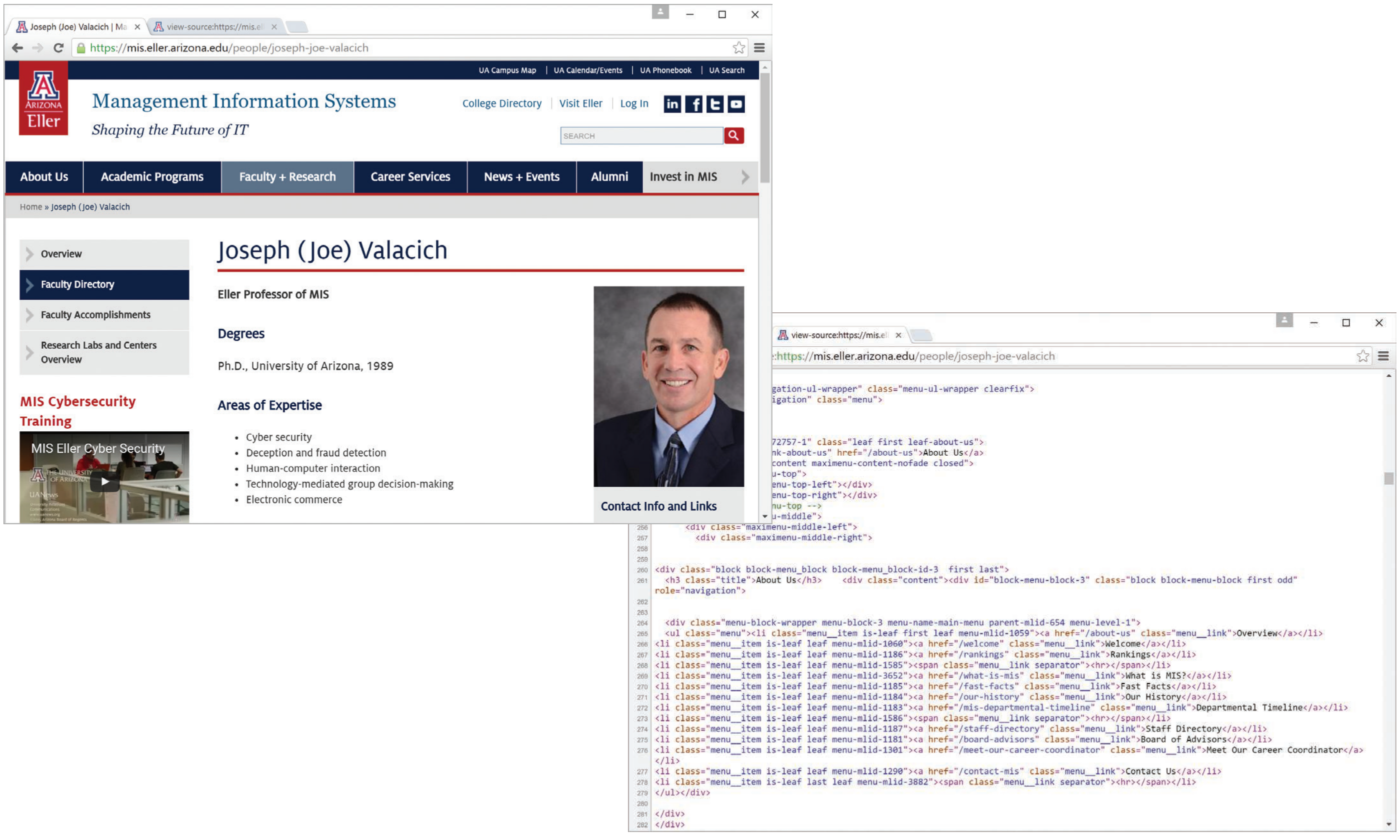


FIGURE TB8

A web page and the HTML source code used to create it.
Source: Visio 2016, Windows 10, Microsoft Corporation.

JavaScript bears little resemblance to Java. The two are similar, however, in that both Java and JavaScript are useful component software tools for creating dynamic, interactive web pages. That is, both allow users to add dynamic content to web pages. Both are also cross-platform programs, meaning that they can typically be executed by computers running Windows, Linux, Mac OS, and other operating systems.

Another common way to add dynamic content to websites is Flash. Flash animation is displayed on your screen using the Adobe Flash player. Yet Flash content is not well suited for mobile devices, and in 2010, Apple announced that it would not support Flash on its iPhones and iPads, rather advocating the use of HTML5, which allows for rich, interactive web applications.

Along with commercial products, there are several open source tools in wide use today. The most common is PHP, originally designed as a high-level tool for producing dynamic web content. The development of programming languages is an ongoing process of change and innovation, and these changes often result in more capable and complex systems for the user. The popularity of the Internet has further spurred the creation of innovative and evolving software. From the pace of change that is occurring, it is clear that many more innovations are on the horizon.

AUTOMATED DEVELOPMENT ENVIRONMENTS. Over the years, the tools for developing information systems have increased in both variety and capabilities. In the early days of systems development, a developer was left using pencil and paper to sketch out design ideas and program code. Computers were cumbersome to use and slow to program, and most designers worked out on paper as much of the system design as they could before moving to the computer. Today, system developers have a vast array of powerful computer-based tools at their disposal. These tools have forever changed the ways in which systems are developed. **Computer-aided software engineering (CASE)** refers to the use of automated software tools by systems developers to design and implement information systems. Developers can use CASE tools to automate or support activities throughout the systems development process with the objective of increasing productivity and improving the overall quality of systems. The capabilities of CASE tools are continually evolving and being integrated into a variety of development environments. Next we briefly review some of the characteristics of CASE.

Types of CASE Tools Two of the primary activities in the development of large-scale information systems are the creation of design documents and the management of information. Over the life of a project, thousands of documents need to be created—from screen prototypes to database content and structure to layouts of sample forms and reports. At the heart of all CASE environments is a repository for managing such information.

CASE also helps developers represent business processes and information flows by using graphical diagramming tools. By providing standard symbols to represent business processes, information flows between processes, data storage, and the organizational entities that interact with the business processes, CASE eases a very tedious and error-prone activity (see Figure TB9). The tools not only ease the drawing process but also ensure that the drawings conform to development standards and are consistent with other design documents created by other developers.

Another powerful capability of CASE is its ability to generate program source code automatically. CASE tools keep pace with contemporary programming languages and can automatically produce programming code directly from high-level designs in languages such as Java, Visual Basic.NET, and C#. In addition to diagramming tools and code generators, a broad range of other tools assists in the systems development process. The general types of CASE tools used throughout the development process are summarized in Table TB9.

Foundational Topics in Networking

Telecommunications and networking technologies have become very important as almost all organizations rely on computer-based information systems to support various business processes. Understanding how the underlying networking technologies work and where these technologies are heading will help you better understand the potential of information systems. The discussion begins with a description of the evolution of computer networking.

Evolution of Computer Networking

Over the past decades, computer networking underwent an evolution from centralized computing to distributed computing to collaborative computing. These eras of computer networking are discussed next.

CENTRALIZED COMPUTING. **Centralized computing**, depicted in Figure TB10, remained largely unchanged through the 1970s. In this model, large centralized computers, called mainframes,

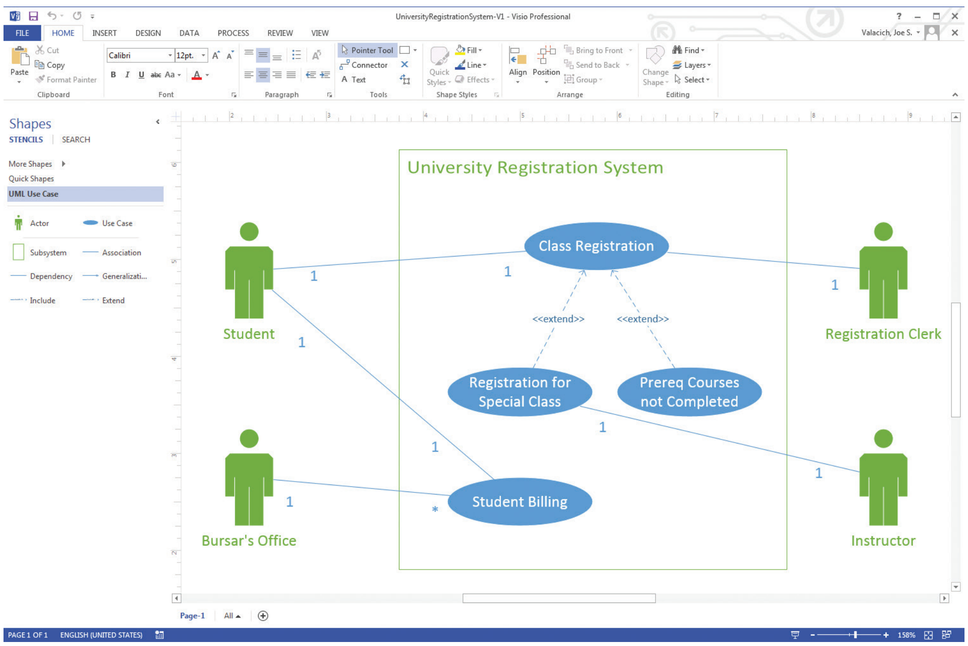


FIGURE TB9

System design diagram from Microsoft Visio.

Source: From *Modern Systems Analysis and Design*, 8ed, published by Pearson Education, Inc.

TABLE TB9 General Types of CASE Tools

CASE Tool	Description
Diagramming tools	Tools for graphically representing a system's processes, data, and control structures.
Screen and report generators	Tools that help model how systems look and feel to users. Screen and report generators also make it easier for the systems analyst to identify data requirements and relationships.
Analysis tools	Tools that automatically check for incomplete, inconsistent, or incorrect specifications in diagrams, screens, and reports.
Repositories	Tools that enable the integrated storage of specifications, diagrams, reports, and project management information.
Documentation generators	Tools that help produce both technical and user documentation in standard formats.
Code generators	Tools that enable the automatic generation of program and database definition code directly from the design documents, diagrams, screens, and reports.

Source: Valacich and George (2017).

were used to process and store data. During the mainframe era (beginning in the 1940s), people entered data on mainframes through the use of local input devices called **terminals**. These devices were called "dumb" terminals because they did not conduct any processing, or "smart," activities. The centralized computing model is not a true network because there is no sharing of data and capabilities. The mainframe provides all the capabilities, and the terminals are only input/output devices. Computer networks evolved in the 1980s when organizations needed separate, independent computers to communicate with each other. Centralized computing has seen a renaissance as businesses turn to thin clients to reduce costs for support, energy, or software licenses and to increase productivity and security.

DISTRIBUTED COMPUTING. The introduction of personal computers in the late 1970s and early 1980s gave individuals control over their own computing. Organizations also realized that they could use multiple small computers to achieve many of the same processing goals of a single large computer. Rather than using one mainframe to perform all the processing, people could work on independent subsets of tasks on separate computers, and combine the individual results. To achieve this, computer networks were needed so that data and services could be easily shared between these distributed computers. The 1980s were characterized by an evolution to a computing model called **distributed computing**, in which separate computers work independently on subsets of tasks and then the individual results are pooled by communicating over a network. Distributed computing has seen a reemergence in the form of grid computing (see Chapter 3). In grid computing architectures, large computing tasks are broken into small chunks, each of which can be completed by individual computers, and the individual results are combined to arrive at the end result, as depicted in Figure TB11.

COLLABORATIVE COMPUTING. In the 1990s, a new computing model, called **collaborative computing**, emerged. Collaborative computing is a synergistic form of distributed computing

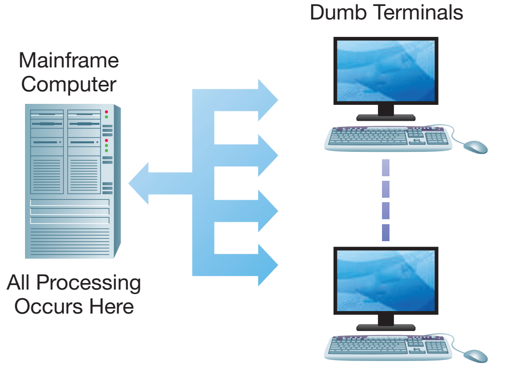


FIGURE TB10
In the centralized computing model, all processing occurs in one central mainframe.

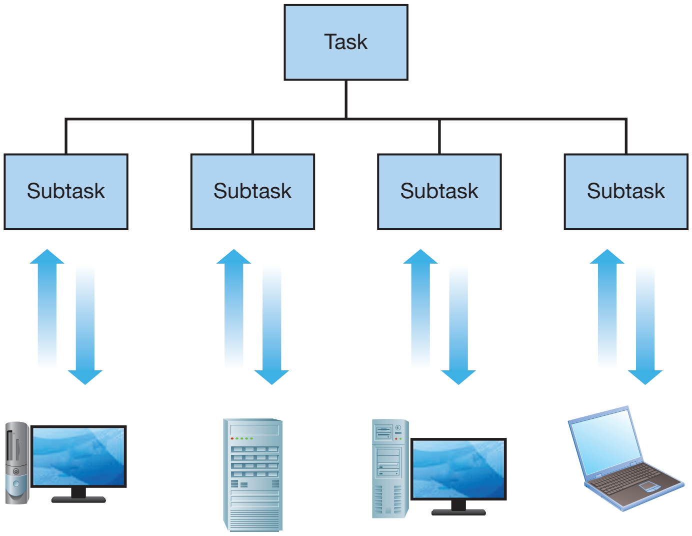


FIGURE TB11

In the distributed computing model, two or more networked computers work independently to accomplish subsets of a complex computing task.

in which two or more networked computers work together to accomplish a common processing task. That is, in this model of computing, computers are not working independently on (more or less equivalent) subtasks, but are have well-defined processing capabilities and responsibilities. For example, one computer may be used to store a large employee database. A second computer may be used to process and update individual employee records retrieved from this database. The two computers collaborate to keep the company's employee records current, as depicted in Figure TB12.

NETWORK SERVICES. Computer networks allow for sharing various capabilities between devices. For example, computer networks allow for efficiently storing, retrieving, and moving data between computers or allow for accessing network printers and network-attached storage devices; similarly, e-mail, instant messaging, and the sending and receiving of pictures or video and audio data require the sender and recipient to be connected to a network. Finally, networks enable computers to share processing power, in that processing can be distributed between a client and a server. Clients request data or services from the servers. The servers store data and application programs. For example, the physical search of database records may take place on the server, while the user interacts with a much smaller database application that runs on the client.

When an organization decides to network its computers and devices, it must decide what services will be provided; typically, different services on the network are offered by different servers, such as print servers, e-mail servers, and so on. In addition to those servers, networks typically have specialized systems for managing the network, its users, and its resources. These include computers providing **authentication services** for verifying the identity of users, or **directory services**, which are repositories (or "address books") containing information about users, user groups, resources on a network, access rights, and so on.

Types of Networks

Computing networks today include all three computing models: centralized, distributed, and collaborative. The emergence of new computing models did not mean that organizations completely

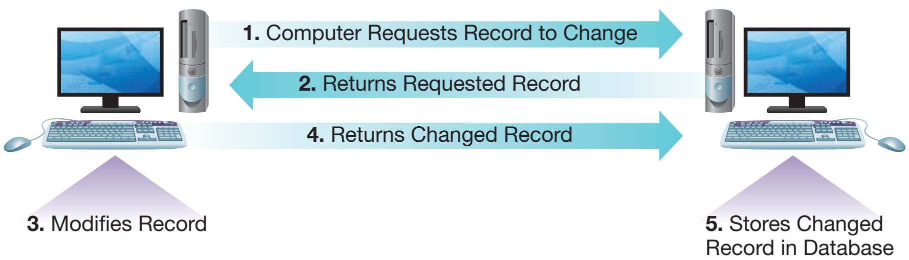


FIGURE TB12

In the collaborative computing model, two or more networked computers work together to accomplish a common task.

discarded older technologies. Rather, a typical organizational computer network includes mainframes, servers, personal computers, and a variety of other devices. Computer networks are commonly classified by size, distance covered, and structure. The most common are described next.

PRIVATE BRANCH EXCHANGE. A private branch exchange (PBX) is a telephone system that serves a particular location, such as a business. It connects telephone extensions within the system and connects internal extensions to the outside telephone network. It can also connect computers within the system to other PBX systems, to an outside network, or to various office devices, such as fax machines or photocopiers. Since they use ordinary telephone lines, PBX systems have limited bandwidth, preventing them from transmitting such forms of data as video, digital music, or high-resolution photos. Using PBX technology, a business requires fewer outside phone lines, but has to purchase or lease the PBX equipment. Many organizations now use *Internet protocol*–based PBX systems, which make use of the organizations' data networks and allow for low-cost voice over IP calling.

LOCAL AREA NETWORK. A local area network (LAN), shown in Figure TB13, is a computer network that spans a relatively small area, allowing all computer users to connect with each other to share data and peripheral devices, such as printers. LAN-based communications may involve the sharing of data, software applications, or other resources between several users. LANs typically do not exceed tens of kilometers in size and are typically contained within a single building or a limited geographical area.

WIDE AREA NETWORK. A wide area network (WAN) is a computer network that spans a relatively large geographical area. WANs are typically used to connect two or more LANs. Different hardware and transmission media are often used in WANs because they must cover large distances efficiently. Used by multinational companies, WANs transmit and receive data across cities and countries. A discussion follows of five specific types of WANs: campus area networks, metropolitan area networks, enterprise WANs, value-added networks, and global networks.

Campus Area Network A campus area network is a computer network that is used (and owned or leased) by a single organization to connect multiple LANs. A campus area network typically spans multiple buildings, such as at a corporate or university campus.

Metropolitan Area Network A metropolitan area network is a computer network of limited geographic scope, typically a citywide area, which combines LAN and high-speed fiber-optic technologies. Such networks are attractive to organizations that need high-speed data transmission within a limited geographic area.

Enterprise WAN An **enterprise WAN** is a WAN connecting disparate local area networks of a single organization into a single network (see Figure TB14).

Value-Added Network **Value-added networks** are private, third-party-managed WANs typically used for B2B communications. With much B2B data communication taking place over

FIGURE TB13

A LAN allows multiple computers located near each other to communicate directly with each other and to share peripheral devices, such as a printer.

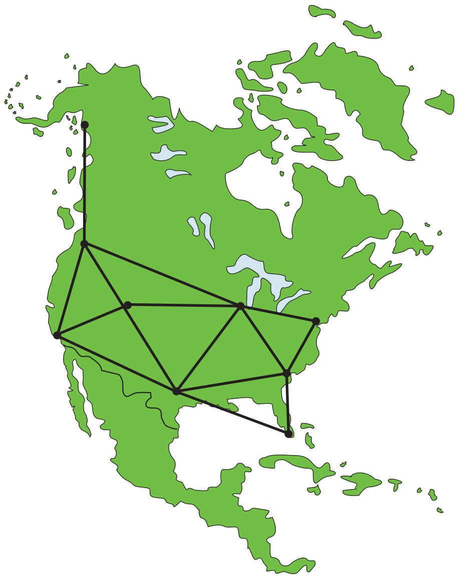


FIGURE TB14

An enterprise network allows an organization to connect distributed locations into a single network.

the Internet, providers focus on offering services such as secure e-mail and translation of EDI standards to facilitate secure communication between businesses.

Global Networks A **global network** spans multiple countries and may include the networks of several organizations. The Internet is an example of a global network. The Internet is the world's largest computer network, consisting of thousands of individual networks connecting billions of computers, smartphones, and other devices in almost every country of the world.

PERSONAL AREA NETWORKS. A final type of computer network, called a personal area network, uses wireless communication to exchange data between computing devices using short-range radio communication, typically within an area of 10 meters (30 feet). The enabling technology for personal area networks is **Bluetooth**, a specification for personal networking of desktop computers, peripheral devices, mobile phones, portable media players, and various other devices. Bluetooth is integrated into a variety of personal devices to ease interoperability and information sharing (see Figure TB15).

FIGURE TB15

Bluetooth is used by many for hands-free communication.

Source: Jupiterimages/Stockbyte/Getty Images.

Now that you have an understanding of the general types of networks, the next sections examine some further fundamental concepts. After discussing packet switching as a concept for sharing communication channels, we will delve deeper into network standards and technologies. Together, these sections provide a foundation for understanding various types of networks.

Packet Switching

Telecommunications advances have enabled connecting individual computer networks—constructed with a variety of hardware and software—together in what appears to be a single network. To enable rapid transmission of massive amounts of data, most data networks rely on packet switching. **Packet switching** is based on the concept of turn taking and enables millions of users to send large and small chunks of data across the network concurrently. To minimize delays, network technologies limit the amount of data that any computer can transfer on each turn. Consider a conveyor belt as a comparison. Suppose that the conveyor belt connects a warehouse and a retail store. When a customer places an order, it is sent from the store to the warehouse, where a clerk assembles the items in the order. The items are placed on the conveyor belt and delivered to the customer in the store. In most situations, clerks finish sending items from one order before proceeding to send items from another order. This process works well when orders are small, but when a large order with many items comes in, sharing a conveyor belt can introduce delays for others. Consider waiting in the store for your one item while another order with 50 items is being filled.

Most networks, including local area networks (LANs), WANs, and the Internet use packet-switching technologies to minimize delivery delays when users share the communication channel. Figure TB16 illustrates how computers use packet switching. Computer A wants to send a message to computer C; similarly, computer B wants to send a message to computer D. For example, computer A is trying to send an e-mail message to computer C, while computer B is trying to send a word processing file to computer D. The outgoing messages are divided into smaller packets of data, and then each sending computer (A and B) takes turns sending the packets over the transmission medium. The incoming packets are reassembled at their respective destinations, using previously assigned packet sequence numbers.

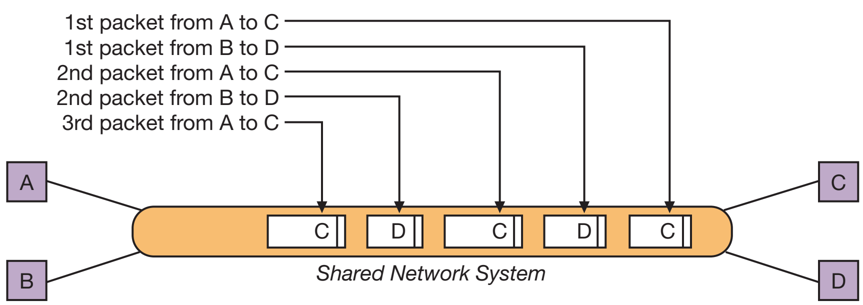
For packet switching to work, each computer attached to a network must have a unique network address, and each packet being sent across a network must be labeled with a header containing the network address of the source (sending computer) and the network address of the destination (receiving computer). As packets are transmitted, network hardware detects whether a particular packet is destined for a local machine. Packet-switching systems adapt instantly to changes in network traffic. If only one computer needs to use the network, it can send data continuously. As soon as another computer needs to send data, packet switching, or turn taking, begins. Next, we explain the importance of network standards and protocols to enable data communication.

Network Standards and Protocols

Standards play a key role in creating networks. The physical elements of networks—adapters, cables, and connectors—are defined by a set of standards that have evolved since the early 1970s. Standards ensure the interoperability and compatibility of network devices, and each standard combines a media access control technique, network topology, and transmission media in different ways. The dominant standard for wired local area networks is 802.3, typically referred to as Ethernet; wireless local area networks are based on the 802.11 family of standards. These standards are continuously evolving, and other competing standards for local area

FIGURE TB16

Computers A and B use packet switching to send messages or files to computers C and D.



networks have all but vanished. Software interacts with hardware to implement protocols that allow different types of computers and networks to communicate successfully.

PROTOCOLS. All networks employ protocols to make sure communication between computers is successful. Protocols are agreed-on formats for transmitting data between connected computers. They specify how computers should be connected to the network, how transmission errors will be detected, what data compression method will be used, how a sending computer will signal that it has finished sending a message, and how a receiving computer will signal that it has received a message. Protocols allow packets to be correctly routed to and from their destinations. There are literally thousands of protocols to choose from, but a few are a lot more important than the others. In this section, we will first review the OSI model, the worldwide standard for implementing protocols. Then, we briefly review TCP/IP, the protocol used by the Internet, and Ethernet, a commonly used protocol for local area networks.

The OSI Model The need of organizations to interconnect computers and networks that use different protocols has driven the industry to an open systems architecture in which different protocols can communicate with each other. The International Organization for Standardization defined a networking model called Open Systems Interconnection (OSI), which divides computer-to-computer communications into seven connected layers. The **Open Systems Interconnection (OSI) model** represents a group of specific tasks (represented in Figure TB17) as successive layers that enable computers to communicate data. Each successively higher layer builds on the functions of the layers below. For example, suppose you are using a PC running Windows and are connected to the Internet, and you want to send a message to a friend who uses a large workstation computer running Unix—two different computers and two different operating systems. When you transmit your message, it is passed down from layer to layer in the Windows protocol environment of your system. At each layer, special bookkeeping information specific to the layer, called a header, is added to the data. Eventually, the data and headers are transferred from the Windows layer 1 to Unix's layer 1 over some physical pathway. On receipt, the message is passed up through the layers in the Unix application. At each layer, the corresponding header information is stripped away, the requested task is performed, and the remaining data package is passed on until your message arrives as you sent it, as shown in Figure TB18. In other words, protocols represent an agreement between different parts of the network about how data are to be transferred.

Transmission Control Protocol/Internet Protocol (TCP/IP) Because so many different networks are interconnected throughout the world, they must have a common language, or protocol, to communicate. The protocol used by the Internet is called Transmission Control Protocol/Internet Protocol (TCP/IP). Whereas **TCP** is responsible for breaking down a message into smaller packets, creating a connection between two computers, and ensuring that data are reliably transmitted and arrive in the correct sequence, **IP** is responsible for addressing and correct routing of packages from source to destination. First, TCP breaks data into small chunks and manages the transfer of those packets from computer to computer via packet switching. For example, a single document may be broken into several packets, each containing several hundred characters, as well as a destination address (the IP part of the protocol). The IP part defines how a data packet must be formed and to where a **router** (an intelligent device used to connect two

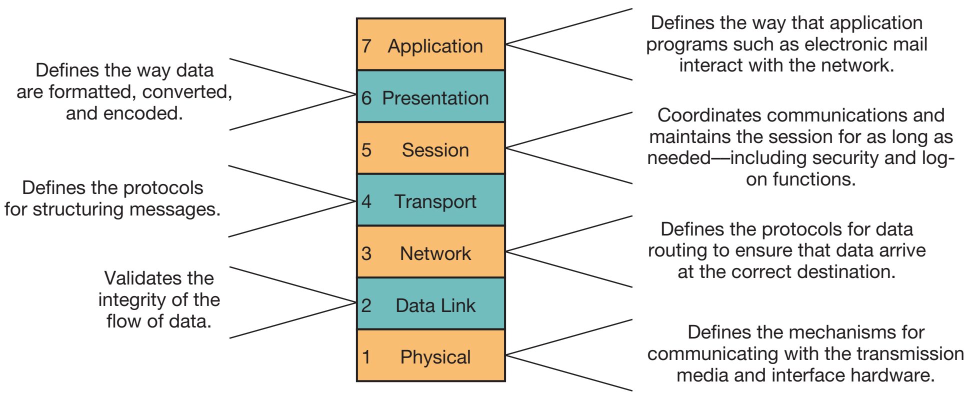


FIGURE TB17

The OSI model has seven layers and provides a framework for connecting different computers with different operating systems to a network.

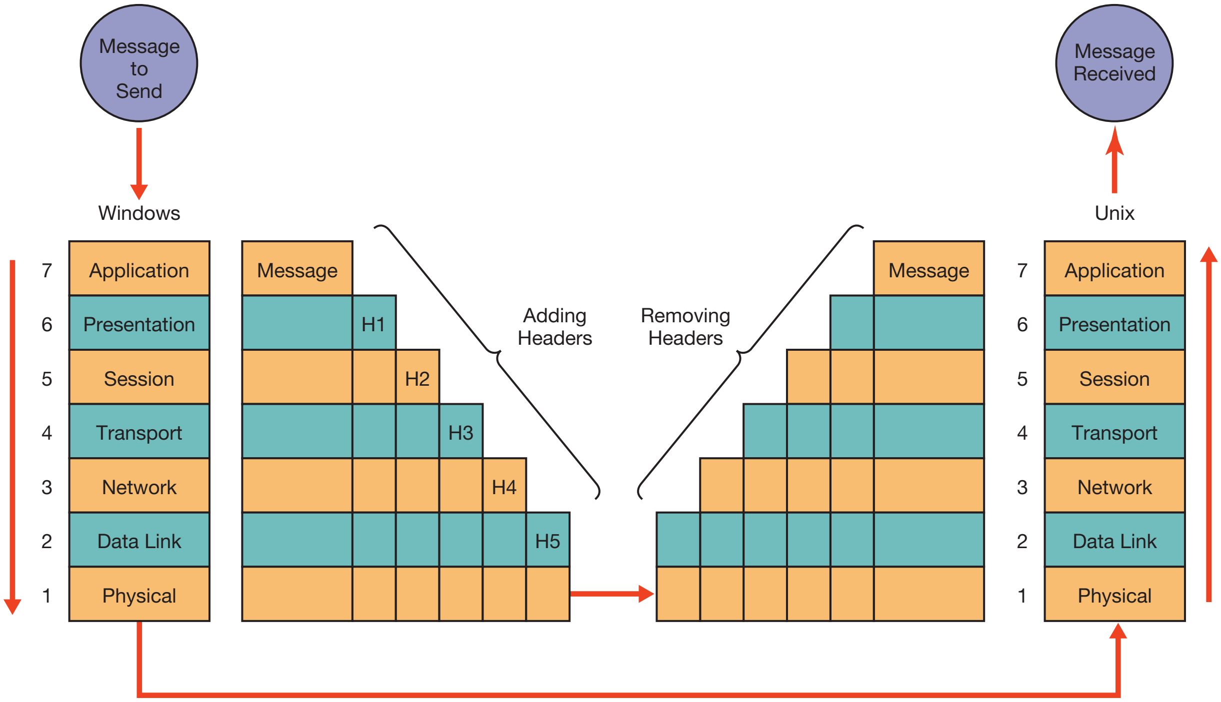


FIGURE TB18

Message passing between two different computers.

or more individual networks) must forward each packet. A data packet that conforms to the IP specification is called an **IP datagram**. Datagram routing and delivery are possible because, as previously mentioned, every computer and router connected to the Internet is assigned a unique address, called its IP address. When an organization connects to the Internet, it obtains a set of IP addresses that it can assign to its computers. Packets travel independently to their destination, sometimes following different paths and arriving out of sequence. The destination computer reassembles all the packets on the basis of their identification and sequencing information: TCP helps IP guarantee delivery of datagrams by performing three main tasks. First, it automatically checks for datagrams that may have been lost en route from their source to their destination. Second, TCP collects the incoming datagrams and puts them in the correct sequence to re-create the original message. Finally, TCP discards any duplicate copies of datagrams that may have been created by network hardware. Together, TCP and IP provide a reliable and efficient way to send data across the Internet.

Ethernet **Ethernet** is a set of LAN protocols using packet switching developed by the Xerox Corporation in 1976. Different types of data (including IP datagrams) can travel on Ethernets by being enclosed in another set of headers to form packets called Ethernet frames. The original Ethernet protocol supports data transfer rates of 10 Mbps. A later version, called 100Base-T or Fast Ethernet, supports transfer rates of 100 Mbps; the latest version, called 100 Gigabit Ethernet (100GbE), supports transfer rates of 100 Gbps, or 100,000 Mbps, over relatively large distances. Most new computers have a **network interface card** (also known as network adapter or Ethernet card) installed, allowing you to use the Ethernet protocol to connect to broadband modems, home networks, or work networks. Each network adapter has a unique identifier (called MAC address, assigned by the manufacturer) that is used to identify the computer on the network. The PC is then connected to other network components via transmission media, such as Ethernet cables. Increasingly, organizations use the Ethernet protocol for wide area networks, called Wide Area Ethernet or Ethernet WAN.

NETWORK TOPOLOGIES. **Network topology** refers to the shape of a network. The four basic network topologies are star, ring, bus, and mesh. A **star network** is configured, as you might expect, in the shape of a star, as shown in Figure TB19a. That is, all nodes or workstations are connected to a central hub through which all messages pass. The workstations represent the

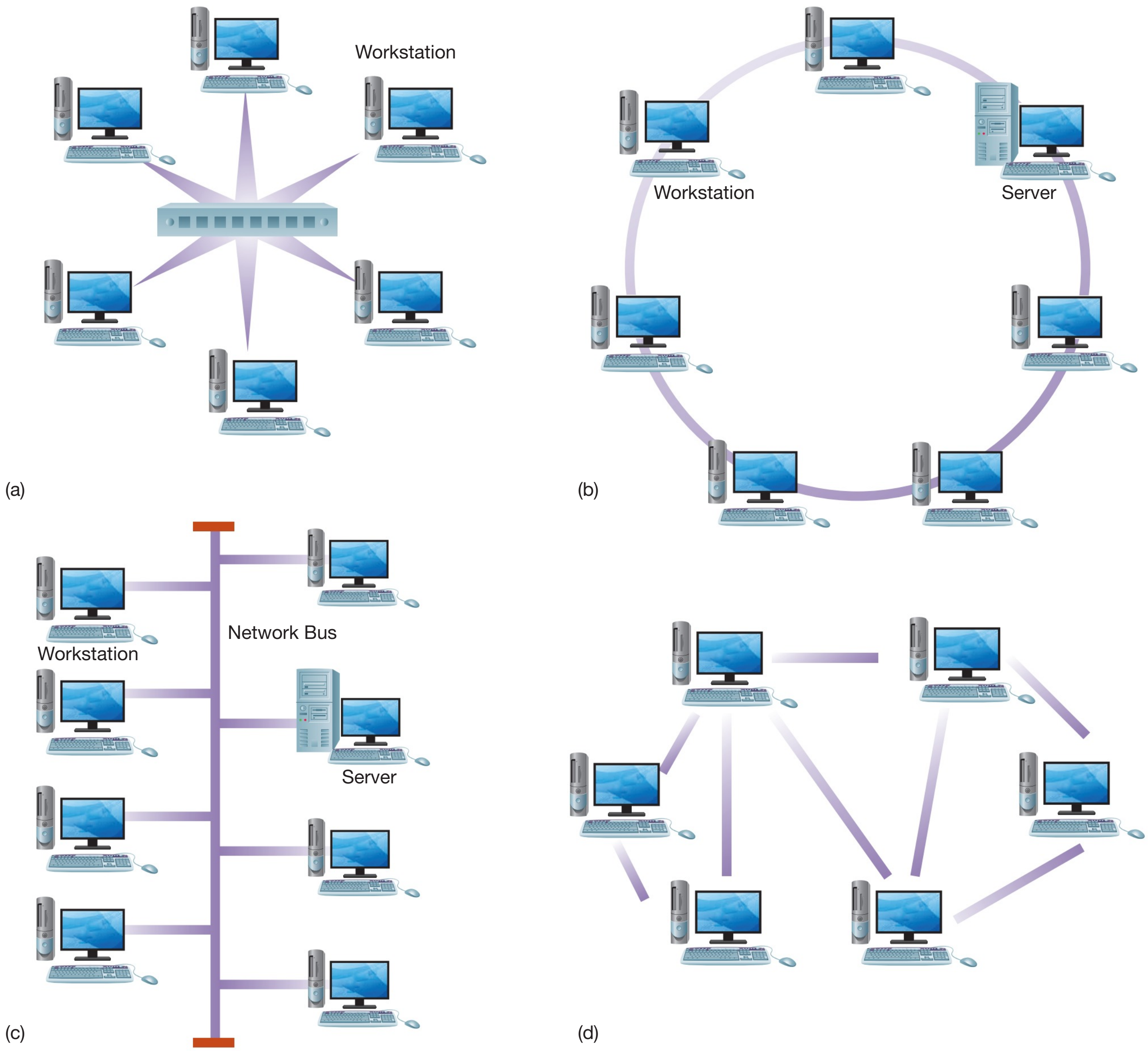


FIGURE TB19

(a) The star network has several workstations connected to a central hub. (b) The ring network is configured in a closed loop, with each workstation connected to another workstation. (c) The bus network is configured in the shape of an open-ended line where each workstation receives the same message simultaneously. (d) The mesh network consists of computers and other devices that are either fully or partially connected to each other.

points of the star. Star topologies are easy to lay out and modify. However, they are also the most costly because they require the largest amount of cabling. Although it is easy to diagnose problems at individual workstations, star networks are susceptible to a single point of failure at the hub that would result in all workstations losing network access. This topology is used in switched Ethernet local area networks, where all devices are connected to a central switch. A **ring network** is configured in the shape of a closed loop or circle with each node connecting to the next node, as shown in Figure TB19b. In ring networks, messages move in one direction around the circle. As a message moves around the circle, each workstation examines it to see whether the message is for that workstation. If not, the message is regenerated and passed on to the next node. This regeneration process enables ring networks to cover much larger distances than star or bus networks can. Relatively little cabling is required, but a failure of any node on the ring network can cause complete network failure. Self-healing ring networks avoid this by having two rings with data flowing in different directions; thus, the failure of a single node does not cause the network to fail. In either case, it is difficult to modify and reconfigure a ring network. Although sometimes used in WANs, ring topologies are not commonly used in LANs anymore. A **bus network** is in the shape of an open-ended line, as shown in Figure TB19c; as a result, it is the easiest network to extend and has the simplest wiring layout. This topology enables all network nodes to receive the same message through the network cable at the same time. However, it is difficult to diagnose and isolate network faults. Whereas early variants of Ethernet used bus networks, they are not commonly used any more. Finally, a **mesh network** consists of computers and other devices that are either fully or partially connected to each other. In a *full* mesh design, each computer and device is connected to every other computer and device. In a *partial* mesh design, many but not all computers and devices are connected (see Figure TB19d). Like a ring network, mesh networks provide relatively short routes from one node to another. Mesh networks also provide many possible routes through the network—a design that prevents one circuit or computer from becoming overloaded when traffic is heavy. Given these benefits, most WANs, including the Internet, use a partial mesh design.

MEDIA ACCESS CONTROL. **Media access control** is the set of rules that governs how a given node or workstation gains access to the network to send or receive data. Without media access control, collisions are likely to happen if two or more workstations simultaneously transmit messages on the network. There are two general types of media access control: distributed and random access. With distributed access control, only a single workstation at a time has authorization to transmit its data. One method of authorization is token passing, where authorization is transferred sequentially from workstation to workstation. Ring networks normally use a token-passing media access control method to regulate network traffic. Another method, polling, uses a master device that centrally controls access to the network by sequentially polling each connected device whether it needs to transmit data. Under random access control (sometimes referred to as contention-based), any workstation can transmit data by checking whether the medium is available. No specific permission is required. A commonly used method of random access control in wireless LANs is called **carrier sense multiple access/collision avoidance (CSMA/CA)**. In CSMA/CA, each connected device "listens" to traffic on the transmission medium to determine whether a message is being transmitted. If no traffic is detected, the device sends its message; otherwise, it waits. Modern Ethernet local area networks use *switches* to do away with the problem of collisions altogether: Each device is connected to a switch, which connects the different devices as needed for transmitting data; in other words, the switch creates separate point-to-point circuits between devices, such that a message is not broadcast to all devices but only travels between the sender and the receiver.

Network Technologies

Typically, devices in a network are not connected directly to each other; rather, computer networks rely on different networking hardware components to connect computers and route messages. In addition, individual devices and hardware components are connected using different wired or wireless media. These are discussed next.

NETWORKING HARDWARE. Because of the complexity of current networks, a variety of specialized pieces of equipment have been developed for computers to connect and transfer data. However, not all pieces of equipment are necessary for connecting computers together, and the use of this equipment is dependent on the intended use and configuration of the network. Table TB9 presents some commonly used types of networking equipment to meet businesses' networking needs. Some of these devices are also commonly used in home networks; for example, your DSL modem may also act as a router and wireless access point. Other networking devices used by telecommunications companies are beyond the scope of this discussion.

CABLE MEDIA. Cable media physically link computers and other devices in a network. The most common forms of cable media are twisted pair, coaxial, and fiber-optic.

Twisted-Pair Cable Twisted-pair (TP) cable is made of two or more pairs of insulated copper wires twisted together (see Figure TB20). TP cables are rated according to quality (in terms of the ability to transmit high frequency signals and the "crosstalk" between individual wires); category 3 (Cat 3), Cat 5, Cat 6, Cat 7, and Cat 8 cables are often used in network installations. Depending on the rating, TP cables have a capacity up to 40 gigabits per second (Gbps) at

TABLE TB9 Networking Hardware

Networking Hardware	Description
Switch	A **switch** is used to connect multiple computers, servers, or printers to create a network. Switches typically inspect data packets received and forward them to the correct addressee.
Router	A router is an intelligent device used to connect two or more different networks. When a router receives a data packet, it looks at the network address and passes the packet on to the appropriate network. Routers are commonly used to connect a LAN to a WAN, such as the Internet.
Wireless access point	A **wireless access point** transmits and receives wireless (Wi-Fi) signals to allow wireless devices to connect to the network.
Wireless controller	A **wireless controller** manages multiple access points and can be used to manage transmission power and channel allocation to establish desired coverage throughout a building and minimize interference between individual access points. Further, wireless controllers can be used to manage authentication and other security features.

distances up to 100 meters (330 feet); faster speeds can be achieved over shorter distances. The cable may be unshielded (UTP, such as Cat 3, Cat 5, or Cat 6) or shielded (STP, such as Cat 7 or Cat 8). Telephone wire installations as well as many local area networks use UTP cabling, as it is cheap and easy to install. However, like all copper wiring, it has rapid attenuation and is very sensitive to electromagnetic interference (EMI) and eavesdropping—the undetected capturing of data transmitted over a network. STP uses wires wrapped in insulation, making it less prone to EMI and eavesdropping. Ethernet cables typically use RJ-45 connectors so that they can be plugged into a network adapter or into other network components.

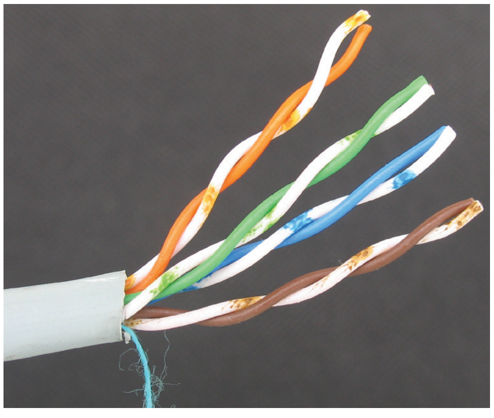
Coaxial Cable Coaxial (or coax) cable contains a solid inner copper conductor surrounded by plastic insulation and an outer braided copper or foil shield (see Figure TB21). Coax cable comes in a variety of thicknesses—thinnet coax and thicknet coax—based on resistance to EMI. Although less costly than TP, thinnet coax is not commonly used in networks anymore; thicknet coax is more expensive than TP. Coax cable is most commonly used for cable television installations and for networks operating at 10 to 100 megabits per second (Mbps). Its attenuation is lower than TP cable's, and it is moderately susceptible to EMI and eavesdropping.

FIGURE TB20

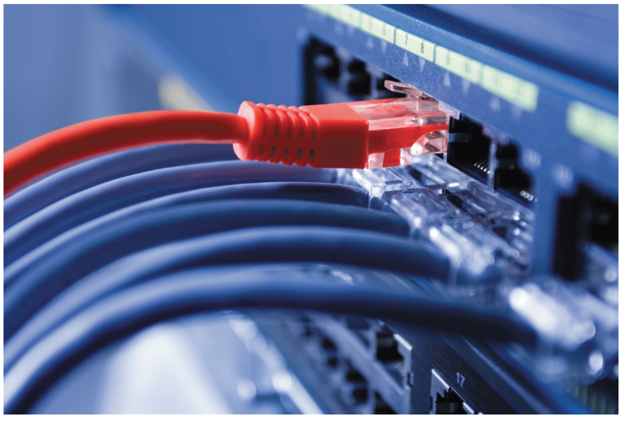
(a) A cable spliced open showing several twisted pairs. (b) A sample network installation that utilizes many TP cables at once.

Sources: (a) Georgios Alexandris/Shutterstock; (b) Inara Prusakova/Shutterstock.

(a)



(b)



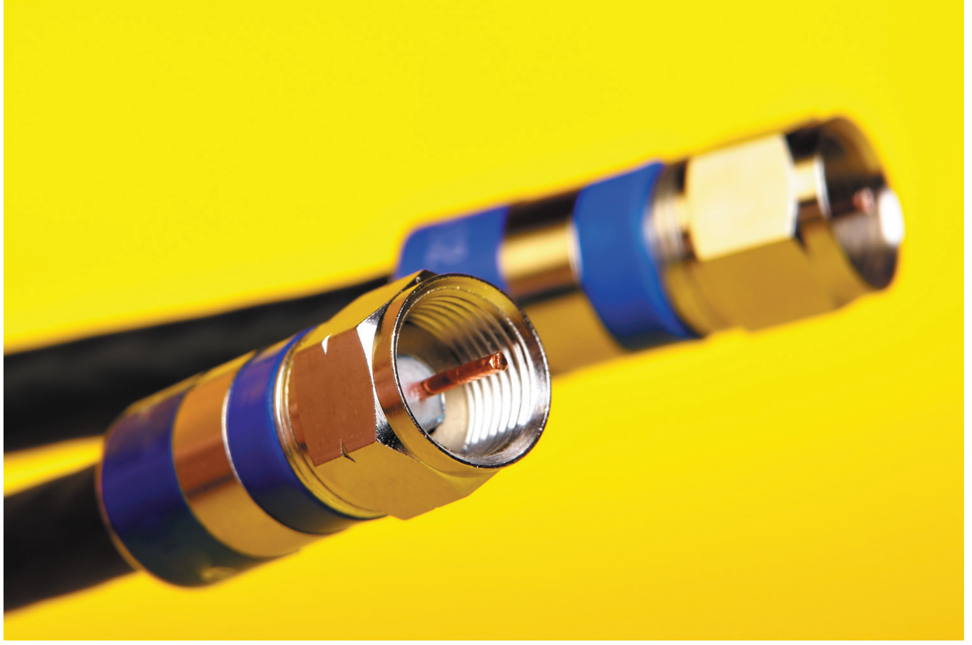


FIGURE TB21

These coaxial cables are ready to be connected to a computer or other device.

Source: Kasia/Shutterstock.

Fiber-Optic Cable Fiber-optic cable is made of a light-conducting glass or plastic core surrounded by more glass, called cladding, and a tough outer sheath (see Figure TB22). The sheath protects the fiber from changes in temperature as well as from bending or breaking. This technology uses pulses of light sent along the optical cable to transmit data. Fiber-optic cable transmits clear and secure data because it is immune to EMI and eavesdropping. Transmission signals do not break up because fiber-optic cable has low attenuation. It is also extremely fast. Practically, it can achieve over 1 Gbps at distances up to 25 kilometers (15 miles). In the lab, researchers have exceeded 43 terabits per second—that is the entire contents of a 1TB hard drive in a fifth of a second. Each year, in a manner similar to increasing CPU performance and Moore's Law, researchers are discovering new ways to rapidly increase the capacity of fiber optic cables. Fiber-optic cable is more expensive than copper wire because the cost and difficulties of installation and repair are higher for fiber-optic. Fiber-optic cables are used for high-speed **backbones**—the high-speed central networks to which many smaller networks can

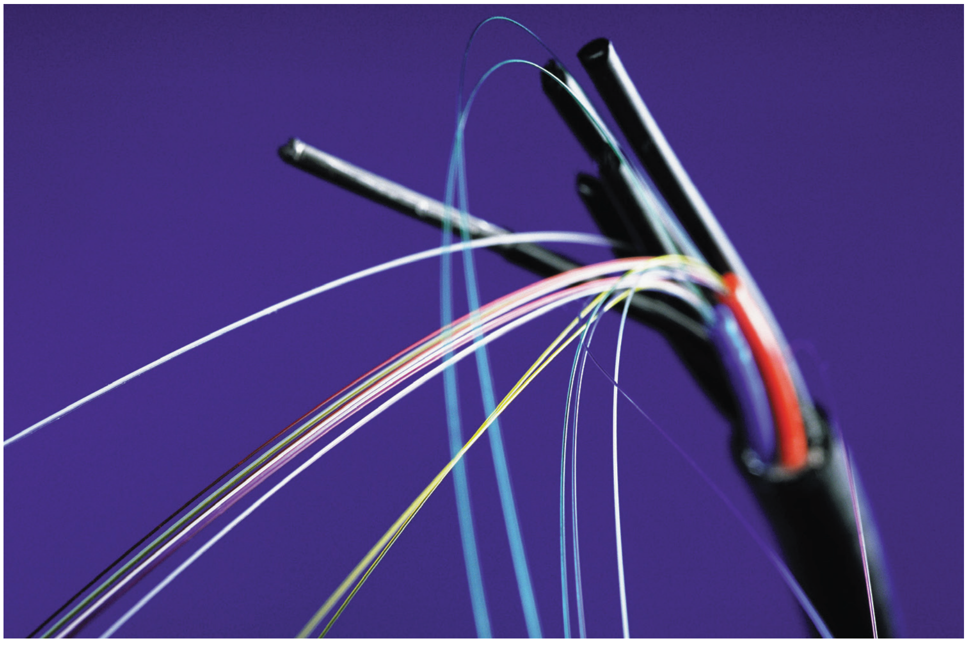


FIGURE TB22

Fiber-optic cable consists of a light-conducting glass or plastic core, surrounded by more glass, called cladding, and a tough outer sheath.

Source: Goodshoot/Getty Images Plus/ Getty Images.

be connected. A backbone may connect, for example, several different buildings in which other, smaller LANs reside. Submarine telecommunications cables (used for telephone and Internet traffic between continents) also use fiber-optic cable. In home environments, fiber-optic cable can be used to connect digital audio devices.

WIRELESS MEDIA. With the popularity of mobile devices such as laptops, tablets, and smartphones, wireless media are rapidly gaining popularity. Wireless media transmit and receive electromagnetic signals using methods such as infrared line of sight, high-frequency radio, and microwave systems.

Infrared Line of Sight Infrared line of sight uses high-frequency light waves to transmit signals on an unobstructed path between nodes. While commonly being used in remote controls for most audiovisual equipment, such as TVs, stereos, and other consumer electronics equipment, infrared systems are not well suited for rapidly transmitting large amounts of data; thus, this technology has since been surpassed by Wi-Fi and Bluetooth for data communication.

High-Frequency Radio High-frequency radio signals can transmit data at rates of up to several hundred Mbps to network nodes from 12.2 up to approximately 40 kilometers (7.5 to 25 miles) apart, depending on the nature of any obstructions between them. The flexibility of the signal path makes high-frequency radio ideal for mobile transmissions. For example, most police departments use high-frequency radio signals that enable police vehicles to communicate with each other as well as with the dispatch office. This medium is expensive because of the cost of antenna towers and high-output transceivers. Installation is complex and often dangerous because of the high voltages. Although attenuation is fairly low, this medium is very susceptible to EMI and eavesdropping.

Two common applications of high-frequency radio communication are cellular phones and wireless networks. A **cellular phone** gets its name from how the signal is distributed. In a cellular system, a coverage area is divided into **cells** with a low-powered radio antenna/receiver in each cell; these cells are monitored and controlled by a central computer (see Figure TB23). Any given cellular network has a fixed number of radio frequencies. When a user initiates or receives a call, the mobile telephone switching office assigns the caller a unique frequency for the duration of the call. As a person travels within the network, the central computer at the switching office monitors the quality of the signal and automatically assigns the call to the closest cellular antenna. Cellular phones have gone through rapid changes since their first commercial use in the mid-1980s (see Table TB10). Because of the costs involved in setting up fixed telephone lines, cellular phones have become very popular in many developing countries and are a key factor in bridging the digital divide.

One of the most significant advances in cellular technology was the introduction of packet switching for data transmission as operators moved from 2G to 2.5G. While 3G networks have

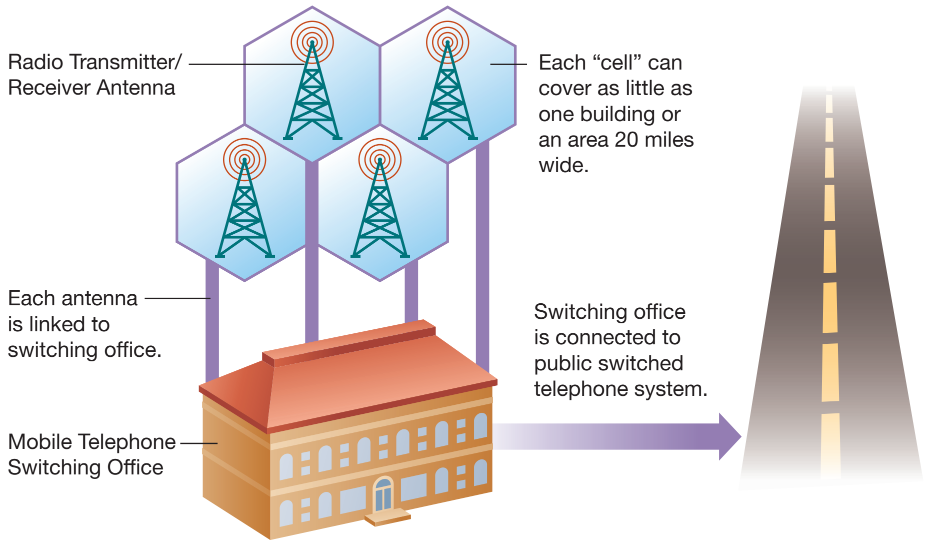


FIGURE TB23

A cellular network divides a geographic region into cells.

TABLE TB10 Evolution of Cell Phone Technology

Generation	Description	Data Transfer	Advantages
0G	Preceded modern cellular mobile telephony and was usually mounted in cars or trucks; it was a closed circuit, so you could call only other radio telephone users.	Analog	Enabled communicating on the go.
1G	This technology, introduced in the 1980s, used circuit switching; it had poor voice quality, unreliable handoffs between towers, and nonexistent security.	Analog	Enabled users to communicate with other cell phones and land lines.
2G	The first all-digital signal that was divided into TDMA and CDMA standards. Allowed for SMS (text) messaging and e-mails to be sent/received.	Digital (up to 9.6 Kbps transfer)	Lower-powered radio signals allowed for longer battery life. Digital format allowed for clearer signal and reduced signal noise.
2.5G	Allows for faster data transmission via a packet-switched domain in addition to the circuit-switched domain.	Digital (up to 115 Kbps transfer)	Higher data speeds allowed for more complex data to be transmitted (e.g., sports scores and news stories).
3G	Even faster. Requires a new cellular network, different from that already available in 2G systems.	Digital (minimum of 384 Kbps when moving and 2 Mbps when stationary)	Transfer full video and audio.
4G	Set of standards for high-speed mobile connectivity. Different standards on different networks and locations.	Digital (up to 100 Mbps when moving and 1 Gbps when stationary)	Data speeds similar to wired networks.

seen widespread deployment, data rates were still limited. The introduction of 4G cellular networks provided mobile broadband Internet access, supporting mobile web access, IP telephony (e.g., Skype), game services, high-definition mobile TV, and videoconferencing. There are competing standards for deploying 4G services; two notable standards are HSPA+ and LTE (long-term evolution). Each standard supports different data rates and distances. Nevertheless, they all are significantly faster than existing 3G networks. HSPA+ (High Speed Packet Access) is a family of high-speed 3G and 4G digital data services available to mobile carriers worldwide that helps to extend the capabilities of existing infrastructures; as an upgrade of 3G technologies, some do not consider it “true” 4G. LTE uses an all IP-based architecture where everything (including voice) is handled as data, similar to the Internet. Each standard continues to evolve and gain (or lose) market share and acceptance with different global carriers; given advantages in terms of speed, LTE is currently the predominant 4G standard in the United States. 5G is still evolving in the lab and test deployments, but promises to be faster, provide better coverage, and more efficiently utilize the increasingly limited wireless spectrum. Over the next decade, industry insiders believe that standards will further advance and converge, making high-speed mobile connectivity a reality for much of the world.

High-frequency radio-wave technology is increasingly being used to support wireless local area networks (WLANs). WLANs based on a family of standards called 802.11 are also referred to as Wi-Fi (wireless fidelity). The 802.11 family of standards has been universally adopted and has transmission speeds up to 450 Mbps (using the 802.11n standard), with even faster standards being under development. The ease of installation has made WLANs popular for business and home use. For example, many homes and buildings have multiple computers or mobile devices and need (or want) to share Internet access, files, and peripheral devices. Unfortunately, many older buildings and homes do not have a wired infrastructure to easily connect computers and devices, making wireless networking particularly attractive. Through the use of wireless technologies, many organizations are transforming their work environments into better team collaboration environments.

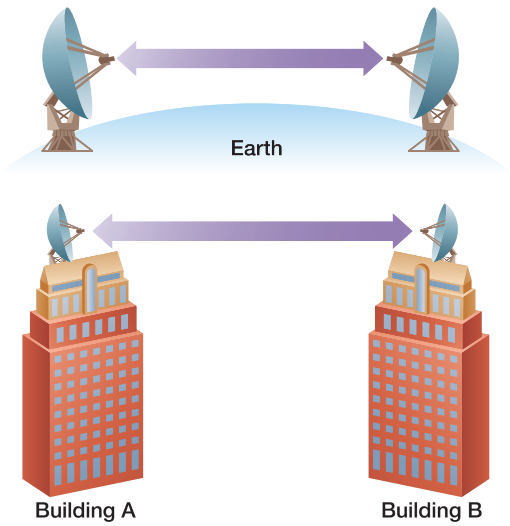


FIGURE TB24

Terrestrial microwave requires a line-of-sight path between a sender and a receiver.

Microwave Transmission Microwave transmission uses high-frequency radio signals that are sent through the air using either terrestrial (earth-based) systems or satellite systems (microwaves are typically of shorter wavelength and thus higher frequency than radio waves used by cellular or Wi-Fi networks). Terrestrial microwave, shown in Figure TB24, uses antennae that require an unobstructed path or line of sight between nodes. The cost of a terrestrial microwave system depends on the distance to be covered. Typically, businesses lease access to these microwave systems from service providers rather than invest in antenna equipment. Data may be transmitted at up to 274 Mbps. Over short distances, attenuation is not a problem, but signals can be disrupted over longer distances by environmental conditions such as high winds and heavy rain. EMI and eavesdropping are significant problems with microwave communications.

Satellite microwave, shown in Figure TB25, uses satellites orbiting the earth as relay stations to transfer signals between ground stations located on earth. Satellites orbit from 400 to 22,300 miles above the earth and have different uses and characteristics (see Table TB11). Because of the distance signals must travel, satellite transmissions are delayed (also known as **propagation delay**). Satellite transmission has become very viable for media such as TV and radio, including the digital radio stations XM and Sirius, both of which have their own satellites that send out scrambled signals to proprietary receivers.

Another strength of satellite communication is that it can be used to access very remote and undeveloped locations on the earth. Yet such systems are extremely costly because their use and installation depends on space technology. Companies such as AT&T sell satellite services with typical transmission rates ranging from less than 1 to 10 Mbps, but the rates can be as high as 90 Mbps. Like terrestrial microwave, satellite systems are prone to attenuation and are susceptible to EMI and eavesdropping. Table TB12 compares wireless media across several criteria.

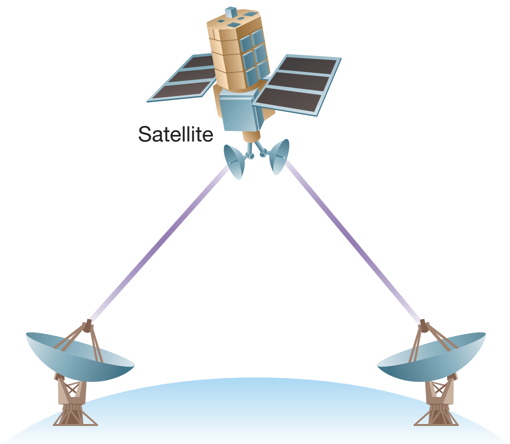


FIGURE TB25

Communications satellites are relay stations that receive signals from one earth station and rebroadcast them to another.

TABLE TB11 Characteristics of Satellites with Different Orbits

Name	Distance from Earth	Characteristics/Common Application
Low Earth Orbit (LEO) Satellite	400–1,000 miles	■ Not fixed in space in relation to the rotation of the earth; circles the earth several times per day. ■ Photography for mapping and locating mineral deposits; monitoring ice caps, coastlines, volcanoes, and rain forests; researching plant and crop changes; monitoring wildlife habitats and changes; search and rescue for downed aircraft or ships that are in trouble; research projects in astronomy and physics.
Medium Earth Orbit (MEO)	1,000–22,300 miles	■ Not fixed in space in relation to the rotation of the earth; circles the earth more than one time per day. ■ Primarily used in geographical positioning systems (such as GPS) for navigation of ships at sea, spacecraft, airplanes, automobiles, and military weapons.
Geosynchronous Earth Orbit (GEO)	22,300 miles	■ Fixed in space in relation to the rotation of the earth; circles the earth one time per day. ■ Because it is fixed in relation to the earth, transmission is simplified. ■ Transmission of high-speed data for television, weather information, remote Internet connections, digital satellite radio, and telecommunications (satellite phones).

The Internet

The name *Internet* is derived from the concept of *internetworking*, which means connecting host computers and their networks to form even larger networks. The Internet is a large worldwide collection of networks that uses a common protocol to communicate. In the following sections, we discuss in more detail how independent networks are connected to form the Internet, who manages the Internet, and how home and business users can connect to the Internet.

HOW DID THE INTERNET GET STARTED? You can trace the roots of the Internet back to the late 1960s, when the U.S. **Defense Advanced Research Projects Agency (DARPA)** began to study ways to interconnect networks of various kinds. This research effort produced the **Advanced Research Projects Agency Network (ARPANET)**, a large wide area network (WAN) that linked many universities and research centers. The first two nodes on the ARPANET were the University of California, Los Angeles, and the Stanford Research Institute, followed by the University of California, Santa Barbara, and the University of Utah.

ARPANET quickly evolved and was combined with other networks. For example, in 1986, the U.S. **National Science Foundation (NSF)** initiated the development of the **National Science Foundation Network (NSFNET)**, which became a major component of the Internet. Other networks throughout the United States and the rest of the world were interconnected and/or morphed into the growing "Internet." Throughout the world, support for the Internet has come from a combination of federal and state governments, universities, national and international research organizations, and industry.

CONNECTING INDEPENDENT NETWORKS. The Internet uses routers to interconnect independent networks. For example, Figure TB26 illustrates a router that connects Networks 1, 2, and 3. A router, like a conventional computer, has a central processor, memory, and network interfaces. However, routers do not use conventional software, nor are they used to run applications. Their

TABLE TB12 Relative Comparison of Wireless Media

Medium	Expense	Speed	Attenuation	EMI	Eavesdropping
Infrared line of sight	Low	Up to 16 Mbps	High	High	High
High-frequency radio	Moderate	Up to 300 Mbps	Low	High	High
Terrestrial microwave	Moderate	Up to 274 Mbps	Low	High	High
Satellite microwave	High	Up to 90 Mbps	Moderate	High	High

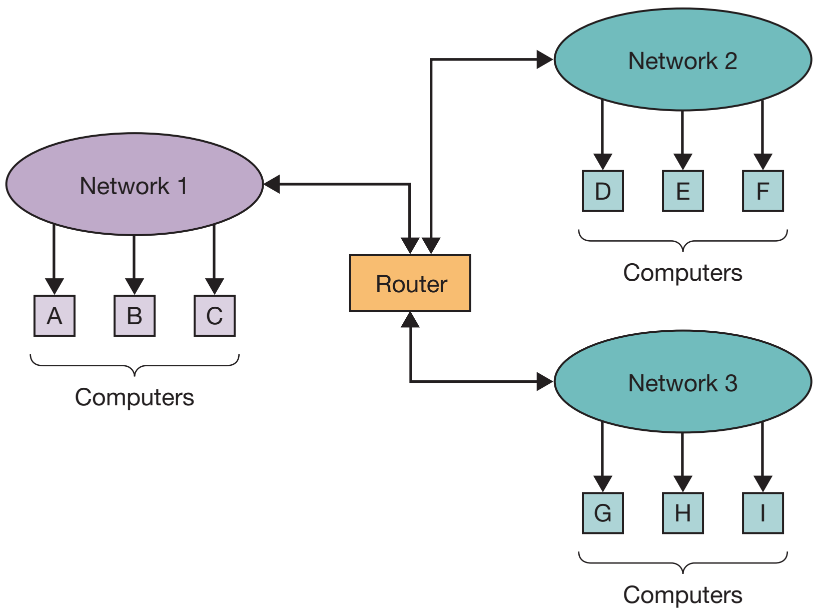


FIGURE TB26

Routers connect independent networks.

only job is to interconnect networks and forward data packets from one network to another. As illustrated in Figure TB26, Computers A and F are connected to independent networks. If Computer A generates a data packet destined for Computer F, the packet is sent to the router that interconnects the two networks. The router forwards the packet on to Network 2, where it is delivered to its destination at Computer F.

Routers are the fundamental building blocks of the Internet because they connect thousands of LANs and WANs. LANs are connected to backbone WANs, as depicted in Figure TB27. A backbone network manages the bulk of network traffic and typically uses a higher-speed connection than the individual LAN segments. For example, a backbone network might use fiber-optic cabling, which can transfer data at a rate of 100 Gbps, whereas a LAN connected to the backbone may use Ethernet with TP cabling, transferring data at a rate of 10 Mbps to 10 Gbps. To gain access to the Internet, an organization installs a router between one of its own networks and the network of its Internet service provider. Business organizations typically connect to the Internet not only with personal computers but with web servers as well.

WHO MANAGES THE INTERNET? Individual computers on the Internet are identified by their IP addresses. So who keeps track of these IP addresses on the Internet? A number of national and

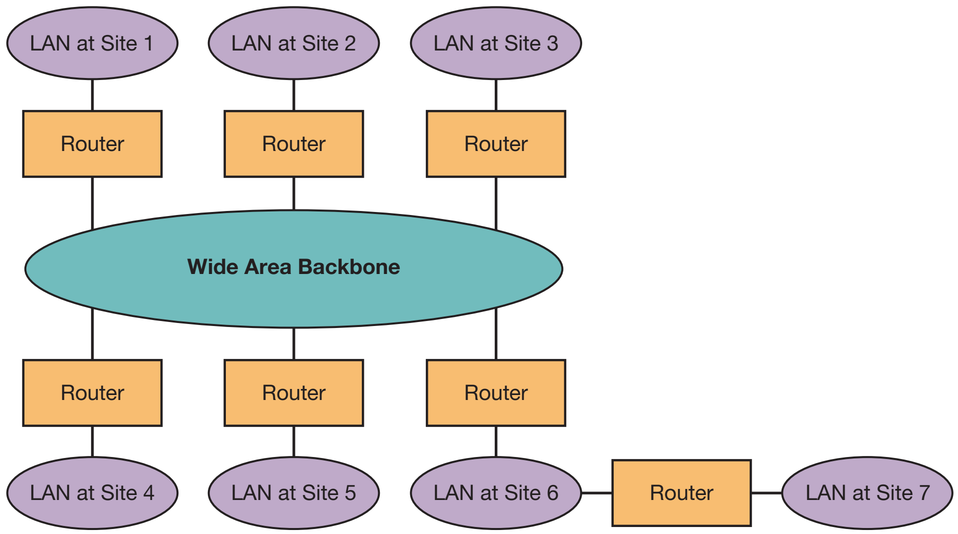


FIGURE TB27

LANs connect to wide area backbones.

international standing committees and task forces have been formed to manage the development and use of the Internet. Most notably, the Internet Assigned Numbers Authority is responsible for managing global and country code top-level domains as well as global IP number space assignments. In addition, the Internet Assigned Numbers Authority provides central maintenance of the **Domain Name System (DNS)** root database, which points to distributed DNS servers replicated throughout the Internet. This database is used to associate Internet host names with their IP addresses. Users can access websites using domain names or IP addresses. The functionality of the DNS is to provide users easy-to-remember domain names to access websites. In other words, it is far easier to remember www.apple.com than it is to remember 17.178.96.59 (the IP address of a server mirroring Apple's content as of mid-2016), but both will work as addresses in any web browser, as the DNS servers will translate the domain names into the accompanying IP address.

In 1993, the NSF created **InterNIC**, a government–industry collaboration, to manage directory and database services, domain registration services, and other information services on the Internet. In the late 1990s, this Internet oversight was transitioned more fully out into industry when InterNIC morphed into the **Internet Corporation for Assigned Names and Numbers**, a nonprofit corporation that assumed responsibility for managing IP addresses, domain names, and root server system management. Using 32-bit addresses, IPv4 provided 2^{32} IP addresses (about 4.29 billion addresses). With the increase of devices connected to the Internet, the number of unassigned Internet addresses is running out, so new classes of addresses were being added as **IPv6**, the latest version of the IP, was adopted in June 2012. Using 128-bit addresses, IPv6 provides 2^{128} addresses, allowing literally trillions and trillions of devices to be connected to the Internet.

HOW TO CONNECT TO THE INTERNET. Now you can see how the Internet works and how it is managed. How do you connect to the Internet? For personal use (i.e., from home), we typically connect to the Internet through an **Internet service provider (ISP)**, also called an *Internet access provider*. ISPs provide several different ways to access the Internet from home (see Table TB13).

TABLE TB13 Methods for Connecting to the Internet

Service	Current Status and Future Outlook	Typical Bandwidth
Dial-up	Although still used in the United States, there are very few new dial-up customers. This market should dry up as broadband moves to rural areas and developing nations.	52 Kbps
Integrated Services Digital Network	This technology has limited market share because of its expense. Typically, these connections are more expensive than broadband connections, although they offer less bandwidth.	128 Kbps
Cable	Coaxial cable used for cable TV provides much greater bandwidth than telephone lines and therefore is the market leader in broadband use for home users. Overselling of bandwidth that causes slower-than-average speeds tends to be a major problem for home users.	Upload: up to 31 Mbps Download: up to 43 Mbps
DSL	DSL technology has gained market share from cable. With many companies offering higher speeds at lower cost, DSL should continue to cut into cable's market share.	Upload: up to 16 Mbps Download: 1.5–50 Mbps
Satellite	Although satellite connectivity had a promising future, many users are moving away from this expensive technology in favor of faster and cheaper cable or DSL connections.	Upload: 50 Kbps Download: 5 Mbps
Wireless broadband	Wireless broadband offers the most promise of any of the current technologies, as the speeds are increasing while the coverage areas continue to grow.	Up to 1 Gbps
Fiber to the home	Fiber to the home has been adopted by several major players in the ISP industry. Although the technology typically can be placed only in new developments, the demand for fast connections is helping make this a significant technology for ISPs.	At least 100 Mbps, up to 1000 Mbps

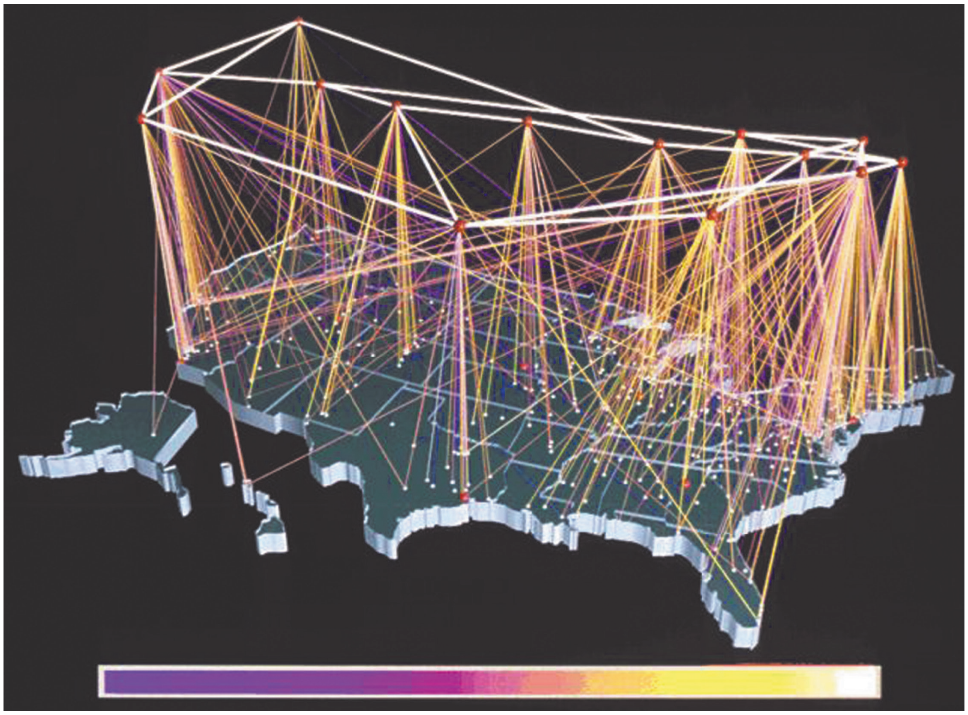


FIGURE TB28

The Internet backbone.

ISPs connect to one another through **Internet exchange points**. Much like railway stations, these serve as access points for ISPs and are exchange points for Internet traffic. They determine how traffic is routed and are often the points of most Internet congestion. Internet exchange points are a key component of the **Internet backbone**, which is the collection of main network connections and telecommunications lines that make up the Internet (see Figure TB28).

The Internet follows a hierarchical structure, similar to the interstate highway system. High-speed backbone network lines are like interstate highways, enabling traffic from midlevel networks to get on and off. Think of midlevel networks as city streets that, in turn, accept traffic from their neighborhood streets or member networks. However, you cannot get on an interstate or city street whenever you want to. You have to share the highway and follow traffic control signs to arrive safely at your destination. The same holds true for traffic on the Internet, and people can connect to the Internet in a number of ways. In the next section, we outline how typical home users connect to the Internet.

Dial-Up Years ago, most people connected to the Internet through a telephone line at home or work. The term we use for connecting via a standard telephone lines is **plain old telephone service (POTS)** (the POTS system is also called the **public switched telephone network [PSTN]**). POTS was designed to pass sounds in the form of **analog signals**—signals consisting of a continuous wave that can take on an infinite number of values within its frequency range. However, computers use electrical pulses—**digital signals**—that consist of discrete ‘on’ and ‘off’ values. The only way to pass digital data over conventional voice telephone lines is to convert it to audio tones—analog signals—that the telephone lines can carry. A **modem** (MOdulator/DEModulator) converts digital signals from a computer into analog signals so that telephone lines may be used as a transmission medium to send and receive digital signals, as shown in Figure TB29. As the speed, or bandwidth, of POTS is generally only about 52 Kbps (52,000 bits per second), today, most people connect to the Internet using some form of digital, high-speed connection.

Integrated Services Digital Network **Integrated services digital network (ISDN)** is a standard for worldwide digital communications. ISDN was designed in the 1980s to replace all analog systems, such as most telephone connections in the United States, with a completely digital transmission system. ISDN uses existing TP telephone wires to provide high-speed data service. ISDN systems can transmit voice, video, and data. Because ISDN is a purely digital network, you can connect your PC to the Internet without the use of a traditional modem.

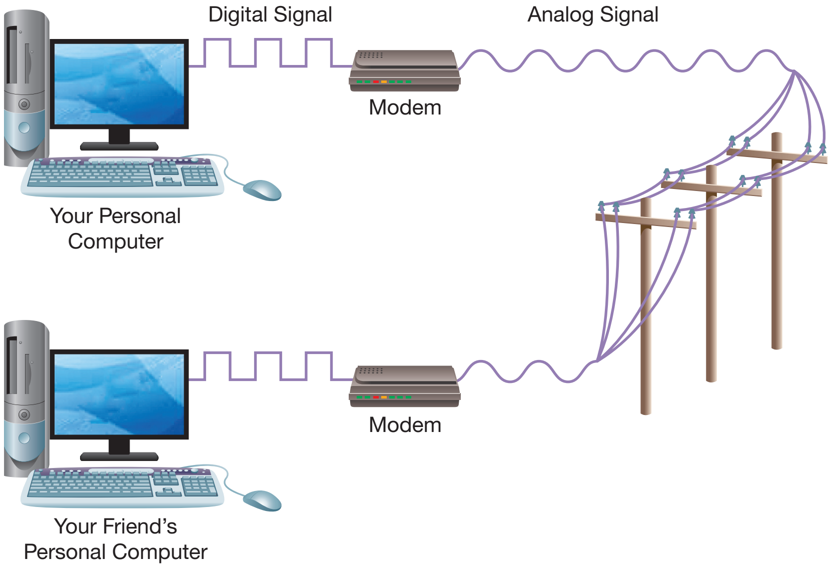


FIGURE TB29

Modems convert digital signals into analog and analog signals into digital.

Removing the analog-to-digital conversion for sending data and the digital-to-analog conversion for receiving data and higher bandwidth greatly increase the data transfer rate. However, a small electronic box called an *ISDN modem* is typically required so that computers and older, analog-based devices such as telephones and fax machines can utilize and share the ISDN-based service. While ISDN has had moderate success in various parts of the world, it has largely been surpassed by DSL and cable modems.

Digital Subscriber Line **Digital subscriber line (DSL)** is a popular way of connecting to the Internet. DSL is referred to as a "last-mile" solution because it is used only for connections from a telephone switching station to a home or office and generally is not used between telephone switching stations.

The abbreviation DSL is used to refer collectively to **asymmetric digital subscriber line (ADSL)**, **symmetric digital subscriber line (SDSL)**, and other forms of DSL. DSL enables more data to be sent over existing copper telephone lines by sending digital pulses in the high-frequency area of telephone wires. Because these high frequencies are not used by normal voice communications, DSL enables your computer to operate simultaneously with voice connections over the same wires. ADSL speeds range from 1.5 to 50 Mbps downstream and up to 16 Mbps upstream. SDSL is said to be symmetric because it supports the same data rates for upstream and downstream traffic (up to 22 Mbps). Like ISDN, ADSL and SDSL require a special modem-like device. As most Internet users primarily download content, ADSL is most popular in consumer environments. SDSL is offered primarily to business customers.

Cable Modems In most areas, the company that provides cable television service also provides Internet service. With this type of service, a special **cable modem** is needed to transmit data over cable TV lines. Coaxial cable used for cable TV provides much greater bandwidth than telephone lines, and millions of homes in the United States are already wired for cable TV, so cable modems are a fast, popular method for accessing the Internet. Cable modems offer download speeds up to 43 Mbps.

Satellite Connections In many regions of the world, people can only access the Internet via satellite, referred to as **Internet over satellite**. These technologies allow users to access the Internet via satellites that are placed in a geostationary orbit above the earth's surface. With these services, your PC is connected to a satellite dish hanging on the side of your home or placed on a pole (much like satellite services for your television); you are able to maintain a reliable connection to the satellite in the sky because the satellite orbits the earth at the exact speed of the earth's rotation. Given the vast distance that signals must travel from the earth up to the satellite and back again, Internet over satellites is slower than high-speed terrestrial (i.e., land-based) connections to the Internet over copper or fiber-optic cables. In remote regions of the world, however, it is the only option available because installing the cables necessary for an Internet connection is not economically feasible or, in many cases, is just not physically possible.

Wireless Broadband **Wireless broadband** is a technology that is usually found in rural areas where other connectivity options, such as DSL and cable, are not available. A common scenario is that the ISP will install an antenna at a high point, such as a large building or radio tower, and the customer will mount a small dish to the roof and point it at the antenna. Wireless broadband offers speeds similar to DSL and cable and can bridge a distance of up to 50 kilometers (30 miles).

Mobile Wireless Access In addition to the fixed wireless approach, there are also many **mobile wireless** approaches for connecting to the Internet. For example, with a subscription to a data plan, smartphones give you Internet access nearly anywhere. Also, special network adapter cards or USB "dongles" from a cellular service provider allow a notebook computer, tablet, or desktop computer to connect to cellular networks. The advantage of these systems is that as long as you are in the coverage area of that cell phone provider you have access to the Internet. Most mobile wireless service providers limit the amount of data that can be downloaded per month without incurring expensive fees, making this a relatively expensive option for a person's exclusive method for accessing the Internet.

Fiber to the Home **Fiber to the home**, also known as **fiber to the premises**, refers to connectivity technology that provides a super-speed connection to people's homes. This is usually done by fiber-optic cabling running directly into new homes. Fiber to the home is currently available only in major metropolitan areas.

Until now, we have talked about ways that individuals typically access the Internet. In the following section, we talk more about ways that organizations typically access the Internet.

BUSINESS INTERNET CONNECTIVITY. Although home users have enjoyed a consistent increase in bandwidth availability, the demand for corporate use has increased at a greater pace; therefore, the need for faster speeds has become of great importance. In addition to the home connectivity options, business customers also have several high-speed options, described next.

Leased Lines To gain adequate access to the Internet, organizations are turning to long-distance carriers to lease dedicated **T1 lines** for digital transmissions. The T1 line was developed by AT&T as a dedicated digital transmission line that can carry 1.544 Mbps of data. In the United States, companies such as MCI that sell long-distance services are called **interexchange carriers** because their circuits carry service between the major telephone exchanges. A T1 line usually traverses hundreds or thousands of miles over leased long-distance facilities.

AT&T and other carriers charge as little as US$200 per month for a dedicated T1 circuit. If you need an even faster link, you might choose a **T3 line**. T3 provides about 45 Mbps of service at about 10 times the cost of leasing a T1 line. Alternatively, organizations often choose to use two or more T1 lines simultaneously rather than jump to the more expensive T3 line. Higher speeds than the T3 are also available but are not typically used for normal business activity. For example, fiber-optic networks offer speeds considerably faster than T3 lines. See Table TB14 for a summary of telecommunication line capacities, including optical carrier (OC) lines that use fiber-optic transmission media.

THE CURRENT STATE OF INTERNET USAGE. The Internet is now the most prominent global network. Internet Live Stats (http://www.internetlivestats.com) reports that, as of May 2016, more than 3.4 billion people worldwide had access to the Internet. This means that more than 46 percent of the world's population had Internet access. Also, about 9 percent of the world's Internet users were located in the United States, with an Internet penetration of nearly 89 percent.

One other way to measure the rapid growth of the Internet, in addition to the number of users, is to examine the growth in the number of **Internet hosts**—that is, computers working as servers on the Internet—as shown in Figure TB30.

TABLE TB14 Capacity of Telecommunication Lines

Type of Line	Data Rate
T1	1.544 Mbps
T3	44.736 Mbps
OC-1	51.85 Mbps
OC-3	155.52 Mbps
OC-12	622.08 Mbps
OC-24	1.244 Gbps
OC-48	2.488 Gbps

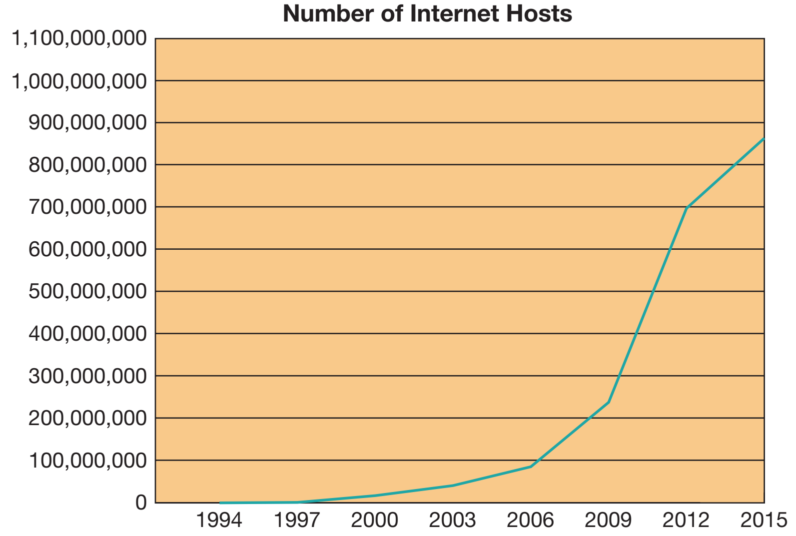


FIGURE TB30

Growth in Internet servers (hosts).

Source: Based on http://www.internetlivestats.com/total-number-of-websites.

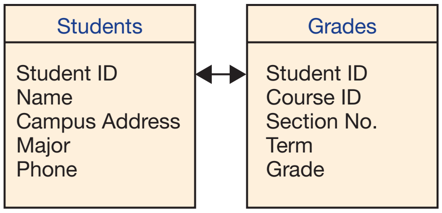
Foundational Topics in Database Management

In Chapter 6, you were introduced to database concepts such as attributes, entities, and relationships, as well as managerial aspects related to databases. In the following sections, we delve deeper into the topic of relational database management to give you a better idea of the intricacies involved in designing a sound database.

Relational Database Design

Much of the work of creating an effective relational database is in the creation of the data model. If the model is not accurate, the database will not be effective. A poor data model will result in data that are inaccurate, redundant, or difficult to search. If the database is relatively small, the effects of a poor design might not be too severe. A corporate database, however, contains many entities, perhaps hundreds or thousands. In this case, the implications of a poor data model can be catastrophic. A poorly organized database is difficult to maintain and process—thus defeating the purpose of having a DBMS in the first place. Undoubtedly, your university maintains databases with a variety of entity types—for example, students and grades—with each of these entities having numerous attributes. Attributes of a Student entity might be Student ID, Name, Campus Address, Major, and Phone. Attributes of a Grades entity might include Student ID, Course ID, Section Number, Term, and Grade (see Figure TB31).

For the DBMS to distinguish between records correctly, each instance of an entity must have one unique identifier. For example, each student has a unique Student ID. Note that using



Students

Student ID	Name	Campus Address	Major	Phone
555-39-3232	Joe Jones	123 Any Avenue	Finance	335-2211
289-42-8776	Sally Carter	1200 Wolf Street #12	Marketing	335-8702

Grades

Student ID	Course ID	Section No.	Term	Grade
555-39-3232	MIS 250	2	F'15	D+
555-39-3232	MIS 250	1	F'16	A–
289-42-8776	MIS 250	3	S'17	B+

FIGURE TB31

The attributes for and links between two entities—students and grades.

the student name (or most other attributes) would not be adequate because students may have the exact same name, live at the same address, or share the same phone number. Consequently, when designing a database, we must always create and use a unique identifier, called a **primary key**, for each type of entity in order to store and retrieve data accurately. In some instances, the primary key can also be a combination of two or more attributes, in which case it is called a **combination primary key**. An example of this is the Grades entity, shown in Figure TB31, where the combination of Student ID, Course ID, Section Number, and Term can be used to uniquely identify the grade of an individual student in a particular class (section number) in a particular term. Attributes not used as the primary key can be referred to as **secondary keys** when they are used to identify one or more records within a table that share a common value. For example, a secondary key in the Student entity shown in Figure TB31 would be Major when used to find all students who share a particular major.

ASSOCIATIONS. To retrieve information from a relational database, it is necessary to associate or relate data from separate tables. The three types of **relationships** (or **associations**) among entities are one-to-one, one-to-many, and many-to-many. Table TB15 summarizes each of these three associations and shows how they should be handled in database design for a basketball league.

To understand how relationships work, consider Figure TB32, which shows four tables—Home Stadium, Team, Player, and Games—for keeping track of the information for a basketball league. The Home Stadium table lists the Stadium ID, Stadium Name, Capacity, and Location, with the primary key underlined. The Team table contains two attributes, Team ID and Team Name, but nothing about the stadium where the team plays. If we wanted to have such information, we could gain it only by creating a relationship between the Home Stadium and Team tables. For example, if each team has only one home stadium and each home stadium has only one team, we have a one-to-one relationship between the Team and the Home Stadium entities. In situations in which we have one-to-one relationships between entities, we place the primary key from one table in the table for the other entity and refer to this attribute as a **foreign key**. In other words, a foreign key refers to an attribute that appears as a non–primary key attribute in one entity and as a primary key attribute (or part of a primary key) in another entity. By sharing this common—but unique—value, entities can be associated, or linked together. We can choose in which of these tables to place the foreign key of the other. After adding the primary key of the Home Stadium entity to the Team entity, we can identify which stadium is the home for a particular team and then be able to find all the details about that stadium (see section A in Figure TB33).

TABLE TB15 Rules for Expressing Relationships Among Entities and Their Corresponding Data Structures

Relationship	Example	Instructions
One-to-one	Each team has only one home stadium, and each home stadium has only one team.	Place the primary key from one table (e.g., Stadium) into the other (e.g., Team) as a foreign key.
One-to-many	Each player is on only one team, but each team has many players.	Place the primary key from the table on the "one" side of the relationship (e.g., Team) as a foreign key in the table on the "many" side of the relationship (e.g., Player).
Many-to-many	Each player participates in many games, and each game has many players.	Create a third table (e.g., Player Statistics) and place the primary keys from each of the original tables (e.g., Player and Team) together in the third as a combination primary key.

FIGURE TB32

Tables used for storing information about several basketball teams, with no foreign key attributes added; thus, associations cannot be made.

Home Stadium

Stadium ID	Stadium Name	Capacity	Location

Team

Team ID	Team Name

Player

Player ID	Player Name	Position

Games

Team ID (1)	Team ID (2)	Date	Final Score

When we find a one-to-many relationship—for example, each player plays for only one team, but each team has many players—we place the primary key from the entity on the "one" side of the relationship, the Team entity, as a foreign key in the table for the entity on the "many" side of the relationship, the Player entity (see section B in Figure TB33). In essence, we take from the one and give to the many, a Robin Hood strategy.

When we find a many-to-many relationship (e.g., each player plays in many games, and each game has many players), we create a third (new) entity—in this case, the Player Statistics entity and corresponding table. We then place the primary keys from each of the original entities together into the third (new) table as a combination primary key (see section C in Figure TB33).

FIGURE TB33

Tables used for storing information about several basketball teams, with foreign key attributes added in order to make associations.

A. One-to-one relationship: Each team has only one home stadium, and each home stadium has only one team.

Team

Team ID	Team Name	*Stadium ID*

B. One-to-many relationship: Each player is on only one team, but each team has many players.

Player

Player ID	Player Name	Position	*Team ID*

C. Many-to-many relationship: Each player participates in many games, and each game has many players.

Player Statistics

Team 1	*Team 2*	*Date*	*Player ID*	Points	Minutes	Fouls

You may have noticed that by placing the primary key from one entity in the table of another entity, we are creating a bit of redundancy. We are repeating the data in different places. We are willing to live with this bit of redundancy, however, because it enables us to keep track of the interrelationships among the many pieces of important organizational data that are stored in different tables. By keeping track of these relationships, we can quickly answer questions such as "Which players on the Wildcats played in the game on February 16 and scored more than 10 points?" In a business setting, the question might be "Which customers purchased a 2016 Toyota Prius from a salesperson named Jeff at the Desert Toyota dealership in Tucson, Arizona, during the first quarter of 2016, and how much did each customer pay?" This kind of question would be useful in calculating the bonus money Jeff should receive for that quarter or in contacting the owners of those specific vehicles in the event of a recall by the manufacturer.

ENTITY-RELATIONSHIP DIAGRAMMING. A diagramming technique that creates an **entity-relationship diagram (ERD)** is commonly used when designing relational databases, especially when showing associations between entities. To create an ERD, you draw entities as boxes and draw lines between entities to show relationships. Each relationship can be labeled on the diagram to give it additional meaning. For example, Figure TB34 shows an ERD for the basketball league data previously discussed. From this diagram, you can see the following associations:

- Each Home Stadium has a Team.
- Each Team has Players.
- Each Team participates in Games.
- For each Player and Game, there are Game Statistics.

When you are designing a complex database, with numerous entities and relationships, ERDs are very useful. They allow the designer to talk with people throughout the organization to make sure that all entities and relationships have been found.

THE RELATIONAL MODEL. Now that we have discussed associations and data models, we need a mechanism for joining entities that have natural relationships with one another. For example, in the University database we described previously, there are several relationships among the four entities: students, instructors, classes, and grades. Students are enrolled in multiple classes. Likewise, instructors teach multiple classes and have many students in their classes in a semester. At the end of the semester, instructors assign a grade to each student, and each student earns grades in multiple classes. It is important to keep track of these relationships. We might, for example, want to know which courses a student is enrolled in so that we can notify her instructors that she will miss classes because of an illness. The primary DBMS approach, or model, for keeping track of these relationships among data entities is the relational model. Other models—the hierarchical, network, and object-oriented models—are also used to join entities within commercial DBMSs, but this is beyond the scope of our discussion (see Hoffer, Ramesh, & Topi, 2016).

The most common DBMS approach in use today is the **relational database model**. A DBMS package using this approach is referred to as a relational DBMS. With this approach, the DBMS views and presents entities as two-dimensional tables, with records as rows and attributes as columns. Tables can be joined when there are common columns in the tables. The uniqueness of the primary key, as mentioned earlier, tells the DBMS which records should be joined with others in the corresponding tables. This structure supports very powerful data manipulation capabilities and linking of interrelated data. Database files in the relational model are

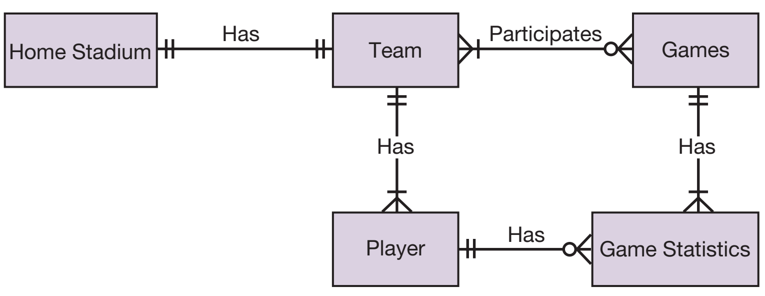


FIGURE TB34

An entity-relationship diagram showing the relationships between entities in a basketball league database.

FIGURE TB35

With the relational model, we represent these two entities, department and instructor, as two separate tables and capture the relationship between them with a common column in each table.

Department Records

Dept No	Dept Name	Location	Dean
Dept A			
Dept B			
Dept C			

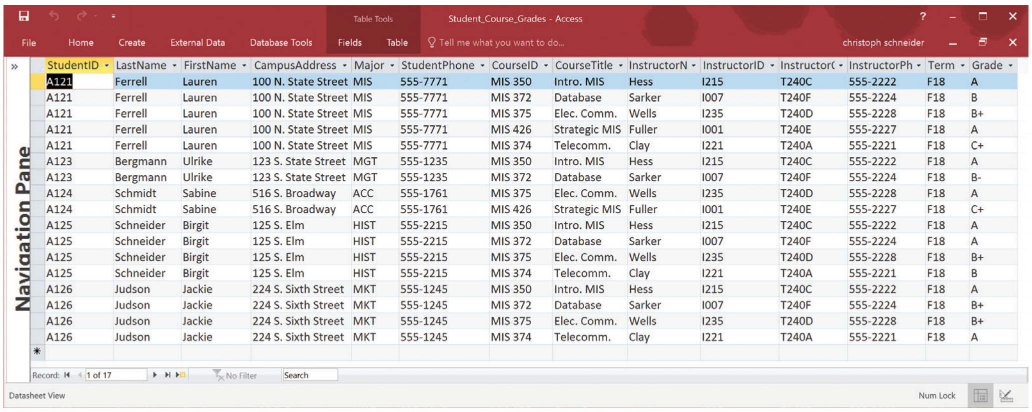
Instructor Records

Instructor No	Inst Name	Title	Salary	Dept No
Inst 1				
Inst 2				
Inst 3				
Inst 4				

three-dimensional: a table has rows (one dimension) and columns (a second dimension) and can contain rows of attributes in common with another table (a third dimension). This three-dimensional database is potentially much more powerful and useful than traditional, two-dimensional, "flat-file" databases (see Figure TB35).

A good relational database design eliminates unnecessary data duplications and is easy to maintain. To design a database with clear, non-redundant relationships, you perform a process called normalization.

NORMALIZATION. To be effective, databases must be efficient. Developed in the 1970s, **normalization** is a technique to make complex relational databases more efficient and more easily handled by the DBMS (Hoffer et al., 2016). Normalization makes sure that each table contains only attributes that are related to the entity; hence, normalization helps to eliminate data duplication. To understand the normalization process, let us return to the scenario in the beginning of this section. Think about your report card. It looks like nearly any other report or invoice. Your personal data are usually at the top, and each of your classes is listed, along with an instructor, a class day and time, the number of credit hours, and a location. Now think about how these data are stored in a relational database. Imagine that this database is organized so that in each row of the database, the student's identification number is listed on the far left. To the right of the student ID are the student's name, local address, major, phone number, course and instructor information, and a final course grade (see Figure TB36). Notice that there are redundant data for students, courses, and instructors in each row of this database. This redundancy means that this database is not well organized. If, for example, we want to change the phone number of an instructor who has hundreds of students, we have to change this number hundreds of times. In addition, this redundancy wastes storage space.

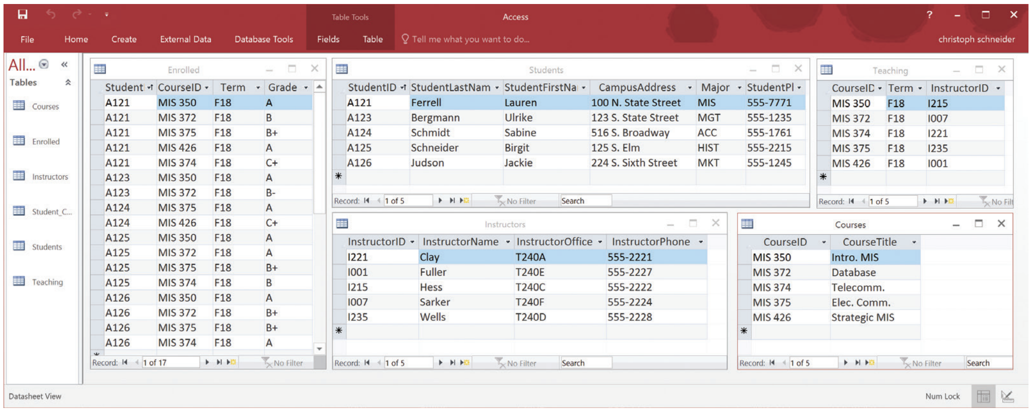


StudentID	LastName	FirstName	CampusAddress	Major	StudentPhone	CourseID	CourseTitle	InstructorN	InstructorID	Instructor(	InstructorPh	Term	Grade
A121	Ferrell	Lauren	100 N. State Street	MIS	555-7771	MIS 350	Intro. MIS	Hess	I215	T240C	555-2222	F18	A
A121	Ferrell	Lauren	100 N. State Street	MIS	555-7771	MIS 372	Database	Sarker	I007	T240F	555-2224	F18	B
A121	Ferrell	Lauren	100 N. State Street	MIS	555-7771	MIS 375	Elec. Comm.	Wells	I235	T240D	555-2228	F18	B+
A121	Ferrell	Lauren	100 N. State Street	MIS	555-7771	MIS 426	Strategic MIS	Fuller	I001	T240E	555-2227	F18	A
A121	Ferrell	Lauren	100 N. State Street	MIS	555-7771	MIS 374	Telecomm.	Clay	I221	T240A	555-2221	F18	C+
A123	Bergmann	Ulrike	123 S. State Street	MGT	555-1235	MIS 350	Intro. MIS	Hess	I215	T240C	555-2222	F18	A
A123	Bergmann	Ulrike	123 S. State Street	MGT	555-1235	MIS 372	Database	Sarker	I007	T240F	555-2224	F18	B-
A124	Schmidt	Sabine	516 S. Broadway	ACC	555-1761	MIS 375	Elec. Comm.	Wells	I235	T240D	555-2228	F18	A
A124	Schmidt	Sabine	516 S. Broadway	ACC	555-1761	MIS 426	Strategic MIS	Fuller	I001	T240E	555-2227	F18	C+
A125	Schneider	Birgit	125 S. Elm	HIST	555-2215	MIS 350	Intro. MIS	Hess	I215	T240C	555-2222	F18	A
A125	Schneider	Birgit	125 S. Elm	HIST	555-2215	MIS 372	Database	Sarker	I007	T240F	555-2224	F18	A
A125	Schneider	Birgit	125 S. Elm	HIST	555-2215	MIS 375	Elec. Comm.	Wells	I235	T240D	555-2228	F18	B+
A125	Schneider	Birgit	125 S. Elm	HIST	555-2215	MIS 374	Telecomm.	Clay	I221	T240A	555-2221	F18	B
A126	Judson	Jackie	224 S. Sixth Street	MKT	555-1245	MIS 350	Intro. MIS	Hess	I215	T240C	555-2222	F18	A
A126	Judson	Jackie	224 S. Sixth Street	MKT	555-1245	MIS 372	Database	Sarker	I007	T240F	555-2224	F18	B+
A126	Judson	Jackie	224 S. Sixth Street	MKT	555-1245	MIS 375	Elec. Comm.	Wells	I235	T240D	555-2228	F18	B+
A126	Judson	Jackie	224 S. Sixth Street	MKT	555-1245	MIS 374	Telecomm.	Clay	I221	T240A	555-2221	F18	A

FIGURE TB36

Database of students, courses, instructors, and grades with redundant data.

Source: Access 2016, Windows 10, Microsoft Corporation.



Enrolled

Student	CourseID	Term	Grade
A121	MIS 350	F18	A
A121	MIS 372	F18	B
A121	MIS 375	F18	B+
A121	MIS 426	F18	A
A121	MIS 374	F18	C+
A123	MIS 350	F18	A
A123	MIS 372	F18	B-
A124	MIS 375	F18	A
A124	MIS 426	F18	C+
A125	MIS 350	F18	A
A125	MIS 372	F18	A
A125	MIS 375	F18	B+
A125	MIS 374	F18	B
A126	MIS 350	F18	A
A126	MIS 372	F18	B+
A126	MIS 375	F18	B+
A126	MIS 374	F18	A

Record: 1 of 17 No Filter

Students

StudentID	StudentLastNam	StudentFirstNa	CampusAddress	Major	StudentPl
A121	Ferrell	Lauren	100 N. State Street	MIS	555-7771
A123	Bergmann	Ulrike	123 S. State Street	MGT	555-1235
A124	Schmidt	Sabine	516 S. Broadway	ACC	555-1761
A125	Schneider	Birgit	125 S. Elm	HIST	555-2215
A126	Judson	Jackie	224 S. Sixth Street	MKT	555-1245

Record: 1 of 5 No Filter Search

Teaching

CourseID	Term	InstructorID
MIS 350	F18	I215
MIS 372	F18	I007
MIS 374	F18	I221
MIS 375	F18	I235
MIS 426	F18	I001

Record: 1 of 5 No Filt

Instructors

InstructorID	InstructorName	InstructorOffice	InstructorPhone
I221	Clay	T240A	555-2221
I001	Fuller	T240E	555-2227
I215	Hess	T240C	555-2222
I007	Sarker	T240F	555-2224
I235	Wells	T240D	555-2228

Record: 1 of 5 No Filter Search

Courses

CourseID	CourseTitle
MIS 350	Intro. MIS
MIS 372	Database
MIS 374	Telecomm.
MIS 375	Elec. Comm.
MIS 426	Strategic MIS

Record: 1 of 5 No Filter Search

FIGURE TB37

Organization of information on students, courses, instructors, and grades after normalization.

Source: Access 2016, Windows 10, Microsoft Corporation.

Elimination of data redundancy is a major goal and benefit of using data normalization techniques. After the normalization process, the student data are organized into five separate tables (see Figure TB37). This reorganization helps simplify the ongoing use and maintenance of the database and any associated analysis programs.

Advanced Database Models

One of the problems with relational databases is that their performance degrades rapidly after getting very large. Relational databases are very efficient when processing highly structured data, but perform very poorly when processing unstructured data. Unstructured data refers to data that do not have an identifiable structure. Unstructured data are typically text-heavy, but may contain data such as dates, numbers, or even different types of media. This results in irregularities that make it difficult to utilize traditional database and processing approaches. In the world of Big Data, the relational model has been found to be less than optimal for storing and processing massive amounts of unstructured data. Companies such as Amazon, Facebook, and Google are storing and processing many petabytes of unstructured data daily. The most prevalent data model for storing Big Data is NoSQL ("not only SQL, referring to nonrelational databases).

Large scale NoSQL databases, such as Hadoop often are processed on computer clusters. A **computer cluster** consists of a set of computers that work together as a single system. Hadoop is an open source programming environment for processing NoSQL databases. Thus, a *Hadoop cluster* is a computer cluster designed for storing and analyzing huge amounts of unstructured data that is stored in a NoSQL database. In addition to Hadoop, there are many other NoSQL databases, including Cassandra, Hypertable, DynamoDB, IBM Informix, and many others. NoSQL is the foundation of web 2.0 technologies and most social media platforms. Being able to process massive amounts of unstructured data is fundamental to virtually all Big Data applications.

Key Points Review

1. ***Discuss foundational information systems (IS) hardware concepts.*** IS hardware is classified into three types: input, processing, and output technologies. Input hardware consists of devices used to enter data into a computer. Processing hardware transforms inputs into outputs. The CPU is the device that performs this transformation, with the help of several other closely related devices that store and recall data. Data are stored on primary and secondary storage devices. Finally, output-related hardware focuses on delivering information in a usable format to users.

2. ***Describe foundational topics related to system software, programming languages, and application development environments.*** System software, or the operating system, performs many different tasks, such as booting your computer, reading programs into memory, managing memory allocation to those programs, managing where programs and files are located in secondary storage, maintaining the structure of directories and subdirectories, and so on. A programming language is the computer language that programmers use to write application programs. In

order to run on a computer, a programs' source code must be translated into binary machine language through special types of programs, called compilers and interpreters. Object-oriented programming, visual programming, and web development languages complement traditional programming languages. Finally, CASE environments help systems developers construct large-scale systems more rapidly and with higher quality.

3. ***Describe foundational networking and Internet concepts.*** Networks provide for services such as transmitting files, sharing printers, or sending and receiving messages. There are several types of computer networks, classified according to their use and distance covered. To enable rapid transmission of massive amounts of data, most data networks rely on packet switching. Protocols are agreed-on formats for transmitting data between connected computers; the most prominent standards are TCP/IP and Ethernet. Networks exchange data by using cable or wireless transmission media, and media access control refers to the rules that govern how a given workstation gains access to the transmission media. The shape of a network can vary; the four most common topologies are star, ring, bus, and mesh configurations. The Internet is composed of networks that are developed and maintained by many different entities. It follows a hierarchical structure; high-speed central networks called backbones are like interstate highways, enabling traffic from midlevel networks to get on and off. Routers are used to interconnect independent networks.
4. ***Explain foundational database management concepts.*** In order to get the most of their data, organizations have to take care to create an accurate data model. Often, entity-relationship diagrams are used when designing relational databases. A primary key is used to uniquely identify records in a database. A foreign key is used to link entities together. A useful diagramming technique is entity-relationship diagramming, displaying entities and the associations between them. Normalization is used to reduce redundancy in a database. Nonrelational databases are used for handling large amounts of unstructured data.

Key Terms

Foundational Hardware Key Terms

American Standard Code for Information Interchange (ASCII) 446
arithmetic logic unit (ALU) 446
audio 444
bar code reader 443
basic input/output system (BIOS) 447
batch data 443
batch processing 443
binary code 446
bit 446
byte 446
bytes per inch (BPI) 449
cache 447
cathode ray tube (CRT) 450
CD-R (compact disc–recordable) 449
CD-RW (compact disc–rewritable) 449
central processing unit (CPU) 445
characters per inch 449
clock speed 446
clock tick 446
control unit 446
density 449
digital video disc 449
digitize 446
DVD-ROM (digital versatile disc–read-only memory) 449
flash drive 449
flash memory 448
hard drive (hard disk drive) 447
head crash 448
input technologies 443
interactive voice response (IVR) 444
liquid crystal display (LCD) 450
magnetic ink character recognition 443
microprocessor 445
motherboard 445
multi-core processor 446
nonvolatile memory 447
optical character recognition 443
optical disk 449
optical mark recognition 443
organic light-emitting diode (OLED) 450
output technologies 449
port 449
power supply 449
primary storage 447
printer 449
processing technologies 445
random-access memory (RAM) 447
read-only memory (ROM) 447
read/write head 448
redundant array of independent disks (RAID) 448
register 447
secondary storage 447
smart card 444
solid-state drive (SSD) 448
speech recognition 444
streaming audio 445
streaming media 445
streaming video 445
system clock 446
tape 449
text recognition software 443
touch screen 450
Unicode 446
video 444
voice-to-text software 444
volatile memory 447

Foundational Software Key Terms

applet 455
cascading style sheets (CSS) 455
compiler 452
computer-aided software engineering (CASE) 456
executable 452
graphical user interface (GUI) 453
HTML editor 454
HTML tag 454
interpreter 452
Java 455
JavaScript 456
Microsoft.NET 455

object-oriented language 453
scripting language 455
source code 452
utilities 451
utility program 451
visual programming language 453
web page builder 454

Foundational Networking Key Terms

Advanced Research Projects Agency Network (ARPANET) 472
analog signals 475
asymmetric digital subscriber line (ADSL) 476
authentication service 459
backbone 468
Bluetooth 461
bus network 466
cable modem 476
carrier sense multiple access/collision avoidance (CSMA/CA) 466
cell 469
cellular phone 469
centralized computing 457
collaborative computing 458
Defense Advanced Research Projects Agency (DARPA) 472
digital signals 475
digital subscriber line (DSL) 476
directory service 459
distributed computing 458
Domain Name System (DNS) 474
enterprise WAN 460
Ethernet 464
fiber to the home 477
fiber to the premises 477
global network 461
integrated services digital network (ISDN) 475
interexchange carrier 477
Internet backbone 475
Internet Corporation for Assigned Names and Numbers 474
Internet exchange point (IXP) 475
Internet host 477
Internet over satellite 476
Internet service provider (ISP) 474
InterNIC 474
IP 463
IP datagram 464
IPv6 474
media access control 466
mesh network 466
mobile wireless 477
modem 475
National Science Foundation (NSF) 472
National Science Foundation Network (NSFNET) 472
network interface card 464
network topology 464
Open Systems Interconnection (OSI) model 463
packet switching 462
plain old telephone service (POTS) 475
propagation delay 471
public switched telephone network (PSTN) 475
ring network 465
router 463
star network 464
switch 467
symmetric digital subscriber line (SDSL) 476
T1 line 477
T3 line 477
TCP 464
terminal 458
value-added network 460
wireless access point 467
wireless broadband 477
wireless controller 467

Foundational Database Key Terms

association 479
computer cluster 483
combination primary key 479
entity-relationship diagram (ERD) 481
foreign key 479
normalization 482
primary key 479
relational database model 481
relationship 479
secondary key 479

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Review Questions

Foundational Hardware Review Questions

TB-1. IS hardware is classified into what three major types?
TB-2. Describe various methods for entering data into and interacting with a computer.
TB-3. How do computers represent data internally?
TB-4. Describe the role of a motherboard.
TB-5. What determines the speed of a CPU?
MyMISLab **TB-6.** Compare and contrast the different types of secondary data storage.
TB-7. What are output devices? Describe various methods for providing computer output.

Foundational Software Review Questions

TB-8. Define the term *software* and list several software packages and their uses.
TB-9. Describe at least four different tasks performed by an operating system.
TB-10. Describe the similarities and differences between at least two major operating systems in use today.
TB-11. Name and describe four functions of utility programs.
TB-12. Name and describe the five important concepts of object-oriented programming.
MyMISLab **TB-13.** What is HTML, and why is it important?
TB-14. Describe various options for adding dynamic content to a web page.
TB-15. What is CASE, and how can it help in the development of information systems?

Foundational Networking Review Questions

TB-16. How are LANs, WANs, and global networks related to each other?
MyMISLab **TB-17.** What are the roles of authentication services and directory services?

TB-18. What is packet switching, and why is it useful?
TB-19. What is the purpose of the OSI model?
TB-20. What is a network topology? Describe the four basic topologies.
TB-21. What are three common types of transmission media that use cabling?
TB-22. What are four common methods of wireless transmission media for networking, and how do they differ from each other?
TB-23. What is the Internet, and why was it created?
TB-24. Other than dial-up, what are three alternatives for connecting to the Internet at home?

Foundational Database Review Questions

MyMISLab **TB-25.** Describe why database design is important for modern organizations.
TB-26. Compare and contrast the primary key, combination key, and foreign key within an entity.
TB-27. Describe the three types of relationships in a relational database.
TB-28. What is the purpose of a secondary key?
TB-29. What is an entity-relationship diagram, and why is it useful?
TB-30. What is the relational model?
TB-31. Why is redundancy undesired?

Self-Study Questions

Foundational Hardware Self-Study Questions

TB-32. All of the following are considered primary storage except ______________.
A. SSDs
B. RAM
C. registers
D. cache

TB-33. Which of the following is not an input device?
A. biometric scanner
B. touch screen
C. LCD screen
D. barcode reader

TB-34. Which of the following is an output device?
A. cathode ray tube
B. scanner
C. video camera
D. keyboard

TB-35. ______________ can convert handwritten text into computer-based characters.
A. scanners
B. bar code/optical character readers
C. text recognition software
D. audio/video

TB-36. A ______________ card is a special credit card with a microprocessor chip and memory circuits.
A. smart
B. master
C. universal
D. proprietary

Answers are on page 489.

Foundational Software Self-Study Questions

TB-37. An operating system performs which of the following tasks?
A. booting the computer
B. managing where programs and files are stored
C. sending documents to the printer
D. all of the above

TB-38. What is the name of the programming language developed by Sun Microsystems in the 1990s?
A. Latte
B. Java
C. Mocha
D. none of the above

TB-39. Which of the following programming languages would most likely not be used for building web applications?
A. HTML
B. JavaScript
C. PHP
D. Fortran

TB-40. A utility program may provide ______________.
A. antivirus protection
B. file conversion capability
C. file compression and defragmentation
D. all of the above

TB-41. CASE tools support all of the following except: ______________.
A. diagramming
B. consistency checking
C. generating code
D. compiling code

Answers are on page 489.

Foundational Networking Self-Study Questions

TB-42. Which of the following is not a type of cable medium?
A. twisted pair
B. coaxial
C. fiber-optic
D. shielded pair

TB-43. All of the following are common applications of high-frequency radio communication except ______________.
A. police radios
B. cellular phones
C. microwave transmission
D. facsimiles

TB-44. Which of the following is the protocol of the Internet, allowing different interconnected networks to communicate using the same language?
A. Ethernet
B. C++
C. TCP/IP
D. router

TB-45. Which is the fastest connection available for home users?
A. dial-up
B. DSL
C. wireless broadband
D. fiber to the home

TB-46. Which of the following is a typical way large corporations connect to the Internet?
A. satellite
B. cable
C. T1 lines
D. all of the above

Answers are on page 489.

Foundational Database Self-Study Questions

TB-47. A(n) ______________ is a unique identifier that can be a combination of one or more attributes.
A. secondary key
B. primary key
C. tertiary key
D. elementary key

TB-48. Which of the following is not true in regard to the relational database model?
A. Entities are viewed as tables, with records as rows and attributes as columns.
B. Databases use keys and redundant data in different tables in order to link interrelated data.
C. Entities are viewed as children of higher-level attributes.
D. A properly designed table has a unique identifier that may consist of one or more attributes.

TB-49. Each team has only one home stadium, and each home stadium has only one team. This is an example of which of the following relationships?
A. one-to-one
B. one-to-many
C. many-to-many
D. many-to-one

TB-50. A popular diagramming technique for designing databases is called ______________.
A. flowcharting
B. database diagramming
C. entity-relationship diagramming
D. none of the above

TB-51. ______________ is a technique to make a complex database more efficient by eliminating redundancy.
A. extraction, transformation, and loading
B. associating
C. normalization
D. standardization

Answers are on page 489.

Problems and Exercises

Foundational Hardware Problems and Exercises

TB-52. Match the following terms with the appropriate definitions:
i. Motherboard
ii. Audio
iii. DVD-ROM
iv. Smart card
v. Streaming video

a. Analog or digital sound data
b. A special credit card–sized card containing a microprocessor chip, memory circuits, and often a magnetic stripe
c. An optical storage device that has more storage space than a CD-ROM disk and uses a shorter-wavelength laser beam, which allows more optical pits to be deposited on the disk
d. A sequence of moving images, sent in a compressed form over the Internet and displayed on the receiver's screen as the images arrive
e. A large printed plastic or fiberglass circuit board that contains all the components that do the actual processing work of the computer and holds or connects to all the computer's electronic components

TB-53. Visit a computer shop or look on the web for trackballs or touch pads. What is new about how these input devices look or how they are used? What are some of the advantages and disadvantages of each device?

TB-54. What types of printers are most common today? What is the cost of a color printer versus a black-and-white one? Compare and contrast laser and ink-jet printers in terms of speed, cost, and quality of output. What kind of printer would you buy or have you bought?

TB-55. Based on your experiences with different input devices, which do you like the best and least? Why? Are your preferences due to the devices' design or usability, or are they based on the integration of the device with the entire information system?

TB-56. Choose a few of the computer hardware vendors that sell computers to the general public. These include Dell, HP, Lenovo, Apple, and many lesser-known brands. Using each company's website, determine what options these vendors provide for input devices, processing devices, and output devices.

Does it seem that this company has a broad range of choices for its customers? Is there something that you did not find available from this company? Present your findings in a 10-minute presentation to the rest of the class.

Foundational Software Problems and Exercises

TB-57. Match the following terms with the appropriate definitions:

i. Applet
ii. Visual programming language
iii. Scripting language
iv. Interpreter
v. Compiler

a. A software program that translates an entire program's source code into machine language that can be read and executed directly by the computer
b. Programming language that provides a graphical user interface and is generally easier to use than non-GUI languages
c. A program designed to be executed within another application (such as a web page)
d. A software program that translates a programming language into machine language one statement at a time
e. A programming language for integrating interactive components into a web page

TB-58. What are the implications for an organization of using more than one operating system? What might be the advantages? What are some of the disadvantages? Would you recommend such a situation? Prepare a 10-minute presentation to the rest of the class on your findings.

TB-59. Visit the website of your favorite online retailer. Which parts of the content are created dynamically? What interactive components do the different web pages include? Do different types of pages (e.g., home page or payment and shipping page) need different types of interactive components?

TB-60. Based on your own experiences with computers and computer systems, what do you like and dislike about different operating systems that you have used? Were these uses on a professional or a personal level or both? Who made the decision to purchase that particular operating system? Did you have any say in the purchase decision?

TB-61. Imagine that you and a friend are at a local ATM getting some cash from your account to pay for a movie. The ATM does not seem to be working. It is giving you an error message every time you press any button. Is this most likely a software-related problem, a hardware-related problem, or a network-related problem? Why? Use the information in this and other briefings to help you make your decision.

Foundational Networking Problems and Exercises

TB-62. Match the following terms with the appropriate definitions:

i. Protocols
ii. Ethernet
iii. FTTH
iv. T1 line
v. Wireless access point

a. A dedicated digital transmission line that can carry 1.544 Mbps of information
b. A networking device that transmits and receives wireless signals to allow wireless devices to connect to the network
c. High-speed network connectivity to homes and offices that is implemented using fiber-optic cable
d. The most widely used local area network protocol, supporting data rates of up to 100 gigabits per second
e. The procedures that different computers follow when they transmit and receive data

TB-63. Discuss the difference between PBX networks and LANs. What are the advantages of each? What are possible disadvantages of each? When would you recommend one over the other?

TB-64. Personal area networks using Bluetooth have become very popular. Visit www.bluetooth.com and investigate the types of products that this wireless technology is being used to enhance. Find three products that you find interesting and prepare a 10-minute presentation on what these products are and how Bluetooth is enhancing their operation and usage.

TB-65. Describe one of your experiences with a computer network. What type of topology was being used? Was the network connected to any other networks? How?

TB-66. Working in a group, have everyone describe what type of network would be most appropriate for a small office with about 10 computers, one printer, and one scanner, all within one floor in one building and relatively close to one another. Be sure to talk about transmission media, network topology, and hardware. Did all group members come up with the same option? Why or why not? What else would you need to know to make a good recommendation?

TB-67. Investigate the options for high-speed, broadband Internet access into your home. What options are available to you, and how much do they cost?

TB-68. You have probably experienced several different types of connection—from the university T1 connections to a home DSL or even dial-up connection. If you had to balance between cost and speed, which connection would you choose?

TB-69. Explain in simple language how the Internet works. Be sure to talk about backbones, packet switching, networks, routers, TCP/IP, and Internet services. What technologies, hardware, and software do you utilize when using the Internet? What would you like to use that isn't available to you?

Foundational Database Problems and Exercises

TB-70. Match the following terms with the appropriate definitions:

i. Primary key
ii. Foreign key
iii. Relational database model
iv. Relationship
v. Secondary key

a. Attributes not used as the primary key that can be used to identify one or more records within a table that share a common value
b. An attribute that appears as a nonprimary key attribute in one entity and as a primary key in another
c. A field included in a database table that ensures that each instance of an entity is stored or retrieved accurately
d. An association between entities in a database to enable data retrieval
e. A data management approach in which entities are presented as two-dimensional tables that can be joined together with common columns

TB-71. You see an announcement for a job as a database administrator for a large corporation but are unclear about what this title means. Research this on the web and obtain a specific job announcement.

TB-72. Why would it matter what data type is used for the attributes within a database? How does this relate to programming? How does this relate to queries and calculations? Does the size of the database matter?

TB-73. Have several classmates interview database administrators within organizations with which they are familiar. To whom do these people report? How many employees report to these people? Is there a big variance in the responsibilities across organizations? Why or why not?

TB-74. Based on your understanding of a primary key and the information in the following sample grades table, determine the best choice of attribute(s) for a primary key.

Student ID	Course	Grade
100013	Visual Programming	A
000117	Telecommunications	A
000117	Introduction to MIS	A

TB-75. Search the web for an organization with a web page that utilizes a link between the web page and the organization's own database. Describe the data that the user enters and the organization's possible uses for these data. Can you retrieve company information, or can you only send information to the company? How are the data displayed on the web page?

Answers to the Foundational Hardware Self-Study Questions

TB-32. A, p. 448 **TB-33.** C, p. 450 **TB-34.** A, p. 450 **TB-35.** C, p. 443 **TB-36.** A, p. 444

Answers to the Foundational Software Self-Study Questions

TB-37. D, p. 451 **TB-38.** B, p. 455 **TB-39.** D, p. 453 **TB-40.** D, p. 452 **TB-41.** D, p. 457

Answers to the Foundational Networking Self-Study Questions

TB-42. D, p. 466 **TB-43.** D, p. 469 **TB-44.** C, p. 463 **TB-45.** D, p. 477 **TB-46.** C, p. 477

Answers to the Foundational Database Self-Study Questions

TB-47. B, p. 479 **TB-48.** C, p. 479 **TB-49.** A, p. 479 **TB-50.** C, p. 481 **TB-51.** C, p. 482

MyMISLab™

Go to **mymislab.com** for auto-graded writing questions as well as the following assisted-graded writing questions.

TB-76. Compare and contrast centralized, distributed, and collaborative computing.
TB-77. What is the purpose of normalization?

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Acronyms

ADSL: Asymmetric Digital Subscriber Line
AI: Artificial Intelligence
ALU: Arithmetic Logic Unit
ARPANET: Advanced Research Projects Agency Network
ASCII: American Standard Code for Information Interchange
ATM: Automated Teller Machine
B2B: Business-to-Business
B2C: Business-to-Consumer
BI: Business Intelligence
BIOS: Basic Input-Output System
BPI: Bytes per Inch
BPM: Business Process Management
BPR: Business Process Reengineering
BYOD: Bring Your Own Device
C2B: Consumer-to-Business
C2C: Consumer-to-Consumer
CAPTCHA: Completely Automated Public Turing Test to Tell Computers and Humans Apart
CASE: Computer-Aided Software Engineering
CD-R: Compact Disc–Recordable
CD-RW: Compact Disc–Rewritable
CDN: Content Delivery Network
CIO: Chief Information Officer
COBIT: Control Objectives for Information and Related Technology
COPA: Child Online Protection Act
CPI: Characters per Inch
CPM: Cost per Mille
CPU: Central Processing Unit
CRM: Customer Relationship Management
CRT: Cathode Ray Tube
CSF: Critical Success Factor
CSMA/CA: Carrier Sense Multiple Access/Collision Avoidance
CSS: Cascading Style Sheet
DARPA: Defense Advanced Research Projects Agency
DBA: Database Administrator
DBMS: Database Management System
DNS: Domain Name System
DoS: Denial of Service
DRM: Digital Rights Management
DSL: Digital Subscriber Line
DSS: Decision Support System
DVD-ROM: Digital Versatile Disc–Read-Only Memory
DVD: Digital Video Disc
DVI: Digital Visual Interface
EC: Electronic Commerce
ECPA: Electronic Communications Privacy Act
EDI: Electronic Data Interchange
EEPROM: Electrically Erasable Programmable Read-Only Memory
EMI: Electromagnetic Interference
ERD: Entity-Relationship Diagram
ERP: Enterprise Resource Planning
ETL: Extraction, Transformation, and Loading
G2B: Government-to-Business
G2C: Government-to-Citizens
G2G: Government-to-Government
GB: Gigabyte
Gbps: Gigabits per second
GEO: Geosynchronous Earth Orbit
GHz: Gigahertz
GIS: Geographic Information System
GPS: Global Positioning System
GTLD: Generic Top-Level Domain
GUI: Graphical User Interface
HCI: Human–Computer Interface
HDMI: High Definition Multimedia Interface
HIPAA: Health Insurance Portability and Accountability Act
HTML: Hypertext Markup Language
HTTP: Hypertext Transfer Protocol
Hz: Hertz
IaaS: Infrastructure as a Service
ICANN: Internet Corporation for Assigned Names and Numbers
IIoT: Industrial Internet of Things
IoT: Internet of Things
IP: Intellectual Property
IP: Internet Protocol
IS: Information System
ISDN: Integrated Services Digital Network
ISP: Internet Service Provider
IT: Information Technology
IVR: Interactive Voice Response

JAD: Joint Application Design
JIT: Just-in-Time
KB: Kilobyte
Kbps: Kilobits per second
KPI: Key Performance Indicator
LAN: Local Area Network
LCD: Liquid Crystal Display
LEO: Low Earth Orbit
LTE: Long-Term Evolution
MB: Megabyte
Mbps: Megabits per second
MDM: Mobile device management
MEO: Middle Earth Orbit
MHz: Megahertz
MICR: Magnetic Ink Character Recognition
MIS: Management Information System
NAT: Network Address Translation
NoSQL: Not Only SQL
NPV: Net Present Value
NSF: National Science Foundation
NSFNET: National Science Foundation Network
OCR: Optical Character Recognition
OLAP: Online Analytical Processing
OLED: Organic Light-Emitting Diode
OLTP: Online Transaction Processing
OMR: Optical Mark Recognition
OSI: Open Systems Interconnection
P2P: Peer-to-Peer
PaaS: Platform as a Service
PBX: Private Branch Exchange
PC: Personal Computer
PDA: Personal Digital Assistant
PIN: Personal Identification Number
POTS: Plain Old Telephone Service
PSTN: Public Switched Telephone Network
RAD: Rapid Application Development
RAID: Redundant Array of Independent Disks
RAM: Random Access Memory
RDBMS: Relational Database Management System
RFID: Radio-Frequency Identification
RFP: Request for Proposal
ROM: Read-Only Memory
RSS: Really Simple Syndication *or* Rich Site Summary
SaaS: Software as a Service
SAD: Systems Analysis and Design
SAM: Software Asset Management
SCM: Supply Chain Management
SDLC: Systems Development Life Cycle
SDSL: Symmetric Digital Subscriber Line
SEO: Search Engine Optimization
SFA: Sales Force Automation
SLA: Service-Level Agreement
SOA: Service-Oriented Architecture
SOX: Sarbanes–Oxley Act
SQL: Structured Query Language
SSD: Solid-State Drive
SSL: Secure Sockets Layer
STP: Shielded Twisted Pair
TB: Terabyte
TCO: Total Cost of Ownership
TCP: Transmission Control Protocol
TCP/IP: Transmission Control Protocol/Internet Protocol
TP: Twisted Pair
TPS: Transaction Processing System
URL: Uniform Resource Locator
USB: Universal Serial Bus
UTP: Unshielded Twisted Pair
VAN: Value-Added Network
VGA: Video Graphics Array
VMI: Vendor Managed Inventory
VoIP: Voice over IP
VPN: Virtual Private Network
WAN: Wide Area Network
Wi-Fi: Wireless Fidelity
WLAN: Wireless Local Area Network
WWW: World Wide Web
XaaS: X as a Service
XBRL: Extensible Business Reporting Language
XML: Extensible Markup Language
XP: eXtreme Programming

Glossary

Acceptable use policies: Computer and/or Internet usage policies for people within an organization, with clearly spelled-out penalties for noncompliance.

Access-control software: Software for securing information systems that allows only specific users access to specific computers, applications, or data.

Ad hoc query: A request for information created due to unplanned information needs that is typically not saved for later use.

Adaptive maintenance: Making changes to an information system to make its functionality meet changing business needs or to migrate it to a different operating environment.

Advanced analytics: Tools and techniques used to discover hidden patterns, trends, and relationships in large amounts of data and to build predictive models.

Advanced Research Projects Agency Network (ARPANET): A wide area network linking various universities and research centers; forerunner of the Internet.

Adware: Free software paid for by advertisements appearing during the use of the software.

Affiliate marketing: A type of marketing that allows individual website owners to earn commission by posting other companies' ads on their web pages.

Agile methodology: An evolutionary systems development approach that focuses on creating small, client-approved parts of the system as the project progresses rather than delivering one large application at the end of the project.

Algorithm: The step-by-step procedures used to make a calculation or perform some type of computer-based process.

Alpha testing: Testing performed by the development organization to assess whether the entire system meets the design requirements of the users.

"Amateurization" of journalism: The replacement of professional journalism by amateur bloggers.

American Standard Code for Information Interchange (ASCII): Character encoding method for representing characters of the English alphabet that provides binary codes to represent symbols.

Analog signals: Signals consisting of a continuous wave that can take on an infinite number of values within its frequency range.

Analytical CRM: Systems for analyzing customer behavior and perceptions in order to provide business intelligence.

App: A software program that is designed to perform a particular, well-defined function, typically built for mobile devices.

Applet: A program designed to be executed within another application, such as a web page.

Application software: Software used to perform a specific task that the user needs to accomplish.

Arithmetic logic unit (ALU): A part of the central processing unit (CPU) that performs mathematics and logical operations.

Artificial intelligence (AI): The science of enabling information technologies to simulate human intelligence as well as gain sensing capabilities.

Association: *See* Relationship.

Association discovery: A data mining technique used to find associations or correlations among sets of items.

Asymmetric digital subscriber line (ADSL): A variant of DSL offering faster download speeds than upload speeds.

Asymmetric encryption: *See* Public-key encryption.

Asynchronous: Not coordinated in time.

Attribute: An individual field containing data describing an entity in a database.

Audio: Analog or digital sound data.

Augmented reality: The use of information systems to enhance a person's perception of reality by providing relevant information about the user's surroundings.

Authentication: The process of confirming the identity of a user who is attempting to access a restricted system or website.

Authentication service: A service on a network verifying the identity of a user.

Authorization: Granting access to resources on a system following successful identification and authentication.

Automating: Using information systems to do an activity faster, cheaper, and perhaps with more accuracy and/or consistency.

Backbone: A high-speed central network to which many smaller networks can be connected.

Backdoor: A hidden access point allowing for unauthorized access to a system.

Backup: A copy of critical data on a separate storage medium.

Backup site: A facility allowing businesses to continue functioning in the event a disaster strikes.

Bandwidth: The transmission capacity of a computer or communications channel.

Bar code reader: A specialized scanner used to read bar code data.

Basic input-output system (BIOS): Programs and instructions that are automatically loaded when the computer is turned on.

Batch data: Large amounts of routine data.

Batch processing: The processing of transactions after a certain number of transactions has been collected; the transactions are processed together as a "batch" at some later time.

Best-cost provider strategy: A strategy to offer products or services of reasonably good quality at competitive prices.

Best practices: Procedures and processes used by business organizations that are widely accepted as being among the most effective and/or efficient.

Beta testing: Testing performed by actual system users with actual data in their work environment.

Big Data: Extremely large and complex data sets, typically characterized as being of high volume, variety, and velocity.

Binary code: The digital representation of data using sequences of zeroes and ones.

Biometrics: Body characteristics such as fingerprints, retinal patterns in the eye, or facial characteristics that allow the unique identification of a person.

Bit: A basic unit of data in computing. Short for "binary digit"; the individual ones and zeros that make up a byte.

Blockchain: A decentralized public ledger that is highly resilient against tampering, as transactions are added in blocks, serving as proof of all transactions ever made.

Blog: *noun:* short for "web log." Chronological online text diary that can focus on anything the user desires. *verb:* to create and maintain a blog.

Bluetooth: A wireless specification for personal area networking of desktop computers, peripheral devices (such as headsets, keyboards, mice, and printers), mobile phones, tablets, and various other devices.

Bot: Short for "software robot"; a program that works in the background to provide some service when a specific event occurs.

Botnet: A collection of zombie computers used for destructive activities or spamming.

Bounce rate: The percentage of single-page visits; reflecting the percentage of users for whom a particular page is the only page visited on the website during a session.

Break-even analysis: A type of cost–benefit analysis to identify at what point (if ever) tangible benefits equal tangible costs.

Brick-and-mortar business strategy: A business approach exclusively utilizing physical locations, such as department stores, business offices, and manufacturing plants, without an online presence.

Bricks-and-clicks business strategy: *See* Click-and-mortar business strategy.

Bullwhip effect: Large fluctuations in suppliers' forecasts caused by small fluctuations in demand for the end product and the need to create safety buffers.

Bus network: A network in the shape of an open-ended line.

Business analytics: The use of business intelligence and advanced analytics tools to enhance organizational decision making.

Business continuity plan: A plan describing how a business continues operating after a disaster.

Business intelligence (BI): Tools and techniques for analyzing data of past and current transactions to obtain an understanding of an organization's performance.

Business model: The summary of a business's strategic direction outlining how the objectives will be achieved; a business model specifies how a company will create, deliver, and capture value.

Business process: A set of related activities an organization performs in order to reach its business goals.

Business process management (BPM): A systematic, structured improvement approach by all or part of an organization, including a critical examination and redesign of business processes in order to achieve dramatic improvements in one or more performance measures such as quality, cycle time, or cost.

Business process reengineering (BPR): Legacy term for business process management (BPM).

Business rules: Policies by which a business runs.

Business/IT alignment: The alignment of information systems with a business's strategy.

Business-to-business (B2B): Electronic commerce transactions between business partners, such as suppliers, manufacturers, and distributors.

Business-to-business marketplace: A trading exchange operated by a third-party vendor, not associated with a particular buyer or supplier.

Business-to-consumer (B2C): Electronic commerce transactions between businesses and end consumers.

Buyer agent: An intelligent agent used to find the best price for a particular product a consumer wishes to purchase. Also known as a "shopping bot."

BYOD: Bring your own device; employees using their own devices for work-related purposes.

Byte: A unit of data typically containing 8 bits, or about one typed character.

Bytes per inch (BPI): The numbers of bytes that can be stored on 1 inch of magnetic tape.

Cable modem: A specialized piece of equipment that enables a computer to access Internet service via cable TV lines.

Cache: A small block of special high-speed memory used by processors to store those instructions most recently or most often used (pronounced "cash").

Campus area network: A type of network spanning multiple buildings, such as a university or business campus.

Capabilities: An organization's ability to leverage its resources.

Capital expenditure: Money spent to acquire or improve a long-term asset such as a piece of equipment or a building.

CAPTCHA: Short for "Completely Automated Public Turing Test to Tell Computers and Humans Apart." A system designed to prevent automated mechanisms from repeatedly attempting to submit forms or gain access to a system.

A CAPTCHA typically requires the user to enter letters or numbers that are presented in the form of a distorted image before submitting an online form.

Card security code: A three-digit code located on the back of a credit card; used in transactions when the physical card is not present.

Carrier sense multiple access/collision avoidance (CSMA/CA): A random access control method in which each workstation "listens" to the traffic on the transmission medium to determine whether another message is being transmitted so as to avoid collisions.

Cascading style sheets (CSS): Style language used to specify the formatting and layout of elements on a web page.

Cathode ray tube (CRT): Display technology similar to a television monitor.

CD-R (compact disc–recordable): A type of optical disk that data can be written to.

CD-RW (compact disc–rewritable): A type of optical disk that can be written onto multiple times.

Cell: A geographic area containing a low-powered radio antenna/receiver for transmitting telecommunications signals within that area; monitored and controlled by a central computer.

Cellular phone: Mobile phone using a communications system that divides a geographic region into sections called cells.

Central processing unit (CPU): Component responsible for performing all the operations of the computer. Also called a microprocessor, processor, or chip.

Centralized computing: A computing model utilizing large centralized computers, called mainframes, to process and store data and local input/output devices called "terminals"; no sharing of data and capabilities between mainframes and terminals.

Certificate authority: A trusted middleman between computers that verifies that a website is a trusted site and that provides large-scale public-key encryption.

Change request management: A formal process that ensures that any proposed system changes are documented, reviewed for potential risks, appropriately authorized, prioritized, and carefully managed.

Characters per inch (CPI): The number of characters that can be stored on 1 inch of magnetic tape.

Chatbot: Intelligent agent that simulates human conversations, such as in online help systems.

Classification: A data mining technique used for grouping instances into predefined categories.

Click-and-mortar business strategy: A business approach utilizing both physical locations and virtual locations. Also referred to as "bricks-and-clicks."

Clickbait: An incomplete or tantalizing headline for a story that encourages users to click on it to learn a key detail or to find out the answer to a question.

Click fraud: The abuse of pay-per-click advertising models by repeatedly clicking on a link to inflate revenue to the host or increase costs for the advertiser.

Click-only business strategy: A business approach that exclusively utilizes an online presence. Companies using this strategy are also referred to as virtual companies.

Click-through rate: The number of visitors who click on an ad (i.e., clicks) divided by the number of times it was displayed (i.e., impressions).

Click-wrap license: A type of software license primarily used for downloaded software that requires computer users to accept the license terms by clicking a button before installing the software.

Clickstream data: A recording of the users' path through a website.

Client: Any computer or software application that requests and uses services provided by a server.

Client-server network: A network in which servers and clients have defined roles.

Climate change: Large-scale and long-term regional and global changes in temperatures and weather patterns.

Clock speed: The speed of the system clock, typically measured in hertz (Hz) or multiples thereof.

Clock tick: A single pulse of the system clock.

Cloud-based collaboration tools: Tools residing in the cloud that enable teams to collaborate on documents or projects.

Cloud computing: A computing model enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cloud security: Security concerned with storing and processing data in the cloud; the need to secure data at rest, data in transit, and data in use.

Clustering: Data mining technique grouping related records on the basis of having similar attributes.

Cold backup site: A backup facility consisting of an empty warehouse with all the necessary connections for power and communications but nothing else.

Collaboration: Two or more people, teams, or organizations working together to achieve a common goal.

Collaborative computing: A synergistic form of distributed computing in which two or more networked computers are used to accomplish common processing tasks.

Collaborative CRM: Systems for providing effective and efficient communication with the customer from the entire organization.

Collaborative economy: *See* Sharing economy.

Collective intelligence: A concept based on the notion that distributed groups of people with a divergent range of information and expertise can outperform the capabilities of individual experts.

Collocation facility: A facility in which businesses can rent space for servers or other information systems equipment.

Combination primary key: A unique identifier consisting of two or more attributes.

Competitive advantage: A firm's ability to do something better, faster, cheaper, or uniquely as compared with rival firms in the market.

Competitive intelligence: Information about competitors, used to enhance a business's strategic position.

Compiler: A software program that translates an entire program's source code into machine language that can be read and executed directly by the computer.

Computer-aided software engineering (CASE): The use of software tools that provide automated support for some portion of the systems development process.

Computer-assisted audit tool: Software used to test information systems controls.

Computer cluster: A set of computers that work together as a single system.

Computer crime: The use of a computer to commit an illegal act.

Computer ethics: A broad range of issues and standards of conduct that have emerged through the use and proliferation of information systems.

Computer fluency: The ability to independently learn new technologies as they emerge and assess their impact on one's work and life.

Computer forensics: The use of formal investigative techniques to evaluate digital information for judicial review.

Computer literacy: The knowledge of how to operate a computer.

Computer networking: The sharing of data or services between computers using wireless or cable transmission media.

Consumer-to-business (C2B): Electronic commerce transactions in which consumers sell goods or services to businesses.

Consumer-to-consumer (C2C): Electronic commerce transactions taking place solely between consumers.

Consumerization of IT: The trend of technological innovations first being introduced in the consumer marketplace before being used by organizations.

Content delivery network: A network of servers in various geographical locations that store copies of particular websites so as to reduce latency.

Content management system (CMS): An information system enabling users to publish, edit, version track, and retrieve digital information (or content).

Continuous planning process: A strategic business planning process involving continuous monitoring and adjusting of business processes to enable rapid reaction to changing business conditions.

Control objectives for information and related technology (COBIT): A set of best practices that help organizations to both maximize the benefits from their information systems infrastructure and establish appropriate controls.

Control unit: Part of the central processing unit (CPU) that works closely with the arithmetic logic unit (ALU) by fetching and decoding instructions as well as retrieving and storing data.

Conversion rate: The percentage of visitors to a website who perform the desired action.

Cookie: A small text file (typically containing certain data collected from/about a user or data related to the user's browsing session) passed by a web server to a web browser to be stored on a user's computer; this message is then sent back to the server each time the user's browser requests a page from that server.

Copyright: A form of intellectual property, referring to creations of the mind such as music, literature, or software.

Core activities: The activities within a value chain that process inputs and produce outputs, including inbound logistics, operations and manufacturing, outbound logistics, marketing and sales, and customer service.

Corrective controls: Policies and procedures used to mitigate the impact of any problem after it has arisen, such as restoring compromised data.

Corrective maintenance: Making changes to an information system to repair flaws in its design, coding, or implementation.

Cost–benefit analysis: Techniques that contrast the total expected tangible costs versus the tangible benefits of an investment.

Cracker: An individual who breaks into computer systems with the intention of doing damage or committing a crime.

Cross-channel retailing: Offering the customer different touchpoints, such that transactions take place *across* multiple environments.

Crowdfunding: The securing of business financing from individuals in the marketplace—the "crowd"—to fund an initiative.

Crowdsourcing: The use of everyday people as cheap labor force, enabled by information technology.

Cryptocurrency: Virtual currency that is not issued by any central bank and uses encryption technologies to secure transactions and generate new units of the currency.

Custom software: Software programs that are designed and developed for a company's specific needs as opposed to being bought off the shelf.

Customer engagement center: A part of operational CRM that provides a central point of contact for an organization's customers, employing multiple communication channels to support the communication preferences of customers.

Customer portal: An enterprise portal designed to automate the business processes that occur before, during, and after sales between a supplier and multiple customers.

Customer relationship management (CRM) system: An information system used to create and maintain lasting relationships with customers by concentrating on the downstream information flows.

Customer service and support: A part of operational CRM that automates service and information requests, complaints, and product returns.

Customization: Modifying software so that it better suits user needs.

Cyberbullying: The use of a computer to deliberately cause emotional distress in someone, often by manipulating, discrediting, or humiliating the victim.

Cyberharassment: The use of a computer to communicate obscene, vulgar, or threatening content about someone with the intent of harming or harassing that person.

Cybersquatting: The dubious practice of registering a domain name, then trying to sell the name to the person, company, or organization most likely to want it.

Cyberstalking: Intentionally following, threatening, and/or intimidating someone using electronic means and causing that person to fear for his or her safety.

Cyberterrorism: The use of computer and networking technologies against persons or property to intimidate or coerce governments, individuals, or any segment of society to attain political, religious, or ideological goals.

Cyberwar: An organized attempt by a country's military to disrupt or destroy the information and communications systems of another country.

Dark web: Web content—typically used for various nefarious purposes (such as trading drugs, stolen credit card information, or illegal porn)—that is not indexed by traditional search engines and that is typically only accessible using specialized browsers that anonymize the user and hide traces.

Data: Raw symbols, such as characters and numbers, that have no meaning in and of themselves, and are of little value until processed.

Data cleansing: The process of detecting, correcting (e.g., standardizing the format), or removing corrupt or inaccurate data retrieved from different systems.

Data dictionary: A document prepared by database designers to describe the characteristics of all items in a database.

Data-driven organization: Organization that makes decisions that can be backed up with verifiable data.

Data flows: Data moving through an organization or within an information system.

Data mart: A data warehouse that is limited in scope and customized for the decision support applications of a particular end-user group.

Data mining: Methods used by companies to discover "hidden" predictive relationships in data to better understand their customers, products, markets, or any other phase of their business for which data have been captured.

Data mining agent: An intelligent agent that continuously analyzes large data warehouses to detect changes deemed important by a user, sending a notification when such changes occur.

Data model: A map or diagram that represents the entities of a database and their relationships.

Data privacy statement: A statement on a website containing information about what data are gathered, what they are used for, who will have access to the data, whether provision of the data is required or voluntary, and how confidentiality will be ensured.

Data quality: The suitability of data for its intended use, consisting of completeness, accuracy, timeliness, validity, and consistency.

Data reduction: A preparatory step to running data mining algorithms, performed by rolling up a data cube to the smallest level of aggregation needed, reducing the dimensionality, or dividing continuous measures into discrete intervals.

Data science: The advanced analytics field of study and practice.

Data type: The type (e.g., text, number, or date) of an attribute in a database.

Data warehouse: A repository containing data from multiple large databases and other sources that is suitable for direct querying, analysis, or processing.

Database: A collection of related data organized in a way to facilitate data searches.

Database management system (DBMS): A software application used to create, store, organize, and retrieve data from a single database or several databases.

Decision support system (DSS): A special-purpose information system designed to support organizational decision making.

Dedicated grid: A grid computing architecture consisting of homogeneous computers that are dedicated to performing the grid's computing tasks.

Deep web: The parts of the web that cannot be indexed by conventional search engines.

Defense Advanced Research Projects Agency (DARPA): The U.S. governmental agency that began to study ways to interconnect networks of various kinds, leading to the development of the ARPANET (Advanced Research Projects Agency Network).

Demographic changes: Changes in the structure of populations, such as related to age, birth rates, and migration.

Denial-of-service (DoS) attack: An attack by crackers—often using zombie computers—that makes a network resource (e.g., website) unavailable to users or available with only a poor degree of service.

Density: The storage capacity of magnetic tape; typically expressed in characters per inch (CPI) or bytes per inch (BPI).

Desktop videoconferencing: The use of integrated computer, telephone, video recording, and playback technologies—by two or more people—to remotely interact with each other using their desktop computers.

Desktop virtualization: The practice of providing workers with a virtual desktop environment (hosted on a central computer), helping to reduce costs for software licensing or maintenance and to comply with stringent privacy and data protection laws.

Destructive agent: A malicious agent designed by spammers and other Internet attackers to farm e-mail addresses off websites or deposit spyware on machines.

Detective controls: Processes and procedures used to discover security events, such as unauthorized access attempts, and to limit damage.

Developmental testing: Testing performed by programmers to ensure that each module of a new program is error free.

Device driver: A computer program that allows a computer to communicate with various different peripherals and other hardware devices.

Differentiation strategy: A strategy in which an organization differentiates itself by providing better products or services than its competitors.

Digital dashboard: A display delivering summary information to managers and executives to provide warnings, action notices, and summaries of business conditions.

Digital divide: The gap between those individuals in our society who are computer literate and have access to information resources such as the Internet and those who do not.

Digital infrastructure: *See* Information systems infrastructure.

Digital rights management (DRM): A technological solution that allows publishers to control their digital media (music, movies, and so on) to discourage, limit, or prevent illegal copying and distribution.

Digital signals: Signals consisting of discrete 'on' and 'off' values that computers use to transmit data.

Digital subscriber line (DSL): A high-speed data transmission method that uses special modulation schemes to fit more data onto traditional copper telephone wires.

Digital video disc: A DVD used for storing movies.

Digitize: To convert analog inputs into digital data.

Dimension: A way to summarize data, such as region, time, or product line.

Directory service: A repository (or "address book") containing information about users, user groups, resources, access rights, and so on, on a network.

Disaster recovery plan: An organizational plan that spells out detailed procedures for recovering from systems-related disasters, such as virus infections and other disasters that might strike critical information systems.

Discount rate: The rate of return used by an organization to compute the present value of future cash flows.

Discussion forum: An electronic bulletin board that allows for threaded discussions among participants.

Disintermediation: The phenomenon of cutting out the "middleman" in transactions and reaching customers more directly and efficiently.

Disruptive innovation: *See* Radical innovation.

Disruptive innovation cycle: A model suggesting that the extent to which modern organizations use information technologies and systems in timely, innovative ways is the key to success.

Distinctive competency: Any unique strength possessed by an organization (e.g., innovation, agility, quality, or low cost) that helps to pursue an organizational strategy.

Distributed computing: Using separate computers to work independently on subsets of tasks and then pooling the individual results by communicating over a network.

Domain name: The part of a Uniform Resource Locator (URL) that identifies a source or host entity on the Internet.

Domain Name System (DNS): A collection of databases used to associate Internet host names with their IP addresses.

Downstream information flow: An information flow that relates to the information that is produced by a company and sent along to another organization, such as a distributor.

Doxing: Researching and broadcasting personally identifiable information about an individual.

Drill down: To analyze data at more detailed levels of a specific dimension.

Drill-down report: A report that provides details behind the summary values on a key-indicator or exception report.

Drive-by hacking: A computer attack in which an attacker accesses a wireless computer network, intercepts data, uses network services, and/or sends attack instructions without entering the office or organization that owns the network.

Dumpster diving: Scouring wastebaskets for potentially useful information.

DVD-ROM (digital versatile disc–read-only memory): A DVD that can be read but not written to.

Dynamic pricing model: Pricing model under which customers specify the product or service they are looking for and how much they are willing to pay for it, and the provider either accepts or rejects the customers' bids.

E-auction: An electronic auction.

E-business: An organization that uses information technologies or systems to support nearly every part of its business.

Economic opportunities: Opportunities that a firm finds for making more money and/or making money in new ways.

Effectiveness: The extent to which goals or tasks are accomplished well.

Efficiency: The extent to which goals are accomplished faster, at lower cost, or with relatively little time and effort.

E-finance: The use of information systems to provide financial services and markets.

E-government: The use of information systems to provide citizens, organizations, and other governmental agencies with information about and access to public services.

Electronic bill pay: The use of online banking for bill paying.

Electronic commerce (EC): The exchange of goods and services via the Internet among and between customers, firms, employees, business partners, suppliers, and so on.

Electronic Data Interchange (EDI): The digital, or electronic, transmission of business documents and related data between organizations via dedicated telecommunications networks.

Electronic meeting system: A collection of personal computers networked together with sophisticated software tools to help group members solve problems and make decisions through interactive electronic idea generation, evaluation, and voting.

Embedded system: A microprocessor-based system optimized to perform a limited, well-defined set of tasks.

Employee portal: An intranet portal used for communication and collaboration between an organization and its employees.

Employee self-service: Intranet-based applications that allow employees to manage human-resources-related tasks.

Enabling technology: An information technology that enables a firm to accomplish a task or goal or to gain or sustain a competitive advantage in some way.

Encryption: The process of encoding messages or files so that only intended recipients can decipher and understand them.

End-to-end encryption: A system of communication where only the participants of the conversation can read the messages.

Enterprise license: A type of software license that is usually negotiated and covers all users within an organization. Also known as a "volume license."

Enterprise marketing management: CRM tools used to integrate and analyze marketing campaigns.

Enterprise resource planning (ERP) system: An information system that integrates business activities across departmental boundaries, including planning, manufacturing, sales, marketing, and so on.

Enterprise system: An information system that spans the entire organization and can be used to integrate business processes, activities, and data across all functional areas of a firm.

Enterprise WAN: A WAN connecting disparate networks of a single organization into a single network.

Enterprise-wide information systems: *See* Enterprise system.

Entity: Something data are collected about, such as people or classes.

Entity-relationship diagram (ERD): A diagram used to display the structure of data and show associations between entities.

ERP core components: The components of an ERP that support the internal activities of an organization for producing products and services.

ERP extended components: The components of an ERP that support the primary external activities of an organization for dealing with suppliers and customers.

E-tailing: Electronic retailing; the online sales of goods and services.

Ethernet: The most widely used local area network protocol.

Exception report: A report providing users with information about situations that are out of the normal operating range.

Executable: A program in machine language that can be read and executed directly by a computer.

Executive level: The top level of the organization, where executives focus on long-term strategic issues facing the organization.

Exit rate: The percentage of visitors who leave the website (terminate the session) after viewing a particular page.

Explicit knowledge asset: A knowledge asset that can be documented, archived, and codified.

Extensible Business Reporting Language (XBRL): An XML-based specification for publishing financial information.

Extensible Markup Language (XML): A data presentation standard that allows designers to create customized markup tags that enable data to be more easily shared between applications and organizations.

External acquisition: The process of purchasing an existing information system from an external organization or vendor.

Externally focused system: An information system that coordinates business activities with customers, suppliers, business partners, and others who operate outside an organization's boundaries.

Extraction, transformation, and loading (ETL): The process of consolidating, cleansing, and manipulating data before loading the data into a data warehouse.

Extranet: A private part of the Internet—cordoned off from ordinary users—that enables two or more firms to use the Internet to do business together.

eXtreme programming (XP): A software development methodology that utilizes fast software releases to customers, small development teams (usually pairs), and extensive code reviews and testing.

Fact: *See* Measure.

Fiber to the home: *See* Fiber to the premises.

Fiber to the premises: High-speed network connectivity to homes and offices that is implemented using fiber-optic cable. Also known as "fiber to the home."

Financial flow: The movement of financial assets throughout the supply chain.

Fintech: Technologies that support activities in the financial sector.

Firewall: Hardware or software designed to keep unauthorized users out of network systems.

First-call resolution: Addressing the customers' issues during the first call.

First-mover advantage: Temporary competitive advantage derived from being the first to enter a market.

Flash drive: A portable, removable data storage device using flash memory.

Flash memory: A memory-chip-based nonvolatile computer storage technology.

Folksonomy: A categorization system created by Internet users (as opposed to experts).

Foreign key: An attribute that appears as a non–primary key attribute in one entity and as a primary key attribute (or part of a primary key) in another entity.

Form: A business document that contains some predefined data and may include some areas where additional data are to be filled in, typically for adding or modifying data related to a single record.

Freemium: Revenue model where limited versions of digital products or services are offered for free, but a premium is charged for special features.

Functional area information system: A cross-organizational-level information system designed to support a specific functional area.

Functional convenience: A web page's characteristics that make the interaction with the site easier or more convenient.

Fuzzy logic: A type of logic used in intelligent systems that allows rules to be represented using approximations or subjective values in order to handle situations where information about a problem is incomplete.

Geographic information system (GIS): A system for creating, storing, analyzing, and managing geographically referenced data.

Geotag: *noun:* geospatial metadata (such as latitude, longitude, or altitude), typically assigned to digital media. *verb:* to add geotags to digital media.

Gig economy: An economy in which workers are not employed by a company, but are only hired for short-term, temporary jobs.

Global network: A network spanning multiple countries that may include the networks of several organizations. The Internet is an example of a global network.

Globalization: The integration of economies throughout the world, enabled by innovation and technological progress.

Government-to-business (G2B): Electronic commerce that involves a country's government and businesses.

Government-to-citizen (G2C): Online interactions between federal, state, and local governments and their constituents.

Government-to-government (G2G): Electronic interactions that take place between countries or between different levels of government within a country.

Graphical user interface (GUI): A computer interface that enables the user to select or manipulate pictures, icons, and menus to send instructions to the computer.

Green computing: Attempts to use computing resources more efficiently to reduce environmental impacts, as well as the use of information systems to reduce negative environmental impacts.

Grid computing: A computing architecture that combines the computing power of a large number of smaller, independent, networked computers (often regular desktop PCs) into a cohesive system in order to solve large-scale computing problems.

Group buying: Special volume discounts negotiated with local businesses and offered to people in the form of "daily deals"; if enough people agree to purchase the product or service, everyone can purchase the product at the discounted price.

Groupware: Software that enables people to collaborate more effectively.

Hacker: An individual who gains unauthorized access to computer systems.

Hacktivist: A cybercriminal pursuing political, religious, or ideological goals.

Hard drive (hard disk drive): A magnetic storage device used for secondary storage.

Hardware: Physical computer equipment, such as the computer monitor, central processing unit, or keyboard.

Hashtag: A tag preceded by a pound sign added to messages to indicate the topic and relate the message to other messages about the same topic.

Head crash: A hard drive failure occurring when the read/write head touches the disk, resulting in the loss of the data and/or irreparable damage to the disk.

Healthcare IS: The use of IS to support everything from patient diagnosis and treatment to analyzing patient and disease data to running doctors' offices and hospitals.

Home automation: *See* Smart home technologies.

Honeypot: A computer, piece of data, or network site that is designed to be enticing to crackers so as to detect, deflect, or counteract illegal activity.

Hot backup site: A fully equipped backup facility, having everything from hardware, software, and current data to office equipment.

HTML editor: *See* Web page builder.

HTML tag: Markup that is inserted into the source document of a web page to specify the content and structure of a document.

Human–computer interface (HCI): The point of contact between an information system and its users.

Hyperlink: A reference or link on a web page to another document that contains related information.

Hypertext: Text in a web document that is linked to other text or content.

Hypertext Markup Language (HTML): The standard method of specifying the structure and content of web pages.

Hypertext Transfer Protocol (HTTP): The standard regulating how servers process user requests for web pages.

Identification: A user's claim or declaration of being someone.

Identity theft: Stealing another person's Social Security number, credit card number, and other personal information for the purpose of using the victim's credit rating to borrow money, buy merchandise, or run up debts that are never repaid.

Impression based model: Pricing model under which pricing is based on the number of times the page containing an ad is displayed, typically expressed in cost per thousand impressions (i.e., cost per mille, or CPM).

In-app purchases: Extra features or content users can buy within an app.

Industrial espionage: A company's (or country's) covert activities, such as the theft of trade secrets, bribery, blackmail, and technological surveillance to gain an advantage over rivals.

Industrial Internet of Things (IIoT): The use of IoT technologies in manufacturing.

Information: Data that have been formatted and/or organized in some way so as to be useful to people.

Information flow: The movement of information along the supply chain.

Information privacy: An ethical issue that is concerned with what information an individual should have to reveal to others through the course of employment or through other transactions such as online shopping.

Information system (IS): The combination of people and information technology that create, collect, process, store, and distribute useful data.

Information systems architecture: The formal definition of an organization's technologies, systems, and processes that support the organization's specific business processes and strategy.

Information systems audit: An assessment of the state of an organization's information systems controls to determine necessary changes and to help ensure the information systems' availability, confidentiality, and integrity.

Information systems controls: Processes and procedures helping to ensure the availability, integrity, and confidentiality of data and information systems.

Information systems infrastructure: The hardware, software, networks, data, facilities, human resources, and services used by organizations to support their decision making, business processes, and competitive strategy.

Information systems planning: A formal process for identifying and assessing all possible information systems development projects of an organization.

Information systems risk assessment: Assessment performed to obtain an understanding of the risks to the confidentiality, integrity, and availability of data and systems.

Information systems security: Precautions taken to keep all aspects of information systems safe from destruction, manipulation, or unauthorized use or access.

Information technology (IT): The hardware, software, and networking components of an information system.

Informational system: A system designed to support decision making based on stable point-in-time or historical data.

Infrastructure: The interconnection of various structural elements to support an overall entity, such as an organization, city, or country.

Infrastructure as a service (IaaS): A cloud computing model in which only the basic capabilities of processing, storage, and networking are provided.

In-memory computing: Processing of analytical and transactional tasks where the data are stored in a computer's main memory, rather than on a comparatively slow hard drive, removing the bottlenecks associated with reading and writing data.

Innovation: The creation of new products, processes, or services that return value to the organization.

Input technologies: Hardware that is used to enter data into a computer.

Insider threat: A trusted adversary or malicious insider who operates within an organization's boundaries.

Instant messaging: Online chat emulating real-time written conversations.

Intangible benefit: A benefit of using a particular system or technology that is difficult to quantify.

Intangible cost: A cost of using a particular system or technology that is difficult to quantify.

Integrated Services Digital Network (ISDN): A standard for worldwide digital telecommunications that uses existing twisted-pair telephone wires to provide high-speed data service.

Intellectual property (IP): Creations of the mind that have commercial value.

Intelligent agent: A program that works in the background to provide some service when a specific event occurs.

Intelligent system: A system comprised of sensors, software, and computers embedded in machines and devices that emulates and enhances human capabilities.

Interactive voice response (IVR): A system using speech recognition technology to guide callers through online surveys or menu options.

Interexchange carrier (IXC): A company selling long-distance services with circuits that carry signals between the major telephone exchanges.

Internally focused system: An information system that supports functional areas, business processes, and decision making within an organization.

Internet: A large worldwide collection of networks that use a common protocol to communicate with each other.

Internet backbone: The collection of primary network connections and telecommunications lines making up the Internet.

Internet Corporation for Assigned Names and Numbers (ICANN): A nonprofit corporation that is responsible for managing IP addresses, domain names, and the root server system.

Internet exchange point: An access point for ISPs and an exchange point for Internet traffic.

Internet hoax: A false message circulated online about any topic of public interest, typically asking the recipient to perform a certain action.

Internet host: A computer working as a server on the Internet.

Internet of Things (IoT): A network of a broad range of physical objects that can automatically share data over the Internet.

Internet over satellite: A technology that allows users to access the Internet via satellites that are placed in a geostationary orbit.

Internet service provider (ISP): An organization that enables individuals and organizations to connect to the Internet.

Internet Tax Freedom Act: An act mandating a moratorium on electronic commerce taxation in order to stimulate electronic commerce.

Internet troll: A person who creates discord on the Internet by starting arguments or upsetting people by posting inflammatory content on social media sites with the deliberate intent of provoking readers into an emotional response, often for the troll's own amusement.

Internetworking: Connecting host computers and their networks to form even larger networks.

InterNIC: A government–industry collaboration that manages directory and database services, domain registration services, and other information services on the Internet.

Interorganizational system: An information system that communicates across organizational boundaries.

Interpreter: A software program that translates a program's source code into machine language one statement at a time.

Intranet: An internal, private network using web technologies to facilitate the secured transmission of proprietary information within an organization, thereby restricting access to authorized users within the organization.

IP: The part of TCP/IP that is responsible for addressing and correct routing of packages from source to destination.

IP address: A numerical address assigned to every computer and router connected to the Internet that serves as the destination address of that computer or device and enables the network to route messages to the proper destination.

IP convergence: The use of the Internet protocol for transporting voice, video, fax, and data traffic.

IP datagram: A data packet that conforms to the Internet protocol specification.

IPv6: The latest version of the Internet protocol.

Jailbreaking: Modifying a mobile phone's operating system to remove manufacturer or carrier restrictions.

Java: An object-oriented programming language that is used for developing applications that can run on multiple computing platforms.

JavaScript: A scripting language that allows developers to add dynamic content to websites.

Joint application design (JAD): A special type of a group meeting in which all (or most) users meet with a systems analyst to jointly define and agree on system requirements or designs.

Just-in-time (JIT): A method to optimize ordering quantities so that parts or raw materials arrive just when they are needed for production.

Key generator: Software used to generate fake license or registration keys to circumvent a program's protection mechanism.

Key-indicator report: A report that provides a summary of critical information on a recurring schedule.

Key performance indicator (KPI): A metric deemed critical to assessing progress toward a certain organizational goal.

Keylogger: Software programs used to capture users' keystrokes.

Knowledge: A body of governing procedures such as guidelines or rules that are used to organize or manipulate data to make the data suitable for a given task.

Knowledge assets: The set of skills, routines, practices, principles, formulas, methods, heuristics, and intuitions (both explicit and tacit) used by organizations to improve efficiency, effectiveness, and profitability.

Knowledge management: The processes an organization uses to gain the greatest value from its knowledge assets.

Knowledge management system: A collection of technology-based tools that includes communications technologies and information storage and retrieval systems to enable the generation, storage, sharing, and management of tacit and explicit knowledge assets.

Knowledge portal: A specific portal used to share knowledge collected in a repository with employees (often using an intranet), with customers and suppliers (often using an extranet), or the general public (often using the Internet).

Knowledge society: A society in which education is the cornerstone of society and there is an increase in the importance of knowledge workers.

Knowledge worker: A professional who is relatively well educated and who creates, modifies, and/or synthesizes knowledge as a fundamental part of his or her job.

Layer: A transparent sheet that can be made visible or invisible and provides specific information or content. In a GIS, layers contain information about roads, utilities, ZIP code boundaries, floodplains, and so on.

Legacy system: Older standalone computer systems within an organization with older versions of applications that are either fast approaching or beyond the end of their useful life within the organization.

Liquid crystal display (LCD): A technology used for thin and lightweight displays in many modern notebook and desktop computers.

Local area network (LAN): A computer network that spans a relatively small area, allowing all computer users to connect with each other to exchange data and share peripheral devices, such as printers.

Location analytics: The combination of geospatial data with business intelligence and advanced analytics tools to enhance organizational decision making

Location-based services: Highly personalized mobile services based on a user's location.

Logic bomb: A type of computer virus that lies in wait for unsuspecting computer users to perform a triggering operation before executing its instructions.

Long tail: The large parts of consumer demand that are outside the relatively small number of mainstream tastes.

Low-cost leadership strategy: A strategy to offer the best prices in the industry on goods or services.

Machine learning: The branch of artificial intelligence that allows systems to learn by identifying meaningful patterns when processing massive amounts of data.

Magnetic ink character recognition (MICR): Scanning technology used by the banking industry to read data, account numbers, bank codes, and check numbers on preprinted checks.

Mainframe: A very large computer typically used as the main, central computing system by major corporations and governmental agencies.

Make-to-order process: The set of processes associated with producing goods based on customers' orders.

Make-to-stock process: The set of processes associated with producing goods based on demand forecasts.

Making the business case: The process of identifying, quantifying, and presenting the value provided by an information system.

Malware: Malicious software, such as viruses, worms, or Trojan horses.

Management information system (MIS): An information system designed to support the management of organizational functions at the managerial level of the organization.

Managerial level: The middle level of the organization, where functional managers focus on monitoring and controlling operational-level activities and providing information to higher levels of the organization.

Mashup: A new application or website that uses data from one or more service providers.

Mass customization: Tailoring products and services to meet the particular needs of individual customers on a large scale.

Master data: The data that are deemed most important in the operation of a business; typically the "actors" in an organization's transactions.

Master data management: Consolidating master data so as to facilitate arriving at a single version of the truth.

M-commerce (mobile commerce): Any electronic transaction or information interaction conducted using a wireless, mobile device and mobile networks that leads to a transfer of real or perceived value in exchange for information, services, or goods.

Measure: The values and numbers a user wants to analyze. Also referred to as "facts."

Measured service: A pricing model in a utility computing model where providers monitor usage and customers pay only for what they use, and the metering depends on type of resource.

Media access control: The rules that govern how a given node or workstation gains access to a network to send or receive data.

Menu-driven pricing model: Pricing model under which companies set and present non-negotiable prices for products to consumers.

Mesh network: A network that consists of computers and other devices that are either fully or partially connected to each other.

Metadata: Data about data, describing data in terms of who, where, when, why, and so on.

Metropolitan area network: A computer network of limited geographic scope—typically a citywide area—that combines LAN and high-speed fiber-optic technologies.

Microblog: *noun:* social networking service (such as Twitter), allowing to post relatively short "status updates." *verb:* to post short status updates on a microblog.

Microprocessor: *See* Central processing unit.

Microsoft.NET: A programming platform that is used to develop applications that are highly interoperable across a variety of platforms and devices.

Mirror: To store data synchronously on independent systems to achieve redundancy for purposes of reliability and/or performance.

Mobile banking: Conducting financial transactions using mobile devices.

Mobile device management (MDM): Administration of an organization's mobile devices to enforce authorization policies, prevent the downloading or installing of non-approved apps, or remotely lock the phones or wipe data.

Mobile wireless: The transfer of data to a moving computer or handheld device.

Model: A conceptual, mathematical, logical, or analytical formula used to represent or project business events or trends.

Modem: Short for "modulator-demodulator"; a device or program that enables a computer to transmit data over telephone or cable television lines.

Module: A component of a software application that can be selected and implemented as needed.

Monitoring and sensing agent: An intelligent agent that keeps track of key data, such as data provided by various sensors, meters, cameras, and the like, and notifies the user when conditions change.

Moore's law: The prediction that computer processing performance would double every 24 months.

Motherboard: A large printed plastic or fiberglass circuit board that holds or connects to all the computer's electronic components.

Multichannel retailing: Offering the customer different (independent) touchpoints, such as a retail store and a catalogue.

Multi-core processor: A single chip central processing unit (CPU) that has more than one set of arithmetic logic units (ALU) and control units.

National Science Foundation (NSF): A U.S. government agency responsible for promoting science and engineering; the NSF initiated the development of the National Science Foundation Network (NSFNET), which became a major component of the Internet.

National Science Foundation Network (NSFNET): A network developed by the United States in 1986 that became a major component of the Internet.

Net neutrality: The principle that all Internet traffic should be treated the same.

Net-present-value analysis: A type of cost–benefit analysis of the cash flow streams associated with an investment.

Network: A group of computers and associated peripheral devices connected by a communication channel capable of sharing data and other resources among users.

Network effect: The notion that the value of a network (or tool or application based on a network) is dependent on the number of other users.

Network interface card: An expansion board that plugs into a computer so that it can be connected to a network; also called network adapter.

Network topology: The shape of a network; the four common network topologies are star, ring, bus, and mesh.

Neural network: An information system that attempts to approximate the functioning of the human brain.

Non-capital expenditure: Money spent on repairs, supplies, payroll, and other operating expenses.

Non-recurring cost: A one-time cost that is not expected to continue after a system is implemented.

Nonvolatile memory: Memory that does not lose its data after power is shut off.

Normalization: A technique for making complex relational databases more efficient and more easily handled by a database management system.

NoSQL: "Not only SQL"; a variety of database technologies enabling highly scalable databases that do not conform to RDBMS schemas.

Object-oriented language: A programming language that groups together data and their corresponding instructions into manipulable objects.

Off-the-shelf software: Software designed and used to support general business processes that does not require any specific tailoring to meet an organization's needs.

Office automation system: A collection of software and hardware for developing documents, scheduling resources, and communicating.

OLAP cube: A data structure allowing for multiple dimensions to be added to a traditional two-dimensional table for detailed analysis.

OLAP server: The chief component of an OLAP system that understands how data are organized in the database and has special functions for analyzing the data.

Omni-channel retailing: Providing seamless, simultaneous retail interactions using different channels, such that a customer does not interact with a single channel but with the brand as a whole.

Online analytical processing (OLAP): The process of quickly conducting complex analyses of data stored in a database, typically using graphical software tools.

Online banking: The use of the Internet to conduct financial transactions.

Online brokerage: The use of the Internet to obtain information about stock quotes and manage financial portfolios.

Online predator: A cybercriminal using the Internet to target vulnerable people, usually the young or old, for sexual or financial purposes.

Online transaction processing (OLTP): Immediate automated responses to the requests from multiple concurrent transactions of customers.

Open innovation: The process of integrating external stakeholders into an organization's innovation process.

Open source software: Software for which the source code is freely available for use and/or modification.

Open Systems Interconnection (OSI) model: A networking model that represents a group of specific communication tasks as successive layers.

Operating system: Software that coordinates the interaction between hardware devices, peripherals, application software, and users.

Operational CRM: Systems for automating the fundamental business processes—marketing, sales, and support—for interacting with the customer.

Operational expenditure: *See* Non-capital expenditure.

Operational level: The bottom level of an organization, where the routine, day-to-day business processes and interactions with customers occur.

Operational system: A system that is used to interact with customers and run a business in real time.

Opt in: To signal agreement to the collection/further use of one's data (e.g., by checking a box).

Opt out: To signal that data cannot be collected/used in other ways (e.g., by checking a box).

Optical character recognition (OCR): Scanning technology used to read and digitize typewritten, computer-printed, or handwritten characters.

Optical disk: A storage disk coated with a metallic substance that is written to (or read from) when a laser beam passes over the surface of the disk.

Optical mark recognition (OMR): Scanning technology used to scan questionnaires and test answer forms ("bubble sheets") where answer choices are marked by filling in circles using a pencil or pen.

Order-to-cash process: The set of processes associated with selling a product or service.

Organic light-emitting diode (OLED): A display technology using less power than LCD technology.

Organizational learning: The ability of an organization to learn from past behavior and data, improving as a result.

Organizational strategy: A firm's plan to accomplish its mission and goals as well as to gain or sustain competitive advantage over rivals.

Output technologies: Hardware devices that deliver information in a usable form.

Outsourcing: The moving of routine jobs and/or tasks to people in another firm.

Packaged software: A software program written by a third-party vendor for the needs of many different users and organizations.

Packet sniffer: Software program to capture and analyze network traffic.

Packet switching: The process of breaking information into small chunks called data packets and then transferring those packets from computer to computer via the Internet, based on the concept of turn taking.

Paid inclusion: The inclusion of a website in a search engine's listing after payment of a fee.

Patch management system: An online system that utilizes web services to automatically check for software updates, downloading and installing these "patches" as they are made available.

Patent: A type of intellectual property typically referring to process, machine, or material inventions.

Patriot hacker: Independent citizens or supporters of a country that perpetrate computer attacks on perceived or real enemies.

Pay-per-click model: A payment model used in online advertising where the advertiser pays the website owner a fee for visitors clicking on a certain link.

Peer: Any computer that may both request and provide services.

Peer production: The creation of goods or services by self-organizing communities.

Peer-to-peer (P2P) networks: Networks that enable any computer or device on the network to provide and request services.

Perfective maintenance: Making enhancements to improve processing performance, to improve usability, or to add desired but not necessarily required system features.

Peripheral: An auxiliary device, such as mouse or keyboard, that is connected to a computer.

Personal area network: A wireless network used to exchange data between computing devices using short-range radio communication, typically within an area of 10 meters.

Personal computer (PC): A stationary computer used for personal computing and small business computing.

Phishing: Attempts to trick financial account and credit card holders into giving away their login credentials, usually by sending spam messages to literally millions of e-mail accounts. Also known as "spoofing."

Plain old telephone service (POTS): Standard analog telephone lines; also called "public switched telephone network (PSTN)."

Planned obsolescence: The design of a product so that it lasts for only a certain predetermined life span.

Platform: A business model that enables others—both other businesses and users—to co-create value, such that some users create value and other users consume.

Platform as a service (PaaS): A cloud computing model in which the customer can run his or her own applications that are typically designed using tools provided by the service provider; the customer has limited or no control over the underlying infrastructure.

Podcast: *See* Webcast.

Port: A hardware interface by which a computer communicates with a peripheral device or another system.

Portal: An access point (or front door) through which a business partner accesses secured, proprietary information from an organization (typically using extranets).

Power supply: A device that converts electricity from the wall socket to a lower voltage appropriate for computer components and regulates the voltage to eliminate surges common in most electrical systems.

Predictive modelling: Analytics techniques focusing on identifying trends or predicting business outcomes.

Preventive controls: Processes and procedures used to prevent any potentially negative event from occurring, such as by preventing outside intruders from accessing a facility.

Preventive maintenance: Making changes to a system to reduce the chance of future system failure.

Primary key: A field included in a database table that contains a unique value for each instance of an entity to ensure that it is stored or retrieved accurately.

Primary storage: Temporary storage for data used in current calculations.

Printer: An output device that produces a paper copy of alphanumeric data or other content from a computer.

Private cloud: Cloud infrastructure that is internal to an organization.

Processing logic: The steps by which data are transformed or moved, as well as a description of the events that trigger these steps.

Processing technologies: Computer hardware that transforms inputs into outputs.

Procure-to-pay process: The set of processes associated with procuring goods from external vendors.

Product flow: The movement of goods from the supplier to production, from production to distribution, and from distribution to the consumer.

Productivity paradox: The observation that productivity increases at a rate that is lower than expected when new technologies are introduced.

Project manager: The person most responsible for ensuring that a project is successfully completed.

Propagation delay: The delay in the transmission of a satellite signal because of the distance the signal must travel.

Protocols: Procedures that different computers follow when they transmit and receive data.

Prototyping: An iterative systems development process in which requirements are converted into a working system that is continually revised through close interaction between analysts and users.

Proxy variable: An alternative measurement of outcomes; used when it is difficult to determine and measure direct effects.

Pseudocode: A way to express processing logic independent of the actual programming language being used.

Public cloud: Cloud infrastructure offered on a commercial basis by a cloud service provider.

Public key encryption: A symmetric encryption method that uses a pair of keys—a public and a private key—such that a message is encoded using the recipient's public key and can only be decoded using the recipient's private key.

Public switched telephone network (PSTN): *See* Plain old telephone service (POTS).

QR code: A two-dimensional barcode with a high storage capacity.

Quantified self: The logging of all aspects of one's daily life to improve overall health and performance.

Query: A method used to retrieve data from a database.

Radical innovation: An innovation that uses markedly new or different technology to access new customer segments and/or provide significantly greater benefits to existing customers, and eventually marginalizes or replaces existing products or services.

Radio frequency identification (RFID): The use of electromagnetic energy to transmit information between a reader (transceiver) and a processing device; used to replace bar codes and bar code readers.

Random-access memory (RAM): A type of volatile primary storage that can be accessed randomly by the CPU.

Ransomware: Malicious software that holds a user's computer hostage by locking or taking control of the user's computer, or encrypting files or documents.

Read-only memory (ROM): A type of nonvolatile primary storage that is used to store programs and instructions that are automatically loaded when the computer is turned on.

Read/write head: A device that inscribes data to or retrieves data from a hard drive or tape.

Record: A collection of related attributes about a single entity.

Recovery point objective: An objective specifying how timely backup data should be preserved.

Recovery time objective: An objective specifying the maximum time allowed to recover from a catastrophic event.

Recurring cost: An ongoing cost that occurs throughout the life cycle of systems development, implementation, and maintenance.

Redundant array of independent disks (RAID): A secondary storage technology that makes redundant copies of data on two or more hard drives.

Register: Relatively small temporary storage location where data must reside while being processed or manipulated.

Reintermediation: The design of a business model that reintroduces middlemen in order to reduce the chaos brought on by disintermediation.

Relational database management system (RDBMS): A database management system based on the relational database model.

Relational database model: The most common DBMS approach; entities are presented as two-dimensional tables, with records as rows and attributes as columns.

Relationship: An association between entities in a database to enable data retrieval.

Report: A compilation of data from a database that is organized and displayed to the user.

Report generator: A software tool that helps users build reports quickly and describe the data in a useful format.

Representational delight: A web page's characteristics that stimulate a user's senses.

Request for proposal (RFP): A communication tool indicating buyer requirements for a proposed system and requesting information or soliciting bids from potential vendors.

Requirements collection: The process of gathering and organizing information from users, managers, customers, business processes, and documents to understand how a proposed information system should function.

Resource scarcity: Limited availability of fossil fuels and other natural resources.

Resources: An organization's specific assets that are utilized to create cost or product differentiation from its competitors.

Revenue model: Part of a business model that describes how the organization will earn revenue, generate profits, and produce a superior return on invested capital.

Reverse engineering: Disassembling a piece of software in order to understand its functioning.

Reverse logistics: Processes in place to efficiently receive products from the point of consumption, so that valuable materials can be recycled or hazardous materials can be properly disposed of.

RFID tag: The processing device used in an RFID system that uniquely identifies an object.

Ring network: A network that is configured in the shape of a closed loop or circle, with each node connecting to the next node.

Risk acceptance: A computer system security policy in which no countermeasures are adopted and any damages that occur are simply absorbed.

Risk avoidance: A computer system security policy in which alternate means are used to perform a task that would cause risk, or the task is not performed at all.

Risk reduction: The process of taking active countermeasures to protect information systems.

Risk transference: A computer system security policy in which someone else absorbs the risk, as with insurance.

Robotics: The use of robots to perform manual tasks.

Roll up: To analyze data at less detailed levels of a certain dimension.

Router: An intelligent device used to connect and route data traffic across two or more individual networks.

RSS: Really Simple Syndication (or Rich Site Summary). A set of standards for sharing updated web content, such as news and sports scores, across sites.

Sales beacon: Bluetooth device that can detect proximate smartphones and send marketing messages or personalized coupons.

Sales force automation (SFA): CRM systems to support the day-to-day sales activities of an organization.

Sarbanes–Oxley Act: A U.S. government regulation mandating companies to demonstrate compliance with accounting standards and establishing controls and corporate governance.

Scalability: The ability to adapt to increases or decreases in demand for processing or data storage.

Scheduled report: A report produced at predefined intervals—daily, weekly, or monthly—to support the routine informational needs of managerial-level decision making.

Scripting language: A programming language for integrating interactive components into a web page.

Search advertising: Advertising that is listed in the sponsored search results for a specific search term.

Search engine optimization (SEO): Methods for improving a site's ranking in search engine results.

Secondary key: An attribute that can be used to identify two or more records within a table that share a common value.

Secondary storage: Large-capacity storage devices, such as hard drives, solid-state drives, or magnetic tapes, for permanently storing data.

Secure Sockets Layer (SSL): A popular public-key encryption method used on the Internet.

Semantic web: A set of design principles that will enable computers to index websites, topics, and subjects, enabling computers to understand the content of web pages and search engines to provide richer and more accurate results.

Semistructured data: Data (such as clickstreams and sensor data) that do not fit neatly into relational database structures.

Semistructured decision: A decision where problems and solutions are not clear-cut and often require judgment and expertise.

Sensor: Device that can detect, record, and report changes in the physical environment.

Sentiment analysis: The analysis of semistructured and unstructured data to learn about people's thoughts, feelings, and emotions.

Sequence discovery: A data mining technique used to discover associations over time.

Server: Any computer on the network that enables access to files, databases, communications, and other services available to users of the network.

Service: An individual software component designed to perform a specific task.

Service-level agreement (SLA): A contract specifying the level of service provided in terms of performance (e.g., as measured by uptime), warranties, disaster recovery, and so on.

Service-oriented architecture (SOA): A software architecture in which business processes are broken down into individual components (or services) that are designed to achieve the desired results for the service consumer (which can be either an application, another service, or a person).

Sharing economy: An economic system in which assets or services are shared between private individuals, either free or for a fee, typically by means of the Internet.

Shifts in global economic power: Changes in countries' purchasing power and control over natural resources.

Shopping bot: *See* Buyer agent.

Shoulder surfing: Looking over one's shoulder while the person is keying in login credentials.

Showrooming: Shoppers coming into a store to evaluate the look and feel of a product and then purchasing it online or at a competitor's store.

Shrink-wrap license: A type of software license that is used primarily for consumer products; the contract is activated when the shrink wrap on the packaging has been removed.

Slicing and dicing: Analyzing data on subsets of certain dimensions.

Smart card: A special credit card-sized card containing a microprocessor chip, memory circuits, and often a magnetic stripe.

Smart home technologies: Technologies enabling the remote monitoring and controlling of lighting, heating, or home appliances.

Social bookmarking: The sharing and categorization of Internet content by Internet users.

Social cataloging: The creation of categorizations by Internet users.

Social commerce: Leveraging visitors' social networks in e-commerce interactions to build lasting relationships, advertise products, or otherwise create value.

Social CRM: The use of social media for customer relationship management.

Social engineering: Misrepresenting oneself to trick others into revealing information.

Social intranet: A type of intranet that incorporates social components, allowing every user to create content and to easily connect with other content creators.

Social media: Web-based applications embodying core web 2.0 values such as collaboration and social sharing, allowing people to communicate, interact, and collaborate in various ways.

Social media monitoring: The process of identifying and assessing the volume and sentiment of what is being said in social media about a company, individual, product, or brand.

Social network analysis: A technique that maps people's contacts to discover connections or missing links (sometimes called structural holes) within the organization.

Social networking: Connecting to colleagues, family members, or friends for business or entertainment purposes.

Social online community: A community within a social network.

Social search: A search functionality that attempts to increase the relevance of search results by including content from social networks, blogs, or microblogging services.

Social software: *See* Social media.

Software: A program (or set of programs) that instructs the computer to perform certain processing functions.

Software as a service (SaaS): A cloud computing model in which a service provider offers applications via a cloud infrastructure.

Software asset management (SAM): A set of activities performed to better manage an organization's software infrastructure by helping to consolidate and standardize software titles, decide when to retire unused software, or decide when to upgrade or replace software.

Software bug: An error or flaw in a computer program or system that causes it to produce an incorrect or unexpected result or to behave in unintended ways.

Software piracy: A type of computer crime where individuals make illegal copies of software protected by copyright laws.

Solid-state drive (SSD): A secondary storage technology using flash memory to store data.

SoLoMo: The integration of social, local, and mobile services.

Source code: A computer program's code written in a programming language.

Spam: Electronic junk mail.

Spam filter: A hardware or software device used to fight spam and other e-mail threats, such as directory harvest attacks, phishing attacks, viruses, and more.

Spear phishing: A sophisticated fraudulent e-mail attack that targets a specific person or organization by personalizing the message in order to make the message appear as if it is from a trusted source, such as an individual within the recipient's company, a government entity, or a well-known company.

Speech recognition: The process of converting spoken words into commands and data.

Sponsored search: *See* Search advertising.

Spyware: Software that covertly gathers information about a user through an Internet connection without the user's knowledge.

Standalone application: A system that focuses on the specific needs of an individual department and is not designed to communicate with other systems in the organization.

Star network: A network with several workstations connected to a central hub.

Startup: Technology-based new venture with high potential for scalability and growth.

Stickiness: A website's ability to attract and keep visitors.

Strategic: A way of thinking in which plans are made to accomplish specific long-term goals.

Strategic necessity: Something an organization must do in order to survive.

Strategic planning: The process of forming a vision of where the organization needs to head, converting that vision into measurable objectives and performance targets, and crafting a plan to achieve the desired results.

Streaming audio: Audio data streams, transmitted via specific protocols, that are available for immediate playback on the recipient's computer.

Streaming media: An umbrella term for streaming audio and streaming video.

Streaming video: Video data streams, transmitted via specific protocols, that are available for immediate playback on the recipient's computer.

Structural firmness: A web page's characteristics related to security and performance.

Structured data: Data (such as transaction data) that fit neatly into spreadsheets or databases.

Structured decision: A decision where the procedures to follow for a given situation can be specified in advance.

Structured Query Language (SQL): The most common language used to interface with databases.

Stuxnet: A computer worm designed to find and infect a particular piece of industrial hardware; used in an attack against Iranian nuclear plants.

Supercomputer: The most expensive and most powerful category of computers. It is primarily used to assist in solving massive research and scientific problems.

Supplier portal: A subset of an organization's extranet designed to automate the business processes that occur before, during, and after sales transactions between a single buyer and multiple suppliers. Also referred to as a "sourcing portal" or "procurement portal."

Supply chain: The collection of companies and processes involved in moving a product from the suppliers of raw materials, to the suppliers of intermediate components, to final production, and ultimately to the customer.

Supply chain analytics: The use of key performance indicators to monitor performance of the entire supply chain, including sourcing, planning, production, and distribution.

Supply chain effectiveness: The extent to which a company's supply chain activities meet the requirements of the partners, customers, suppliers, or vendors involved.

Supply chain efficiency: The extent to which a company optimizes the use of resources in its supply chain activities.

Supply chain execution: The execution of supply chain planning, involving the management of product flows, information flows, and financial flows.

Supply chain management (SCM) system: Information system focusing on improving upstream information flows with two main objectives—to accelerate product development and to reduce costs associated with procuring raw materials, components, and services from suppliers.

Supply chain planning: The process of developing various resource plans to support the efficient and effective production of goods and services.

Supply chain visibility: The ability to track products as they move through the supply chain and to foresee external events.

Supply network: The network of multiple (sometimes interrelated) producers of supplies that a company uses.

Support activities: Business activities that enable the primary activities to take place. Support activities include administrative activities, infrastructure, human resources, technology development, and procurement.

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Switch: A device used to connect multiple computers, servers, or printers to create a network.

Symmetric digital subscriber line (SDSL): A variant of DSL that supports the same data rates for upstream and downstream traffic.

Symmetric encryption: An encryption method that uses the same key to encode and decode a message, thus requiring a secure channel to share the key between the sending and receiving party.

Synchronous: Coordinated in time.

System clock: An electronic circuit inside a computer that generates pulses at a rapid rate for setting the pace of processing events.

System conversion: The process of decommissioning the current system and installing a new system in an organization.

System software: The collection of programs that controls the basic operations of computer hardware.

Systems analysis: The second phase of the systems development life cycle, in which the current ways of doing business are studied and alternative replacement systems are proposed.

Systems analysis and design: The process of designing, building, and maintaining information systems.

Systems analyst: The primary person responsible for performing systems analysis and design activities.

Systems benchmarking: The use of standardized performance tests to compare different systems.

Systems design: The third phase of the systems development life cycle, in which details of the chosen approach are developed.

Systems development controls: Systems development processes and procedures used to ensure that necessary security features are implemented and enabled and that proper change management processes are followed.

Systems development life cycle (SDLC): A model describing the life of an information system from conception to retirement.

Systems implementation: The fourth phase of the systems development life cycle in which the information system is programmed, tested, installed, and supported.

Systems integration: Linking together different computing systems and software applications physically or functionally to act as a coordinated whole.

Systems maintenance: The process of systematically repairing and/or improving an information system.

Systems planning and selection: The first phase of the systems development life cycle, in which potential projects are identified, selected, and planned.

T1 line: A dedicated digital transmission line that can carry 1.544 Mbps of data.

T3 line: A dedicated digital transmission line that can carry about 45 Mbps of data.

Table: A collection of related records in a database where each row is a record and each column is an attribute.

Tacit knowledge assets: Knowledge assets that reflect the processes and procedures located in employees' minds.

Tag: *noun:* metadata assigned to digital media or other content. *verb:* to add metadata to digital content.

Tag cloud: A way to visualize user-generated tags or content on a site, where the size of a word represents its importance or frequency.

Tangible benefit: A benefit of using a particular system or technology that is quantifiable.

Tangible cost: A cost of using a particular system of technology that is quantifiable.

Tape: A removable, high-capacity, secondary storage medium allowing only for sequential access; typically used for archiving data.

TCP: Part of TCP/IP that is responsible for breaking down a message into smaller packets, creating a connection between two computers, and ensuring that data are reliably transmitted and arrive in the correct sequence.

Telecommunications network: A group of two or more computer systems linked together with communications equipment.

Terminal: A local input device used to enter data into mainframes in centralized computing systems.

Text mining: Analytical techniques for extracting information from textual documents.

Text recognition software: Software designed to convert handwritten text into computer-based characters.

Thin client: A microcomputer with minimal memory, storage, and processing capabilities, used for remotely accessing virtual desktops.

Threat: An undesirable event that can cause harm.

3D printing: Technology for creating physical three-dimensional objects from digital models.

Time bomb: A type of computer virus that lies in wait for a specific date before executing its instructions.

Top-level domain: A URL's suffix (i.e., .com, .edu, or .org) representing the highest level of Internet domain names in the domain name system.

Total cost of ownership (TCO): The cost of owning and operating a system, including the total cost of acquisition, as well as all costs associated with its ongoing use and maintenance.

Touch screen: A touch-sensitive computer display used as an input device.

Transaction: Any event, such as the exchange of goods or services for money, that occurs as part of daily business of which an organization must keep a record.

Transaction processing system (TPS): An information system designed to process day-to-day business-event data at the operational level of the organization.

Transmission Control Protocol/Internet Protocol (TCP/IP): The protocol of the Internet, which allows different interconnected networks to communicate using the same language.

Transmission media: The physical pathways to send data and information between two or more entities on a network.

Trending: A word phrase or topic that is tagged at a greater rate than others.

Trojan horse: A program that appears to be a legitimate, benign program, but carries a destructive payload. Trojan horses typically do not replicate themselves.

Tunneling: A technology used by VPNs to encapsulate, encrypt, and securely transmit data over the public Internet infrastructure, enabling business partners to exchange confidential data in a secured, private manner between organizational networks.

Two-factor authentication: The use of two types of credentials to confirm one's identity.

Unauthorized access: An information systems security breach where an unauthorized individual sees, manipulates, or otherwise handles data.

Unauthorized data modification: The intentional change of electronic data by unauthorized users.

Unicode: Character encoding method for representing characters and scripts beyond the Latin alphabet, including Chinese, Cyrillic, Hebrew, and Arabic.

Uniform Resource Locator (URL): The unique Internet address for a website and specific web pages within sites.

Unstructured data: Data (such as audio and video data, comments on social networks, and so on) that do not have any identifiable structure.

Unstructured decision: A decision where few or no procedures to follow for a given situation can be specified in advance.

Upstream information flow: An information flow consisting of information received from another organization, such as from a supplier.

Urbanization: The movement of rural populations to urban areas.

Usability: A system's quality of being easy to use and aesthetically pleasing.

User agent: An intelligent agent that automatically performs specific tasks for a user, such as automatically sending a report at the first of the month, assembling customized news, or filling out a web form with routine information.

User-generated content: Content (such as text or media) that is generated by users (typically on social media sites).

Utilities: *See* Utility programs.

Utility computing: A form of on-demand computing where resources in terms of processing, data storage, or networking are rented on an as-needed basis. The organization only pays for the services used.

Utility program: Software designed to manage computer resources and files.

Value-added network: Private, third-party-managed WANs typically used for B2B communications, offering services such as secure e-mail and translation of EDI standards to facilitate secure communication between a business and its suppliers and/or customers.

Value chain: The set of primary and support activities in an organization where value is added to a product or service.

Value chain analysis: The process of analyzing an organization's activities to determine where value is added to products and/or services and the costs that are incurred for doing so.

Value creation: The outcome of an organization's activities that increase the worth of products or services for the customer.

Value proposition: The utility that the product/service has to offer to customers.

Value system: A collection of interlocking company value chains.

Vanilla version: The features and modules that a packaged software system comes with out of the box.

Vendor-managed inventory (VMI): A business model in which the suppliers to a manufacturer (or retailer) manage the manufacturer's (or retailer's) inventory levels based on negotiated service levels.

Vertical market: A market comprised of firms within a specific industry sector.

Video: Still and moving images that can be recorded, manipulated, and displayed on a computer.

Videoconferencing over IP: The use of Internet technologies for videoconferences.

Viral marketing: A type of marketing that resembles offline word-of-mouth communication in which advertising messages are spread similar to how real viruses are transmitted through offline social networks.

Virtual company: *See* Click-only business strategy.

Virtual meeting: A meeting taking place using an online environment.

Virtual private network (VPN): A network connection that is constructed dynamically within an existing network—often called a "secure tunnel"—in order to securely connect remote users or nodes to an organization's network.

Virtual team: A work team that is composed of members who may be from different organizations and different locations that forms and disbands as needed.

Virtual reality (VR) headset: Head-mounted device enabling immersive three-dimensional experiences.

Virus: A destructive program that disrupts the normal functioning of computer systems.

Virus prevention: A set of activities designed to detect and prevent computer viruses.

Visual analytics: The combination of various analysis techniques and interactive visualizations to solve complex problems.

Visual data discovery: *See* Visual analytics.

Visual programming language: A programming language that has a graphical user interface (GUI) for the programmer and is designed for programming applications that will have a GUI.

Visualization: The display of complex data relationships using a variety of graphical methods.

Voice over IP (VoIP): The use of Internet technologies for placing telephone calls.

Voice-to-text software: An application that uses a microphone to monitor a person's speech and then converts the speech into text.

Volatile memory: Memory that loses its contents when the power is turned off.

Volume license: *See* Enterprise license.

Vulnerability: A weaknesses in an organization's systems or security policies that can be exploited to cause damage.

Vulnerability scanners: Software programs that automatically test targeted systems for weaknesses.

Warez: A slang term for stolen proprietary software that is sold or shared for free over the Internet.

Watermark: A digital or physical mark that is difficult to reproduce; used to prevent counterfeiting or to trace illegal copies to the original purchaser.

Wearable technologies: Clothing or accessories, such as smart watches or fitness trackers, that incorporate information technologies.

Web 2.0: A term used to describe dynamic web applications that allow people to collaborate and share information online.

Web analytics: The analysis of web use's behavior in order to improve a site's performance.

Web browser: A software application that can be used to access and display web pages including text, graphics, and multimedia content.

Web content mining: Extracting textual information from web documents.

Web crawler: An intelligent agent that continuously browses the web for specific content (e.g., used by search engines). Also known as a "web spider."

Web page: A hypertext document stored on a web server that contains not only content, but also references or links to other documents that contain related content.

Web page builder: A program for assisting in the creation and maintenance of web pages.

Web server: A computer used to host websites.

Website: A collection of interlinked web pages typically belonging to the same person or business organization.

Web spider: *See* Web crawler.

Web usage mining: An analysis of a website's usage patterns, such as navigational paths or time spent.

Web vandalism: The act of defacing websites.

Webcam: A small camera that is used to transmit real-time video images within desktop videoconferencing systems.

Webcast: *noun:* a digital media stream that can be distributed to and played by digital media players. *verb:* to create and publish webcasts.

Weighted multicriteria analysis: A method for deciding among different information systems investments or alternative designs for a given system in which requirements and constraints are weighted on the basis of their importance.

What-if analysis: An analysis of the effects hypothetical changes to data have on the results.

Wide area network (WAN): A computer network that spans a relatively large geographic area; typically used to connect two or more LANs.

Wi-Fi network (wireless fidelity): Wireless LAN, based on the 802.11 family of standards.

Wiki: A website allowing people to create, edit, or delete content, as well as discuss article content or suggested changes with other members of the community. A wiki is linked to a database keeping a history of all prior versions and changes; therefore, a wiki allows viewing prior versions of the pages as well as reverting any changes made to the content.

WikiLeaks: An information disclosure portal where volunteers submit and analyze classified and restricted material provided by whistleblowers.

Wireless access point: A networking device that transmits and receives wireless (Wi-Fi) signals to allow wireless devices to connect to the network.

Wireless broadband: Wireless transmission technology with speeds similar to DSL and cable that requires line of sight between the sender and receiver.

Wireless controller: A networking device that manages multiple access points and can be used to manage transmission power and channel allocation to establish desired coverage throughout a building and minimize interference between individual access points.

Wireless LAN control: Methods of configuring a WLAN so that only authorized users can gain access.

Wireless local area network (WLAN): A local area network that uses a wireless transmission protocol.

Workstation: A high-performance computer that is designed for medical, engineering, or animation and graphics design uses, and is optimized for visualization and rendering of three-dimensional models.

World Wide Web (WWW): A system of Internet servers that support documents formatted in HTML, which supports links to other documents as well as graphics, audio, and video files.

Worm: A destructive computer code that is designed to copy and send itself throughout networked computers.

XaaS: "X as a service"; type of business model centered around not selling products, but providing these as services.

XML tag: Markup that is inserted into a document in order to specify how data contained in the document or a portion of the document should be interpreted and used.

Zero-day: An undisclosed hardware or software vulnerability that crackers can exploit to adversely affect computer programs, data, other computers, or networks.

Zombie computer: A virus-infected computer that can be used to launch attacks on websites.

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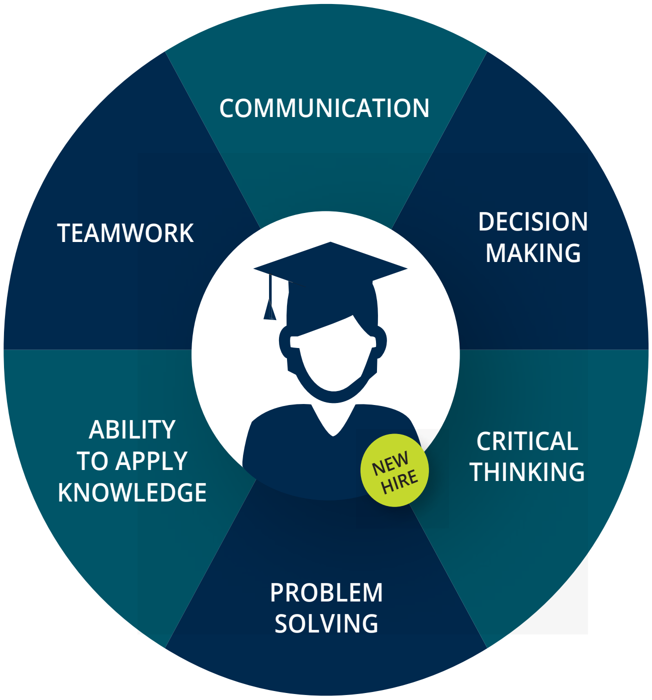
MIS: Engage, Apply, Empower



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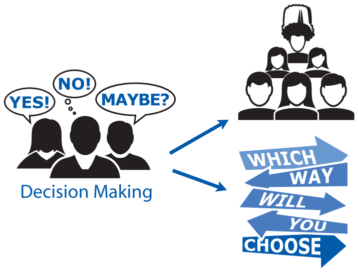

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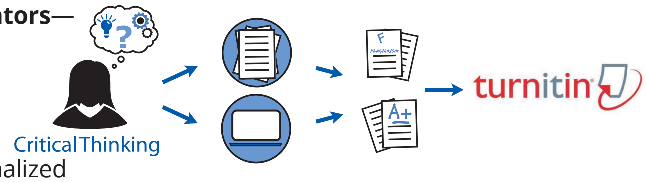

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ISBN-13: 978-0-13-463520-0
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