Information Systems Today

MANAGING IN THE DIGITAL WORLD

9e

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NINTH EDITION

INFORMATION SYSTEMS TODAY

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Dedication

To Jackie, thank you for your love and support.
—Joe

To Birgit for your love and support.
—Christoph

To my wonderful wife Allie, and my four amazing children.
—Matt

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About the Authors

Joseph (Joe) Valacich is the *Eller Professor of MIS* within the Eller College of Management at the University of Arizona and a co-founder, Chairman, and 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 start-up 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. He is the Honorary Conference Chair for ICIS 2021 in Austin, Texas.

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 technologies, and e-business. He is a prolific scholar, having published more than 250 scholarly articles in numerous prestigious journals and conferences, including *MIS Quarterly, Information Systems Research, Management Science, Academy of Management Journal, The Accounting Review, Journal of MIS, Decision Sciences, Journal of the AIS, Communications of the ACM, Organizational Behavior and Human Decision Processes, Journal of Applied Psychology,* and many others. He is a coauthor of the leading textbooks *Modern Systems Analysis and Design* (9th ed.) and *Information Systems Project Management: A Process Approach* (2nd ed.).

Dr. Valacich has multiple issued and pending patents focusing on the analysis of fine-grained human-computer interaction data to infer user intent, confidence, and emotional state. Software based on this work, commercialized by Neuro-ID, is being used by many of the world's leading online platforms, processing millions of customer interactions per month. He is a *Senior Member of the National Academy of Inventors* (2020), a *Distinguished Alumnus of the University of Montana* (2012), and a *Fellow of the Association for Information Systems* (2009). In 2016, Dr. Valacich was awarded the University of Arizona, Tech Launch Arizona, *Innovation & Impact Award* for Information Technology discovery. 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 IESE Business School in Barcelona, Spain. He previously held faculty appointments at Boise State University and City University of Hong Kong. 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 organizational transformation, the management of information systems, digital marketing, 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*. He is a coauthor of the leading textbook *Information Systems Project Management: A Process Approach* (2nd ed.).

Matthew (Matt) Hashim is an Associate Professor in the Department of Management Information Systems within the Eller College of Management at the University of Arizona. He received his PhD in Management (MIS) from Purdue University, MBA (MIS) from California State University, Fresno, and BS in MIS and Accounting from California Polytechnic State University, San Luis Obispo. Prior to pursuing his academic career, Dr. Hashim worked in both large and start-up organizations in the Silicon Valley and Central California. Students and college administrators have recognized his efforts in the classroom with several teaching awards. His teaching interests include information security, the management of information systems, and systems analysis and design.

Dr. Hashim is primarily interested in research contexts that shed light on the intersection of information security problems and human behavior. Topic areas include information privacy, digital piracy, password security, and social engineering problems. He uses methods such as experimental and behavioral economics to understand and manipulate security behaviors in these contexts. He also uses econometric techniques to explore the economic effects of information technologies. His research has been published in peer-reviewed journals such as *Information Systems Research, Journal of Management Information Systems*, and *Decision Support Systems*. His work has been presented at major conferences and workshops such as the Workshop on Experimental and Behavioral Economics in Information Systems, Workshop on Information Systems and Economics, Workshop on Information Technologies and Systems, Workshop on the Economics of Information Security, INFORMS Conference on Information Systems and Technology, and the Hawaii International Conference on System Sciences. He co-founded the Workshop on Experimental and Behavioral Economics in Information Systems and has served in various leadership roles with the INFORMS eBusiness Section.

Brief Contents

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Preface

Approach

Information systems have become *pervasive. Digital density* is increasing with more connected devices providing ever greater amounts of connected data, enabling new interactions and business models. *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 today's dynamic and highly competitive marketplace? The answer to these and many similar questions is that the increase in digital density is 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,* Ninth 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; consequently, we focus on digital density as the high-level concept that gives rise to the new and emerging technologies and phenomena we are seeing. 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,* Ninth 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, Ninth 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, Ninth 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 Ninth Edition

Our primary goal for *Information Systems Today,* Ninth Edition, was to emphasize the importance of information systems to all business students as digital density continues to increase within organizations and society. Most notably, we extensively examine how this increase in digital density is 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 the effects of increasing digital density and the API economy.
- An extensively revised chapter—Chapter 2, "Gaining Competitive Advantage Through Information Systems"—provides extended content on platform-based business models and new content describing how the lean startup approach plays 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 extended content on APIs and organizations' needs to adapt agile mindsets and approaches.
- 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 fintech, content marketing, and voice commerce.
- 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, Analytics, and Artificial Intelligence"—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 emerging concepts (such as blockchain) in supply chain management.
- A revised chapter—Chapter 9, "Developing and Acquiring Information Systems"—provides updates to various topics and extended content on prototyping and agile 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 provides an update to all topics and deeper coverage on Internet of Things 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 a new feature to each chapter—Digital Density. This element presents topics related to the increasing digital density throughout the world, highlighting opportunities as well as threats arising from this rapid change. For example, we discuss how increasing digital density can increase the digital divide and how increasing digital density can aid in contact tracing during pandemics.

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,* Ninth Edition. We hope you agree.

Key Features

As authors, teachers, developers, and managers of information systems, we understand that for students to best learn about information systems with this book, they must be motivated to learn. To this end, we have included many 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'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

NEW! DIGITAL DENSITY Increasing digital density has effects in all industries and all areas of society. Related to each chapter's content, this new feature examines topics related to increasing digital density throughout the world. The topics discussed are as follows:

- How increasing digital density amplifies the effects of the digital divide
- How information systems support the lifestyle of the digital nomads
- How digital density aids in contact tracing during pandemics
- The rise of digital payments
- Leveraging data to go SoLoMo: Yelp

- Using machine learning to outsmart superbugs
- Managing businesses on the road using mobile ERP
- Developing mobile CRM apps for customers
- Malicious software development
- Backdoors in mobile phones

GREEN IT 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 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 Internet of Things and Artificial Intelligence fuel environmental sustainability
- 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 smart cities support sustainability
- 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 prioritization of cloud services can increase efficiency

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 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 deepfakes pose a threat to society
- How companies must weigh the benefits and dangers of not updating ERP systems
- How hacking customer data can protect 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
- Augmented shopping
- How gaming PCs and grid technologies help fight diseases
- Using artificial intelligence to manage hedge funds
- Neural implants
- Emotion aware technology
- Transforming ERP and organizations using the Internet of Things
- Reducing supply chain problems using augmented reality
- Harvesting human energy
- Can we eliminate passwords?

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 social media can quickly disseminate *mis*information, with unforeseen consequences
- How the COVID-19 pandemic exposed the need for COBOL coders
- The chicken sandwich war of 2019
- How user interface design inconsistency led to suicide
- How the "heartbleed" bug almost killed the internet

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
- How Amazon is building an ecosystem of your personal data
- Using CRM systems to target or exploit consumers
- Ethical app development
- The ethics of cyberwar

INDUSTRY ANALYSIS Every industry is being transformed by the effects of increasing digital density. 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. 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 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 and later faded into obscurity
- 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,* Ninth 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.

[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).

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 increasing digital density influences 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, and how the lean startup methodology can help organizations deal with a rapidly increasing number of nimble competitors.
- ***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 and successfully building new business models. 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, Dell, or Taobao; governments; financial services providers; and fintech 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 fintech developments 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 enhance communication, collaboration, cooperation, and connection not only 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, Analytics, and Artificial Intelligence***—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, and how emergent technologies have the potential to transform how supply chains are managed. 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 agile development approaches can help organizations become more nimble in developing systems when requirements are unclear and rapidly changing. 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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media supplements that accompany this text. Visit https://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:

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1 Managing in the Digital World

Preview

In the past decades, technology has progressed tremendously, and the digital connection of people, things, and organizations has accelerated exponentially. Not only has this increasing digital density helped organizations from Apple to Zappos to better manage their organizations, provide high-quality goods and services, or gain or sustain competitive advantage over rivals, it has also contributed to tremendous changes in all areas of society. 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 increasing digital density 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 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

After 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 how increasing digital density is 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.**

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 implemented over the years. 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, creating more convenient packaging, and even accelerating ideas for bringing new products to market. Open innovation has also linked experts across industries and disciplines to tackle the urgent health challenges of the day such as fighting COVID-19. 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 way of innovating would not be possible without information systems.

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

1. How does increasing digital density fuel open innovation?

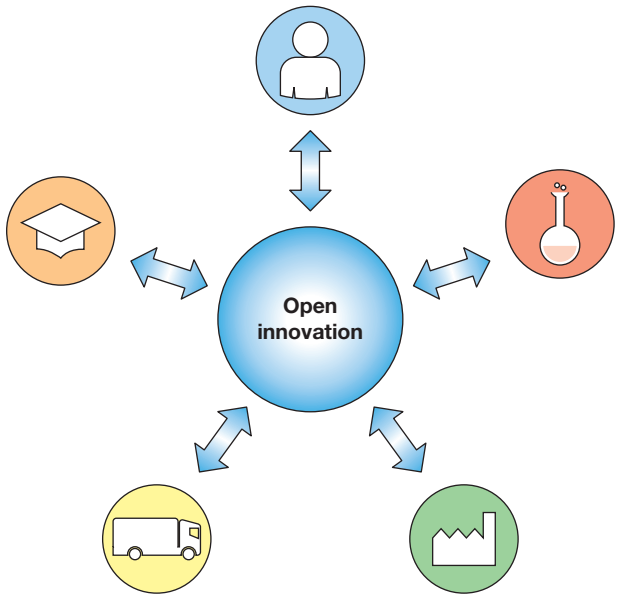

FIGURE 1.1

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

2. What are the primary information systems components that enable open innovation?

3. What intellectual property issues arise from engaging in open innovation?

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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* (summaries of business's strategic directions that outline how the objectives will be achieved), 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 email, Twitter, or other social media 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 email and many other tasks. Your paychecks are probably generated by computer and automatically deposited into your bank account via high-speed networks. Even (and especially) in your spare time, information systems are ubiquitous: You use social networking sites like Facebook or TikTok 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 emails, navigating through your city, purchasing concert tickets, 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 workers no matter where they are located.

Clearly, we are living in a digital world. With the proliferation of mobile devices—such as tablets or smartphones—and the possibility to connect *things*—ranging from tennis shoes to wind turbines—we are now living in the post-PC era, where connected devices are replacing 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 (Nielsen, 2016). Initially created as consumer devices, tablets are now commonplace in various professional settings, including warehouses, showrooms, airplane cockpits, and hospitals (Figure 1.2). Devices with newer form factors 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 have 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 in the past, people were bound to a stationary PC to do essential tasks, they are not bound to any particular location any more. 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 emails) 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 providing new benefits and services, and to encompass various social and casual activities. Devices such as smartphones or tablets, paired with mobile broadband networks, allow for instant-on

FIGURE 1.2

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

computing experiences, whenever and wherever; advances in *cloud computing* (think Gmail, Office 365, or Dropbox) allow for accessing emails, 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 email, 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.

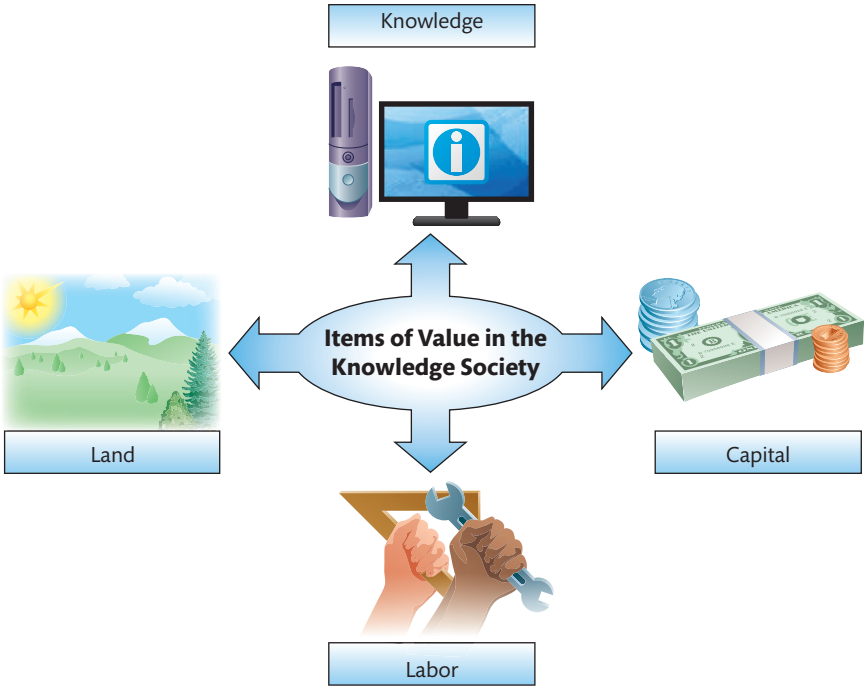
KNOWLEDGE WORKERS AND THE KNOWLEDGE SOCIETY. In 1959, Peter Drucker predicted that information and information systems would become increasingly important, and at that point, more than 60 years ago, he coined the term **knowledge worker**. Knowledge workers are typically professionals who are relatively 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 (2018 data) reinforce the value of a college education: Median earnings for workers 25 and over with a bachelor's degree were US$50,515 a year, while those for workers with a high school diploma were US$27,868. Median earnings for workers with a graduate or professional degree were US$66,944, and for those without a high school diploma US$19,954. 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. Additionally, getting a college degree will qualify you for many jobs that would not

FIGURE 1.3

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



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. While now almost every worker can be considered a knowledge worker, workers of the future need to become *learning workers*, as not the knowledge itself, but the knowledge of how to learn will be of primary importance.

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 (32–256 GB). The quartz material is highly stable (up to 13.8 billion years at room temperature and can survive a maximum of 1,000 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, ensuring that evidence of our past will live forever. As a first test of preserving our history, SpaceX has already launched a copy of Asimov's *Foundation* on 5D storage to space, riding co-pilot with Elon Musk's Starman.

Based on:

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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 many countries, 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 technology has also facilitated an increase in authoritarianism and restrictions on free flow of communication and content on the internet, such as on the popular social media WeChat and TikTok). 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. 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:

- 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: humphery/Shutterstock.

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 must 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 must 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, with an estimated market size of US$85.6 billion in 2018 (Kachkovska, 2019).

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, 2020; Schreiber, 2018). 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 related to factors such as 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 continue to 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, 2020); 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 their dominating positions in the world's economy, resulting

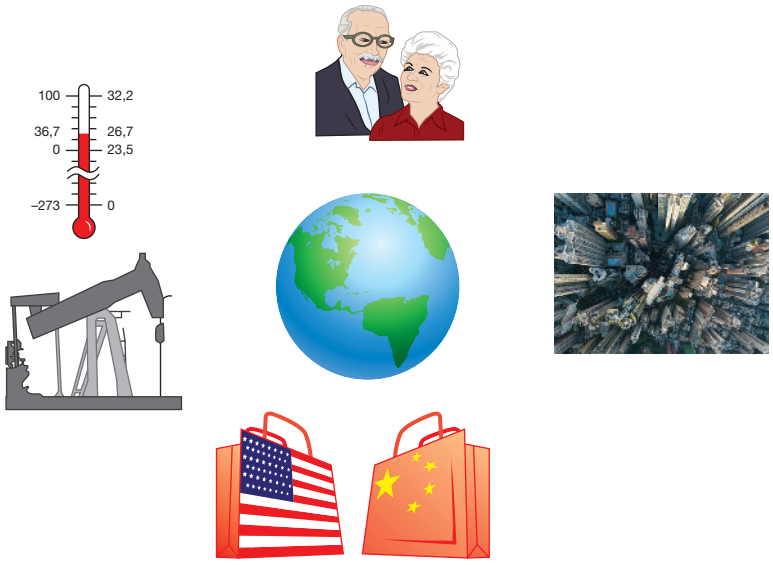


FIGURE 1.5

Societal issues in the digital world.

Source: Bigone/Shutterstock.

in the need to resolve political struggles (PWC, 2020). Many of these issues interact, affect each other, and/or fuel other issues, such as those 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 many 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 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 (e.g., as Uber has wreaked havoc on the taxi industry) but can also help address pressing societal issues. Next, we will discuss how increasing digital density shapes the digital future.

Digital Density and 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"). 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. In essence, we are seeing an exponential increase in **digital density** (i.e., the amount of connected data per unit of activity) (Zamora, 2017), in that every unit of activity generates ever more connected data, enabling new value-added interactions and business models (Figure 1.6).

THE DRIVERS OF DIGITAL DENSITY. Understanding the effects of increasing digital density will be increasingly important: Individuals will increasingly feel the impact 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. Next, we will discuss connections and data, the essential drivers of digital density.

Connections. In the past, connections were between people, between organizations, or between computers; today, it is possible to connect just about *any* element of the physical world—people, organizations, or things—to the digital realm (Zamora, 2017). A key enabler of increasing connections is the move toward mobile devices, as indicated in the opening section of this chapter. In developed countries, most 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

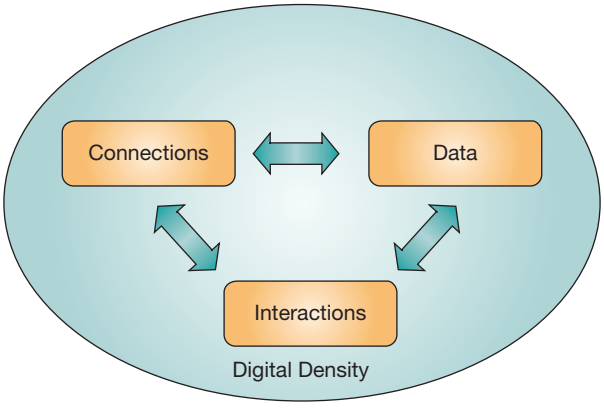


FIGURE 1.6
Increasing digital density enables new value-added interactions and business models.

DIGITAL DENSITY

Technology (Not) Included

With increasing digital density in all aspects of our lives, there is one core element that we increasingly tend to take for granted—access to technology. The threat of the COVID-19 pandemic showed us all that this requirement is not a given. Besides the obvious health and economic consequences from shutting down the world to limit the spread of disease, other technology-related consequences manifested because of the digital divide. Across the world, less than 55 percent of the population has internet access, and in the U.S., households earning less than US$30,000 are much less likely to have access than wealthier families. Yet increasingly, technology is required to engage in today's workforce, work from home, and have access to education. How can an employee be expected to work remotely if they do not own a personal computer or have access to broadband? How can our children participate in remote learning? In some cases, employers issue technology resources to address these questions about access, but that is certainly not guaranteed. Regarding remote learning, some school districts have the financial resources to provide children with computers, but families again face the issue of being able to afford internet access.

Besides lack of or limited daily access to technology for creating the connections and data required for digital density, less obvious consequences arise regarding routine healthcare visits. Infectious diseases such as COVID-19 require the implementation of social distancing and isolation measures. With social distancing comes a rise in telemedicine so that patients can interact with their physicians without unnecessary exposure to contagion for either the patient or the medical provider. Therefore, it is not surprising that underserved communities, already suffering from a digital divide, see that divide further manifest in difficulty accessing healthcare. According to Cleveland, Ohio physician Dr. Harwell, "when you need telemedicine everywhere, you see a vulnerable population that doesn't have the means to use it." Patients struggle with assumed simple tasks like using Wi-Fi or joining a Zoom session. So, the question remains, how do we as a society bridge the digital divide before the next inevitable pandemic?

Based on:

Holpuch, A. (2020, April 13). US's digital divide 'is going to kill people' as COVID-19 exposes inequalities. *The Guardian.* Retrieved July 8, 2020, from https://www.theguardian.com/world/2020/apr/13/coronavirus-covid-19-exposes-cracks-us-digital-divide

Renault, M. (2020, June 8). When health care moves online, many patients are left behind. *Wired.* Retrieved July 9, 2020, from https://www.wired.com/story/health-care-online-patients-left-behind

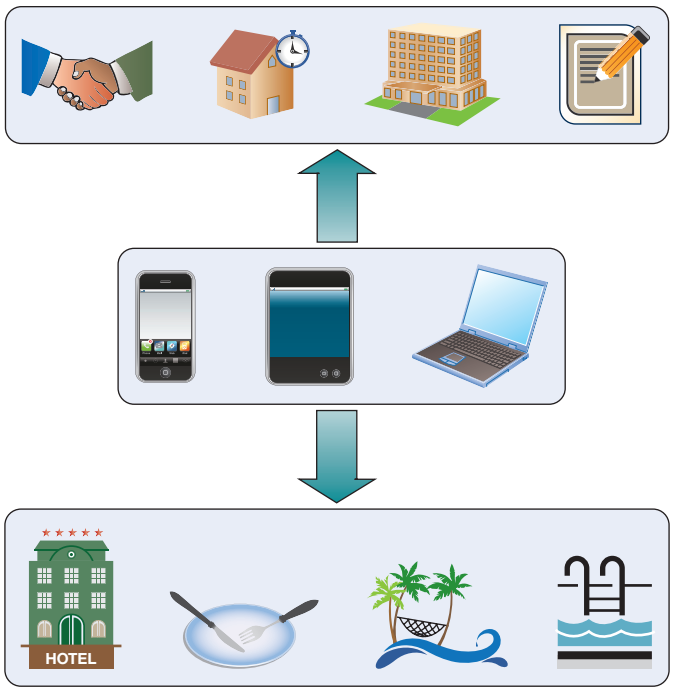
Sadeque, S. (2020, May 8). COVID-19: the digital divide grows wider amid global lockdown. *Inter Press Service.* Retrieved July 8, 2020, from http://www.ipsnews.net/2020/05/covid-19-digital-divide-grows-wider-amid-global-lockdown

Samms, G. (2020, April 2). As cities face COVID-19, the digital divide becomes more acute. *Forbes.* Retrieved July 8, 2020, from https://www.forbes.com/sites/pikeresearch/2020/04/02/as-cities-face-covid-19-the-digital-divide-becomes-more-acute

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). For organizations, it is now essential to create mobile-device-friendly versions of their websites or mobile **apps** (software programs designed to perform a particular, well-defined function) to market their products or services; customers' interactions with companies happen less during well-defined sessions using a laptop or desktop PC, but rather are increasingly driven by **micro-moments**, during which a person almost instinctively picks up a mobile device to accomplish a particular goal—to buy something, know something, do something, or go somewhere. 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 email 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

FIGURE 1.7

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



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 must 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.

In addition to an increase in mobile devices, the **Internet of Things (IoT)**—a network of a broad range of physical objects that can automatically share data over the internet—is a key factor in increasing digital density. 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 will be equipped with sensors and wireless radios to connect to other devices or the cloud (Figure 1.8). 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$140 billion by 2023. **Wearable technologies**—clothing or accessories that incorporate electronic technologies, such as 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. Cardiac monitors can alert physicians of patients' health risks. In public spaces, sensors integrated in a road's surface can monitor temperatures and trigger dynamic speed limits in case there is the risk of ice or

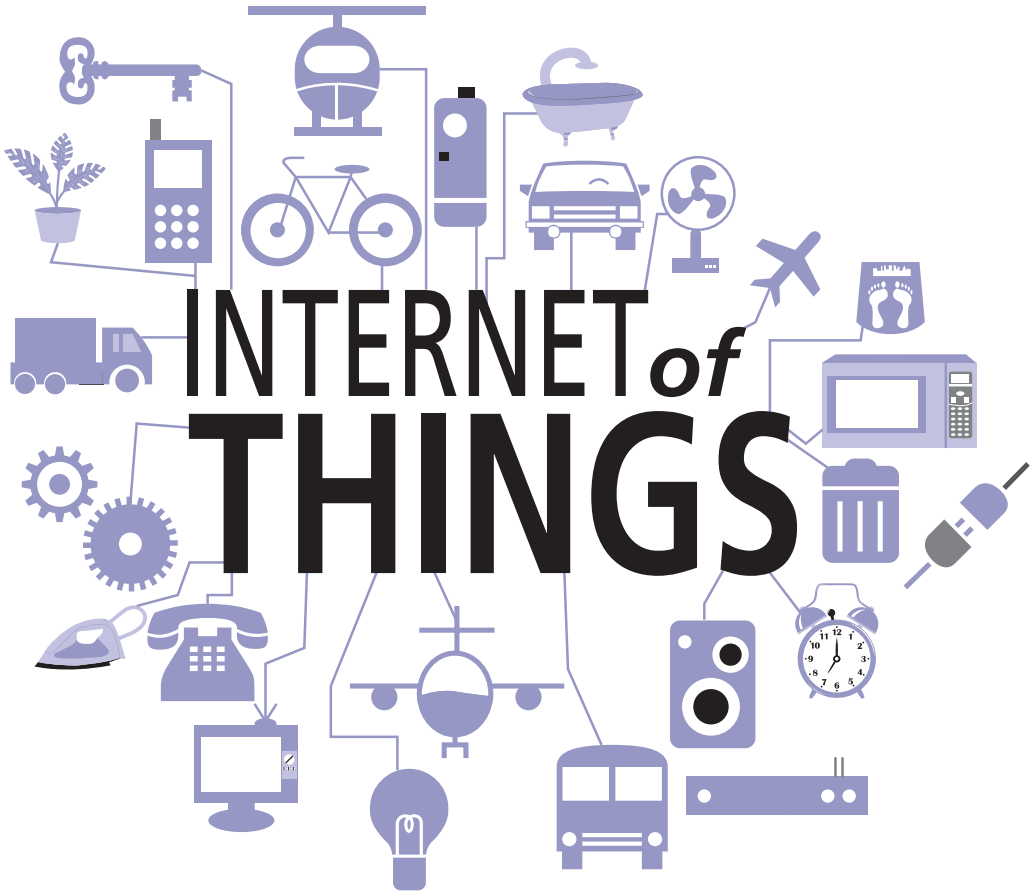


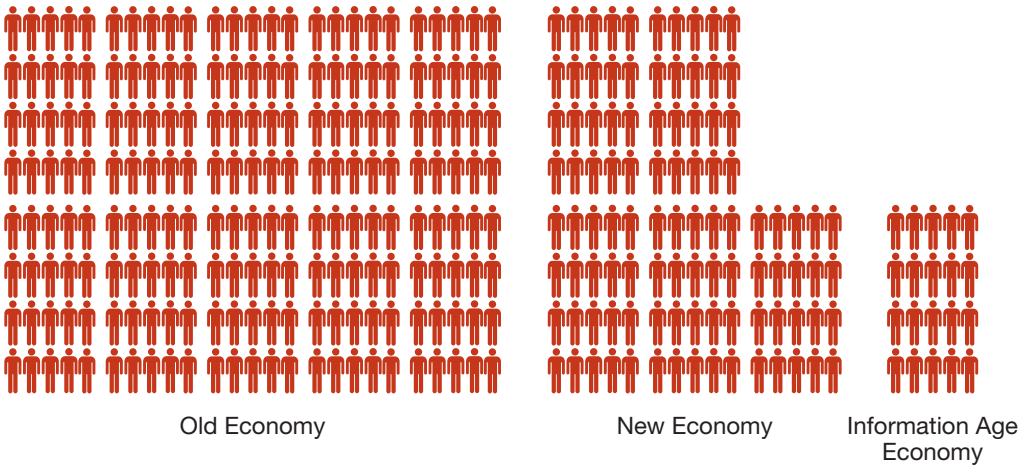
FIGURE 1.8
The Internet of Things.

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. 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.

Data. The ability to connect elements of the physical to the digital world has generated tremendous amounts of **Big Data**. Big Data is 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 and are generating and collecting ever more data from internal and external sources. In addition, 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. With decreasing costs for capturing and storing data, data are now not only ubiquitous but also cheap, with many organizations using *cloud computing* (see Chapter 3, "Managing the Information Systems Infrastructure and Services") to store data and maintain their information systems infrastructure. Further, cloud computing can enable advanced analytics of massive amounts of Big Data generated by mobile devices, sensors, or users of social networks. A study by research

FIGURE 1.9

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



firm IDC estimated that by 2025, the world's data will have grown to 175 zettabytes. How much is 175 zettabytes? Well, 175 zettabytes equal 175 trillion gigabytes, or the equivalent of 350 billion 512GB iPads.

Interactions. Together, increasing connections and data enable new value-added interactions and business models. 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 Airbnb, Facebook, or Twitter) have risen to the top with a mere 5,000–15,000 employees by creating value from data (Hofmann, 2011) (Figure 1.9). 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. For example, Big Data is a key factor enabling research ranging from genomics to climate change. However, analyzing enormous amounts of (often unstructured) data (i.e., Big Data) poses tremendous challenges for organizations.

Continuous input from various sensors, paired with **artificial intelligence** (AI; i.e., using information technologies to simulate human intelligence) to make sense of such Big Data streams, enables advances in **robotics** (i.e., the use of robots to perform manual tasks). The increase of connections and data has also enabled various business model innovations that disrupt established industries, and connected data has become a core aspect of many organizations' business models. For example, benefiting from 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—Uber and Airbnb are examples of innovative business models that disrupt traditional industries. 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. Whereas traditionally, data and information systems were used primarily to enhance efficiency, increasingly connected data allow for anticipating changes, improving coordination of resources, and personalizing product or service offerings (Zamora, 2017).

THE API ECONOMY. One of the key drivers of continuous innovations and new business models has been the rise of **APIs (application programming interfaces)**, which are intermediaries that provide ways for different components of software to interact and exchange data or functionality using common web communication protocols. Through APIs, a website or service provider can make parts of its functionality or data available for others to use without the need for users

to have intimate knowledge about the provider's inner workings. Think of an API just like a power socket in your home or apartment. The power socket is an interface that allows you to receive services (electricity) from a service provider (the electric utility); the power socket has a standardized format in terms of the input (i.e., the plug format) and output (the voltage and frequency). As a service user, you do not need to know how the electricity is produced or how it is delivered to you so that you can charge your smartphone.

The business value of APIs is twofold: Organizations providing the APIs can create new revenue streams and increase the accessibility of its services, whereas users of the APIs can utilize the functionality to offer value-added services. APIs have become both commonplace and important in today's digital interactions, such that some argue that we are in an "API economy." In fact, the cloud services company Akamai estimated that whereas in 2014, API traffic had accounted for 47 percent of all data traffic, in 2018, this had jumped to 83 percent with HTML (website) traffic having only accounted for 17 percent One example of a successful company using APIs is the payment platform Stripe, which handles online payments for companies ranging from Target to Lyft. Stripe processes payments using its highly reliable and secure internal systems and makes these payment processing services available to others through a variety of APIs. Companies such as Lyft can connect their system to Stripe's API and focus on their core competencies while making payments appear seamless. If Stripe needs to make any changes to its internal systems, this happens behind the scenes, such that the API remains unchanged, and the API users typically will not even notice that anything has changed. The use of APIs has enabled Stripe to quickly expand and to become one of the most successful payment processing services.

Likewise, Lyft uses Google Map's API to integrate mapping functionality into their app to visualize riders and available vehicles. The proliferation of APIs has enabled numerous successful startups, who draw on various APIs to scale quickly and provide innovative services to their customers; as building an entire app would have taken too long to build, Uber built almost their entire app around APIs provided by other companies (further, it would have been close to impossible to develop functionality that matches Google's mapping services). The use of APIs, however, is not limited to startups. Traditional companies make heavy use of APIs to extend their service offerings. For example, Expedia offers APIs allowing hotels to connect to Expedia's systems, and banks use APIs to collaborate with fintech startups to provide value-added services or to allow organizations to connect their information systems to the bank and access a variety of transaction data or process transactions. Together, the use of APIs enables companies to focus on what they do best, while drawing on services and functionalities offered by others.

DIGITAL DENSITY AND TODAY'S WORKFORCE. While increasing digital density opens up an almost unlimited potential for innovative products, services, or processes, it also poses 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 increasing digital density. What does increasing digital density 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 fact, today there are few occupations where computers are not somehow in use. Information systems are used to manage air traffic, perform medical tests, monitor investment portfolios, control construction machinery, and more. Engineers, architects, interior designers, and artists

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 is 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. Not only are new computing resources designed for low power consumption, but 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. Farmers know exactly how much water, sun, and fertilizer their crops have received, and 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:
Pinola, M. (2019, June 24). A guide to green IT and green technology. *Lifewire.com*. Retrieved May 13, 2020, from https://www.lifewire.com/what-is-green-it-2377417

Ravindra, S. (2020, January 3). IoT applications in agriculture. The demand for growing population can be successfully met with IoT. *IoTforall.com*. Retrieved May 13, 2020, from https://www.iotforall.com/iot-applications-in-agriculture

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**, that is, information systems that support various healthcare processes, ranging from patient diagnosis and treatment to analyzing patient and disease data to running doctors' offices and hospitals (see Chapter 6, "Enhancing Business Intelligence Using Big Data, Analytics, and Artificial Intelligence"). Not only do we use information systems 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 email, surf the internet, purchase products, and play games on them. With the increasing use of information systems 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

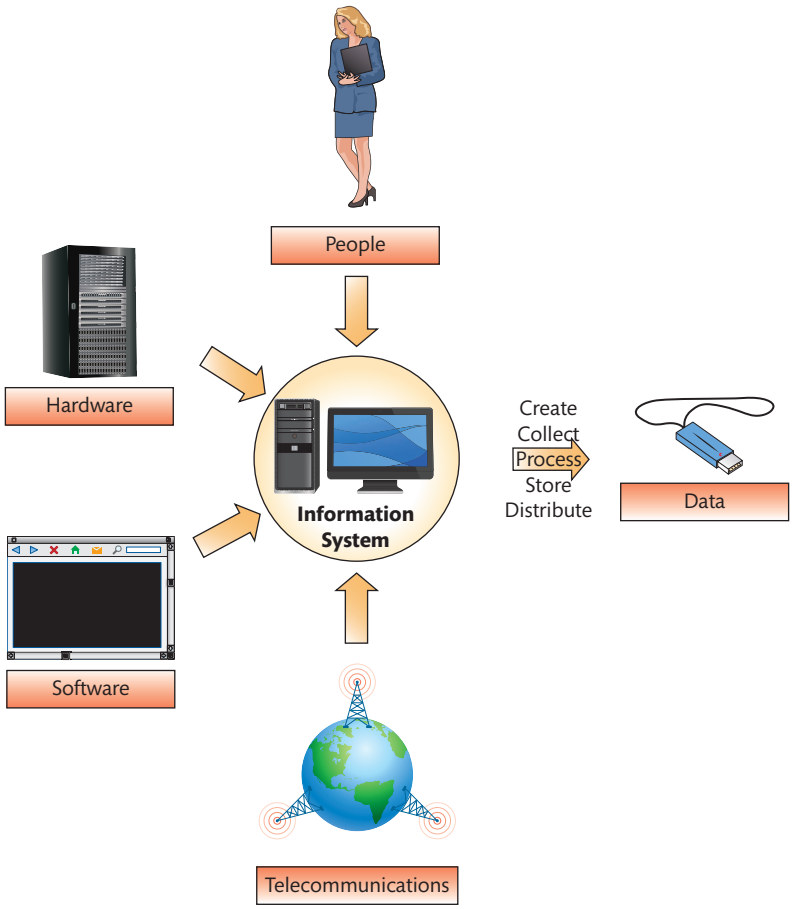


FIGURE 1.10

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

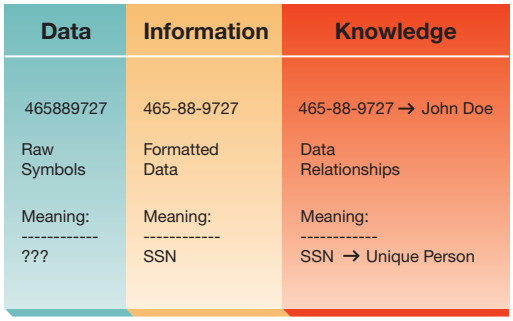
tell the computer to perform certain tasks. Telecommunications networks refer to a group of two or more computer systems linked together with communications equipment. Although we discuss the design, implementation, use, and implications of hardware, software, and telecommunications throughout the text, 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 do not 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 1.10, 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 1.11

Data, information, and knowledge.



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 1.11). 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 make them *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 1.11). 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. 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 1.11). 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, 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 and discover new ways of using information systems for gaining competitive advantage. 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 *Occupational Outlook Handbook* published by the U.S. Bureau of Labor Statistics (2020a) predicted that employment for computer and IS managers will grow 11 percent through 2028, much faster than the average for all other occupations (https://www.bls.gov/ooh/management/computer-and-information-systems-managers.htm). As more and more organizations rely increasingly heavily on IS professionals, this boost in employment will occur in nearly every industry, not just computer hardware and software companies. Among the 50 best jobs in America ranked by the job site Glassdoor, six of the top ten jobs (and one third of the top jobs overall) were IS related (see Table 1.1). *Money* magazine (http://money.cnn.com/pf/best-jobs) ranked mobile app developer as the best job in America, with information assurance analyst and data analyst also being among the top 10 best jobs in America; *U.S. News* magazine (http://money.usnews.com/careers/best-jobs/rankings/the-100-best-jobs) rated software developer and IT manager among the top 20 jobs as well as the data science-related jobs statistician, mathematician, and operations research analyst (together, these are the only nonmedical jobs in that list).

TABLE 1.1 Best Jobs in America (2020)

Rank	Career	Job Score (out of 5.0)	Median Pay (in US$)
1	Front end engineer	3.9	105,000
2	Java developer	3.9	84,000
3	Data scientist	4.0	108,000
4	Product manager	3.8	118,000
5	DevOps engineer	3.9	107,000
6	Data engineer	3.9	102,000
7	Software engineer	3.6	106,000
8	Speech language pathologist	3.8	72,000
9	Strategy manager	4.3	133,000
10	Business development manager	4.1	78,000

Source: Based on 50 Best Jobs in America for 2020, published by Glassdoor (2020).

Likewise, a degree in information systems can provide the foundation for becoming a data scientist, currently one of the jobs with highest demand (Heltzel, 2019). Whereas the rankings differ, it is clear that many professions related to data and information systems remain in high demand and will likely do so for the foreseeable future.

In addition to an ample supply of jobs, earnings for IS professionals will remain strong. According to the U.S. Bureau of Labor Statistics (2020b), median annual earnings of these managers in May 2019 were US$146,360, with the top 10 percent earning more than US$208,000. Also, according to Salary.com, the median salary in 2020 for IT managers was US$122,220. According to a 2019 report by the National Association of Colleges and Employers, management information systems was expected to be the highest-paid business major, with a mean starting salary of US$61,697. Likewise, information systems graduates with a master's degree had an average starting salary of US$84,113, higher than business majors such as accounting, finance, or marketing, according to a study by the Association for Information Systems and Institute for Business and Information Technology at 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.

TABLE 1.2 Some IS Management Job Titles and Brief Job Descriptions

IS Activity	Job Title	Job Description	Salary Range, in US$
Develop	Systems analyst	Analyze business requirements and select information systems that meet those needs	67,500–84,000
	Software developer I	Code, test, debug, and install programs	61,000–76,000
	Software architect	Create customized software for large corporations	124,000–152,000
	IT consultant	Provide IT knowledge to external clients	45,000–135,000
	Senior database developer	Develop, modernize, and streamline databases	80,000–106,000
Maintain	IT auditor	Audit information systems and operating procedures for compliance with internal and external standards	68,000–88,000
	Database administrator	Manage database and database management software use	80,000–104,000
	Webmaster	Manage a firm's website	66,000–89,000
Manage	IT manager	Manage existing information systems	80,000–103,000
	IS security manager	Manage security measures and disaster recovery	111,000–136,000
	Information assurance analyst	Ensure availability and security of information stored on networks and in the cloud	61,000–81,000
	E-commerce manager	Manage development, maintenance, and strategy related to e-commerce systems	98,000–129,000
	Chief information officer (CIO)	Highest-ranking IS manager; oversee strategic planning and IS use throughout the firm	80,000–147,000
	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	205,000–246,000
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.

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 1.12).

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.

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, non-relational databases, AI and machine learning, mobile apps, APIs
Networking	Network administration, wireless networks, 5G, 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

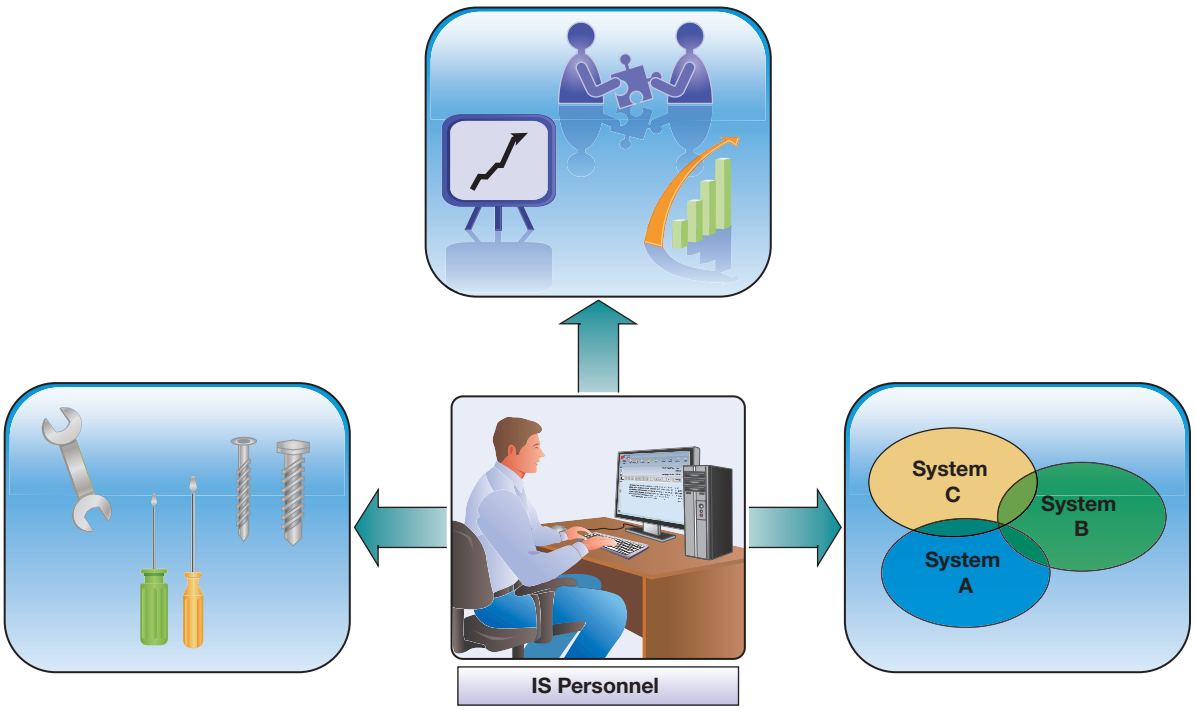


FIGURE 1.12

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

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 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; systems architecture; APIs
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; API 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	AI and machine learning; advanced analytics; data warehousing; data mining; unstructured data analysis; data visualization; Big Data

Source: Based on Day (2019), Florentine (2019).

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 rapid evolution of new business models, existing organizations are starting new projects and new startups start and scale their businesses; 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. 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 (2020a) recently reported that there is an increased need for IS managers as organizations embrace mobility and cloud computing (https://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.

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 business-related field, you will be extensively using information systems, and you will likely be involved in various information

SECURITY MATTERS

Ransomware

As more and more of our personal 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 email 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 2018 was just US$530 according to researchers, with an upper limit of about US$1,000. However, there has been a shift to larger, higher-value companies, government agencies, and organizations, to fuel the multi-hundred million US dollar criminal enterprise. The School of Medicine at University of California, San Francisco was forced to pay a US$1.14 million ransom after its network was broadly infected with ransomware in mid-2020. Additionally, ransom amounts demanded from the healthcare industry, specifically, have ranged between US$1,600 and US$14 million. 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 to become more resilient to such attacks.

Based on:

Lemos, R. (2019, October 21). Ransomware moves away from consumers. *Symantec Enterprise Blogs.* Retrieved May 15, 2020, from https://symantec-enterprise-blogs.security.com/blogs/feature-stories/ransomware-moves-away-consumers

Muchmore, S. (2020, February 11). Hospitals, clinics most likely to be hit with ransomware attack. *Healthcare Dive.* Retrieved May 15, 2020, from https://www.healthcaredive.com/news/hospitals-clinics-most-likely-to-be-hit-with-ransomware-attack/572091

Winder, D. (2020, June 29). The University of California pays $1 million ransom following cyber attack. *Forbes.* Retrieved July 1, 2020, from https://www.forbes.com/sites/daveywinder/2020/06/29/the-university-of-california-pays-1-million-ransom-following-cyber-attack

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 various 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 the Tizen operating system. Such decisions are likely to include your own preferences or influence by your peers, but there are a few 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 1.13). The website was so popular that approximately 220,000 users visited it

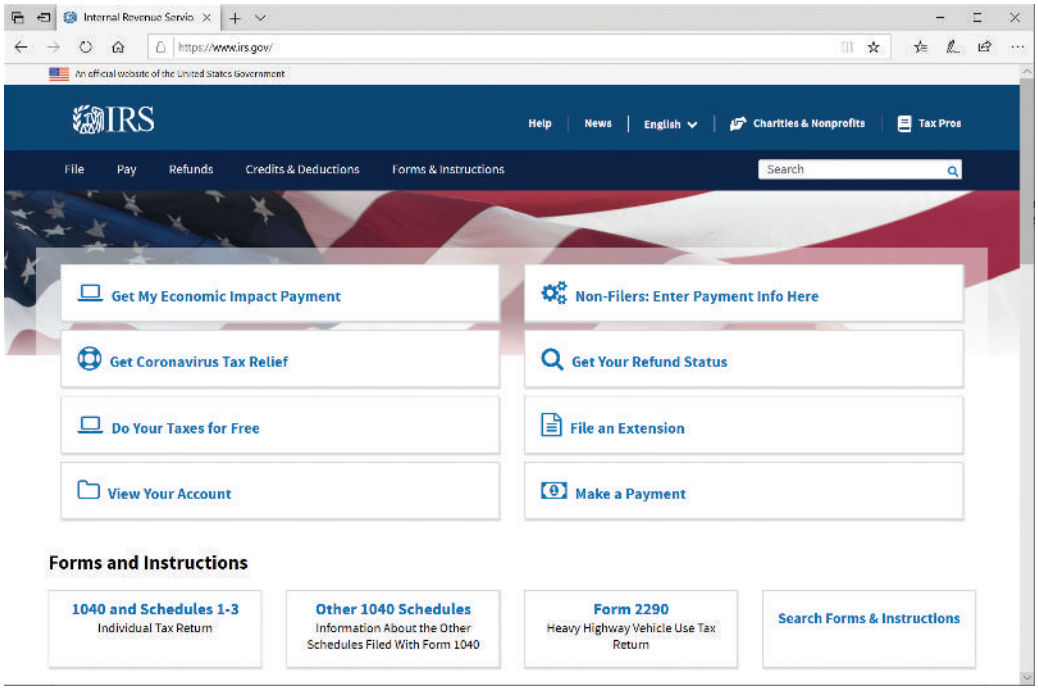


FIGURE 1.13

Website of the U.S. Department of the Treasury, Internal Revenue Service, https://www.irs.gov.
Source: Courtesy of the United States Department of the Treasury.

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.

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 to support quantitative decision making	Product demand forecasting system, loan and investment analysis
Intelligent system	Emulate or enhance human capabilities	AI system for analyzing bank loan applications, self-driving cars, Siri, Alexa
Business intelligence system	Analyze Big Data to better understand various aspects of a business	Online analytical processing (OLAP) system and data visualization
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, email client
Collaboration system	Enable people to communicate, collaborate, and coordinate with each other	Email 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, eBay, Nordstrom.com
Mobile app	Perform a well-defined function, typically on a mobile device	Instagram, Snapchat, WhatsApp, Office Mobile, Google Pay, Lyft

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'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 support systems, intelligent systems, business intelligence systems, knowledge management systems, social software, geographic information systems*, and *functional area information systems*. Ten to fifteen 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 email, 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—especially with increasing use of *agile approaches* such as "scrum"—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 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 integrating people from the IS staff 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 must adjust to this change in pace.