twelfth edition

USING MIS 2021

David M. Kroenke | Randall J. Boyle

Using MIS

Dear Student,

You're going to enjoy this class. This class is about using technology to create value for organizations. You'll learn how companies can use technology to reduce costs, increase revenue, improve working conditions, and create innovative products and services.

You'll learn about things like artificial intelligence, machine learning, self-driving cars, 3D printing, social media, Big Data, virtual reality, the cloud, and cybersecurity. Students enjoy this class because they get the opportunity to learn more about the things they read about in the news. These are cool, innovative, and interesting technologies that lead to exciting jobs. People want these jobs, but they just don't know enough about them. This book will introduce you to these technologies.

With the knowledge from this class, you can get a great job, increase your earning potential, and become indispensable to your future employer. You may not be a superstar entrepreneur like Jeff Bezos or Steve Jobs, but you can succeed beyond your expectations by applying the knowledge you learn in this class. Companies are becoming increasingly dependent on technology. They need people who understand how to use new technology to solve new types of problems. And that's you.

Think about it. Over time, technology creates new jobs that didn't exist before. Machine learning engineers, cloud data engineers, robotic process automation developers, social media analysts, information security specialists, business intelligence analysts, and data architects didn't exist 20—even 10—years ago. Similarly, the best jobs 20 years from now probably don't currently exist.

For example, companies have been rushing to automate their workforce using artificial intelligence, machine learning, smart IoT devices, and robotics. An automated workforce reduces costs and makes products cheaper for consumers. But what about the workers? Where do those jobs go?

It turns out that all of these new technologies need workers with different knowledge and skill sets. Companies will need experts to create and manage AI applications, databases, high-speed networks, smart devices, and robotic systems. The number of workers won't decrease, but the skills demanded by employers will. Mundane, repetitive, lower-paying, routine jobs will disappear. But new highly paid jobs will be created to manage these new technologies.

If you're willing to continuously learn, be creative, develop nonroutine problem-solving skills, and look for new opportunities to apply emerging technology to facilitate your organization's strategy, you'll never want for work. This is true whether your job is in marketing, operations, sales, accounting, finance, entrepreneurship, or another discipline.

The trick to turning information systems to your advantage is being able to predict technological innovations and then get ahead of them. During your career, you will find many opportunities for the innovative application of information systems in business and government—but only if you know how to look for them.

You can use the knowledge from this course to help you obtain and then thrive in an interesting and rewarding career in business. Learn more than just the MIS terminology—understand the ways information systems are transforming business and the many, many ways you can participate in that transformation.

In this endeavor, we wish you, a future business professional, the very best success!

David Kroenke & Randy Boyle

The Guides

Each chapter includes four unique **guides** that focus on current issues in information systems. In each chapter, one of the guides focuses on the impact of *innovative* technology, and the second focuses on information *security* issues in business. The third guide focuses on information systems *careers*, and the fourth focuses on an *ethical* issue in field of information systems. The content of each guide is designed to stimulate thought, discussion, and active participation in order to help *you* develop your problem-solving skills and become a better business professional.

LEARNING AIDS FOR STUDENTS

We have structured this book so you can maximize the benefit from the time you spend reading it. As shown in the following table, each chapter includes various learning aids to help you succeed in this course.

Resource	Description	Benefit	Example
Guides	Each chapter includes four guides that focus on current issues in information systems. One addresses new *innovations*, one addresses *ethics*, one addresses *security*, and the fourth addresses information systems *careers*.	Stimulate thought and discussion. Understand how new innovations in the chapter apply to everyday situations. Address ethics and security once per chapter. Learn about real-world IS jobs.	Chapter 5, Ethics Guide: Searching for Clues and Your Face Chapter 8, Security Guide: ERP Vulnerabilities Chapter 9, Career Guide: Social Media/Online Reputation Manager Chapter 2, So What? Amazon Everywhere
Chapter Introduction Business Example	Each chapter begins with a description of a business situation that motivates the need for the chapter's contents. We focus on two different businesses over the course of the text: eHermes, an automated mobile storefront retailer; and iMed Analytics, a healthcare analytics startup opportunity.	Understand the relevance of the chapter's content by applying it to a business situation.	Chapter 9, opening vignette: Social Media Information Systems and iMed Analytics
Query-Based Chapter Format	Each chapter starts with a list of questions, and each major heading is a question. The Active Review contains tasks for you to perform in order to demonstrate your ability to answer the questions.	Use the questions to manage your time, guide your study, and review for exams.	Chapter 1, Q1-4: How Can You Use the Five-Component Model? Chapter 6, Q6-4: How Does the Internet Work?
2031?	Each chapter concludes with a discussion of how the concepts, technology, and systems described in that chapter might change by 2031.	Learn to anticipate changes in technology and recognize how those changes may affect the future business environment.	Chapter 8, 2031? discusses the future of ERP applications

Resource	Description	Benefit	Example
Active Review	This review provides a set of activities for you to perform in order to demonstrate your ability to answer the primary questions addressed by the chapter.	After reading the chapter, use the Active Review to check your comprehension. Use for class and exam preparation.	Chapter 9, Active Review
Using Your Knowledge	These exercises ask you to take your new knowledge one step further by applying it to a practice problem.	Test your critical-thinking skills.	Chapter 4, Using Your Knowledge
Collaboration Exercises	These exercises and cases ask you to collaborate with a group of fellow students, using collaboration tools introduced in Chapter 1.	Practice working with colleagues toward a stated goal.	Collaboration Exercise 2 discusses how to tailor a high-end resort's information system to fit its competitive strategy
Case Studies	Each chapter includes a case study at the end.	Apply newly acquired knowledge to real-world situations.	Case Study 6, Salesforce.com
Application Exercises	These exercises ask you to solve situations using spreadsheet (Excel), database (Access), or Web applications.	Develop your computer skills.	AE10-2 builds on your knowledge from Chapter 10 by asking you to install and use a Tor Web browser.
International Dimension	This module at the end of the text discusses international aspects of MIS. It includes the importance of international IS, the localization of system components, the roles of functional and cross-functional systems, international applications, supply chain management, and challenges of international systems development.	Understand the international implications and applications of the chapters' content.	International Dimension QID-3, How Do Inter-enterprise IS Facilitate Global Supply Chain Management?

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TWELFTH EDITION

Using MIS

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Please contact *https://support.pearson.com/getsupport/s* with any queries on this content.

Cover Image: Metamorworks/Shutterstock
Chapter opener image: bestfoto77/Shutterstock

Library of Congress Cataloging-in-Publication Data

Names: Kroenke, David M., | Boyle, Randall, author.
Title: Using MIS/David M. Kroenke, Randall J. Boyle.
Other titles: Using management information systems
Description: Twelfth edition. | New York: Pearson Education, [2020] | Includes index.
Identifiers: LCCN 2018043431 | ISBN 9780136921653 | ISBN 0136921655
Subjects: LCSH: Management information systems.
Classification: LCC HD30.213 .K76 2020 | DDC 658.4/038011 -dc23
LC record available at https://lccn.loc.gov/2018043431

ScoutAutomatedPrintCode

ISBN 10: 0-13-692165-5
ISBN 13: 978-0-13-692165-3

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PREFACE

In Chapter 1, we claim that MIS is the most important class in the business curriculum. That's a bold statement, and every year we ask whether it remains true. Is there any discipline having a greater impact on contemporary business and government than IS? We continue to doubt there is. Every year brings important new technology to organizations, and many of these organizations respond by creating innovative applications that increase productivity and help them accomplish their strategies.

Over the past year, we've seen long-discussed innovations take big leaps forward. Self-driving vehicles made huge strides over the past year. Uber, Tesla Motors, and Waymo (Google) logged tens of millions of autonomous miles. Nearly all other automobile manufacturers are running full-tilt to turn their traditional cars into fully autonomous smart cars. A recent report by McKinsey & Company indicates that self-driving vehicles could reach widespread adoption as early as 2030,[1] but KPMG estimates that widespread adoption won't happen until 2050.[2] Consider what will happen when Amazon starts formal adoption of the self-driving trucks it's currently testing. It could reduce shipping costs by 80 percent!

At the annual Consumer Electronics Show (CES) in 2020, foldable screens for computers and tablets were a big hit. Foldable screens have been available in some mobile phones, but this technology is now being applied to larger devices to ease space and size requirements. Toyota unveiled its plans for a city of the future that will be built in Japan. The 200-acre city will feature a variety of innovative technologies, including autonomous cars, IoT-laden homes, and numerous robots. Segway introduced the Segway S-Pod, which is shaped like a stroller for adults but without the front wheel. Riders can control the S-Pod using a joystick, and it is full of safety features.

Digital reality (sometimes called virtual reality) has really taken off. Microsoft (HoloLens 2) and Magic Leap (Magic Leap 1) released their mixed-reality devices in 2019. Microsoft has had success focusing on shipping devices to enterprise partners. Magic Leap, on the other hand, was focusing on the consumer market and had to let 600 employees go in 2020. Most of Magic Leap's former employees were hired at Apple, supposedly to work on its secretive AR device. It's estimated that the digital reality market will be $120 billion by 2026.[3] These devices will create entirely new types of companies and could change the way people live, work, shop, and entertain themselves.

In addition to changing the ways individuals live and gather data, recent innovations are changing the way companies work, too. The worldwide coronavirus lockdown forced every organization to adapt to having workers work remotely. Many companies were forced to shut down because their human workforce was prohibited from coming to work. This has forced companies to focus on automation and an increased use of robotics.

For example, Amazon now has 200,000 Kiva robots working around the clock in its 110 warehouses. Kiva robots have reduced operating costs by 20 percent ($22 million per warehouse) and reduced click-to-ship times by 75 percent.[4] Amazon, FedEx, UPS, Boeing, and DHL are all testing drones for package delivery. The drone package delivery market is estimated to be worth $91 billion by 2030.[5] Amazon anticipated starting drone deliveries in late 2019, but they were still not happening by mid-2020. McKinsey & Company estimates that it costs $4 to ship a package, and Amazon's shipping costs for 2019 were $38 billion. Drone delivery is expected to reduce Amazon's shipping costs by 50 percent.[6] Technology—in this case, an automated workforce—is fundamentally changing the way organizations operate. It's enabling them to be more productive, innovative, and adaptable.

A worldwide pandemic lockdown wasn't the only troubling news in 2020. Large-scale data breaches continue to be a major problem. In fact, Risk Based Security reported the loss of *15 billion*

personal records in a record 7,000 security incidents that year.[7] Some of the more notable data breaches include the loss of user accounts at Sina Weibo (538 million), OxyData (380 million), Zynga (218 million), and Capital One (100 million). Overall, businesses accounted for 66 percent of stolen accounts. More than 84 percent of user records stolen were taken by external attackers via Web vulnerabilities (89 percent) or direct hacking (10 percent).[8] And these are just a fraction of the total number of organizations affected in 2020.

This edition of the text has been updated for these developments as well as normal revisions that address emergent technologies like artificial intelligence, machine learning, cloud-based services, and so on.

All of these changes highlight the fact that more sophisticated and demanding users push organizations into a rapidly changing future—one that requires continual adjustments in business planning. In order to participate in this business environment, our graduates need to know how to apply emerging technologies to better achieve their organizations' strategies. Knowledge of MIS is critical to this endeavor. And this pace continues to remind us of Carrie Fisher's statement "The problem with instantaneous gratification is that it's just not fast enough."

Why This Twelfth Edition?

To reiterate the preface of earlier editions, we believe it is exceedingly important to make frequent adaptations to this text because of the delays associated with long textbook revision cycles. Text materials we develop in April of one year are published in January of the next year and are first used by students in September—a minimum 17-month delay.

For some areas of study, a year and a half may not seem long because little changes in that amount of time. But in MIS, entire companies can be founded and then sold for billions of dollars in just a few years. YouTube, for example, was founded in February 2005 and then sold in November 2006 to Google for $1.65B (21 months). And that wasn't just a one-time fluke. Facebook Inc. started in 2004, led the social media revolution, and became a public company currently (as of mid-2020) valued at $666B. That's a whopping $41B in growth per year for 16 years! MIS changes fast—very fast. We hope this new edition is the most up-to-date MIS textbook available.

The changes in this twelfth edition are listed in Table 1. Larger changes were made to Chapters 3, 4, 6, and 10. New sections include coverage of low-code systems, robotic process automation, intelligent automation, data lakes, data discovery, automated labor, continuous intelligence, industrial IoT,

TABLE 1: CHANGES IN THE TWELFTH EDITION

Chapter	Change
1	New So What? Guide (IoTrends)
	New and updated charts for CPU and data storage growth
	New job sector comparison statistics
	Updated BLS job statistics for Business and MIS occupations
	Updated 2031 discussion in Q1-7
	New MyLab MIS question on information (1-4)
	All guides moved to end of chapter to make them easier to locate
2	New So What? Guide (Amazon Everywhere)
	New Security Guide (Critical Ransom)
	New Career Guide (Managing Director)
	New Ethics Guide (The Robot Will Hire You Now)
	New Q2-8 2031 discussion
	Discussion of startups, unicorns, low-code systems, robotics process automation, and intelligent automation
	Updated Amazon case study
3	New So What? Guide (Continuous Intelligence)
	New Security Guide (Capital Data Breach)
	New Career Guide (Senior Business Systems Analyst)
	New Ethics Guide (Want a Loan, Who's in Your Phone?)
	New Case Study (Zoom)

Chapter	Change
	Q3-1 New discussion of master data management and data aggregators
	Q3-2 New discussion of data lakes and data swamps
	Q3-3 New discussion of data discovery and data visualization
	Q3-6 Updated discussion on automated labor
	Q3-8 New discussion of continuous intelligence
	New Collaboration exercise 3 (Zoom)
	Updated images, charts, and statistics throughout the chapter
4	New So What? Guide (New from CES 2020)
	New Security Guide (Cyber-Physical Attacks)
	New Ethics Guide (Big Data = Big Surveillance)
	New Case Study (Peloton)
	Q4-1 New discussion of Industrial Internet of Things (IIoT), machine to machine (M2M) communication, edge computing
	Expanded discussion of IoT
	Q4-2 Updated discussion of autonomous vehicles
	Q4-2 New discussion of drones, robots, industrial robots, and upskilling
	Q4-2 Updated 3D printing example
	Q4-2 New discussion of FinTech and digital wallets
	Q4-3 Updated discussion of mobile operating systems
	Updated Collaboration Exercise 4 (HoloLens 2)
	Updated industry statistics throughout the chapter
5	New Security Guide (Don't Reuse That Password)
	New Ethics Guide (Searching for Clues and Your Face)
	New Case Study (Datadog)
	Updated images and statistics throughout the chapter
	Updated Excel and Access 2019 images
6	New So What? Guide (Working@Home)
	New Security Guide (Insiders and Submarines and Cryptojacking, Oh My!)
	New Career Guide (Cloud Engineer)
	New Ethics Guide (Cloudy with a Chance of Bitcoin)
	Updated cloud usage and market share statistics
	Q6-3 Discussion of on-premises
	Q6-3 New discussion of Bluetooth Low Energy (BLE) and 5G
	Q6-7 New discussion of public clouds, private clouds, hybrid clouds, multi-cloud strategies, cloud interoperability, and data fabrics

Chapter	Change
	Q6-8 Updated 2031 discussion
	Updated industry statistics, web screenshots throughout the chapter
7	New iMed Analytics introductory vignette
	New So What? Guide (Zoombombing)
	New Security Guide (Exploiting COVID-19)
	New Ethics Guide (Halt and Catch-22)
	Updated references to Google Meet, ZOOM, Microsoft 365, Google Docs, other desktop and cloud-based software
	Updated chapter statistics and images
	Updated SharePoint and Google Drive images
8	New iMed Analytics introductory vignette
	New So What? Guide (Wearables in the Workplace)
	New Security Guide (ERP Vulnerabilities)
	New Career Guide (Project Manager SME)
	New Ethics Guide (You Cannot Manage What You Cannot Measure)
	New Case Study (Uber)
	New Q8-7 example looking at Inter-Enterprise IS using iMed Analytics
	Updated chapter statistics and images
9	New iMed Analytics introductory vignette
	New So What? Guide (Evolving Social Media)
	New Security Guide (Digital Throne of Lies)
	New Ethics Guide (Life, Liberty, and the Pursuit of Not Being Rated)
	Removed references to Google+ and Klout (discontinued)
	Updated industry statistics and charts throughout the chapter
	Expanded Q9-7 discussion on rules of social media engagement
10	New iMed Analytics introductory vignette
	New So What? Guide (New from Black Hat 2019)
	New Security Guide (Using Tech to Mitigate COVID-19 Risks)
	New Career Guide (Cyber Systems Engineer)
	New Ethics Guide (White Hat, Blackballed)
	New Case Study (CrowdStrike)
	Discussion of third-party cookies and tracking
	Q10-3 discussion of password reuse and credential stuffing
	Q10-4 discussion of information security fatigue
	Q10-5 discussion of cryptojacking and crypto malware
	Q10-6 discussion of General Data Protection Regulation (GDPR)

Chapter	Change
	New industry statistics and charts throughout the chapter
11	New iMed Analytics introductory vignette
	New Security Guide (Carrot or Stick? Neither.)
	New Case Study (Slack)
	Q10-6 updated 2031 discussion
	Updated industry statistics and charts throughout the chapter
12	New iMed Analytics introductory vignette
	New So What? Guide Speed into the Future with 5G
	New Ethics Guide (The Doctor Is in . . . Your Laptop)
	Updated Microsoft Project Professional 2019 images
	New charts and statistics about agile and scrum use
	Updated Case Study 12
International Dimension	Updated statistics about International Internet access (fixed and mobile) and native and second languages
	New Career Guide (Consumer Direct Sciences Advanced Analytics)

Chapter	Change
	New example of localization (Samoan language)
	Updated examples of international bribery, visa restrictions, privacy laws, and content distribution restrictions
Appl Ex	New exercise AE3-4 AI Chat Bot Mitsuku
	New exercise AE7-3 Collaboration using Google Drive
	New exercise AE10-2 Tor Web Browser
	New exercise AE12-3 Microsoft MakeCode application development
	Updated exercise AE3-3 *How-Old.net*
	Updated data files
	Updated Microsoft Office 2019 compliant files and chapter images
	New Security Guide (Critical Ransom)
	New Career Guide (Managing Director)
	New Ethics Guide (The Robot Will Hire You Now)
	New Q2-8 2031 discussion
	Discussion of startups, unicorns, low-code systems, robotics process automation, and intelligent automation

autonomous vehicles, drones, industrial robots, FinTech, mobile operating systems, 5G, Bluetooth Low Energy (BLE), hybrid clouds, multi-cloud strategies, data fabrics, password reuse, credential stuffing, security fatigue, cryptojacking, crypto malware, and GDPR.

Chapters 7 through 12 begin with a new discussion of iMed Analytics, a cloud-based medical analytics startup. Chapters 1 through 6 continue to be introduced by the discussion of eHermes, a startup that provides mobile shopping experiences using self-driving vehicles. In addition to motivating the chapter material, both case scenarios provide numerous opportunities for students to practice one of Chapter 1's key skills: "Assess, evaluate, and apply emerging technology to business."

This edition also continues to focus on teaching ethics. Every Ethics Guide asks students to apply Immanuel Kant's categorical imperative, Bentham and Mill's utilitarianism, or both to the business situation described in the guide. We hope you find the ethical considerations rich and deep with these exercises. The categorical imperative is introduced in the Ethics Guide in Chapter 1 (pages 28–29), and utilitarianism is introduced in the Ethics Guide in Chapter 2 (pages 56–58).

As shown in Table 1, additional changes were made to every chapter, including 10 new So What? features, 10 new Security Guides, 6 new Career Guides, 10 new Ethics Guides, and 6 new chapter cases. Additional figures, like the one showing the differences between public, private, and hybrid clouds in Chapter 6, were added to make the text more accessible. Numerous changes were made throughout the chapters in an attempt to keep them up-to-date. MIS moves fast, and to keep the text current, we checked every fact, data point, sentence, and industry reference for obsolescence and replaced them as necessary.

Importance of MIS

As stated, we continue to believe we are teaching the single most important course in the business school. The rationale for this bold statement is presented in Chapter 1, starting on page 1. In brief, the argument relies on two observations.

First, processing power, interconnectivity of devices, storage capacity, and bandwidth are all increasing so rapidly that it's fundamentally changing how we use digital devices. Businesses are increasingly finding—and, more importantly, increasingly *required* to find—innovative applications for information systems. The incorporation of Facebook and Twitter into marketing systems is an obvious example, but this example is only the tip of the iceberg. For at least the next 10 years, every business professional will, at the minimum, need to be able to assess the efficacy of proposed IS applications. To excel, business professionals will also need to define innovative IS applications.

Further, professionals who want to emerge from the middle ranks of management will, at some point, need to demonstrate the ability to manage projects that develop these innovative information systems. Such skills will not be optional. Businesses that fail to create systems that take advantage of changes in technology will fall prey to competition that can create such systems. So, too, will business professionals.

The second premise for the singular importance of the MIS class relies on the work of Robert Reich, former Secretary of Labor for the Bill Clinton administration. In *The Work of Nations*,[9] Reich identifies four essential skills for knowledge workers in the 21st century:

- Abstract thinking
- Systems thinking
- Collaboration
- Experimentation

For reasons set out in Chapter 1, we believe the MIS course is the single best course in the business curriculum for learning these four key skills.

Today's Role for Professors

What is our role as MIS professors? Students don't need us for definitions; they have the Web for that. They don't need us for detailed notes; they have the PowerPoints. Consequently, when we attempt to give long and detailed lectures, student attendance falls. And this situation is even more dramatic for online courses.

We need to construct useful and interesting experiences for students to apply MIS knowledge to their goals and objectives. In this mode, we are more like track coaches than the chemistry professor of the past. And our classrooms are more like practice fields than lecture halls.[10]

Of course, the degree to which each of us moves to this new mode depends on our goals, our students, and our individual teaching styles. Nothing in the structure or content of this edition assumes that a particular topic will be presented in a nontraditional manner. But every chapter contains materials suitable for use with a coaching approach, if desired.

In addition to the chapter feature titled "So What?" all chapters include a collaboration exercise that students can use for team projects inside and outside of class. As with earlier editions, each chapter contains guides that describe practical implications of the chapter contents that can be used for small in-class exercises. Additionally, every chapter concludes with a case study that can be the basis for student activities. Finally, this edition contains 45 application exercises (see page 509).

eHermes and iMed Analytics Cases

Each part and each chapter opens with a scenario intended to get students involved emotionally, if possible. We want students to mentally place themselves in the situation and to realize that this situation—or something like it—could happen to them. Each scenario sets up the chapter's content and provides an obvious example of why the chapter is relevant to them. These scenarios help support the goals of student motivation and learning transfer.

Furthermore, both of these introductory cases involve the application of new technology to existing businesses. Our goal is to provide opportunities for students to see and understand how businesses are affected by new technology and how they need to adapt while, we hope, providing numerous avenues for you to explore such adaptation with your students.

In developing these scenarios, we endeavor to create business situations rich enough to realistically carry the discussions of information systems while at the same time simple enough that students with little business knowledge and even less business experience can understand. We also attempt to create scenarios that will be interesting to teach. This edition introduces the new iMed Analytics case and continues the eHermes case from the eleventh edition.

eHermes

The chapters in Parts 1 and 2 are introduced with dialogue from key players at eHermes, a privately owned company that provides mobile shopping experiences using self-driving vehicles. We wanted to develop the case around an interesting business model that students would want to learn more about. Self-driving vehicles get a lot of attention in the press, but students may not know a lot about how they're used in business. Self-driving vehicles are on the road now. They should see widespread adoption in the next several years. It's likely that students will own or use a self-driving vehicle in the near future.

eHermes is considering strengthening its competitive advantage by using some type of artificial intelligence (AI) or machine learning to increase the efficiency of the fleet. However, were the company to do so, it would require a considerable capital investment. It would also need to hire a team of AI experts, develop new business processes, and modify its internal information systems. All of this is good fodder for Chapter 2 and for underlining the importance of the ways that IS needs to support evolving business strategy.

Ultimately, eHermes determines that it does not want to invest in an AI. It would be too costly, and it wants to use its capital to grow other parts of its business. The company doesn't have enough reliable data to train the AI, and it would need to invest more in additional infrastructure. eHermes decides to focus on its core strength of selling items through its mobile storefronts.

Students may object that, in studying eHermes, they devoted considerable time to an opportunity that ultimately didn't make business sense and was rejected. But this outcome is at least as informative as a successful outcome. The example uses knowledge of processes as well as application of business intelligence to avoid making a serious blunder and wasting substantial money. eHermes didn't have to hire a dozen AI experts, buy new infrastructure, and build a complex AI just to find out it would be a mistake. It could try to make a prototype, analyze the costs and benefits, and then avoid making the mistake in the first place. The very best way to solve a problem is not to have it!

iMed Analytics

iMed Analytics is an embryonic healthcare informatics company that uses AI and machine learning to analyze medical data in the hopes of improving medical outcomes for patients. iMed allows patients to upload medical data from a variety of approved IoT medical devices like smartwatches, smart scales, oximeters, blood pressure monitors, glucose monitors, EKG monitors, smart inhalers, air quality sensors, and so on.

This data is then analyzed using iMed's custom AI and machine learning algorithms specifically designed for patient data. Patients can see their own customized healthcare dashboards and share this data with their doctors. Doctors can continuously monitor patients to see how they respond to new medications, encounter problems, or experience life-threatening events.

Dr. Greg Solomon, a famous oncologist working at Tampa General Hospital, saw the need for a system like iMed during the COVID-19 pandemic. Due to quarantine lockdowns, he was unable to see many of his cancer patients on a regular basis. Some of his patients were genuinely afraid to come in for visits. He wanted a way to provide medical care to his patients even if he couldn't physically see them. iMed, to some extent, made this possible.

iMed is based on a real-world prototype written in C#, and the code runs against an Azure database in the cloud. It uses the Windows Phone emulator that is part of Visual Studio. Dr. Solomon hired Emily Lewis as the information systems manager of his newly formed company and developed a simple prototype he could demonstrate to hospitals and medical practices. He also found and hired a new general manager (Jasmine Moore), customer service manager (Felix Ramos), and machine learning guru (Jose Navarro). All of this is described at the start of Chapter 7.

Use of the Categorical Imperative and Utilitarianism in Ethics Guides

Since the introduction of the Ethics Guides into the first edition of this text, we believe there has been a shift in students' attitudes about ethics. Students seem, at least many of them, to be more cynical and callous about ethical issues. As a result, in the seventh edition, we began to use Kant's categorical imperative and Bentham and Mill's utilitarianism to ask students, whose ethical standards are often immature, to adopt the categorical imperative and utilitarian perspectives rather than their own perspectives and, in some cases, in addition to their own perspectives. By doing so, the students are asked to "try on" those criteria, and we hope in the process they think more deeply about ethical principles than they do when we allow them simply to apply their personal biases.

The Ethics Guide in Chapter 1 introduces the categorical imperative, and the guide in Chapter 2 introduces utilitarianism. If you choose to use these perspectives, you will need to assign both of those guides.

2031?

Every chapter concludes with a question labeled "2031?" This section presents our guesses about how the subject of that chapter is likely to change between now and 2031. Clearly, if we had a crystal ball that would give good answers to that question, we wouldn't be writing textbooks.

However, we make what we believe is a reasonable stab at an answer. You will probably have different ideas, and we hope students will have different ideas as well. The goal of these sections is to prompt students to think, wonder, assess, and project about future technology. These sections usually produce some of the liveliest in-class discussions.

Why Might You Want Your Students to Use SharePoint?

The difficult part of teaching collaboration is knowing how to assess it. Collaboration assessment is not simply finding out which students did the bulk of the work. It also involves assessing feedback and iteration; that is, identifying who provided feedback, who benefited from the feedback, and how well the work product evolved over time.

Microsoft SharePoint is a tool that can help assess collaboration. It automatically maintains detailed records of all changes that have been made to a SharePoint site. It tracks document versions, along with the date, time, and version author. It also maintains records of user activity—who visited the site, how often, what site features they visited, what work they did, what contributions they made, and so forth. SharePoint makes it easy to determine which students were making sincere efforts to collaborate by giving and receiving critical feedback throughout the project assignment and which students were making a single contribution 5 minutes before midnight the day before the project was due.

Additionally, SharePoint has built-in facilities for team surveys, team wikis, and member blogs as well as document and list libraries. All of this capability is backed up by a rich and flexible security system. To be clear, we do not use SharePoint to run our classes; we use either Canvas or Blackboard for that purpose. However, we do require students to use SharePoint for their collaborative projects. A side benefit is that they can claim, rightfully, experience and knowledge of using SharePoint in their job interviews.

You might also want to use Microsoft 365 because it includes Skype, hosted Exchange, 1TB online storage, and SharePoint Online as an add-on. Microsoft offers Microsoft 365 to academic institutions as a whole or to students directly at reduced educational rates.

Why Are the Chapters Organized by Questions?

The chapters of *Using MIS* are organized by questions. According to Marilla Svinicki,[11] a leading researcher on student learning at the University of Texas, we should not give reading assignments such as "Read pages 50 through 70." The reason is that today's students need help organizing their time. With such a reading assignment, they will fiddle with pages 50 through 70 while texting their friends, surfing the Internet, and listening to their iPods. After 30 or 45 minutes, they will conclude they have fiddled enough and will believe they have completed the assignment.

Instead, Svinicki states we should give students a list of questions and tell them their job is to answer those questions, treating pages 50 through 70 as a resource for that purpose. When students can answer the questions, they have finished the assignment.

Using that philosophy, every chapter in this text begins with a list of questions. Each major heading in the chapter is one of those questions, and the Active Review at the end of each chapter provides students a set of actions to take in order to demonstrate that they are able to answer the questions. Since learning this approach from Professor Svinicki, we have used it in our classes and have found that it works exceedingly well.

How Does This Book Differ from *Experiencing MIS* and from *Processes, Systems, and Information*?

In addition to *Using MIS*, we've written an MIS text titled *Experiencing MIS*. These two texts provide different perspectives for teaching this class. The principal difference between *Using MIS* and *Experiencing MIS* is that the latter is modular in design and has a more "in your face" attitude about MIS. Modularity definitely has a role and place, but not every class needs or appreciates the flexibility and brevity a modular text offers.

There is also a third MIS text titled *Processes, Systems, and Information: An Introduction to MIS* coauthored with Earl McKinney of Bowling Green State University. It represents a third approach to this class and is structured around business processes. It has a strong ERP emphasis and includes two chapters on SAP as well as two chapter tutorials for using the SAP Alliance Global Bikes simulation. Earl has taught SAP for many years and has extensive experience in teaching others how to use the Global Bikes simulation.

In *Using MIS*, we have endeavored to take advantage of continuity and to build the discussion and knowledge gradually through the chapter sequence, in many places taking advantage of knowledge from prior chapters.

The goal in writing these books is to offer professors a choice of approach. We are committed to each of these books and plan to revise them for some time. We sincerely hope that one of them will fit your style and objectives for teaching this increasingly important class.

Instructor Resources

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

The following supplements are available with this text:

- Instructor's Resource Manual
- Image Library
- Test Bank
- TestGen® Computerized Test Bank
- PowerPoint Presentation

AACSB Learning Standards Tags

What Is the AACSB?

The Association to Advance Collegiate Schools of Business (AACSB) is a nonprofit corporation of educational institutions, corporations, and other organizations devoted to the promotion and improvement of higher education in business administration and accounting. A collegiate institution offering degrees in business administration or accounting may volunteer for AACSB accreditation review. The AACSB makes initial accreditation decisions and conducts periodic reviews to promote continuous quality improvement in management education. Pearson Education is a proud member of the AACSB and is pleased to provide advice to help you apply AACSB Learning Standards.

What Are AACSB Learning Standards?

One of the criteria for AACSB accreditation is the quality of the curricula. Although no specific courses are required, the AACSB expects a curriculum to include learning experiences in such areas as:

- Communication Abilities
- Ethical Understanding and Reasoning Abilities
- Analytic Skills
- Use of Information Technology
- Dynamics of the Global Economy
- Multicultural and Diversity Understanding
- Reflective Thinking Skills

These seven categories are AACSB Learning Standards. Questions that test skills relevant to these standards are tagged with the appropriate standard. For example, a question testing the moral questions associated with externalities would receive the Ethical Understanding tag.

How Can I Use These Tags?

Tagged questions help you measure whether students are grasping the course content that aligns with AACSB guidelines. In addition, the tagged questions may help to identify potential applications of these skills. This, in turn, may suggest enrichment activities or other educational experiences to help students achieve these goals.

Available in MyLab MIS

- MIS Video Exercises—videos illustrating MIS concepts, paired with brief quizzes
- MIS Decision Simulations—interactive exercises allowing students to play the role of a manager and make business decisions
- Chapter Warm Ups, Chapter Quizzes—objective-based quizzing to test knowledge
- Discussion Questions—taken from the end of chapter
- Dynamic Study Modules—on the go adaptive quizzing, also available on a mobile phone
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Acknowledgments

First, we wish to thank Earl McKinney, professor of information systems at Bowling Green University and author of *Processes, Systems, and Information*, for many hours of insightful conversation about the role of processes in this MIS course as well as for his deep insights into the theory of information. We also thank David Auer of Western Washington University for help with data communications technology and Jeffrey Proudfoot of Bentley University for his insights on information security. Also, a special thanks to Harry Reif at James Madison University for most insightful observations about ways to improve this text.

At Microsoft, we are grateful for the help of Randy Guthrie, who supports MIS professors in many ways, including facilitating use of Microsoft Imagine as well as giving many presentations to students. Also, we thank Rob Howard for conversations and consulting about SharePoint and SharePoint Designer and Steve Fox for helpful conversations about both SharePoint and Microsoft Azure. Regarding our SharePoint program, a very special thanks to David Auer of Western Washington University and Laura Atkins of James Madison University, who serve as the community proctors for our SharePoint MIS community site, which enables dozens of professors and hundreds of students to learn how to use SharePoint. Our SharePoint solution is hosted by NSPI in Atlanta, Georgia. Additionally, we thank Don Nilson, a certified scrum master, for essential ideas and guidance on the new material on agile development and scrum.

We'd also like to thank all of the industry professionals that wrote Career Guides for this edition including Andrew Yenchick, Colton Mouritsen, Marshall Pettit, Kailey Smith, Ryan Fisher, Christie Wruck, Jason Koop, Adam Young, Chris Heywood, Susan Jones, and Lindsey Tsuya. We hope their real-world advice provides students with insight into the daily lives of MIS professionals.

We are grateful for the support, knowledge, expertise, and great attitude of our developmental editor, Cheryl Slavik. The textbook industry is undergoing dramatic changes at this time, and her knowledge, guidance, and wisdom on the textbook production process are most appreciated.

We would like to thank those who contributed to the development of our excellent Instructor Resources: Instructor's Manual, Chris Parent; PowerPoints, Tony Nowakowski; and Test Bank, Douglas Courter. We would also like to express our thanks to the following authors for creating a superb set of resources for our MyLab: Roberta M. Roth, University of Northern Iowa; Robert J. Mills, Utah State University; and John Hupp, Columbus State University.

Pearson Education is a great publishing company, chock-full of dedicated, talented, and creative people. We thank Jenifer Niles and Stephanie Kiel for taking over production management of a complex set of texts and doing it so efficiently and willingly. We also thank Rudrani Mukherjee and Gowthaman Sadhanandham for managing the production of the book.

No textbook makes its way into the hands of students without the active involvement of a dedicated and professional sales force. We thank the Pearson sales team for their tireless efforts. Thanks also goes to our former, and now happily retired, editor Bob Horan for his years of friendship, support, and wise counsel. Finally, like so many authors in college publishing, we owe tremendous thanks to our current editor, Jenifer Niles. Jenifer continues to provide us with the skilled guidance necessary to make these texts a great success.

David Kroenke
Randy Boyle

Thanks to Our Reviewers

The following people deserve special recognition for their review work on this and previous editions of the book—for their careful reading, thoughtful and insightful comments, sensitive criticism, and willingness to follow up with email conversations, many of which were lengthy when necessary. Their collaboration on this project is truly appreciated.

Dennis Adams, *University of Houston, Main*
Heather Adams, *University of Colorado*
Hans-Joachim Adler, *University of Texas, Dallas*
Mark Alexander, *Indiana Wesleyan University*
Paul Ambrose, *University of Wisconsin, Whitewater*
Craig Anderson, *Augustana College*
Michelle Ashton, *University of Utah*
Laura Atkins, *James Madison University*
Cynthia Barnes, *Lamar University*
Reneta Barneva, *SUNY Fredonia*
Michael Bartolacci, *Penn State Lehigh Valley*
Ozden Bayazit, *Central Washington University*
Jack Becker, *University of North Texas*
Paula Bell, *Lock Haven University*
Kristi Berg, *Minot State University*
Doug Bickerstaff, *Eastern Washington University*
Hossein Bidgoli, *California State University, Bakersfield*
James Borden, *Villanova University*
Mari Buche, *Michigan Technological University*
Sheryl Bulloch, *Columbia Southern University*
Thomas Case, *Georgia Southern University*
Thomas Cavaiani, *Boise State University*
Vera Cervantez, *Collin County Community College*
Siew Chan, *University of Massachusetts, Boston*
Andrea Chandler, *independent consultant*
Joey Cho, *Utah State University*
Jimmy Clark, *Austin Community College*
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Roy Dejoie, *Purdue University*
Charles DeSassure, *Tarrant County College*
Carol DesJardins, *St. Claire Community College*
Dawna Dewire, *Babson College*
Michael Doherty, *Marian College of Fond du Lac*
Mike Doherty, *University of Wyoming*
Richard Dowell, *The Citadel*
Chuck Downing, *University of Northern Illinois*
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Kevin Elder, *Georgia Southern Statesboro*
Kevin Lee Elder, *Georgia Southern University*
Sean Eom, *Southeast Missouri State University*
Patrick Fan, *Virginia Polytechnic Institute and State University*
Badie Farah, *Eastern Michigan University*
M. Farkas, *Fairfield University*
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William H. Friedman, *University of Central Arkansas*
Sharyn Gallagher, *University of Massachusetts, Lowell*
Gary Garrison, *Belmont University*
Beena George, *University of St. Thomas*
Biswadip Ghosh, *Metropolitan State College of Denver*

Dawn Giannoni, *Nova Southeastern University*
Ernest Gines, *Tarrant County College*
Steven Gordon, *Babson College*
Donald Gray, *independent consultant*
George Griffin, *Regis University*
Randy Guthrie, *California Polytechnic State University, Pomona*
Tom Hankins, *Marshall University*
Bassam Hasan, *University of Toledo*
Richard Herschel, *St. Joseph's University*
Vicki Hightower, *Elon University*
Bogdan Hoanca, *University of Alaska Anchorage*
Richard Holowczak, *Baruch College*
Walter Horn, *Webster University*
Dennis Howard, *University of Alaska Anchorage*
James Hu, *Santa Clara University*
Adam Huarng, *California State University, Los Angeles*
John Hupp, *Columbus State University*
Brent Hussin, *University of Wisconsin*
Mark Hwang, *Central Michigan University*
James Isaak, *Southern New Hampshire University*
Wade Jackson, *University of Memphis*
Thaddeus Janicki, *Mount Olive College*
Chuck Johnston, *Midwestern State University*
Susan Jones, *Utah State University*
Iris Junglas, *University of Houston, Main*
George Kelley, *Erie Community College-City Campus*
Richard Kesner, *Northeastern University*
Jadon Klopson, *United States Coast Guard Academy*
Brian Kovar, *Kansas State University*
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Stephen Kwan, *San Jose State University*
Jackie Lamoureux, *Central New Mexico Community College*
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Joo Eng Lee-Partridge, *Central Connecticut State University*
Diane Lending, *James Madison University*
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Keith Lindsey, *Trinity University*
Stephen Loy, *Eastern Kentucky University*
Steven Lunce, *Midwestern State University*
Efrem Mallach, *University of Massachusetts*
Purnendu Mandal, *Marshall University*
Ronald Mashburn, *West Texas A&M University*
Richard Mathieu, *James Madison University*
Sathasivam Mathiyalakan, *University of Massachusetts, Boston*
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Stephanie Miserlis, *Hellenic College*
Wai Mok, *University of Alabama in Huntsville*
Janette Moody, *The Citadel*
Ata Nahouraii, *Indiana University of Pennsylvania*
Adriene Nawrocki, *John F. Kennedy University*
Anne Nelson, *Nova Southeastern University*
Irina Neuman, *McKendree College*
Donald Norris, *Southern New Hampshire University*
Margaret O'Hara, *East Carolina University*
Ravi Patnayakuni, *University of Alabama, Huntsville*
Ravi Paul, *East Carolina University*
Lowell Peck, *Central Connecticut State University*
Richard Peschke, *Minnesota State University, Mankato*
Doncho Petkov, *Eastern Connecticut State University*
Olga Petkova, *Central Connecticut State University*
Leonard Presby, *William Paterson University of New Jersey*
Terry Province, *North Central Texas College*
Uzma Raja, *University of Alabama*
Adriane Randolph, *Kennesaw State University*
Harry Reif, *James Madison University*
Karl Reimers, *Mount Olive College*
Wes Rhea, *Kennesaw State University*
Frances Roebuck, *Wilson Technical Community College*
Richard Roncone, *United States Coast Guard Academy*
Roberta Roth, *University of Northern Iowa*
Cynthia Ruppel, *Nova Southeastern University*
Bruce Russell, *Northeastern University*
Ramesh Sankaranarayanan, *University of Connecticut*
Eric Santanen, *Bucknell University*
Atul Saxena, *Mercer University*
Charles Saxon, *Eastern Michigan University*
David Scanlan, *California State University, Sacramento*
Herb Schuette, *Elon University*
Ken Sears, *University of Texas, Arlington*
Robert Seidman, *Southern New Hampshire University*
Tom Seymour, *Minot State University*
Sherri Shade, *Kennesaw State University*
Ganesan Shankar, *Boston University*
Emily Shepard, *Central Carolina Community College*
Lakisha Simmons, *Belmont University*
David Smith, *Cameron University*
Glenn Smith, *James Madison University*
Stephen Solosky, *Nassau Community College*
Howard Sparks, *University of Alaska Fairbanks*
George Strouse, *York College*
Gladys Swindler, *Fort Hays State University*
Arta Szathmary, *Bucks County Community College*
Robert Szymanski, *University of South Carolina*
Albert Tay, *Idaho State University*
Winston Tellis, *Fairfield University*
Asela Thomason, *California State University, Long Beach*
Lou Thompson, *University of Texas, Dallas*
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Goran Trajkovski, *Western Governors University*
Kim Troboy, *Arkansas Technical University*
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Ronald Trugman, *Cañada College*
Nancy Tsai, *California State University, Sacramento*
Betty Tucker, *Weber State University*
William Tucker, *Austin Community College*
David VanOver, *Sam Houston State University*
Therese Viscelli, *Georgia State University*
William Wagner, *Villanova University*
Rick Weible, *Marshall University*
Melody White, *University of North Texas*
Robert Wilson, *California State University, San Bernardino*
Elaine Winston, *Hofstra University*
Joe Wood, *Webster University*
Michael Workman, *Florida Institute of Technology*
Kathie Wright, *Salisbury University*
James Yao, *Montclair State University*
Don Yates, *Louisiana State University*

ENDNOTES

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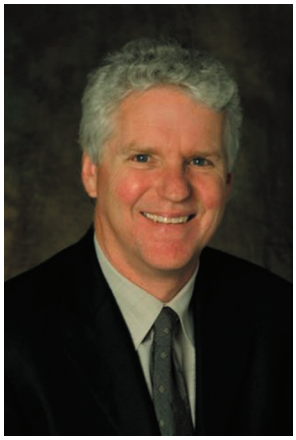

David Kroenke has many years of teaching experience at Colorado State University, Seattle University, and the University of Washington. He has led dozens of seminars for college professors on the teaching of information systems and technology; in 1991, the International Association of Information Systems named him Computer Educator of the Year. In 2009, David was named Educator of the Year by the Association of Information Technology Professionals-Education Special Interest Group (AITP-EDSIG).

David worked for the U.S. Air Force and Boeing Computer Services. He was a principal in the startup of three companies, serving as the vice president of product marketing and development for the Microrim Corporation and as chief of database technologies for Wall Data, Inc. He is the father of the semantic object data model. David's consulting clients have included IBM, Microsoft, and Computer Sciences Corporations as well as numerous smaller companies. Recently, David has focused on using information systems for teaching collaboration and teamwork.

His text *Database Processing* was first published in 1977 and is now in its 15th edition. He has authored and coauthored many other textbooks, including *Database Concepts,* 9th ed. (2020), *Experiencing MIS,* 9th ed. (2020), *SharePoint for Students* (2012), *Office 365 in Business* (2012), and *Processes, Systems, and Information: An Introduction to MIS*, 3rd ed. (2018).

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His research areas include deception detection in computer-mediated environments, secure information systems, the effects of IT on cognitive biases, the effects of IT on knowledge workers, and e-commerce. He has published in several academic journals and has authored several textbooks, including *Experiencing MIS*, 9th ed., *Corporate Computer and Network Security,* 5th ed., *Applied Information Security*, 2nd ed., and *Applied Networking Labs*, 2nd ed.

To C.J., Carter, and Charlotte
—David Kroenke

To Courtney, Noah, Fiona, Layla, and Henry
—Randy Boyle

PART 1

Why MIS?

eHermes is a 5-year-old, privately owned company that provides mobile shopping experiences using self-driving vehicles. Essentially, it's eBay on wheels that brings a mobile storefront right to your door. eHermes acts as a local classified broker that sells both used and new items. Its mobile storefronts pick up items customers want to sell and drop off items customers want to buy. Each of eHermes' mobile storefronts, which look like futuristic transparent shipping containers, can hold hundreds of different items.

eHermes mobile storefronts allow customers to physically inspect hundreds of similar items without having to meet sellers in person. Customers love this feature, and they often end up buying several items when the storefront stops in front of their house. eHermes charges a fee to put items up for sale for a set amount of time and receives a commission on each item purchased. The company also makes a moderate amount of ad revenue from its website and mobile app.

eHermes' CEO and cofounder is Jessica Ramma, a former VP at a midsized venture capital (VC) firm in California. Jessica got her MBA from the University of Chicago and immediately went to work analyzing high-tech startups for the VC firm. She quickly rose within the firm and made vice president in 8 years. Along the way, she developed a large network of highly skilled engineers and angel investors.

Source: Chesky/Shutterstock

While investigating a startup, she met Victor Vazquez. At the time, Victor was managing a small artificial intelligence startup that was working on a groundbreaking vision system. Victor was charming, intelligent, and wealthy and had already run several successful startups. He had the uncanny

Source: Andrey Suslov/Shutterstock

ability to know which companies were going to be successful, and he could effectively work with the founders to grow their companies quickly.

Jessica asked Victor about the practical applications of his company's vision system, and he kept coming back to its potential use in self-driving vehicles. Victor explained that self-driving vehicles can see better than human drivers and can react much more quickly if something goes wrong. The conversation then shifted to a broader discussion of the impact of self-driving vehicles. Jessica was convinced of the inevitability of widespread self-driving vehicle adoption and wondered how this might affect existing business models. In fact, a friend of hers, Kamala Patel, had developed some of the first inter-vehicle protocols used to send information between vehicles. Kamala was passionate about automation and believed self-driving vehicles would affect nearly every industry. Jessica asked Victor if he would have lunch with her and Kamala the following week. She had an idea.

At the lunch, Jessica pitched Victor and Kamala on the eHermes idea, and the company was born a few months later. Fast-forward 5 years. eHermes now has several dozen mobile storefronts with revenues of about $8 million per year. As the CEO, Jessica wants to grow the company more quickly by providing mobile storefronts to traditional companies like Walmart and local grocery stores as well as e-commerce retailers like Amazon. Victor is worried that the company is not ready. It's been a bumpy ride just to get the existing mobile storefronts working correctly.

Designing, building, and testing the storefronts have been expensive and, at times, frustrating. Creating the inventory tracking system was more complicated than initially thought. The routing, coordination, and optimization of the storefronts have been a nightmare, too. Inefficient routes increase fuel consumption, which has a big impact on the company's bottom line. And then there's the hugely expensive systems development project that's currently underway to automate the collection, storage, and analysis of storefront data. Currently, everything is recorded manually by sales associates who ride inside each storefront. Any new inventory is brought back to the warehouse, where it's photographed and entered into the online system.

Victor feels like they should wait to expand the business. The company doesn't have the money or the people to start a major expansion like the one Jessica is thinking about. But customers love buying from eHermes, and sales projections look promising. The company has gotten a lot of positive press lately, and investors are more than willing to throw money into the company.

Jessica also mentioned that they should explore the possibility of using some type of artificial intelligence (AI) or machine learning to increase the efficiency of the fleet. Coordinating all of the sales stops, inventory pickups, mobile storefront stocking, travel routes, charging and fueling times, and maintenance schedules is incredibly complex. The current system is working OK, but it's not optimal. And it's hurting eHermes financially. The company needs a fully integrated solution.

CHAPTER 1

The Importance of MIS

"Fired? You're firing me?"

"Well, fired is a harsh word, but ... well, eHermes has no further need of your services."

"But, Victor, I don't get it. I really don't. I worked hard, and I did everything you told me to do."

"Amanda, that's just it. You did everything I told you to do."

"I put in so many hours. How could you fire me?"

"Your job was to find ways to reduce our costs using AI or machine learning."

"Right! And I did that."

"No, you didn't. You followed up on ideas that I gave you. But we don't need someone who can follow up on my plans. We need someone who can figure out what we need to do, create her own plans, and bring them back to me ... and others."

"How could you expect me to do that? I've only been here 6 months!"

"It's called teamwork. Sure, you're just learning our business, but I made sure all of our senior staff would be available to you ..."

"I didn't want to bother them."

MyLab MIS
Using Your Knowledge
Questions 1-1, 1-2, 1-3

"Well, you succeeded. I asked Kamala what she thought of the plans you're working on. 'Who's Amanda?' she asked."

"But doesn't she work down at the warehouse hub?"

"Right. She's in charge of operations ... and it would seem to be worth talking to her."

"I'll go do that!"

"Amanda, do you see what just happened? I gave you an idea, and you said you'd do it. That's not what I need. I need you to find solutions on your own."

"I worked really hard. I put in a lot of hours. I've got all these reports written."

"Has anyone seen them?"

"I talked to you about some of them. But I was waiting until I was satisfied with them."

"Right. That's not how we do things here. We develop ideas and then kick them around with each other. Nobody has all the smarts. Our plans get better when we comment and rework them ... I think I told you that."

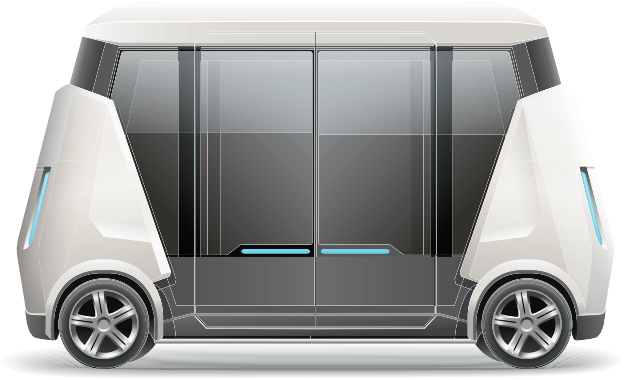
"Maybe you did. But I'm just not comfortable with that."

"Well, it's a key skill here."

"I know I can do this job."

"Amanda, you've been here almost 6 months; you have a degree in business and information systems. Several weeks ago, I asked you for your first idea for a process that would identify which AIs or machine learning processes could be used to reduce costs and increase efficiency. Do you remember what you said?"

"Yes, I wasn't sure how to proceed. I didn't want to just throw something out that might not work."



"But today, they're not enough."

Source: VORTEX/Shutterstock

"But how would you find out if it would work?"

"I don't want to waste money ..."

"No, you don't. So, when you didn't get very far with that task, I backed up and asked you to send me a list of companies that are currently using AIs and machine learning. I wanted to know what types of problems they're solving, the magnitude of efficiency gains they're realizing, how long it took to implement these systems, and a basic description of how they might be used in our company. Not details, just an overview."

"Yes, I sent you those lists and descriptions."

"Amanda, they made no sense. Your lists included companies that use AI vision systems and natural language processing systems, and your description of how AI could be used at eHermes was focused on robotics."

"I know they can be used for planning and optimization too. I just didn't include it in the material I sent you. But I'll try again!"

Study QUESTIONS

- **Q1-1** Why is Introduction to MIS the most important class in the business school?
- **Q1-2** How will MIS affect you?
- **Q1-3** What is MIS?
- **Q1-4** How can you use the five-component model?
- **Q1-5** What is information?
- **Q1-6** What are necessary data characteristics?
- **Q1-7** 2031?

"Well, I appreciate that attitude, but we're a small company, really still a startup in many ways. Everyone needs to pull more than their own weight here. Maybe if we were a bigger company, I'd be able to find for a spot for you, see if we could bring you along. But we can't afford to do that now."

"What about my references?"

"I'll be happy to tell anyone that you're reliable, that you work 40 to 45 hours a week, and that you're honest and have integrity."

"Those are important!"

"Yes, they are. But today, they're not enough."

Chapter PREVIEW

"But today, they're not enough."

Do you find that statement sobering? And if hard work isn't enough, what is? We'll begin this book by discussing the key skills that Amanda (and you) need and explaining why this course is the single best course in the business school for teaching you those key skills.

You may find that last statement surprising. If you are like most students, you have no clear idea of what your MIS class will be about. If someone were to ask you, "What do you study in that class?" you might respond that the class has something to do with computers and maybe computer programming. Beyond that, you might be hard-pressed to say more. You might add, "Well, it has something to do with computers in business," or maybe, "We are going to learn to solve business problems with computers using spreadsheets and other programs." So, how could this course be the most important one in the business school?

We begin with that question. After you understand how important this class will be to your career, we will discuss fundamental concepts. We'll wrap up with some practice on one of the key skills you need to learn.

Q1-1 Why Is Introduction to MIS the Most Important Class in the Business School?

Introduction to MIS is the most important class in the business school. This wasn't always the case. A couple decades ago, majoring in "computers" was considered a nerdy thing to do. But things have changed—a lot. Now the hottest jobs are found in tech companies. People brag about working for tech startups. Microsoft Corp. is the largest corporation in the world with a market cap of about $1.36T. The second largest IPO offering in history ($25B) came from the online e-commerce giant Alibaba (Alibaba Holdings Group) in 2014.

But why? Why has information technology changed from a minor corporate support function to a primary driver of corporate profitability? Why are tech jobs some of the highest paid? Why is working for a tech company considered übercool?

The answer has to do with the way technology is fundamentally changing business.

The Digital Revolution

You've probably heard that we live in the **Information Age**, or a period in history where the production, distribution, and control of information is the primary driver of the economy. The Information Age started in the 1970s with the **Digital Revolution**, or the conversion from mechanical

and analog devices to digital devices. This shift to digital devices meant monumental changes for companies, individuals, and our society as a whole.

The problem was, people couldn't really understand how, or even why, this shift was going to affect them. Much like people today, they based their future projections on past events. They knew factories, bureaucracies, mass production, and operational efficiency. But this knowledge didn't prepare them for the changes that were coming.

The Digital Revolution didn't just mean that new "digital" equipment was replacing old mechanical, or analog, equipment. These new digital devices could now be connected to other digital devices and share data among themselves. They could also work faster as processor speed increased. This was groundbreaking. In 1972, computer scientist Gordon Bell recognized that these digital devices would change the world as they evolved and became widely used. He formulated **Bell's Law**, which states that "a new computer class forms roughly each decade establishing a new industry."[1] In other words, digital devices will evolve so quickly that they will enable new platforms, programming environments, industries, networks, and information systems every 10 years.

And it has happened just as Bell predicted. About every 10 years since 1970, entirely new classes of digital devices have emerged. They have created entirely new industries, companies, and platforms. In the 1980s, we saw the rise of the personal computer (PC) and small local networks. In the 1990s, we saw the rise of the Internet and widespread adoption of cellular phones. In the 2000s, we saw a push toward making all "things" network-enabled. Social networking and cloud-based services really took off, creating a flurry of new companies. In the 2010s, we've seen huge advances in artificial intelligence, 3D printing, digital reality devices (e.g., Microsoft HoloLens), self-driving vehicles, and cryptocurrencies.

The evolution of digital technology has fundamentally altered businesses and become a primary driver of corporate profitability. And it will probably continue to do so for at least the next few decades. The key to understanding how businesses will be affected by this digital evolution is understanding the forces pushing the evolution of these new digital devices.

Evolving Capabilities

To understand the fundamental forces pushing the evolution of digital devices, let's imagine your body is evolving at the same rate as digital devices. Suppose you can run 8 miles per hour today. That's about average. Now suppose, hypothetically, that your body is changing so quickly that you can run twice as fast every 18 months. In 18 months, you'd be able to run 16 mph. In another 18 months, you'd be at 32 mph. Then 64, 128, 256, and 512. Then, after 10 1/2 years of growth, you'd be running 1,024 mph—on foot! How would this change your life?

Well, you'd certainly give up your car. It would be much too slow. Air travel would also probably be a thing of the past. You could start a very profitable package delivery business and quickly corner the market. You could live outside of the city because your commute would be shorter. You'd also need new clothes and some really tough shoes! And this is the key point—not only would *you* change, but *what* you do and *how* you do it would also change. This is Bell's Law. This same thing is happening to digital devices.

This example may seem silly at first, but it helps you understand how exponential change is affecting digital devices. Processing power, interconnectivity of devices, storage capacity, and bandwidth are all increasing extremely rapidly—so rapidly that it's changing how these devices are used. Let's explore some of these forces by looking at the laws that describe them.

Moore's Law

In 1965, Gordon Moore, cofounder of Intel Corporation, stated that because of technology improvements in electronic chip design and manufacturing, "The number of transistors per square inch on an integrated chip doubles every 18 months." This became known as **Moore's Law**. His statement has been commonly misunderstood to be "The speed of a computer doubles every 18 months," which is incorrect but captures the sense of his principle.

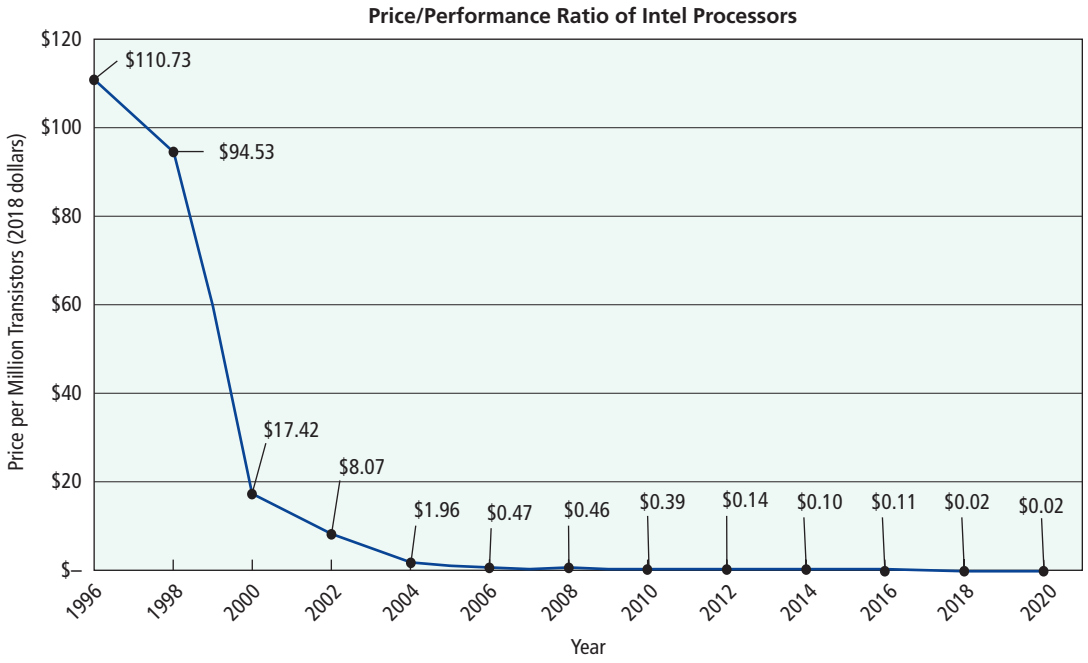


FIGURE 1-1
Computer Price/Performance Ratio Decreases
Source: © Based on data from ark.intel.com#@Processors and techpowerup.com

Because of Moore's Law, the ratio of price to performance of computer processors has fallen dramatically. In 1996, when the Internet was really starting to take off, a standard CPU cost about $110 per million transistors. By 2020 that price had fallen to $0.02 per million transistors.[2] See Figure 1-1. Increasing processing power has had a greater impact on the global economy in the past 30 years than any other single factor. It has enabled new devices, applications, companies, and platforms. In fact, most tech companies would not exist today if processing power hadn't increased exponentially.

As a future business professional, however, you needn't care how fast a computer your company can buy for $1,000. That's not the point. The point is, because of Moore's Law, the cost of data processing is approaching zero. Current applications like new drug development, artificial intelligence, and molecular modeling require massive amounts of processing power. Innovations in these areas are being held back because the cost of buying sufficient processing power is so high. But the good news is that the cost of processing is dropping—rapidly.

Metcalfe's Law

Another fundamental force that is changing digital devices is Metcalfe's Law, named after Robert Metcalfe, the inventor of Ethernet. **Metcalfe's Law** states that the value of a network is equal to the square of the number of users connected to it. In other words, as more digital devices are connected together, the value of that network will increase.[3] See Figure 1-2. Metcalfe's Law can be clearly seen in the dramatic rise of the Internet in the 1990s. As more users gained access to the Internet, it became more valuable. The dot-com boom ushered in tech giants like Google, Amazon, and eBay. None of these companies would have existed without large numbers of users connected to the Internet.

Metcalfe's Law isn't lost on tech companies, either. Google's Project Loon is a major effort to bring Internet access to everyone on the planet using a network of inflated balloons floating around the world. One of the primary metrics for social media companies is the number of monthly active users (MAU) using their social network. The more people they can get in their network, the more their company will be worth. And look at the network effects of using products like Microsoft Word. Why do you pay for Microsoft Word when you could use a free word processor like LibreOffice Writer? You pay for Microsoft Word because everyone else uses it.

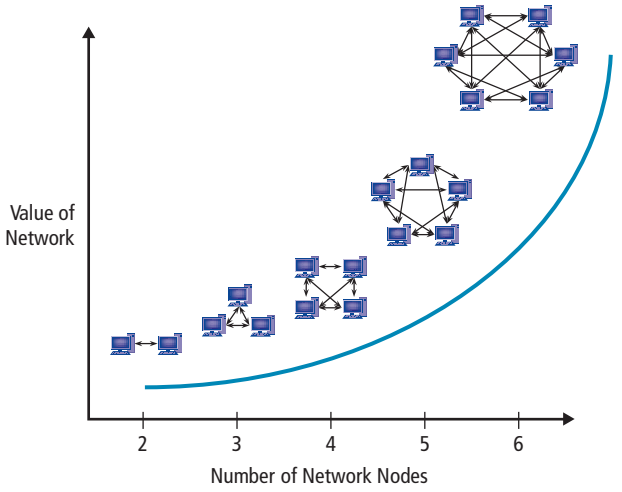


FIGURE 1-2
Increasing Value of Networks

Other Forces Pushing Digital Change

And it's not just the number of users on the network that's changing the way we use digital devices—it's the *speed* of the network. **Nielsen's Law**, named after Jakob Nielsen, says that network connection speeds for high-end users will increase by 50 percent per year. As networks become faster, new companies, new products, and new platforms will emerge.

YouTube, for example, started in February 2005 when there wasn't a lot of video shared over the Internet. But average Internet speeds were increasing to the point where a typical Internet connection could handle a stream of YouTube videos. By November 2006, the company was bought by Google for $1.65B. If you're counting, that's less than 2 years to create a billion-dollar company. Network speed matters. The question is why didn't Google, Microsoft, IBM, or Apple think of video sharing before the YouTube founders?

There are other forces changing digital devices beyond Nielsen's Law, Metcalfe's Law, and Moore's Law. See Figure 1-3. **Kryder's Law**, named after Mark Kryder, the former chief technology officer of Seagate Corp., says that the storage density on magnetic disks is increasing at an exponential rate. See Figure 1-4. Digital storage is so important that it's typically the first question you ask when you buy a new computer, smartphone, or tablet. There's also power consumption, image resolution, and interconnectivity between devices, all of which are changing, too. And this isn't a complete list.

Law	Meaning	Implications
Moore's Law	The number of transistors per square inch on an integrated chip doubles every 18 months.	Computers are getting exponentially faster. The cost of data processing is approaching zero.
Metcalfe's Law	The value of a network is equal to the square of the number of users connected to it.	More digital devices are connected together. The value of digital and social networks is increasing exponentially.
Nielsen's Law	Network connection speeds for high-end users will increase by 50 percent per year.	Network speed is increasing. Higher speeds enable new products, platforms, and companies.
Kryder's Law	The storage density on magnetic disks is increasing at an exponential rate.	Storage capacity is increasing exponentially. The cost of storing data is approaching zero.

FIGURE 1-3
Fundamental Forces Changing Technology

This Is the Most Important Class in the School of Business

This takes us back to our original statement that Introduction to MIS is the most important class you will take in the school of business. Why? Because this class will show you how technology is fundamentally changing businesses. You'll learn why executives are constantly trying to find ways

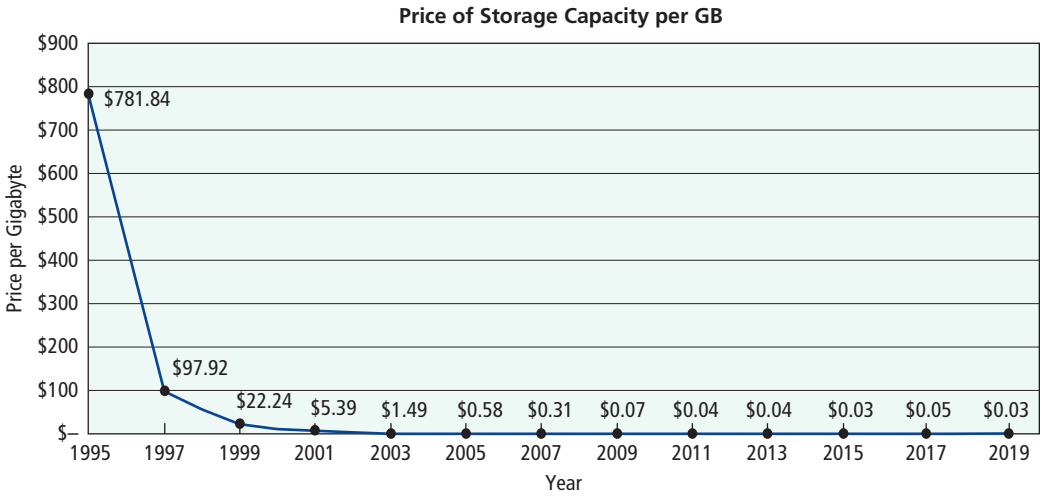


FIGURE 1-4
Price of Storage Capacity per GB

to use new technology to create a sustainable competitive advantage. This leads us to the first reason Introduction to MIS is the most important course in the business school today:

Future business professionals need to be able to assess, evaluate, and apply emerging information technology to business.

You need the knowledge of this course to attain that skill.

Q1-2 How Will MIS Affect You?

Technological change is accelerating. So what? How is this going to affect you? You may think that the evolution of technology is just great. You can hardly wait for the next iGadget to come out.

But pause for a second and imagine you graduated from college in 2004 and went to work for one of the largest and most successful home entertainment companies in the United States—Blockbuster LLC. In 2004, Blockbuster had 60,000 employees and 9,000-plus stores with $5.9B in annual revenues. Everything looked peachy. Fast-forward 6 years to 2010 and Blockbuster was bankrupt! Why? Because streaming a video over the Internet is easier than driving to a store. High-speed Internet connections made it all possible.

The point is that after graduation you too may choose to go to work for a large, successful, well-branded company. And 6 years down the road, it could be bankrupt because technology changed and it didn't.

How Can You Attain Job Security?

Many years ago, I had a wise and experienced mentor. One day I asked him about job security, and he told me that the only job security that exists is "a marketable skill and the courage to use it." He continued, "There is no security in our company, there is no security in any government program, there is no security in your investments, and there is no security in Social Security." Alas, how right he turned out to be.

So, what is a marketable skill? It used to be that one could name particular skills, such as computer programming, tax accounting, or marketing. But today, because of Moore's Law, Metcalfe's Law, and Kryder's Law, the cost of data processing, storage, and communications is essentially zero. Any routine skill can and will be outsourced to the lowest bidder. And if you live in the United States, Canada, Australia, Europe, or another advanced economy, the lowest bidder is unlikely to be you.

Numerous organizations and experts have studied the question of what skills will be marketable during your career. Consider two of them. First, the RAND Corporation, a think tank located in Santa Monica, California, has published innovative and groundbreaking ideas for more than

Skill	Example	Amanda's Problem at eHermes
Abstract reasoning	Construct a model or representation.	Hesitancy and uncertainty when conceptualizing a method for using AI and machine learning.
Systems thinking	Model system components and show how components' inputs and outputs relate to one another.	Inability to model eHermes' operational needs.
Collaboration	Develop ideas and plans with others. Provide and receive critical feedback.	Unwilling to work with others on works in progress.
Ability to experiment	Create and test promising new alternatives, consistent with available resources.	Fear of failure prohibited discussion of new ideas.

FIGURE 1-5
Examples of Critical Skills for Nonroutine Cognition

70 years, including the initial design for the Internet. In 2004, RAND published a description of the skills that workers in the 21st century will need:

> Rapid technological change and increased international competition place the spotlight on the skills and preparation of the workforce, particularly the ability to adapt to changing technology and shifting demand. Shifts in the nature of organizations ... favor strong nonroutine cognitive skills.[4]

Whether you're majoring in accounting, marketing, finance, or information systems, you need to develop strong nonroutine cognitive skills.

What are such skills? Robert Reich, former Secretary of Labor, enumerates four:[5]

- Abstract reasoning
- Systems thinking
- Collaboration
- Ability to experiment

Figure 1-5 shows an example of each. Reread the eHermes case that started this chapter, and you'll see that Amanda lost her job because of her inability to practice these key skills. Even though Reich's book was written in the early 1990s, the cognitive skills he mentions are still relevant today because humans, unlike technology, aren't changing that rapidly.[6]

How Can Intro to MIS Help You Learn Nonroutine Skills?

Introduction to MIS is the best course in the business school for learning Reich's four key skills because every topic requires you to apply and practice them. Here's how.

Abstract Reasoning

Abstract reasoning is the ability to make and manipulate models. You will work with one or more models in every course topic and book chapter. For example, later in this chapter you will learn about a *model* of the five components of an information system. This chapter will describe how to use this model to assess the scope of any new information system project; other chapters will build upon this model.

In this course, you will not just manipulate models that we have developed, you will also be asked to construct models of your own. In Chapter 5, for example, you'll learn how to create data models, and in Chapter 12 you'll learn to make process models.

Systems Thinking

Can you go to a grocery store, look at a can of green beans, and connect that can to U.S. immigration policy? Can you watch tractors dig up a forest of pulpwood trees and connect that woody trash

to Moore's Law? Do you know why Cisco Systems is one of the major beneficiaries of YouTube? Answers to all of these questions require systems thinking. **Systems thinking** is the ability to model the components of the system to connect the inputs and outputs among those components into a sensible whole that reflects the structure and dynamics of the phenomenon observed.

As you are about to learn, this class is about information *systems.* We will discuss and illustrate systems; you will be asked to critique systems; you will be asked to compare alternative systems; you will be asked to apply different systems to different situations. All of those tasks will prepare you for systems thinking as a professional.

Collaboration

Collaboration is the activity of two or more people working together to achieve a common goal, result, or work product. Chapter 7 will teach you collaboration skills and illustrate several sample collaboration information systems. Every chapter of this book includes collaboration exercises that you may be assigned in class or as homework.

Here's a fact that surprises many students: Effective collaboration isn't about being nice. In fact, surveys indicate the single most important skill for effective collaboration is to give and receive critical feedback. Advance a proposal in business that challenges the cherished program of the VP of marketing, and you'll quickly learn that effective collaboration skills differ from party manners at the neighborhood barbeque. So, how do you advance your idea in the face of the VP's resistance? And without losing your job? In this course, you can learn both skills and information systems for such collaboration. Even better, you will have many opportunities to practice them.

Ability to Experiment

"I've never done this before."
"I don't know how to do it."
"But will it work?"
"Is it too weird for the market?"

Fear of failure: the fear that paralyzes so many good people and so many good ideas. In the days when business was stable, when new ideas were just different verses of the same song, professionals could allow themselves to be limited by fear of failure.

Let's look at an example of the application of social networking to the oil change business. Is there a legitimate application of social networking there? If so, has anyone ever done it? Is there anyone in the world who can tell you what to do? How to proceed? No. As Reich says, professionals in the 21st century need to be able to experiment.

Successful experimentation is not throwing buckets of money at every crazy idea that enters your head. Instead, **experimentation** is making a reasoned analysis of an opportunity, envisioning potential solutions, evaluating those possibilities, and developing the most promising ones, consistent with the resources you have.

In this course, you will be asked to use products with which you have no familiarity. Those products might be Microsoft Excel or Access, or they might be features and functions of Blackboard that you have not used. Or you may be asked to collaborate using OneDrive or SharePoint or Google Drive. Will your instructor explain and show every feature of those products that you'll need? You should hope not. You should hope your instructor will leave it up to you to experiment, to envision new possibilities on your own, and to experiment with those possibilities, consistent with the time you have available.

Jobs

Employment is another factor that makes the Introduction to MIS course vitally important to you. Accenture, a technology consulting and outsourcing company, conducted a survey of CEOs in 2018. It found that 74 percent of CEOs plan to use Artificial Intelligence (AI) to automate tasks

to a large or very large extent over the next three years. But those same CEOs also believe that only 26 percent of their workers are prepared to collaborate with their AI coworkers. Even worse, only 3 percent of CEOs plan on increasing investments toward training and reskilling employees to prepare them for these new tech-centric jobs.[7] Understanding technology and having a willingness to learn new tech skills will be an increasingly important part of staying gainfully employed in the future. You will learn more about intelligent systems, including AI, in Chapter 3.

The demand for information systems and business jobs is high and driving future wage growth. According to data from the U.S. Bureau of Labor Statistics, shown in Figure 1-6, the top five occupational categories with the highest median wages in 2019 were management, computer and mathematical, legal, architecture and engineering, and business and financial operations. Projected job growth in computer and mathematical jobs (12.7 percent) was more than double the average for all occupations (5.2 percent). The mismatch between the high level of tech skills demanded by employers and the low level of tech skills held by employees is known as the **technology skills gap**.

Occupations	2018 Median Wage	2019 Median Wage	2018–28 Percent Job Growth
Management	$ 104,240	$ 105,660	6.9
Computer and mathematical	$ 86,340	$ 88,340	12.7
Legal	$ 80,810	$ 81,820	6.9
Architecture and engineering	$ 80,170	$ 81,440	4.2
Business and financial operations	$ 68,350	$ 69,820	6.9
Healthcare practitioners and technical	$ 66,440	$ 68,190	11.9
Life, physical, and social science	$ 66,070	$ 68,160	7.4
Education, training, and library	$ 49,290	$ 51,150	3.3
Arts, design, entertainment, sports, and media	$ 49,700	$ 50,790	5.3
Construction and extraction	$ 46,010	$ 47,430	9.8
Installation, maintenance, and repair	$ 45,540	$ 46,630	3.8
Community and social service	$ 44,960	$ 46,090	11.2
Protective service	$ 40,640	$ 41,580	2.7
All occupations	$ 38,640	$ 39,810	5.2
Office and administrative support	$ 35,760	$ 37,580	−2.6
Production	$ 35,070	$ 36,000	−4.5
Transportation and material moving	$ 32,730	$ 32,440	4.5
Healthcare support	$ 28,180	$ 29,630	−0.5
Sales and related	$ 29,740	$ 28,470	18.2
Building and grounds cleaning and maintenance	$ 26,840	$ 28,330	5.1
Farming, fishing, and forestry	$ 25,380	$ 27,180	0.3
Personal care and service	$ 24,420	$ 26,220	17.4
Food preparation and serving related	$ 23,070	$ 24,220	10.9

FIGURE 1-6
Median Wage and Percent Job Growth by Sector
Source: Employment Projections program, U.S. Bureau of Labor Statistics.

Figure 1-7 shows a more detailed breakdown of salary growth from 2017 to 2019 for specific subcategories under business managers, computer and information technology, and other business occupations. It also shows job growth projections for the years 2018 to 2028.[8] Growth rates of all information systems–related jobs are at or above the 5.2 percent average for all occupations. Some are growing many times faster.

	2017 Median Pay	2018 Median Pay	2019 Median Pay	Job Growth (%) 2018–28	Job Growth (N) 2018–28
Business Managers					
Marketing Managers	$ 129,380	$ 132,620	$ 135,900	8%	21,800
Information Systems Managers	$ 139,220	$ 142,530	$ 146,360	11%	46,800
Financial Managers	$ 125,080	$ 127,990	$ 129,890	16%	104,700
Human Resources Managers	$ 110,120	$ 113,300	$ 116,720	7%	10,800
Sales Managers	$ 121,060	$ 124,220	$ 126,640	5%	20,600
Computer and Information Technology					
Computer Network Architects	$ 104,650	$ 109,020	$ 112,690	5%	8,400
Computer Systems Analysts	$ 88,270	$ 88,740	$ 90,920	9%	56,000
Database Administrators	$ 87,020	$ 90,070	$ 93,750	9%	10,500
Information Security Analysts	$ 95,510	$ 98,350	$ 99,730	32%	35,500
Network and Systems Administration	$ 81,100	$ 82,050	$ 83,510	5%	18,200
Software Developers	$ 103,560	$ 105,590	$ 105,590	21%	284,100
Web Developers	$ 67,990	$ 69,430	$ 73,760	13%	20,900
Business Occupations					
Accountants and Auditors	$ 69,350	$ 70,500	$ 71,550	6%	90,700
Financial Analysts	$ 84,300	$ 85,660	$ 85,660	6%	20,300
Management Analysts	$ 82,450	$ 83,610	$ 85,260	14%	118,300
Market Research Analysts	$ 63,230	$ 63,120	$ 63,790	20%	139,200
Logisticians	$ 74,590	$ 74,600	$ 74,750	5%	8,400
Human Resources Specialists	$ 60,350	$ 60,800	$ 61,920	5%	33,000

FIGURE 1-7
Bureau of Labor Statistics Occupational Outlook 2018–2028
Source: Based on Bureau of Labor Statistics, "Computer Systems Analysts," Occupational Outlook Handbook, accessed May 14, 2020, *www.bls.gov/ooh*.

Information systems and computer technology provide job and wage benefits beyond just IS professionals. Acemoglu and Autor published an impressive empirical study of jobs and wages in the United States and parts of Europe from the 1960s to 2010. They found that early in this period, education and industry were the strongest determinants of employment and salary. However, since 1990, the most significant determinant of employment and salary is the nature of work performed. In short, as the price of computer technology plummets, the value of jobs that benefit from it increases dramatically.[9]

For example, plentiful, high-paying jobs are available to business professionals who know how to use information systems to improve business process quality, or those who know how to interpret data mining results for improved marketing, or those who know how to use emerging technology like 3D printing to create new products and address new markets. See the Career Guide on pages 26–27 for more thoughts on why you might consider an IS-related job.

What Is the Bottom Line?

The bottom line? This course is the most important course in the business school because:

1. **It will give you the background you need to assess, evaluate, and apply emerging information systems technology to business.**
2. **It can give you the ultimate in job security—marketable skills—by helping you learn abstraction, systems thinking, collaboration, and experimentation.**
3. **Many well-paid MIS-related jobs are in high demand.**

Q1-3 What Is MIS?

We've used the term *MIS* several times, and you may be wondering exactly what it is. **MIS** stands for **management information systems**, which we define as *the management and use of information systems that help organizations achieve their strategies*. MIS is often confused with the closely related terms *information technology* and *information systems*. An **information system (IS)** is an assembly of hardware, software, data, procedures, and people that produces information. In contrast, **information technology (IT)** refers to the products, methods, inventions, and standards used for the purpose of producing information.

How are MIS, IS, and IT different? You cannot buy an IS. But you can buy IT; you can buy or lease hardware, you can license programs and databases, and you can even obtain predesigned procedures. Ultimately, however, it is *your* people who will assemble the IT you purchase and execute those procedures to employ that new IT. Information technology drives the development of new information systems.

For any new system, you will always have training tasks (and costs), you will always have the need to overcome employees' resistance to change, and you will always need to manage the employees as they use the new system. Hence, you can buy IT, but you cannot buy IS. Once your new information system is up and running, it must be managed and used effectively in order to achieve the organization's overall strategy. This is MIS.

Consider a simple example. Suppose your organization decides to develop a Facebook page. Facebook provides the IT. It provides the hardware and programs, the database structures, and standard procedures. You, however, must create the IS. You have to provide the data to fill your portion of its database, and you must extend its standard procedures with your own procedures for keeping that data current. Those procedures need to provide, for example, a means to review your page's content regularly and a means to remove content that is judged inappropriate. Furthermore, you need to train employees on how to follow those procedures and manage those employees to ensure that they do. MIS is the management of your Facebook page to achieve your organization's overall strategy. Managing your own Facebook page is as simple an IS as exists. Larger, more comprehensive IS that involve many, even dozens, of departments and thousands of employees require considerable work.

The definition of MIS has three key elements: *management and use, information systems*, and *strategies*. Let's consider each, starting first with information systems and their components.

Components of an Information System

A **system** is a group of components that interact to achieve some purpose. As you might guess, an *information system (IS)* is a group of components that interacts to produce information. That sentence, although true, raises another question: What are these components that interact to produce information?

Figure 1-8 shows the **five-component framework**—a model of the components of an information system: **computer hardware**, **software**, **data**, **procedures**, and **people**. These five components are present in every information system, from the simplest to the most complex. For example, when you use a computer to write a class report, you are using hardware (the computer, storage disk, keyboard, and monitor), software (Word, WordPerfect, or some other word-processing program), data (the words, sentences, and paragraphs in your report), procedures (the methods you use to start the program, enter your report, print it, and save and back up your file), and people (you).

Consider a more complex example, say, an airline reservation system. It, too, consists of these five components, even though each one is far more complicated. The hardware consists of

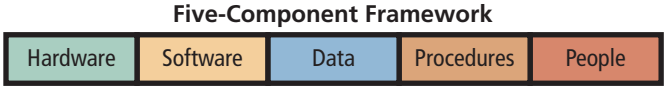


FIGURE 1-8
Five Components of an Information System

thousands of computers linked together by data communications hardware. Hundreds of different programs coordinate communications among the computers, and still other programs perform the reservations and related services. Additionally, the system must store millions upon millions of characters of data about flights, customers, reservations, and other facts. Hundreds of different procedures are followed by airline personnel, travel agents, and customers. Finally, the information system includes people, not only the users of the system but also those who operate and service the computers, those who maintain the data, and those who support the networks of computers.

The important point here is that the five components in Figure 1-8 are common to all information systems, from the smallest to the largest. As you think about any information system, including a new one like social networking, learn to look for these five components. Realize, too, that an information system is not just a computer and a program, but rather an assembly of computers, programs, data, procedures, and people.

As we will discuss later in this chapter, these five components also mean that many different skills are required besides those of hardware technicians or computer programmers when building or using an information system. See the Career Guide starting on pages 26–27 for more.

Before we move forward, note that we have defined an information system to include a computer. Some people would say that such a system is a **computer-based information system**. They would note that there are information systems that do not include computers, such as a calendar hanging on the wall outside of a conference room that is used to schedule the room's use. Such systems have been used by businesses for centuries. Although this point is true, in this book we focus on computer-based information systems. To simplify and shorten the book, we will use the term *information system* as a synonym for *computer-based information system*.

Management and Use of Information Systems

The next element in our definition of MIS is the *management and use* of information systems. Here we define management to mean develop, maintain, and adapt. Information systems do not pop up like mushrooms after a hard rain; they must be developed. They must also be maintained, and because business is dynamic, they must be adapted to new requirements.

You may be saying, "Wait a minute, I'm a finance (or accounting or management) major, not an information systems major. I don't need to know how to manage information systems." If you are saying that, you are like a lamb headed for shearing. Throughout your career, in whatever field you choose, information systems will be built for your use and sometimes under your direction. To create an information system that meets your needs, you need to take an *active role* in that system's development. Even if you are not a programmer or a database designer or some other IS professional, you must take an active role in specifying the system's requirements and in managing the system's development project. You will also have an important role in testing the new system. Without active involvement on your part, it will only be good luck that causes the new system to meet your needs.

As a business professional, you are the person who understands business needs and requirements. If you want to apply social networking to your products, you are the one who knows how best to obtain customer responses. The technical people who build networks, the database designers who create the database, the IT people who configure the computers—none of these people know what is needed and whether the system you have is sufficient or whether it needs to be adapted to new requirements. You do!

Security is critically important when using information systems today. You'll learn much more about it in Chapter 10. But you need to know about strong passwords and their use now, before you get to that chapter. Read and follow the Security Guide on pages 24–25.

In addition to management tasks, you will also have important roles to play in the *use* of information systems. Of course, you will need to learn how to employ the system to accomplish your job tasks. But you will also have important ancillary functions as well. For example, when using an information system, you will have responsibilities for protecting the security of the system and its data. You may also have tasks for backing up data. When the system fails (all do, at some point), you will have tasks to perform while the system is down as well as tasks to accomplish to help recover the system correctly and quickly.

Achieving Strategies

The last part of the definition of MIS is that information systems exist to help organizations *achieve their strategies*. First, realize that this statement hides an important fact: Organizations themselves do not "do" anything. An organization is not alive, and it cannot act. It is the people within a business who sell, buy, design, produce, finance, market, account, and manage. So, information systems exist to help people who work in an organization to achieve the strategies of that business.

Information systems are not created for the sheer joy of exploring technology. They are not created so the company can be "modern" or so the company can show it has a social networking presence on the Web. They are not created because the information systems department thinks it needs to be created or because the company is "falling behind the technology curve."

This point may seem so obvious that you might wonder why we mention it. Every day, however, some business somewhere is developing an information system for the wrong reasons. Right now, somewhere in the world, a company is deciding to create a Facebook presence for the sole reason that "every other business has one." This company is not asking questions such as:

- "What is the purpose of our Facebook page?"
- "What is it going to do for us?"
- "What is our policy for employees' contributions?"
- "What should we do about critical customer reviews?"
- "Are the costs of maintaining the page sufficiently offset by the benefits?"

For more information on how an understanding of MIS can broaden your career options, see the Career Guide on pages 26–27.

But that company should ask those questions! Chapter 2 addresses the relationship between information systems and strategy in more depth. Chapter 9 addresses social media and strategy specifically.

Again, MIS is the development and use of information systems that help businesses achieve their strategies. You should already be realizing that there is much more to this class than buying a computer, working with a spreadsheet, or creating a Web page.

Q1-4 How Can You Use the Five-Component Model?

The five-component model in Figure 1-8 can help guide your learning and thinking about IS, both now and in the future. To understand this framework better, first note in Figure 1-9 that these five components are symmetric. The outermost components, hardware and people, are both actors; they can take actions. The software and procedure components are both sets of instructions: Software is instructions for hardware, and procedures are instructions for people. Finally, data is the bridge between the computer side on the left and the human side on the right.

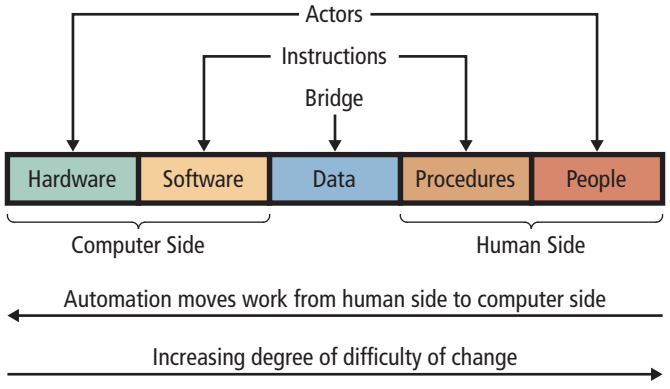


FIGURE 1-9
Characteristics of the Five Components

Now, when we automate a business task, we take work that people are doing by following procedures and move it so that computers will do that work, following instructions in software. Thus, the process of automation is a process of moving work from the right side of Figure 1-9 to the left.

The Most Important Component—You

You are part of every information system that you use. When you consider the five components of an information system, the last component, people, includes you. Your mind and your thinking are not merely a component of the information systems you use; they are the most important component.

As you will learn later in this chapter, computer hardware and programs manipulate data, but no matter how much data they manipulate, it is still just data. It is only humans that produce information. When you take a set of data, say, a list of customer responses to a marketing campaign, that list, no matter if it was produced using 10,000 servers and Hadoop, is still just data. It does not become information until you or some other human take it into your mind and are informed by it.

Even if you have the largest computer farm in the world and even if you are processing that data with the most sophisticated programs, if you do not know what to do with the data those programs produce, you are wasting your time and money. The quality of your thinking is what determines the quality of the information that is produced.

Substantial cognitive research has shown that although you cannot increase your basic IQ, you can dramatically increase the quality of your thinking. That is one reason we have emphasized the need for you to use and develop your abstract reasoning. The effectiveness of an IS depends on the abstract reasoning of the people who use it.

All Components Must Work

Information systems often encounter problems—despite our best efforts, they don't work right. And in these situations, blame is frequently placed on the wrong component. You will often hear people complain that the computer doesn't work, and certainly hardware or software is sometimes at fault. But with the five-component model, you can be more specific, and you have more suspects to consider. Sometimes the data is not in the right format or, worse, is incorrect. Sometimes, the procedures are not clear and the people using the system are not properly trained. By using the five-component model, you can better locate the cause of a problem and create effective solutions.

High-Tech Versus Low-Tech Information Systems

Information systems differ in the amount of work moved from the human side (people and procedures) to the computer side (hardware and programs). For example, consider two different versions of a customer support information system: A system that consists only of a file of email addresses and an email program is a very low-tech system. Only a small amount of work has been moved from the human side to the computer side. Considerable human work is required to determine when to send which emails to which customers.

In contrast, a customer support system that keeps track of the equipment that customers have and the maintenance schedules for that equipment and then automatically generates email reminders to customers is a higher-tech system. This simply means that more work has been moved from the human side to the computer side. The computer is providing more services on behalf of the humans.

Often, when considering different information systems alternatives, it will be helpful to consider the low-tech versus high-tech alternatives in light of the amount of work being moved from people to computers.

The Ethics Guide in each chapter of this book considers the ethics of information systems use. These guides challenge you to think deeply about ethical standards, and they provide for some interesting discussions with classmates. The Ethics Guide on pages 28–29 considers the ethics of presenting data that deceives the viewer.

Understanding the Scope of New Information Systems

The five-component framework can also be used when assessing the scope of new systems. When in the future some vendor pitches the need for a new technology to you, use the five components to assess how big of an investment that new technology represents. What new hardware will you need? What programs will you need to license? What databases and other data must you create? What procedures will need to be developed for both use and administration of the information system? And, finally, what will be the impact of the new technology on people? Which jobs will change? Who will need training? How will the new technology affect morale? Will you need to hire new people? Will you need to reorganize?

Components Ordered by Difficulty and Disruption

Finally, as you consider the five components, keep in mind that Figure 1-9 shows them in order of ease of change and the amount of organizational disruption. It is a simple matter to order additional hardware. Obtaining or developing new programs is more difficult. Creating new databases or changing the structure of existing databases is still more difficult. Changing procedures, requiring people to work in new ways, is even more difficult. Finally, changing personnel responsibilities and reporting relationships and hiring and terminating employees are all very difficult and very disruptive to the organization.

Q1-5 What Is Information?

Based on our earlier discussions, we can now define an information system as an assembly of hardware, software, data, procedures, and people that interact to produce information. The only term left undefined in that definition is *information*, and we turn to it next.

Definitions Vary

Information is one of those fundamental terms that we use every day but that turns out to be surprisingly difficult to define. Defining information is like defining words such as *alive* and *truth*. We know what those words mean, we use them with each other without confusion, but nonetheless, they are difficult to define.

In this text, we will avoid the technical issues of defining information and will use common, intuitive definitions instead. Probably the most common definition is that **information** is knowledge derived from data, whereas *data* is defined as recorded facts or figures. Thus, the facts that employee James Smith earns $70.00 per hour and that Mary Jones earns $50.00 per hour are *data*. The statement that the average hourly wage of all the graphic designers is $60.00 per hour is *information*. Average wage is knowledge derived from the data of individual wages.

Another common definition is that *information is data presented in a meaningful context*. The fact that Jeff Parks earns $30.00 per hour is data.[10] The statement that Jeff Parks earns less than half the average hourly wage of the company's graphic designers, however, is information. It is data presented in a meaningful context.

Another definition of information that you will hear is that *information is processed data* or, sometimes, *information is data processed by summing, ordering, averaging, grouping, comparing, or other similar operations.* The fundamental idea of this definition is that we do something to data to produce information.

There is yet a fourth definition of information, which was set out by the great research psychologist Gregory Bateson. He defined information as *a difference that makes a difference.*