GLOBAL EDITION

Accounting Information Systems

FIFTEENTH EDITION

Marshall B. Romney
Paul John Steinbart
Scott L. Summers
David A. Wood

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Preface

New to This Edition

INTRODUCING TWO NEW CO-AUTHORS

Scott L. Summers and David A. Wood, both from Brigham Young University, joined as new co-authors. Scott and David created the new section on data analytics (Part II), consisting of four chapters. The first chapter is an update of Chapter 4 that discusses relational databases not only as the basis for transaction processing systems, but also as one of the sources of Big Data and Analytics. The next three chapters (Chapters 5–7) discuss the Extract, Transfer, and Load (ETL) process and various data analytic techniques. This new content covers an extremely important topic that affects all aspects of designing, using, managing, and auditing an AIS.

ENHANCEMENTS IN THE FIFTEENTH EDITION

We made extensive revisions to the content of the material to incorporate recent developments while retaining the features that have made prior editions easy to use. Every chapter has been revised to include up-to-date examples of important concepts. Specific changes include the following:

1. Introduced several new topics in Chapter 1. The chapter discusses how an AIS can use artificial intelligence and data analytics to improve decision making, how the AIS is affected by blockchain technology, and the use of cloud computing, virtualization, and the internet of things.
2. Shortened and simplified the discussion of computer fraud and abuse techniques by eliminating many of the less frequently used techniques.
3. Simplified the discussion of control and the AIS by using the COSO Internal Control framework instead of the COSO Enterprise Risk Management framework as the structure for discussing controls.
4. Updated the discussion of information security countermeasures.
5. Updated the discussion of transaction processing and encryption to include blockchain technology.
6. Updated the discussion of privacy to include the EU's General Data Privacy Regulation (GDPR).
7. Updated the end-of-chapter discussion questions and problems, including Excel exercises that are based on articles from the *Journal of Accountancy* so that students can develop the specific skills used by practitioners. Most chapters also include a problem that consists of multiple-choice questions we have used in our exams to provide students with an additional chance to check how well they understand the chapter material.
8. Moved the topic of auditing (Chapter 11 in the fourteenth edition) to a web-only appendix because most of that material is covered in other courses.

Solving Learning and Teaching Challenges

STRUCTURED LEARNING

KEY LEARNING OBJECTIVES When you finish reading this text, you should understand the following key concepts:

- Basic activities performed in major business cycles.
- What data needs to be collected to enable managers to plan, evaluate, and control an organization's business activities.
- How to extract, transfer, and load (ETL) data from both the organization's AIS and other sources into a common repository that can be used for data analytics.
- How IT developments can improve the efficiency and effectiveness of business processes.
- How to design an AIS to provide the information needed to make key decisions in each business cycle.
- Risk of fraud and motives and techniques used to perpetrate fraud.
- COSO's models (Internal Control and ERM) for internal control and risk management as well as specific controls used to achieve these objectives.
- Control Objectives for Information and Related Technology (COBIT) framework for the effective governance and control of information systems and how IT affects the implementation of internal controls.
- AICPA's Trust Services framework for ensuring systems reliability by developing procedures to protect the confidentiality of proprietary information, maintain the privacy of personally identifying information collected from customers, assure the availability of information resources, and provide for information processing integrity.
- Fundamentals of information security.
- Fundamental concepts of database technology and data modeling and their effect on an AIS.
- Tools for documenting AIS work, such as REA diagrams, business processing diagrams, data flow diagrams, and flowcharts.
- Basic steps in the system development process to design and improve an AIS.

FEATURES TO FACILITATE LEARNING To help students understand these concepts, the text includes the following features:

1. **Each chapter begins with an integrated case that introduces key chapter concepts and topics and identifies several key issues or problems that students should be able to solve after mastering the material presented in that chapter.** The case is referenced throughout the chapter, and the chapter summary presents solutions to the problems and issues raised in the case.
2. **Focus boxes and real-world examples** to help students understand how companies use the latest IT developments to improve their AIS.
3. **Hands-on Excel exercises in many chapters** to help students hone their computer skills. Many of these exercises are based on "how-to" tutorials that appeared in recent issues of the *Journal of Accountancy*. Some of those articles discuss older versions of Excel, thereby giving students practice in developing the important life-long learning skill of adapting older instructions to updated versions of software.
4. **Numerous discussion questions and problems in every chapter** provide additional opportunities for students to demonstrate mastery of key concepts. Many problems were developed from reports in current periodicals. Other problems were selected from various professional examinations, including the CPA, CMA, CIA, and SMAC exams. One problem in every chapter consists of a set of multiple-choice questions to provide practice in answering exam-style questions. One or more problems where students are asked to match terms with their definitions to help students learn the terminology introduced in that chapter. **Each chapter also has one or more cases** that require more extensive exploration of specific topics.

5. **Quizzes** at the end of each chapter enable students to self-assess their understanding of the material. We also provide detailed explanations about the correct answer to each quiz question.
6. A number of chapters have a **comprehensive problem** in the AIS in Action section at the end of the chapter with the solution to the problem provided after quiz question solutions and explanations at the very end of the chapter.
7. **Extensive use of full-color graphics.** The text contains hundreds of figures, diagrams, flowcharts, and tables that illustrate chapter concepts, and color is used to highlight key points.
8. Definitions of key terms are repeated in the **glossary margins** in each chapter. In addition, a **comprehensive glossary** located at the back of the book makes it easy to look up the definition of the various technical terms used in the text.

CONTENT AND ORGANIZATION

Part I: Conceptual Foundations of Accounting Information Systems Part I consists of three chapters that present the underlying concepts fundamental to an understanding of AIS.

Chapter 1 introduces basic terminology and provides an overview of AIS topics. It discusses how an AIS can add value to an organization and how it can be used to help organizations implement corporate strategy. It also discusses the types of information companies need to successfully operate and introduces the basic business processes that produce that information. It concludes by describing the role of the AIS in an organization's value chain. It also introduces several new topics in the text: artificial intelligence, data analytics, blockchain, virtualization, cloud computing, and the Internet of Things.

Chapter 2 introduces transaction processing in automated systems and presents basic information about input/output, processing, and data storage concepts as well as the wide range of data that must be collected by the AIS. This information helps students understand what an AIS does; throughout the remainder of the book, we discuss advances in IT and how it affects the manner in which those functions are performed. The chapter discusses the impact of blockchain on transaction processing. Chapter 2 also introduces Enterprise Resource Planning (ERP) systems and their importance and uses in modern business.

Chapter 3 covers three of the most important tools and techniques used to understand, evaluate, design, and document information systems: business process diagrams, flowcharts, and data flow diagrams. Students will learn how to read, critique, and create systems documentation using these tools.

Part II: Data Analytics Part II consists of four chapters about relational databases, the ETL process, and various data analytics techniques.

Chapter 4 describes the principles of relational database design and how to use SQL to analyze the data. It also discusses how an organization's relational database used for transaction processing provides one important source of data for advanced data analytics.

Chapter 5 introduces the topic of data analysis and begins by stressing the importance of formulating and asking the right questions to obtain useful insights. It then explains the basic steps of extracting, transforming, and loading (ETL) data to be used for analytics. Next, it discusses how to choose appropriate analytic techniques and how to interpret and share the results. A discussion about the potential for automating analytics and a word of caution about the limits of what analytics can and cannot do concludes the chapter.

Chapter 6 delves into more detail about the different steps in the ETL process, focusing on how to transform data. It begins by describing the attributes that make data useful for analytics and then discusses techniques for structuring data, standardizing data being consolidated from multiple sources, cleaning data, and validating data.

Chapter 7 discusses the differences between descriptive, diagnostic, predictive, and prescriptive analytic techniques. It also describes how to choose the right visualization tools to aid in analysis and presents best practices for designing high-quality visualizations.

Part III: Control of Accounting Information Systems The six chapters in Part III focus on threats to the reliability of the AIS and applicable controls for addressing and mitigating the risks associated with those threats.

Chapter 8 introduces students to the different kinds of threats faced by information systems, primarily focusing on the threats of fraud and errors. The chapter describes the different types of fraud and explains how fraud is perpetrated, who perpetrates it, and why it occurs.

Chapter 9 discusses computer fraud and abuse techniques. Three major types of computer fraud are discussed: computer attacks and abuse, social engineering, and malware. The chapter explains the dozens of ways computer fraud and abuse can be perpetrated.

Chapter 10 uses the COSO Internal Control framework, to discuss the basic concepts of internal control. It introduces the expanded enterprise risk management (COSO-ERM) model and compares it with the COSO Internal Control framework. It also introduces the COBIT framework which applies those concepts to IT, thereby providing a foundation for effective governance and control of information systems.

Chapter 11 focuses on information security. It introduces the fundamental concepts of defense-in-depth and the time-based approach to security. The chapter provides a broad survey of a variety of security topics, including access controls, firewalls, encryption, and incident detection and response.

Chapter 12 discusses the many specific computer controls used in business organizations to achieve the objectives of ensuring privacy and confidentiality and discusses the implications of new regulations such as the EU's General Data Privacy Regulation (GDPR) and similar laws enacted by California and other states. The chapter also provides a detailed discussion of blockchain technology.

Chapter 13 addresses the controls necessary to achieve the objectives of accurate processing of information and ensuring that information is available to managers whenever and wherever they need it. It also discusses how virtualization and cloud technology are changing the methods used for backup and recovery.

Part IV: Accounting Information Systems Applications Part IV focuses on how a company's AIS provides critical support for its fundamental business processes. Most large and many medium-sized organizations use enterprise resource planning (ERP) systems to collect, process, and store data about their business processes as well as to provide information reports designed to enable managers and external parties to assess the organization's efficiency and effectiveness. To make it easier to understand how an ERP system functions, Part III consists of five chapters, each focusing on a particular business process.

Chapter 14 covers the revenue cycle (also referred to as the sales-to-cash business process), describing all the activities involved in taking customer orders, fulfilling those orders, and collecting cash.

Chapter 15 examines the expenditure cycle (also referred to as the purchase-to-pay business process), describing all the activities involved in ordering, receiving, and paying for merchandise, supplies, and services.

Chapter 16 reviews the production (manufacturing) cycle, with a special focus on the implications of recent cost accounting developments, such as activity-based costing, for the design of the production cycle information system.

Chapter 17 explains the human resources management/payroll cycle, focusing primarily on the activities involved in processing payroll.

Chapter 18 explores the general ledger and reporting activities in an organization, discussing topics such as XBRL, the balanced scorecard, and the switch from GAAP to IFRS.

Each of these five chapters explains the three basic functions performed by the AIS: efficient transaction processing, provision of adequate internal controls to safeguard assets (including data), and preparation of information useful for effective decision making.

Part V: The REA Data Model Part V consists of three chapters that focus on the REA data model, which provides a conceptual tool for designing and understanding the database underlying an AIS.

Chapter 19 introduces the REA data model and how it can be used to design an AIS database. The chapter focuses on modeling the revenue and expenditure cycles. It also demonstrates how the REA model can be used to develop an AIS that can not only generate traditional financial statements and reports but can also more fully meet the information needs of management.

Chapter 20 explains how to implement an REA data model in a relational database system. It also shows how to query a relational database to produce various financial statements and management reports.

Chapter 21 explains how to develop REA data models of the production, HR/payroll, and financing cycles. It also discusses a number of advanced modeling issues such as the acquisition and sale of intangible products and services and rental transactions.

Part VI: The Systems Development Process Part VI consists of three chapters that cover various aspects of the systems development process.

Chapter 22 introduces the systems development life cycle and discusses the introductory steps of this process (systems analysis, feasibility, and planning). Particular emphasis is placed on the behavioral ramifications of change.

Chapter 23 discusses an organization's many options for acquiring or developing an AIS (e.g., purchasing software, writing software, end-user-developed software, and outsourcing) and for speeding up or improving the development process (business process management, prototyping, agile methodologies, and computer-assisted software engineering).

Chapter 24 covers the remaining stages of the systems development life cycle (conceptual design, physical design, implementation, and operation and maintenance) and emphasizes the interrelationships among the phases.

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EXCEL HOMEWORK PROBLEMS Accountants need to become proficient with Excel because it is a useful tool for tasks related to every business process. That is why each of the chapters in the business process section contains several homework problems designed to teach new Excel skills in a context related to one of the business processes discussed in the chapter.

As with any software, Microsoft regularly releases updates to Microsoft Office, but not everyone always immediately switches. During your career you will periodically move to a newer version of Excel. When you do, you will find that sometimes you need to make only minor changes to existing spreadsheets, but other times you may have to make more significant changes because the newer version of Excel now incorporates different features and functions.

So how do you keep abreast of changes? And how can you learn new Excel skills "on the job" to simplify tasks that you now find yourself doing repeatedly? You could pay to take a course, but that can be costly, time-consuming and not always timely. Alternatively, you can develop life-long learning skills to continuously update your knowledge. One important way to do this is to begin now to save copies of two types of articles that regularly appear in the *Journal of Accountancy*. The first is the monthly column, "Technology Q&A," which often contains answers to questions about how do you do something in a newer version of Excel that you know how to do in an older version. The second type of article is a complete tutorial about a powerful way to use one or more Excel functions to automate a recurring task. Often, this second type of article has an online spreadsheet file that you can download and use to follow along with the example and thereby teach yourself a new skill.

The *Journal of Accountancy* website maintains an archive of these articles that you can search to see if there is one that addresses a task that is new for you. Even if the article explains how to do something (such as create a pivot table) in an older version of Excel, in most cases you will find that many of the steps have not changed. For those that have, if you read the old way to do it as described in the article, you can then use Excel's built-in help feature to see how to do the same task in the newer version that you are now using.

The ability to learn how to use new versions of software on your own is an important lifelong learning skill. Indeed, recruiters are looking for evidence that a job candidate not only has acquired a body of knowledge but also knows how to research and learn new versions of existing software tools. The various Excel homework problems in this text help you learn how to do this.

From the Authors

TO THE INSTRUCTOR

This book is intended for use in a one-semester course in accounting information systems at either the undergraduate or graduate level. Introductory financial and managerial accounting courses are suggested prerequisites, and an introductory information systems course that covers a computer language or software package is helpful, but not necessary.

The book can also be used as the main text in graduate or advanced undergraduate management information systems courses.

The topics covered in this text provide information systems students with a solid understanding of transaction processing systems that they can then build on as they pursue more in-depth study of specific topics such as databases, data analytics, networks, systems analysis and design, cloud computing, virtualization, blockchain, artificial intelligence, Internet of Things, computer security, and information system controls.

TO THE STUDENT

As in previous editions, the fifteenth edition of *Accounting Information Systems* is designed to prepare you for a successful accounting career whether you enter public practice, industry, or government. All of you will be users of accounting information systems. In addition to being users, some of you will become managers. Others will become internal and external auditors, and some of you will become consultants. Regardless of your role, you will need to understand how accounting information systems work in order to effectively measure how cost-effectively they perform, to assess their reliability and that of the information produced, or to lead the redesign and implementation of new and better systems. Mastering the material presented in this text will give you the foundational knowledge you need to excel at all those tasks.

This text discusses important new IT developments, such as blockchain and data analytics, because such developments affect business processes and often cause organizations to redesign their accounting systems to take advantage of new capabilities. The focus, however, is not on IT for the sake of IT, but on how IT affects business processes and controls. Indeed, new IT developments not only bring new capabilities, but also often create new threats and affect the overall level of risk. This text will help you understand these issues so that you can properly determine how to modify accounting systems controls to effectively address those new threats and accurately assess the adequacy of controls in those redesigned systems. We also discuss the effect of recent regulatory developments, such as the EU's General Data Privacy Regulation (GDPR) and similar legislation in California and other states, on the design and operation of accounting systems.

In addition to technology- and regulatory-driven changes, companies are responding to the increasingly competitive business environment by reexamining every internal activity to reap the most value at the least cost. As a result, accountants are asked to do more than simply report the results of past activities. They must take a more proactive role in both providing and interpreting financial and nonfinancial information about the organization's

activities. Therefore, throughout this text, we discuss how accountants can improve the design and functioning of the accounting information system (AIS) so that it truly adds value to the organization by providing management with the information needed to effectively run an organization.

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Conceptual Foundations of Accounting Information Systems

PART

I

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CHAPTER 1
Accounting Information Systems: An Overview

CHAPTER 2
Overview of Transaction Processing and Enterprise Resource Planning Systems

CHAPTER 3
Systems Documentation Techniques

CHAPTER

1

Accounting Information Systems: An Overview

LEARNING OBJECTIVES

After studying this chapter, you should be able to:

1. Distinguish data from information, discuss the characteristics of useful information, and explain how to determine the value of information.
2. Explain the decisions an organization makes, the information needed to make them, and the major business processes present in most companies.
3. Explain how an accounting information system (AIS) adds value to an organization, how it affects and is affected by corporate strategy, and its role in a value chain.

INTEGRATIVE CASE S&S

After working for years as a regional manager for a retail organization, Scott Parry opened his own business with Susan Gonzalez, one of his district managers, as his partner. They formed S&S to sell appliances and consumer electronics. Scott and Susan pursued a "clicks and bricks" strategy by renting a building in a busy part of town and adding an electronic storefront.

Scott and Susan invested enough money to see them through the first six months. They will hire 15 employees within the next two weeks—three to stock the shelves, four sales representatives, six checkout clerks, and two to develop and maintain the electronic storefront.

Scott and Susan will host S&S's grand opening in five weeks. To meet that deadline, they have to address the following important issues:

1. What decisions do they need to make to be successful and profitable? For example:
   a. How should they price products to be competitive yet earn a profit?
   b. Should they extend credit, and, if so, on what terms? How can they accurately track what customers owe and pay?
   c. How should they hire, train, and supervise employees? What compensation and benefits package should they offer? How should they process payroll?
   d. How can they track cash inflows and outflows to avoid a cash squeeze?
   e. What is the appropriate product mix? What inventory quantities should they carry, given their limited showroom space?

NduV/123RF

2. What information do Scott and Susan need to make those decisions?
   a. What information do the external entities they interact with need?
   b. What information do management and other employees need?
   c. How can they gather, store, and disseminate that information?
3. What business processes are needed, and how should they be carried out?
4. What functionality should be provided on the website?

Although Scott and Susan could use an educated guess or "gut feeling" to make these decisions, they know they can make better decisions if they obtain additional information. A well-designed AIS can solve these issues and provide the information they need to make any remaining decisions.

Introduction

We begin this chapter by explaining important terms and discussing the kinds of information organizations need and the business processes used to produce that information. We continue with an exploration of what an accounting information system (AIS) is, how an AIS adds value to an organization, how an AIS and corporate strategy affect each other, and the role of the AIS in the value chain.

A **system** is a set of detailed methods, procedures, and routines that carry out specific activities, perform a duty, achieve goals or objectives, or solve one or more problems. Most systems are composed of smaller subsystems that support the larger system. For example, a college of business is a system composed of various departments, each of which is a subsystem. Moreover, the college itself is a subsystem of the university.

Each subsystem is designed to achieve one or more organizational goals. Changes in subsystems cannot be made without considering the effect on other subsystems and on the system as a whole. **Goal conflict** occurs when a subsystem's goals are inconsistent with the goals of another subsystem or with the system as a whole. **Goal congruence** occurs when a subsystem achieves its goals while contributing to the organization's overall goal. The larger the organization and the more complicated the system, the more difficult it is to achieve goal congruence.

Data are facts that are collected, recorded, stored, and processed by an information system. Businesses need to collect several kinds of data such as the activities that take place, the resources affected by the activities, and the people who participate in the activity. For example, the business needs to collect data about a sale (date, total amount), the resource sold (good or service, quantity sold, unit price), and the people who participated (customer, salesperson).

Information is data that have been organized and processed to provide meaning and context that can improve the decision-making process. As a rule, users make better decisions as the quantity and quality of information increase. Table 1-1 presents 14 characteristics that make information useful and meaningful.

system - Detailed methods, procedures, and routines that carry out activities, perform a duty, achieve goals or objectives, or solve problems.

goal conflict - When a subsystem's goals are inconsistent with the goals of another subsystem or the system as a whole.

goal congruence - When a subsystem achieves its goals while contributing to the organization's overall goal.

data - Facts that are collected, recorded, stored, and processed by an information system.

information - Data that have been organized and processed to provide meaning and improve decision making.

TABLE 1-1 Characteristics of Useful Information

Access restricted	Able to limit access to authorized parties
Accurate	Correct; free of error; accurately represents events and activities
Available	Available to users when needed; in a format that can be easily and quickly used
Reputable	Perceived as true and credible due to highly regarded source or content
Complete	Does not omit aspects of events or activities; of enough breadth and depth
Concise	Clear, succinct; appropriate volume presented briefly but comprehensively
Consistent	Presented in same format over time
Current	Includes event and activity data up to the present date and time
Objective	Unbiased; unprejudiced; impartial
Relevant	Reduces uncertainty; improves decision making; applicable and helpful
Timely	Provided in time for decision makers to make decisions
Useable	Easy to use for different tasks; human and machine readable
Understandable	Presented in a useful and intelligible format; easily comprehended and interpreted
Verifiable	Same information produced by two independent, knowledgeable people

machine-readable - Data in a format that can be processed by a computer.

Data is most useful when it is in a **machine-readable** format that can be read and processed by a computer. This processing may involve data collection, recording, storage, updating, and data dissemination. For example, public companies are now required to code their financial statements using XBRL (eXtensible Business Reporting Language)—a programming language designed specifically to facilitate the communication of financial and other business information. Without XBRL, electronic documents are digital versions of paper reports. Humans can read the data, but computers cannot automatically process the data until a person manually enters it in the appropriate format. XBRL changes that by encoding information about what a particular data item means so that other computer programs can understand what to do with it. XBRL is discussed more fully in Chapter 16.

Using machine readable formats like XBRL improves many of the other 14 characteristics that make information useful. For example, XBRL improves:

- Reliability by reducing human error and using standard taxonomies.
- Relevance by assigning relevant meaning to data so it can be compared to similar data from other organizations.
- Accessibility by enabling the automatic importing of data into decision models and other computer systems.
- Understandability and usability by making the data readable to both humans and computers.
- Timeliness by reducing the time needed to import, produce, and distribute information.

Machine readable data also facilitates newer technologies such as artificial intelligence and data analytics, which are discussed later in the chapter.

information overload - Exceeding the amount of information a human mind can absorb and process, resulting in a decline in decision-making quality and an increase in the cost of providing information.

information technology (IT) - The computers and other electronic devices used to store, retrieve, transmit, and manipulate data.

value of information - The benefit provided by information minus the cost of producing it.

However, there are limits to the amount of information the human mind can absorb and process. **Information overload** occurs when those limits are passed, resulting in a decline in decision-making quality and an increase in the cost of providing that information. Information system designers use **information technology (IT)** to help decision makers more effectively filter and condense information. For example, Walmart has invested heavily in IT so that every day it can collect and process almost 50 petabytes of transaction data and mine more than 200 internal and external databases to produce valuable information.

The **value of information** is the benefit produced by the information minus the cost of producing it. Benefits of information include reduced uncertainty, improved decisions, and improved ability to plan and schedule activities. The costs include the time and resources spent to produce and distribute the information. Information costs and benefits can