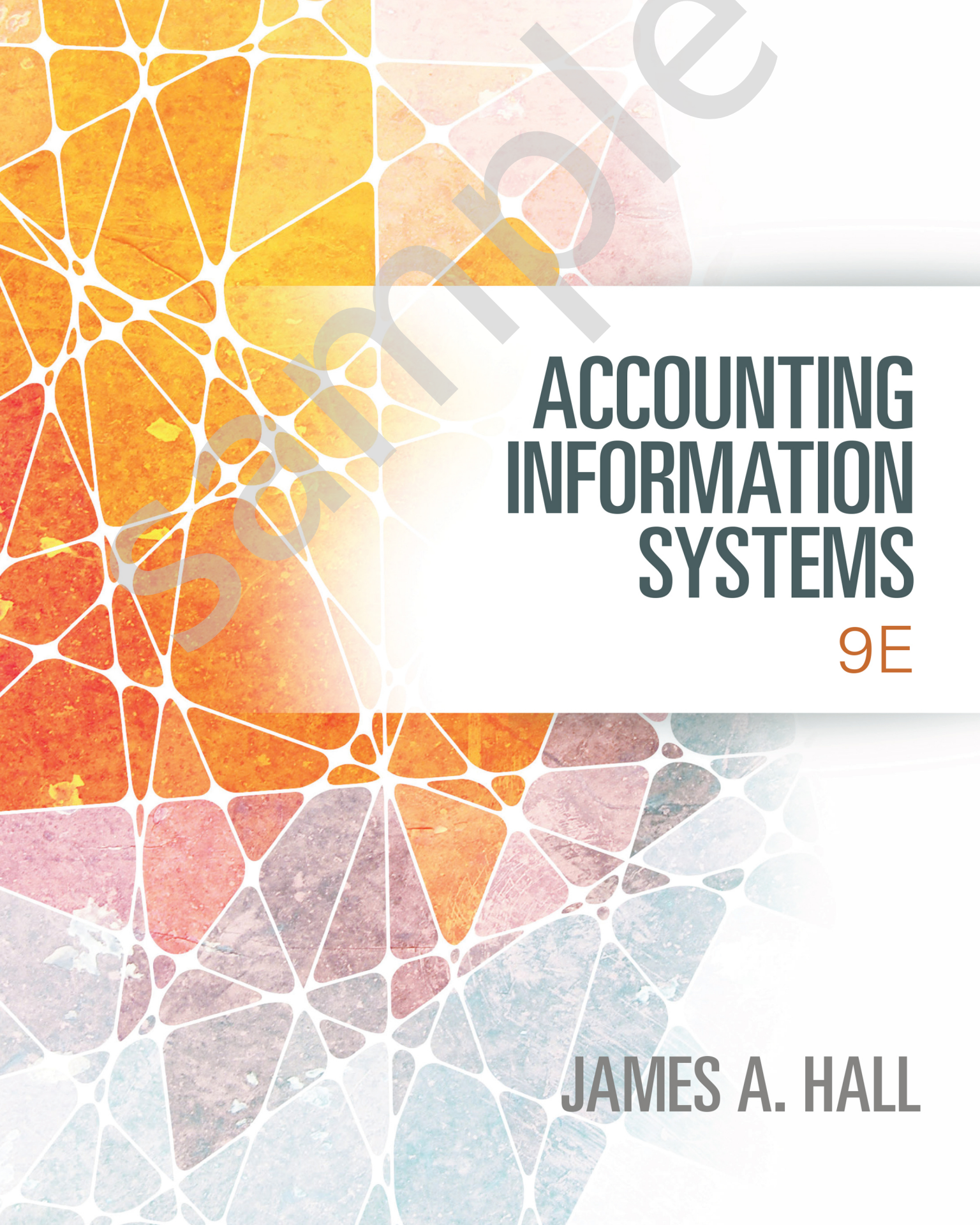

ACCOUNTING INFORMATION SYSTEMS

9E

JAMES A. HALL

Accounting Information Systems

NINTH EDITION

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Lehigh University

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Accounting Information Systems, Ninth Edition

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Library of Congress Control Number: 2014954894

ISBN: 978-1-133-93440-0

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Printed in the United States of America
Print Number: 01 Print Year: 2014

DEDICATION

To my wife Eileen, and my children Elizabeth and Katie

BRIEF CONTENTS

CONTENTS

PREFACE

Welcome to the Ninth Edition

The ninth edition *of Accounting Information Systems* includes a range of new and revised homework assignments and up-to-date content changes, as well as several reorganized chapters. All of these changes add up to more student and instructor enhancements than ever before. As this preface makes clear, we have made these changes to keep students and instructors as current as possible on issues such as business processes, systems development methods, IT governance and strategy, security, internal controls, and relevant aspects of Sarbanes-Oxley legislation.

Focus and Flexibility in Designing Your AIS Course

Among accounting courses, accounting information systems (AIS) courses tend to be the least standardized. Often, the objectives, background, and orientation of the instructor, rather than adherence to a standard body of knowledge, determine the direction the AIS course takes. Therefore, we have designed this text for maximum flexibility:

- This textbook covers a **full range of AIS topics** to provide instructors with flexibility in setting the direction and intensity of their courses.
- At the same time, for those who desire a **structured model,** the first nine chapters of the text, along with the chapters on electronic commerce and general IT controls, provide what has proven to be a **successful template for developing an AIS course.**
- Previous editions of this book have been used successfully in **introductory-, advanced-, and graduate-level AIS courses.**
- The **topics in this book are presented from the perspective of the managers' and accountants' AIS-related responsibilities under the Sarbanes-Oxley Act.**
- Although this book was written primarily to meet the needs of accounting majors about to enter the modern business world, we have also developed it to be an **effective text for general business, industrial engineering, and computer science students who seek a thorough understanding of AIS and internal control issues as part of their professional education.**

Key Features

CONCEPTUAL FRAMEWORK

This book employs a conceptual framework to emphasize the professional and legal responsibility of accountants, auditors, and management for the design, operation,

and control of AIS applications. This responsibility pertains to business events that are narrowly defined as financial transactions. Systems that process nonfinancial transactions are not subject to the standards of internal control under Sarbanes-Oxley legislation. Supporting the information needs of all users in a modern organization, however, requires systems that integrate both accounting and nonaccounting functions. While providing the organization with unquestioned benefit, a potential consequence of such integration is a loss of control due to the blurring of the lines that traditionally separate AIS from non-AIS functions. **The conceptual framework presented in this book distinguishes AIS applications that are legally subject to specific internal control standards.**

EVOLUTIONARY APPROACH

Over the years, accounting information systems have been represented by a number of different approaches or models. Each new model evolved because of the shortcomings and limitations of its predecessor. An interesting feature in this evolution is that older models are not immediately replaced by the newest technique. Thus, at any point in time, various generations of legacy systems exist across different organizations and often coexist within a single enterprise. Modern accountants need to be familiar with the operational characteristics of all AIS approaches that they are likely to encounter. **Therefore, this book presents the salient aspects of legacy and state-of-the-art systems.**

EMPHASIS ON INTERNAL CONTROLS

The book presents a conceptual model for designing and assessing internal controls based on the Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework. We use the COSO model to explore control issues related to both the manual and the IT aspects of AIS. In addition to the classic controls designed to influence human behavior, such as segregation of duties, independent verification, and supervision, special emphasis is placed on controls that address the following IT risks and concerns:

- Computer application integrity
- Operating systems security
- Database management systems security
- Electronic data interchange (EDI)
- Electronic commerce and network security
- Enterprise resource planning (ERP) systems
- Systems development and program change procedures
- Organization of the corporate IT function
- IT outsourcing and cloud computing
- Data center security

EXPOSURE TO SYSTEMS DESIGN AND DOCUMENTATION TOOLS

IT professionals employ a number of documentation tools to communicate the key features of information systems. Among these tools are data flow diagrams (DFDs), systems flowcharts, entity relationship diagrams (ERDs), and program

logic flowcharts. Modern accountants, whether in the conduct of an audit or the provision of advisory services, work closely with IT professionals and must master the use of IT documentation tools and techniques This book contains numerous systems design and documentation cases and assignments intended to develop students' competency in this area.

Significant Changes in the Ninth Edition

End-of-Chapter Material

The end-of-chapter material in the ninth edition has undergone significant revision. Most of the multiple choice questions and problems, and all of the cases have been revised or replaced. This important body of material is tailored to the chapters' contents, and the solutions provided in the solutions manual accurately reflect the problem requirements. In particular, great attention was given to internal control case solutions to ensure consistency in appearance and an accurate reflection of the cases in the text. All case solution flowcharts are numerically coded and cross-referenced to text that explains the internal control issues. This approach, which has been classroom tested, facilitates effective presentation of internal control case materials.

Chapter 3, "Ethics, Fraud, and Internal Control"

This chapter has been revised to include the most recent research results published by the Association of Certified Fraud Examiners (ACFE). The ACFE study provides estimates of losses due to fraud, categorizes fraud by various factors, and creates a profile of fraud perpetrators.

Chapter 4, "The Revenue Cycle"; Chapter 5, "The Expenditure Cycle Part I: Purchases and Cash Disbursements Procedures"; Chapter 6, "The Expenditure Cycle Part II: Payroll Processing and Fixed Asset Procedures"; Chapter 7, "The Conversion Cycle"; and Chapter 8, "Financial Reporting and Management Reporting Systems"

These chapters have been significantly revised to reflect a risk-based approach to AIS design and audit. The approach taken in each chapter is to examine the risks from errors and fraud that are inherent to the particular cycle being studied. Based on the risk analysis, and the level of technology in place, specific physical and IT controls are described to mitigate the risks. Since the purpose of internal controls is to mitigate risk, this risk-based approach fits more logically into a classroom discussion. Furthermore, challenging students to think about what can go wrong encourages classroom discussion and supports the notion of brainstorming as recommended by Statement on Auditing Standards (SAS) 109.

Chapter 9, "Database Management Systems"

At one time, an accountant in the conduct of an audit could pull an invoice from a filing cabinet. Today that invoice is most likely stored in various pieces on several normalized database tables and accessing it requires an understanding of relational database structures. The chapter has been extensively rewritten to address this

growing need for modern accountants to have a working understanding of data modeling techniques. The chapter begins with an overview of database technology and describes in detail the functions and relationship between its primary elements. It then presents the key characteristics of the relational database model including data modeling, deriving relational tables from entity relationship (ER) diagrams, the creation of user views, and data normalization techniques. The chapter concludes with a discussion of distributed database issues.

Chapter 15, "Auditing IT Controls Part I: Sarbanes-Oxley and IT Governance"

This chapter was revised to provide an introduction to IT auditing. It opens with an overview of auditing in which the key components of an audit are discussed. Topics in this revised section include auditing standards, the structure of an audit, management assertions, and the audit risk model. Next, the chapter turns to internal control and audit issues related to Sections 302 and 404 of SOX including IT control and computer fraud issues. The body of the chapter is basically unchanged from the eighth edition, which deals with the risks and controls related to IT governance including the structure of the IT function within an organization, computer center threats, and key elements of a disaster recovery planning. The final section of the chapter has been revised to examine the current issues surrounding the growing trend toward IT outsourcing. In particular, it reviews the theories underlying outsourcing and the expected benefits. IT outsourcing is also associated with significant risks, which are addressed. The chapter concludes with a discussion of audit issues related to outsourcing including the Statement on Standards for Attestation Engagements (SSAE) 16 reporting standard.

Organization and Content

PART I: OVERVIEW OF ACCOUNTING INFORMATION SYSTEMS

Chapter 1, "The Information System: An Accountant's Perspective"

Chapter 1 places the subject of accounting information systems in perspective for accountants. It is divided into three major sections, each dealing with a different aspect of information systems.

- The first section explores the information environment of the firm. It identifies the types of information used in business, describes the flows of information through an organization, and presents a framework for viewing AIS in relation to other information systems components. The section concludes with a review of the key elements of the general model for AIS.
- The second section deals with the impact of organization structure on AIS. It presents the business organization as a system of interrelated functions. Extensive attention is given the IT and accounting segments, which play collaborative roles as the purveyors of financial information for the rest of the organization.
- The third section discusses the role of accountants as designers and auditors of AIS. The nature of the responsibilities shared by accountants and computer professionals for developing AIS applications is examined.

Chapter 2, "Introduction to Transaction Processing"

Chapter 2 divides the treatment of transaction processing systems into six major sections.

- The first section provides an overview of transaction processing, showing its vital role as an information provider for financial reporting, internal management reporting, and the support of day-to-day operations. Three transaction cycles account for most of a firm's economic activity: the revenue cycle, the expenditure cycle, and the conversion cycle.
- The second section describes the relationship among accounting records, both hard copy and digital, in forming an audit trail.
- The third section describes the key features of flat file and database structures used to store accounting data.
- The fourth section presents an overview of documentation techniques used to describe the key features of systems. This section presents several documentation techniques for representing manual procedures and computer operations. These include data flow diagrams, entity relationship diagrams, system flowcharts, program flowcharts, and record layout diagrams.
- The fifth section addresses alternative transaction processing approaches. It reviews the fundamental features of batch and real-time technologies, and their implication for transaction processing.
- The final section examines data coding schemes, their role in transaction processing and AIS as a means of coordinating and managing a firm's transactions, and the advantages and disadvantages of the major types of numeric and alphabetic coding schemes.

Chapter 3, "Ethics, Fraud, and Internal Control"

Chapter 3 deals with the related topics of ethics, fraud, and internal control.

- The first section examines ethical issues related to business and specifically to computer systems. The questions raised are intended to stimulate class discussions.
- The second section deals with the subject of fraud and its implications for accountants. Although the term *fraud* is very familiar in today's financial press, it is not always clear what constitutes fraud. This section distinguishes between management fraud and employee fraud. This section presents techniques for identifying unethical and dishonest management and for assessing the risk of management fraud. Employee fraud can be prevented and detected by a system of internal controls. The section discusses the results of a research study conducted by the Association of Certified Fraud Examiners.
- The final section describes the internal control structure and control activities specified in the COSO framework. The controls presented in this chapter, both physical and IT controls, are applied to specific applications in chapters that follow.

PART II: TRANSACTION CYCLES AND BUSINESS PROCESSES

Chapter 4, "The Revenue Cycle"; Chapter 5, "The Expenditure Cycle Part I: Purchases and Cash Disbursements Procedures"; and Chapter 6, "The Expenditure Cycle Part II: Processing and Fixed Asset Procedures"

The approach taken in these three chapters is similar. First, the respective cycle is reviewed conceptually using data flow diagrams to present key features and control points of each major subsystem. We then examine physical systems with two objectives in mind: (1) illustrate how system functionality changes under different levels of technology, and (2) demonstrate how the internal control focus shifts as the mix between technology and manual procedures changes. To accomplish this, we review examples of systems at different points on the technology continuum. The first examples are basic technology systems that use independent PCs, which function primarily as record keeping devices. We then move on to examples of advanced technologies that integrate key business functions.

Under each technology, the risks from errors and fraud are examined and the controls to mitigate risks are discussed. This approach provides the student with a solid understanding of the business tasks in each cycle and an awareness of how different technologies influence changes in the operation and control of the systems.

Chapter 7, "The Conversion Cycle"

Manufacturing systems represent a dynamic aspect of AIS. **Chapter 7** discusses the technologies and techniques used in support of two alternative manufacturing environments: traditional mass production (batch) processing and lean manufacturing. These environments are driven by information technologies, such as materials requirements planning (MRP), manufacturing resources planning (MRP II), and enterprise resource planning (ERP). The chapter addresses the shortcomings of the traditional cost accounting model as it compares to two alternative models: activity-based costing (ABC) and value stream accounting.

Chapter 8, "Financial Reporting and Management Reporting Systems"

Chapter 8 examines an organization's nondiscretionary and discretionary reporting systems.

- First, it focuses on the general ledger system (GLS) and on the files that constitute a GLS database.
- Next, it examines how financial statement information is provided to both external and internal users through a multistep reporting process. The emerging technology of Extensible Business Reporting Language (XBRL) is changing traditional financial reporting for many organizations. The key features of XBRL and the internal control implications of this technology are considered.
- The chapter then looks at discretionary reporting systems that constitute the management reporting system (MRS). Discretionary reporting is not subject to the professional guidelines and legal statutes that govern nondiscretionary financial reporting. Rather, it is driven by several factors, including

management principles; management function, level, and decision type; problem structure; responsibility accounting; and behavioral considerations. The impact of each factor on the design of the management reporting system is investigated.

PART III: ADVANCED TECHNOLOGIES IN ACCOUNTING INFORMATION

Chapter 9, "Database Management Systems"

Chapter 9 addresses the design and management of an organization's data resources.

- The first section demonstrates how problems associated with traditional flat-file systems are resolved under the database approach.
- The second section describes in detail the functions and relationships among four primary elements of the database environment: the users, the database management system (DBMS), the database administrator (DBA), and the physical database.
- The third section is devoted to an in-depth explanation of the characteristics of the relational database model.
- The fourth section examines database design topics including data modeling, deriving relational tables from ER diagrams, the creation of user views, and data normalization techniques.
- The chapter concludes with a discussion of distributed database issues. It examines three possible database configurations in a distributed environment: centralized, partitioned, and replicated databases.

Chapter 10, "The REA Approach to Database Modeling"

Chapter 10 presents the resources, events, and agents (REA) model as a means of specifying and designing accounting information systems that serve the needs of all users within an organization. The chapter is composed of three major sections.

- The chapter begins by defining the key elements of REA. The basic model employs a unique form of ER diagram called an REA diagram. The diagram consists of three entity types (resources, events, and agents) and a set of associations linking them.
- Next, the rules for developing an REA diagram are explained and illustrated in detail. An important aspect of the model is the concept of economic duality, which specifies that each economic event must be mirrored by an associated economic event in the opposite direction. The section illustrates the development of an REA database for a hypothetical firm, following a multistep process called view modeling. The result of this process is an REA diagram for a single organizational function.
- The chapter's third section explains how multiple REA diagrams (revenue cycle, purchases, cash disbursements, and payroll) are integrated into a global or enterprise-wide model. The enterprise model is then implemented into a relational database structure, and user views are constructed. The section concludes with a discussion of how REA modeling can improve competitive advantage by allowing management to focus on the value-added activities of their operations.

Chapter 11, "Enterprise Resource Planning Systems"

Chapter 11 presents a number of issues related to the implementation of enterprise resource planning (ERP) systems. It is composed of five major sections.

- The first section outlines the key features of a generic ERP system by comparing the function and data storage techniques of a traditional flat-file or database system to that of an ERP.
- The second section describes various ERP configurations related to servers, databases, and bolt-on software.
- Data warehousing is the topic of the third section. A data warehouse is a relational or multidimensional database that supports online analytical processing (OLAP). Issues discussed include data modeling, data extraction from operational databases, data cleansing, data transformation, and loading data into the warehouse.
- The fourth section examines risks associated with ERP implementation. These include "big bang" issues, opposition to change within the organization, choosing the wrong ERP model, choosing the wrong consultant, cost overrun issues, and disruptions to operations.
- The fifth section reviews several control and auditing issues related to ERPs. The discussion follows the COSO framework.

Chapter 12, "Electronic Commerce Systems"

Driven by the Internet revolution, electronic commerce is dramatically expanding and undergoing radical changes. Although electronic commerce has brought enormous opportunities for consumers and businesses, its effective control present challenges to organization management teams and accountants. To properly evaluate the potential exposures and risks in this environment, the modern accountant must be familiar with the technologies and techniques that underlie electronic commerce. **Chapter 12** and its associated appendix deal with several aspects of electronic commerce.

- The body of the chapter examines Internet commerce including business-to-consumer and business-to-business relationships. It presents the risks associated with electronic commerce, including hardware failures, software errors, unauthorized access from remote locations, and denial of service attacks that can prevent an organization from conducting business.
- The chapter also reviews security and assurance techniques to reduce risk and promote trust.
- The chapter concludes with a discussion of how Internet commerce impacts the accounting and auditing profession.
- The internal usage of networks to support distributed data processing and traditional business-to-business transactions conducted via EDI systems are presented in the appendix.

PART IV: SYSTEMS DEVELOPMENT ACTIVITIES

Chapter 13, "Managing the Systems Development Life Cycle," and Chapter 14, "Construct, Deliver, and Maintain Systems Projects"

The chapters in Part IV examine the accountant's role in the systems development process.

- **Chapter 13** begins with an overview to the systems development life cycle (SDLC). This multistage process guides organization management through the development and/or purchase of information systems.
- Next, Chapter 13 presents the key issues pertaining to developing a systems strategy, including its relationship to the strategic business plan, the current legacy situation, and feedback from the user community. The chapter provides a methodology for assessing the feasibility of proposed projects and for selecting individual projects to go forward for construction and delivery to their users.
- The chapter concludes by reviewing the role of accountants in managing the SDLC.
- **Chapter 14** covers the many activities associated with in-house development, which fall conceptually into two categories: (1) constructing the system and (2) delivering the system. Through these activities, systems selected in the project initiation phase (discussed in Chapter 13) are designed in detail and implemented. This involves creating input screen formats, output report layouts, database structures, and application logic. Finally, the completed system is tested, documented, and rolled out to the user.
- The chapter then examines the increasingly important option of using commercial software packages. Conceptually, the commercial software approach also consists of construct and delivery activities. The chapter examines the pros, cons, and issues involved in selecting off-the-shelf systems.
- The chapter also addresses the important activities associated with systems maintenance and the associated risks that are important to managers, accountants, and auditors.

Several comprehensive cases designed as team-based systems development projects are available online at www.cengagebrain.com. These cases have been used effectively by groups of three or four students working as a design team. Each case has sufficient details to allow analysis of user needs, preparation of a conceptual solution, and the development of a detailed design, including user views (input and output), processes, and databases.

PART V: COMPUTER CONTROLS AND IT AUDITING

Chapter 15, "Auditing IT Controls Part I: Sarbanes-Oxley and IT Governance"

Chapter 15 opens with an overview of IT auditing in which the key components of an audit are discussed including auditing standards, the structure of an audit, management assertions, and the audit risk model. Next, the chapter examines management and auditor responsibilities under Sections 302 and 404 of the Sarbanes-Oxley Act (SOX). The design, implementation, and assessment of IT controls form the central theme for this chapter and the two chapters that follow. This chapter presents risks, controls, and tests of controls related to IT governance, including organizing the IT function, controlling computer center operations, designing an adequate disaster recovery plan, and IT outsourcing.

Chapter 16, "Auditing IT Controls Part II: Security and Access"

Chapter 16 continues the treatment of IT controls as described by the COSO control framework. The focus of the chapter is on SOX compliance regarding the security and

control of operating systems, database management systems, and communication networks. This chapter examines the risks, controls, audit objectives, and tests of controls that may be performed to satisfy either compliance or attest responsibilities.

Chapter 17, "Auditing IT Controls Part III: Systems Development, Program Changes, and Application Auditing"

Chapter 17 concludes the examination of general IT controls as outlined in the COSO control framework. The chapter focuses on SOX compliance regarding systems development and program change procedures. It examines the risks, controls, audit objectives, and tests of controls that may be performed to satisfy compliance or attest responsibilities. The chapter also examines several computer-assisted audit tools and techniques (CAATTs) for testing IT application controls and for performing substantive tests.

SUPPLEMENTS

Product Website

Additional teaching and learning resources, including access to additional internal control and systems development cases, are available by download from the book's website at www.cengagebrain.com.

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Test Bank

The *Test Bank,* available in Word, contains true/false, multiple-choice, short answer, and essay questions. The files are available for download from the text website.

Solutions Manual

The *Solutions Manual* contains solutions to all end-of-chapter problems and cases. Adopting instructors may download the *Solutions Manual* under password protection at the Instructor's Resource page of the book's website.

ACKNOWLEDGMENTS

I am grateful to the following people for reviewing the book in recent editions and for providing helpful comments:

Beth Brilliant
Kean University

Sarah Brown
Southern Arkansas University

Stephen Burd
University of New Mexico

David M. Cannon
Grand Valley State University

Meir Fischer
Post University

James Holmes
University of Kentucky

Alan Levitan
University of Louisville

Andrew D. Luzi
California State University, Fullerton

Sakthi Mahenthiran
Butler University

Gerald Myers
Pacific Lutheran University

John Nader
Grace Bible College

Jeff L. Payne
University of Kentucky

H. Sam Riner
University of North Alabama

Kirsten Rosacker
University of Wisconsin-Lacrosse

Helen M. Savage
Youngstown State University

Jerry D. Siebel
University of South Florida

Richard M. Sokolowski
Teikyo Post University

Dennis Stovall
Grand Valley State University

Jerry Turner
Texas Christian University

Patrick Wheeler
University of Missouri-Columbia

Srini Ragothaman
University of South Dakota

James A. Hall
Lehigh University

PART

I

Overview of Accounting Information Systems

CHAPTER

1

The Information System: An Accountant's Perspective

Unlike many other accounting subjects, such as intermediate accounting, **accounting information systems (AIS)** lacks a well-defined body of knowledge. Much controversy exists among college faculty as to what should and should not be covered in the AIS course. To some extent, however, the controversy is being resolved through legislation. The Sarbanes-Oxley Act (SOX) of 2002 established new corporate governance regulations and standards for public companies registered with the Securities and Exchange Commission (SEC). This wide-sweeping legislation impacts public companies, their management, and their auditors. Of particular importance to AIS students is the impact of SOX on internal control standards and related auditing procedures. Although SOX does not define the entire content of the AIS course, it does identify critical areas of study that need to be included. These topics and more are covered in the chapters of this text.

The purpose of this chapter is to place the subject of AIS in perspective for accountants. Toward this end, the chapter is divided into three major sections, each dealing with a different aspect of information systems. The first section explores the information environment of the firm. It identifies the types of information used in business, describes the flow of information through an organization, and presents a framework for viewing AIS in relation to other information systems components. The section concludes with a review of the key elements of the general model for AIS. The second section of the chapter deals with the impact of organizational structure on AIS. Here we examine the business organization as a system of interrelated functions. Extensive attention is given the IT and accounting segments, which play collaborative roles as the purveyors of financial information for the rest of the

Learning Objectives

After studying this chapter, you should:

- Recognize the primary information flows within the business environment.
- Understand the difference between accounting information systems and management information systems.
- Understand the difference between financial transactions and nonfinancial transactions.
- Know the principal features of the general model for information systems.
- Understand the organizational structure and functional areas of a business.
- Be able to distinguish between external auditing, internal auditing, and advisory services as they relate to accounting information systems.

organization. The final section discusses the unique responsibility of accountants as domain experts in the design of AIS and as auditors of AIS.

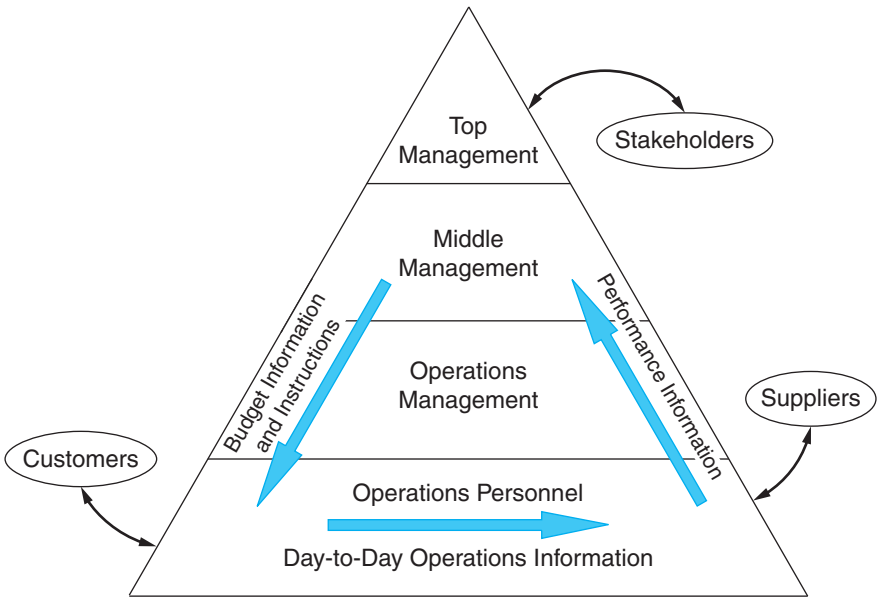
The Information Environment

We begin the study of AIS with the recognition that information is a business resource. Like other business resources such as raw materials, capital, and labor, information is vital to the survival of the contemporary business organization. Every business day, vast quantities of information flow to decision makers and other users to meet a variety of internal needs. In addition, information flows out from the organization to external users, such as customers, suppliers, and stakeholders who have an interest in the firm. Figure 1-1 presents an overview of these internal and external **information flows**.

The pyramid in Figure 1-1 shows the business organization divided horizontally into several levels of activity. Business operations form the base of the pyramid. These activities consist of the product-oriented work of the organization, such as manufacturing, sales, distribution, billing, and cash receipts. Above the base level, the organization is divided into three management tiers: operations management, middle management, and top management. Operations management is directly responsible for controlling day-to-day operations. Middle management is accountable for the short-term planning and coordination of activities necessary to accomplish organizational objectives. Top management is responsible for longer-term planning and setting organizational objectives. Every individual in the organization, from business operations to top management, needs information to accomplish his or her tasks.

Notice in Figure 1-1 how information flows in two directions within the organization: horizontally and vertically. The horizontal flow supports operations-level tasks with highly detailed information about the many business transactions affecting the firm. This includes information about events such as the sale and shipment of goods, the use of labor and materials in the production process, and internal transfers of resources from one department to another. The vertical flow

FIGURE 1-1 INTERNAL AND EXTERNAL FLOWS OF INFORMATION



distributes information downward from senior managers to junior managers and operations personnel in the form of instructions, quotas, and budgets. In addition, summarized information pertaining to operations and other activities flows upward to managers at all levels. Management uses this information to support its various planning and control functions.

A third flow of information depicted in Figure 1-1 represents exchanges between the organization and users in the external environment. External users fall into two groups: **trading partners** and **stakeholders**. Exchanges with trading partners include customer sales and billing information, purchase information for suppliers, and inventory receipts information. Stakeholders are external entities with a direct or indirect interest in the firm. Stockholders, financial institutions, and government agencies are examples of external stakeholders. Information exchanges with these groups include financial statements, tax returns, and stock transaction information.

INFORMATION OBJECTIVES

Specific information objectives will differ from firm to firm as specific user needs vary. Three fundamental objectives are, however, common to all organizations:

1. *To support the firm's day-to-day operations.* Operations personnel use information to assist them in the efficient and effective discharge of their daily tasks.
2. *To support management decision making.* Managers use information to assist them in planning and control decisions related to their areas of responsibility.
3. *To support the stewardship function of management.* Stewardship refers to managers' responsibility to properly manage the resources of the firm and to report on their activities. External users receive stewardship information through traditional financial statements and other mandated reports. Internally, managers receive stewardship information from various responsibility reports.

These objectives call for information sets that are diverse in their level of detail and nature. For example, managers cannot effectively employ the finely detailed information needed to support day-to-day operations. Management decision information tends to be highly summarized and oriented toward reporting on overall performance and trends rather than routine tasks. Similarly, accrual-based financial statement information, which is prepared for stakeholders, is unsuitable for most internal uses. The information needed to satisfy these diverse needs is the product of the information system.

AN INFORMATION SYSTEMS FRAMEWORK

The **information system** is the set of formal procedures by which data are collected, stored, processed into information, and distributed to users.

Figure 1-2 shows the information system of a hypothetical manufacturing firm decomposed into its elemental subsystems. Notice that two broad classes of systems emerge from the decomposition: the accounting information system (AIS) and the **management information system (MIS)**. We will use this framework to identify the domain of AIS and distinguish it from MIS. Keep in mind that Figure 1-2 is a conceptual view; physical information systems are not typically organized into such discrete packages. More often, MIS and AIS functions are integrated within physical systems to achieve operational efficiency.

The distinction between AIS and MIS centers on the concept of a transaction, as illustrated by Figure 1-3. The information system accepts input, called transactions, which are converted through various processes into output information that goes to users. Transactions fall into two classes: financial transactions and nonfinancial transactions. Before exploring this distinction, let's first define the term *transaction*:

> *A* **transaction** *is an event that affects or is of interest to the organization and is processed by its information system as a unit of work.*

FIGURE 1-2 A Framework for Information Systems

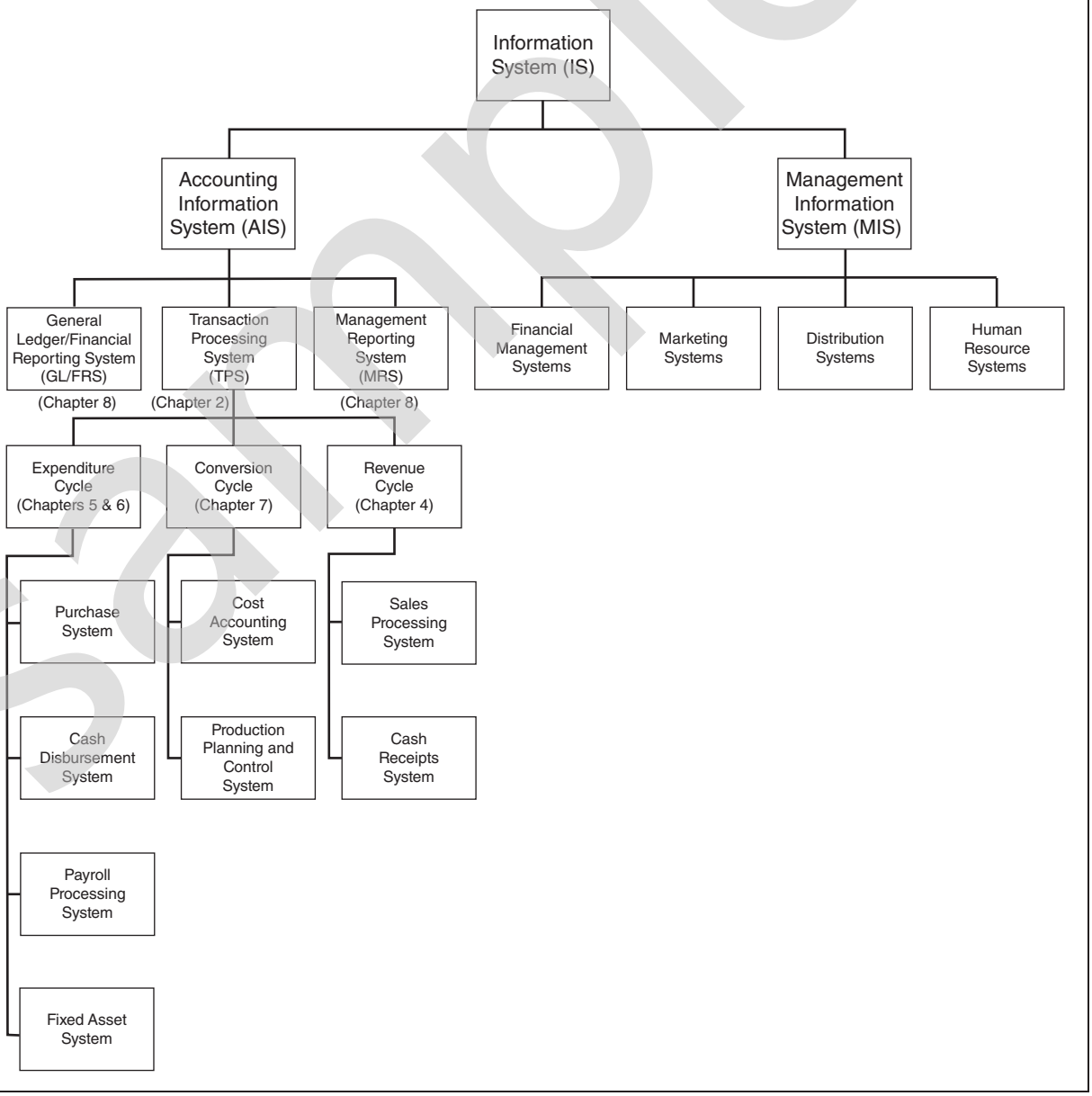
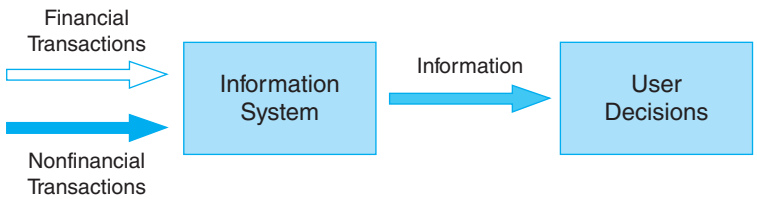


FIGURE 1-3 Transactions Processed by the Information System



This definition encompasses both financial and nonfinancial events. Because financial transactions are of particular importance to the accountant's understanding of information systems, we need a precise definition for this class of transaction:

> *A* **financial transaction** *is an economic event that affects the assets and equities of the organization, is reflected in its accounts, and is measured in monetary terms.*

Sales of products to customers, purchases of inventory from vendors, and cash disbursements and receipts are examples of financial transactions. Every business organization is legally bound to correctly process these types of transactions.

Nonfinancial transactions are events that do not meet the narrow definition of a financial transaction. For example, adding a new supplier of raw materials to the list of valid suppliers is an event that may be processed by the enterprise's information system as a transaction. Important as this information obviously is, it is not a financial transaction, and the firm has no legal obligation to process it correctly—or at all.

Financial transactions and nonfinancial transactions are closely related and are often processed by the same physical system. For example, consider a financial portfolio management system that collects and tracks stock prices (nonfinancial transactions). When the stocks reach a threshold price, the system places an automatic buy or sell order (financial transaction). Buying high and selling low is bad for business, but it is not against the law. Therefore, no law requires company management to design optimal buy-and-sell rules into their system. Once the order is placed, however, the processing of this financial transaction must comply with legal and professional guidelines.

The Accounting Information System

AIS subsystems process financial transactions and nonfinancial transactions that directly affect the processing of financial transactions. For example, changes to customers' names and addresses are processed by the AIS to keep the customer file current. Although not technically financial transactions, these changes provide vital information for processing future sales to the customer.

The AIS is composed of three major subsystems: (1) the **transaction processing system (TPS)**, which supports daily business operations with numerous reports, documents, and messages for users throughout the organization; (2) the **general ledger/financial reporting system (GL/FRS)**, which produces the traditional financial statements, such as the income statement, balance sheet, statement of cash flows, tax returns, and other reports required by law; and (3) the **management reporting system (MRS)**, which provides internal management with special-purpose financial reports and information needed for decision making such as budgets, variance reports, and responsibility reports. We examine each of these subsystems in the following sections of this chapter.

The Management Information System

Management often requires information that goes beyond the domain of AIS. As organizations grow in size and complexity, specialized functional areas emerge, requiring additional information for production planning and control, sales forecasting, inventory warehouse planning, market research, and so on. The MIS processes nonfinancial transactions that are not normally processed by traditional AIS. Table 1-1 gives examples of typical MIS applications related to functional areas of a firm.

The Need to Distinguish between AIS and MIS

SOX legislation requires that corporate management design and implement internal controls over the entire financial reporting process. This includes the financial reporting system, the general ledger system, and the transaction processing systems that supply the data for financial reporting. SOX further requires that management certify these controls and that the external auditors express an opinion on control effectiveness. Because of the highly integrative nature of modern

TABLE 1-1 EXAMPLES OF MIS APPLICATIONS IN FUNCTIONAL AREAS

Function	Examples of MIS Applications
Finance	Portfolio management systems Capital budgeting systems
Marketing	Market analysis New product development Product analysis
Distribution	Warehouse organization and scheduling Delivery scheduling Vehicle loading and allocation models
Personnel	Human resource management systems ■ Job skill tracking system ■ Employee benefits system

information systems, management and auditors need a conceptual view of the information system that clearly distinguishes key processes and areas of risk and legal responsibility from other (non-legally binding) aspects of the system. Without such a model, mandated management and audit responsibilities under SOX may not be efficiently or adequately met.

AIS SUBSYSTEMS

We devote separate chapters to an in-depth study of each AIS subsystem depicted in Figure 1-2. At this point, we briefly outline the role of each subsystem.

Transaction Processing System

The TPS is central to the overall function of the information system. It converts economic events into financial transactions, records financial transactions in the accounting records (journals and ledgers), and distributes essential financial information to operations personnel to support their daily operations.

The TPS deals with business events that occur frequently. In a given day, a firm may process thousands of transactions. To deal efficiently with such volume, similar types of transactions are grouped into transaction cycles. The TPS consists of three transaction cycles: the revenue cycle, the expenditure cycle, and the conversion cycle. Each cycle captures and processes different types of financial transactions. Chapter 2 of this text provides an overview of transaction processing. Chapters 4, 5, 6, and 7 examine in detail the revenue, expenditure, and conversion cycles.

General Ledger/Financial Reporting Systems

The general ledger system (GLS) and the financial reporting system (FRS) are two closely related subsystems. Because of their operational interdependency, however, they are generally viewed as a single integrated system—the GL/FRS. The bulk of the input to the GL portion of the system comes from transaction cycle subsystems. Summaries of transaction activity are processed by the GLS to update the general ledger control accounts. Other, less common and infrequent, events such as stock transactions, mergers, and lawsuit settlements, for which there may be no formal processing cycle in place, enter the GLS through alternate sources. The FRS measures the status of financial resources and the changes in those resources and communicates this information to external users. This type of reporting is called **nondiscretionary reporting** because the organization has few or no choices in the information it provides. Much of this information consists of traditional financial statements, tax returns, and other reports demanded by law.

Management Reporting System

Managers must respond rapidly to many day-to-day business problems, as well as plan and control their operations. The MRS provides the internal financial information needed to manage a business. Typical reports produced by the MRS include budgets, variance reports, cost-volume-profit analyses, and reports using current (rather than historical) cost data. This type of reporting is called **discretionary reporting** because the organization can choose what information to report and how to present it.

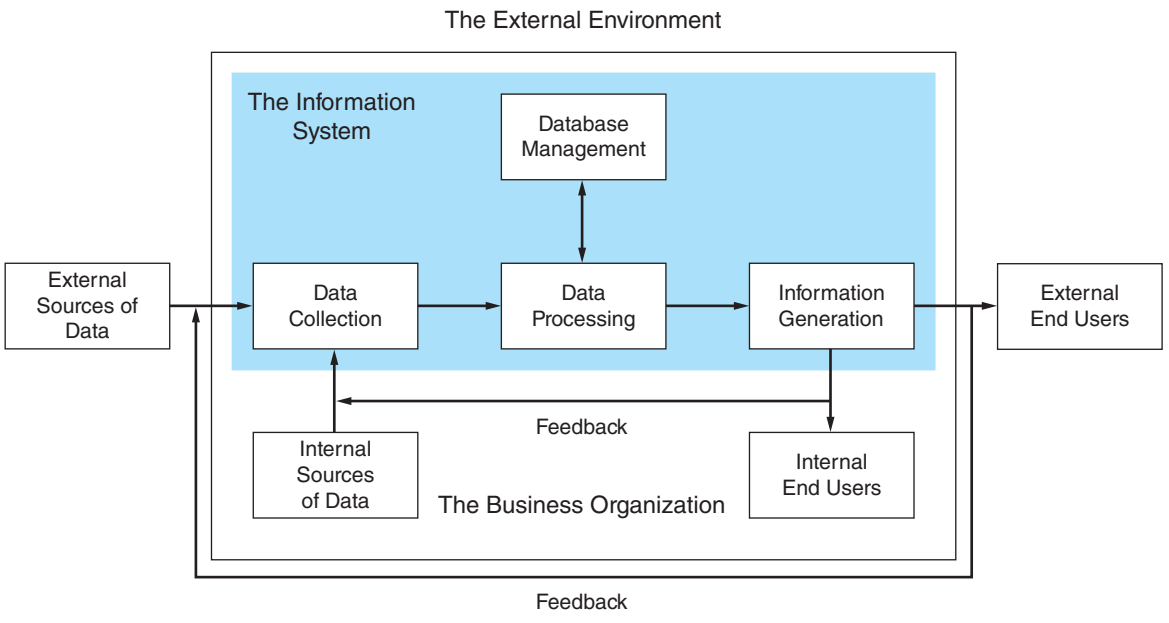
A GENERAL MODEL FOR AIS

Figure 1-4 presents the **general model for AIS**. This is a *general* model because it applies to all accounting information systems, regardless of their underlying technologies. The model depicts the relationship between the key elements that constitute an AIS application: end users, data sources, data collection, data processing, database management, information generation, and feedback. Each of these is discussed next.

End Users

End users fall into two general groups: external and internal. **External users** include creditors, stockholders, potential investors, regulatory agencies, tax authorities, suppliers, and customers. **Internal users** include management at all levels of the organization, as well as operations personnel. In contrast to their more structured external reporting responsibilities, organizations have a great deal of latitude when it comes to internal reporting, which is driven by what best gets the job done. Internal reporting is, however, characterized by frequent changes in the information needs of internal users. This volatility poses a significant challenge to system designers who must balance the information requests and needs of internal users against legal, economic, internal control, and security issues. Frequent changes in information requirements necessitate information system changes, which in turn expose systems to material errors and, as we shall see later in this text, the potential for fraud.

FIGURE 1-4 GENERAL MODEL FOR ACCOUNTING INFORMATION SYSTEMS



DATA VERSUS INFORMATION. Before discussing the data sources portion of Figure 1-4, we need to make an important distinction between the terms *data* and *information*. **Data** are facts, which may or may not be processed (edited, summarized, or refined) and have no direct effect on a user's actions. By contrast, **information** causes the user to take an action that he or she otherwise could not, or would not, have taken. Information is often defined simply as processed data, but this definition is inadequate. Information is determined by the effect it has on the user, not by its physical form. For example, a purchasing agent receives a daily report listing raw material inventory items that are at low levels. This report causes the agent to place orders for more inventories. The facts in this report have information content for the purchasing agent. This same report in the hands of the personnel manager, however, is a mere collection of facts, or data, causing no action and having no information content.

In other words, one person's information is another person's data. Thus, information is not just a set of processed facts arranged in a formal report. Information triggers users to take actions that support their day-to-day business tasks, resolve conflicts, and plan for the future. We should note that action does not necessarily mean a physical act. For instance, a purchasing agent who receives a report showing that inventory levels are adequate will respond by ordering nothing. The agent's action to do nothing is a conscious decision, triggered by information and different from doing nothing because of being uninformed. The distinction between data and information has pervasive implications for the study of information systems. If output from the information system fails to cause users to act, the system serves no purpose.

Data Sources

Data sources are financial transactions that enter the information system from either internal or external sources. External financial transactions are the most common source of data. These are economic exchanges with other business entities and individuals outside the firm. Examples include the sale of goods and services, the purchase of inventory, the receipt of cash, and the disbursement of cash (including payroll). Internal financial transactions involve the exchange or movement of resources within the organization. Examples include the movement of raw materials into work-in-process (WIP), the application of labor and overhead to WIP, the transfer of WIP into finished goods inventory, and the depreciation of plant and equipment.

Data Collection

Data collection is the first operational stage in the information system. The objective is to ensure that event data entering the system are valid, complete, and free from material errors. In many respects, this is the most important stage in the system. Should transaction errors pass through data collection undetected, the system may process the errors and generate erroneous and unreliable output. This, in turn, could lead to incorrect actions and poor decisions by the users.

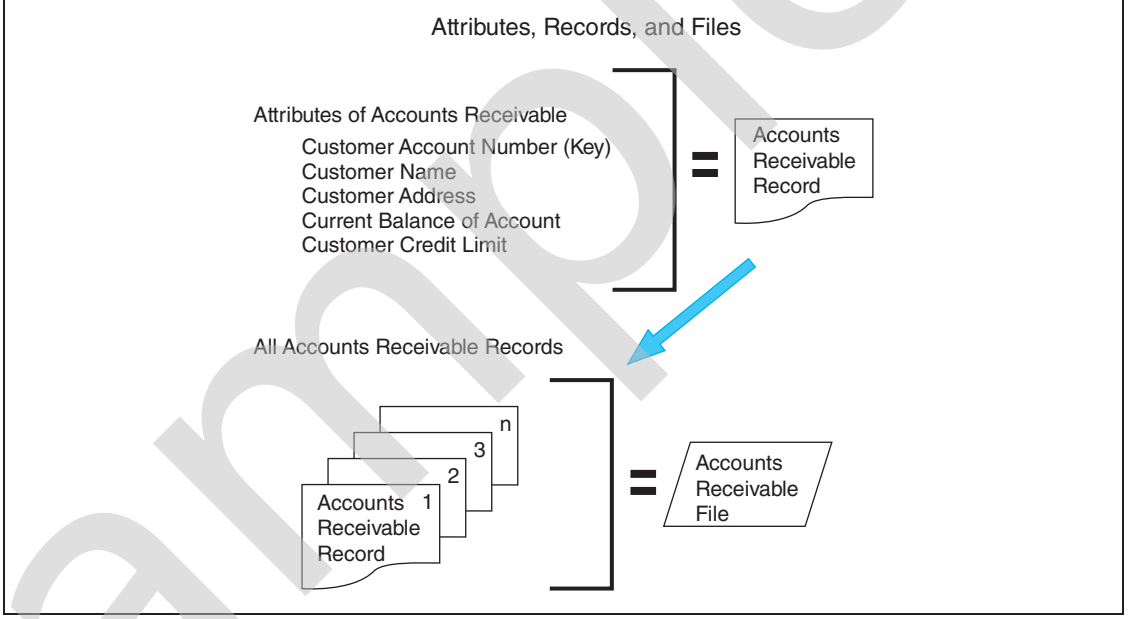
Two rules govern the design of data collection procedures: relevance and efficiency. The information system should capture only relevant data. A fundamental task of the system designer is to determine what is and what is not relevant. He or she does so by analyzing the user's needs. Only data that ultimately contribute to information (as defined previously) are relevant. The data collection stage should be designed to filter irrelevant facts from the system.

Efficient data collection procedures are designed to collect data only once. These data can then be made available to multiple users. Capturing the same data more than once overloads facilities and leads to data redundancy, which causes inconsistencies among the redundant elements and reduces overall system effectiveness.

Data Processing

Once collected, data usually require processing to produce information. **Data processing** tasks range from simple to complex. Examples include mathematical algorithms (such as linear programming models) used for production scheduling applications, statistical techniques for sales forecasting, and posting and summarizing procedures used for accounting applications.

FIGURE 1-5 THE DATA HIERARCHY



Database Management

The organization's **database** is its physical repository for financial and nonfinancial data. We use the term *database* in the generic sense. The term could apply to a filing cabinet or a computer disk. Regardless of the database's physical form, business data are organized in a logical hierarchy. The levels in the data hierarchy—attribute, record, and file—are illustrated in Figure 1-5.

DATA ATTRIBUTE. The data attribute is the most elemental piece of potentially useful data in the database. An attribute is a logical and relevant characteristic of an entity about which the firm captures data. The attributes shown in Figure 1-5 are logical because they all relate to a common entity—accounts receivable (AR). Each attribute is also relevant because it contributes to the information content of the entire set of attributes. As proof of this, the absence of any single relevant attribute diminishes or destroys the information content of the set. The addition of irrelevant or illogical attributes would not enhance the information content of the set.

RECORD. A record is a complete set of attributes for a single occurrence within an entity class. For example, a particular customer's name, address, and account balance is one occurrence (or record) within the AR class. To find a particular record within the database, we must be able to identify it uniquely. Therefore, every record in the database must be unique in at least one attribute.[1] This unique identifier attribute is called the primary key. Because no natural attribute (such as customer name) can guarantee uniqueness, we typically assign artificial keys to records.

The key for the AR records in Figure 1-5 is the customer account number. This is the only unique identifier in this record class. The other attributes possess values that may also exist in other records. For instance, multiple customers may have the same name, sales amounts, credit limits, and balances. Using any one of these as a key to find a specific record would not work efficiently. These nonunique attributes are, however, often used as secondary keys for categorizing

1 When we get into more advanced topics, we will see how a combination of nonunique attributes can be used as a unique identifier.

data. For example, the account balance attribute can be used to prepare a list of customers with balances greater than $10,000.

FILE. A file (or table) is a complete set of records of an identical class. For example, all the AR records of the organization constitute the AR file. Similarly, files are constructed for other classes of records such as inventory, accounts payable, and payroll. The organization's database is the entire collection of such files.

DATABASE MANAGEMENT TASKS. Database management involves three fundamental tasks: storage, retrieval, and deletion. The storage task assigns keys to new records and stores them in their proper location in the database. Retrieval is the task of locating and extracting an existing record from the database for processing. After processing is complete, the storage task restores the updated record to its place in the database. Deletion is the task of permanently removing obsolete or redundant records from the database.

Information Generation

Information generation is the process of compiling, arranging, formatting, and presenting information to users. Information can be an operational document such as a sales order, a structured report, or a message on a computer screen. Regardless of physical form, useful information has the following characteristics: relevance, timeliness, accuracy, completeness, and summarization.

RELEVANCE. The contents of a report or document must serve a purpose. This could be to support a manager's decision or a clerk's task. We have established that only data relevant to a user's action have information content. Therefore, the information system should present only relevant data in its reports. Reports containing irrelevancies waste resources and may be counterproductive to the user. Irrelevancies detract attention from the true message of the report and may result in incorrect decisions or actions.

TIMELINESS. The age of information is a critical factor in determining its usefulness. Information must be no older than the time frame of the action it supports. For example, if a manager makes decisions daily to purchase inventory from a supplier based on an inventory status report, then the information in the report should be no more than a day old.

ACCURACY. Information must be free from material errors. Materiality is, however, a difficult concept to quantify. It has no absolute value; it is a problem-specific concept. This means that, in some cases, information must be perfectly accurate. In other instances, the level of accuracy may be lower. A material error exists when the amount of inaccuracy in information causes the user to make poor decisions or to fail to make necessary decisions. We sometimes must sacrifice absolute accuracy to obtain timely information. Often, perfect information is not available within the user's decision time frame. Therefore, in providing information, system designers seek a balance between information that is as accurate as possible, yet timely enough to be useful.

COMPLETENESS. No piece of information essential to a decision or task should be missing. For example, a report should provide all necessary calculations and present its message clearly and unambiguously.

SUMMARIZATION. Information should be aggregated in accordance with the user's needs. Lower-level managers tend to need information that is highly detailed. As information flows upward through the organization to top management, it becomes more summarized.

Feedback

Feedback is a form of output that is sent back to the system as a source of data. Feedback may be internal or external and is used to initiate or alter a process. For example, an inventory status

report signals the inventory control clerk that items of inventory have fallen to, or below, their minimum allowable levels. Internal feedback from this information will initiate the inventory ordering process to replenish the inventories. Similarly, external feedback about the level of uncollected customer accounts can be used to adjust the organization's credit-granting policies.

Organizational Structure and AIS

In later chapters we see how the design and/or audit of accounting information systems require an understanding of the functional segments and activities that constitute an organization's structure. Physical accounting information systems are comprised of technologies of various types and configurations, as well as people and tasks from across the organization. Indeed, the so-called accounting information system actually involves diverse accounting and nonaccounting activities and personnel. For example, the sales processing system, which is a subsystem of the revenue cycle (refer to Figure 1-2), includes the following organization functions: sales, credit, inventory control, warehousing, shipping, billing, accounts receivable, general ledger, and data processing. Figure 1-6 depicts these and other typical business functions for a hypothetical manufacturing firm. The shaded functions in Figure 1-6 (those associated with processing sales orders) emphasize the entity-wide impact of AIS.

FUNCTIONAL SEGMENTATION

Segmentation by business function is a common method of organizing a business entity. Functional **segments** derive from the flow of resources through the firm. For example, assume a manufacturing firm that employs the following resources: materials, labor, financial capital, and information. Table 1-2 shows the relationship between these resources and the functional segments that manage them.

The segments and the functions within them will vary among organizations, depending on their size and lines of business. A public water company, for example, does not need to market its product and probably will have little in the way of advertising or market research functions. Also, a service organization with no inventories to manage will not need an inventory control function. The remainder of this section outlines the functional areas for the hypothetical firm represented in Figure 1-6.

Materials Management

The objective of materials management is to plan and control the materials inventory of the company. A manufacturing firm must have sufficient inventories on hand to meet its production needs and yet avoid excessive inventory levels. Every dollar invested in inventory is a dollar that is not earning a return. Furthermore, idle inventory can become obsolete, lost, or stolen. Ideally, a firm would coordinate inventory arrivals from suppliers such that they move directly into the production process. As a practical matter, however, most organizations maintain safety stocks to carry them through the lead time between placing the order for inventory and its arrival. We see from Figure 1-6 that materials management has three sub-functions:

1. *Purchasing* is responsible for ordering inventory from vendors when inventory levels fall to their reorder points. The nature of this task varies among organizations. In some cases, purchasing requires no more than sending a purchase order to a designated vendor. In other cases, this task involves soliciting bids from a number of competing vendors. The nature of the business and the type of inventory determine the extent of the purchasing function.
2. *Receiving* is the task of accepting the inventory previously ordered by purchasing. Receiving activities include counting and checking the physical condition of these items. This is an organization's first, and perhaps only, opportunity to detect incomplete deliveries and damaged merchandise before they move into the production process.
3. *Stores* takes physical custody of the inventory received and releases these resources into the production process as needed.

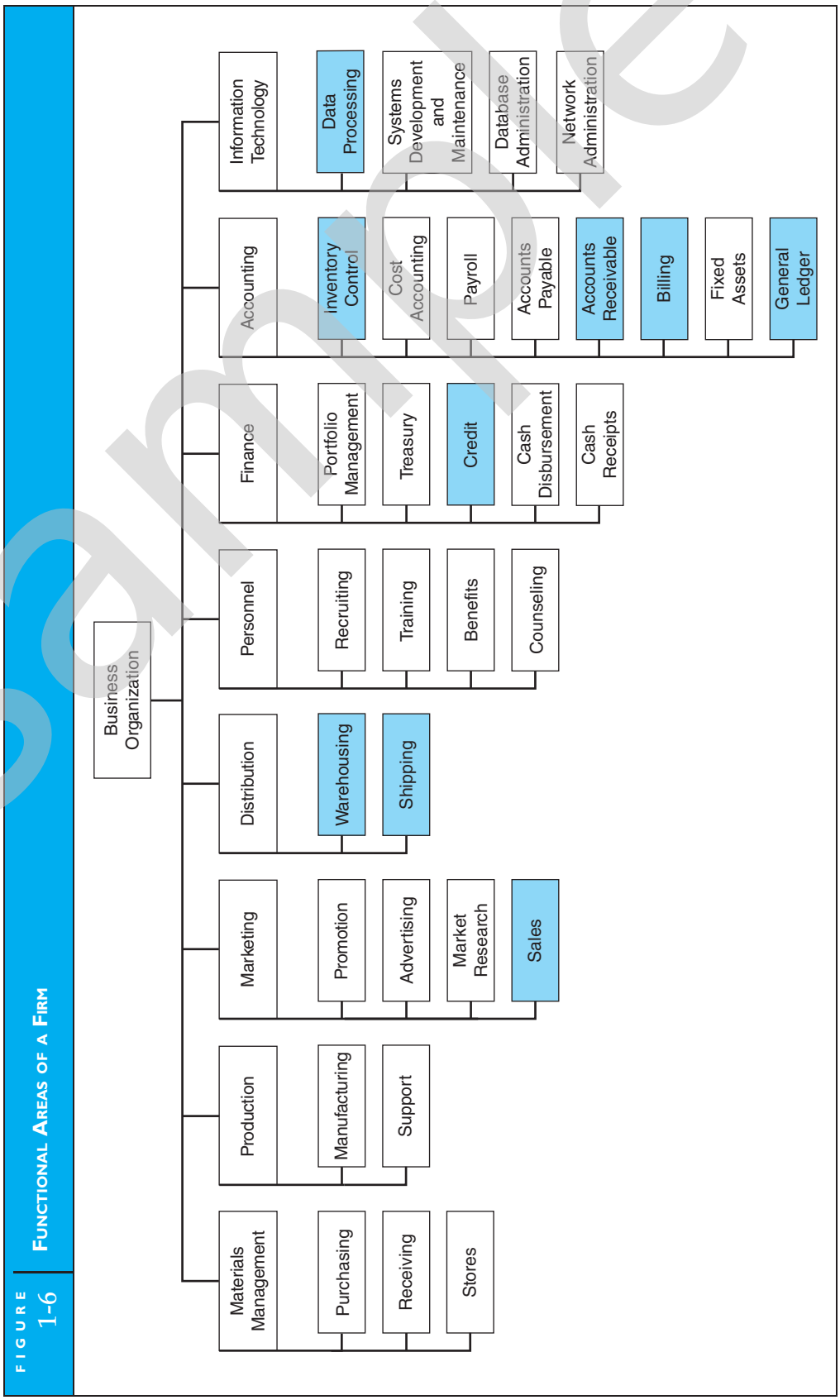


FIGURE 1-6 FUNCTIONAL AREAS OF A FIRM

TABLE 1-2 FUNCTIONS FROM RESOURCES

Resource	Functional Segment
Materials	Materials Management
	Production
	Marketing
	Distribution
Labor	Personnel
Financial Capital	Finance
Information	Accounting
	Information technology

Production

Production activities occur in the conversion cycle in which raw materials, labor, and plant assets are used to create finished products. The specific activities are determined by the nature of the products being manufactured. In general they fall into two broad classes: (1) primary manufacturing activities and (2) production support activities. Primary manufacturing activities shape and assemble raw materials into finished products. Production support activities ensure that primary manufacturing activities operate efficiently and effectively. These include, but are not limited to, the following types of activities:

Production planning *involves scheduling the flow of materials, labor, and machinery to efficiently meet production needs. This requires information about the status of sales orders, raw materials inventory, finished goods inventory, and machine and labor availability.*

Quality control *monitors the manufacturing process at various points to ensure that the finished products meet the firm's quality standards. Effective quality control detects problems early to facilitate corrective action. Failure to do so may result in excessive waste of materials and labor.*

Maintenance *keeps the firm's machinery and other manufacturing facilities in running order. The manufacturing process relies on its plant and equipment and cannot tolerate breakdowns during peak production periods. Therefore, the key to maintenance is prevention—the scheduled removal of equipment from operations for cleaning, servicing, and repairs. Many manufacturers have elaborate preventive maintenance programs. To plan and coordinate these activities, maintenance engineers need extensive information about the history of equipment usage and future scheduled production.*

Marketing

The marketplace needs to know about, and have access to, a firm's products. The marketing function deals with the strategic problems of product promotion, advertising, and market research. On an operational level, marketing performs such daily activities as sales order entry.

Distribution

Distribution is the activity of getting the product to the customer after the sale. This is a critical step since much can go wrong before the customer takes possession of the product. Incorrect shipments, damaged merchandise, or excessive lags between taking and filling of orders can result in customer dissatisfaction and lost sales. Ultimately, success depends on filling orders accurately in the warehouse, packaging goods correctly, and shipping them quickly to the customer.

Personnel

Competent and reliable employees are a valuable resource to a business. The objective of the personnel function is to effectively manage this resource. A well-developed personnel function includes recruiting, training, continuing education, counseling, evaluating, labor relations, and compensation administration.

Finance

The finance function manages the financial resources of the firm through banking and treasury activities, portfolio management, credit evaluation, cash disbursements, and cash receipts. Because of the cyclical nature of business, many firms swing between positions of excess funds and cash deficits. In response to these cash flow patterns, financial planners seek lucrative investments in stocks and other assets, and low-cost lines of credit from banks. The finance function also administers the daily flow of cash in and out of the firm.

THE ACCOUNTING FUNCTION

Accounting manages the financial information resource of the firm. In this regard, it plays two important roles in transaction processing. First, accounting captures and records the financial effects of the economic events that constitute the firm's transactions. These include events such as the movement of raw materials from the warehouse into production, shipments of the finished products to customers, cash flows into the firm and deposits in the bank, the acquisition of inventory, and the discharge of financial obligations. Second, accounting distributes transaction information to operations personnel to coordinate many of their key tasks. The following accounting functions contribute directly to business operations: inventory control, cost accounting, payroll, accounts payable, accounts receivable, billing, fixed asset accounting, and the general ledger. We deal with each of these specifically in later chapters. For the moment, however, we need to maintain a broad view of accounting to understand its functional role in the organization.

The Value of Information

The value of information to a user is determined by its **reliability**. We saw earlier that the purpose of information is to lead the user to a desired action. For this to happen, information must possess certain attributes—relevance, accuracy, completeness, summarization, and timeliness. When these attributes are consistently present, information has reliability and provides value to the user. Unreliable information has no value. At best, it is a waste of resources; at worst, it can lead to dysfunctional decisions. Consider the following example:

> *A marketing manager signed a contract with a customer to supply a large quantity of product by a certain deadline. He made this decision based on information about finished goods inventory levels. Because of faulty record keeping, however, the information was incorrect. The actual inventory levels of the product were insufficient to meet the order, and the necessary quantities could not be manufactured by the deadline. Failure to comply with the terms of the contract resulted in litigation.*

This poor sales decision was a result of flawed information. Effective decisions require information that has a high degree of reliability.

Accounting Independence

Information reliability rests heavily on the concept of accounting **independence**. Simply stated, accounting activities must be separate and independent of the functional areas that manage and maintain custody of physical resources. For example, accounting monitors and records the movement of raw materials into production and the sale of finished goods to customers. Accounting authorizes purchases of raw materials and the disbursement of cash payments to vendors and employees. Accounting supports these functions with information, but does not participate in the physical activities.

INFORMATION TECHNOLOGY

Figure 1-6 depicts four information technology (IT) functions: (1) data processing, (2) systems development and maintenance, (3) database administration, and (4) network administration. Although an organization may have many additional IT functions, these four are included in this discussion because they hold specific internal control concerns for management and auditors that we will investigate in detail in later chapters. Below, we outline the key features of each of them.

Data Processing

The data processing function brings to bear IT personnel, computer hardware, application programs (software), and corporate data to support user information needs through transaction processing and information reporting. Data processing configurations vary among different types of business entities. At one end of a continuum of options is the centralized data processing model, and at the other end is the distributed data processing model. Many organizations employ a combination of centralized and distributed processing.

CENTRALIZED DATA PROCESSING. Under the **centralized data processing** model, all data processing is performed by one or more large computers housed in a common data center that serves users throughout the organization. Figure 1-7 illustrates the centralized approach. End users process transactions from terminals in their respective departments, which are connected to the central computer and database. Because the computing resources (IT personnel, hardware, software, and data) are centrally located and accessible by all authorized users, the centralized data processing configuration lends itself to intra-organization communication and data sharing between user departments.

DISTRIBUTED DATA PROCESSING. Figure 1-8 depicts the **distributed data processing (DDP)** model, in which users process their transactions locally. Under this configuration each user segment possesses the IT personnel, facilities, hardware, software, and data they need to support

FIGURE 1-7 CENTRALIZED DATA PROCESSING MODEL

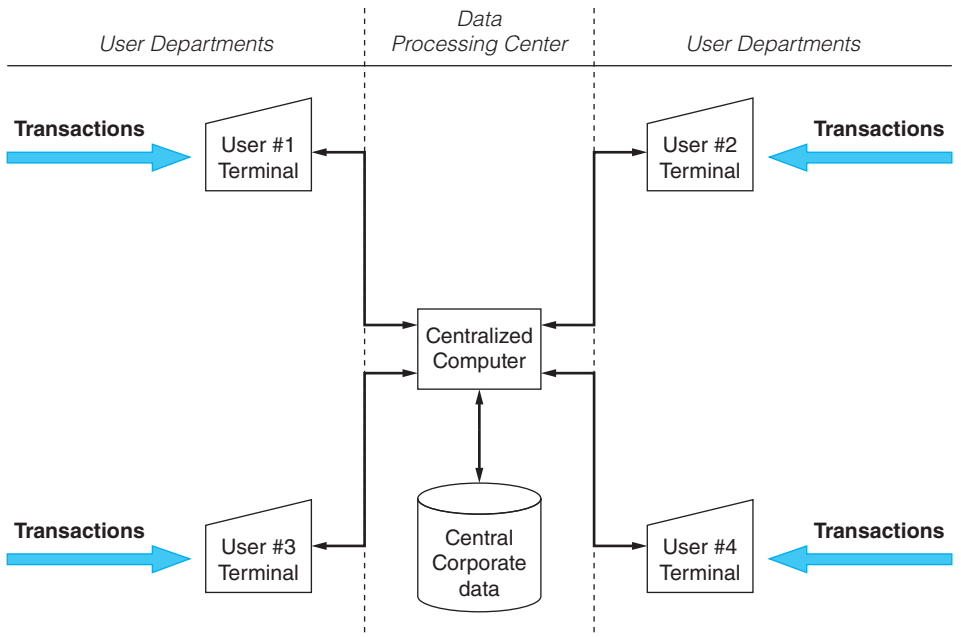
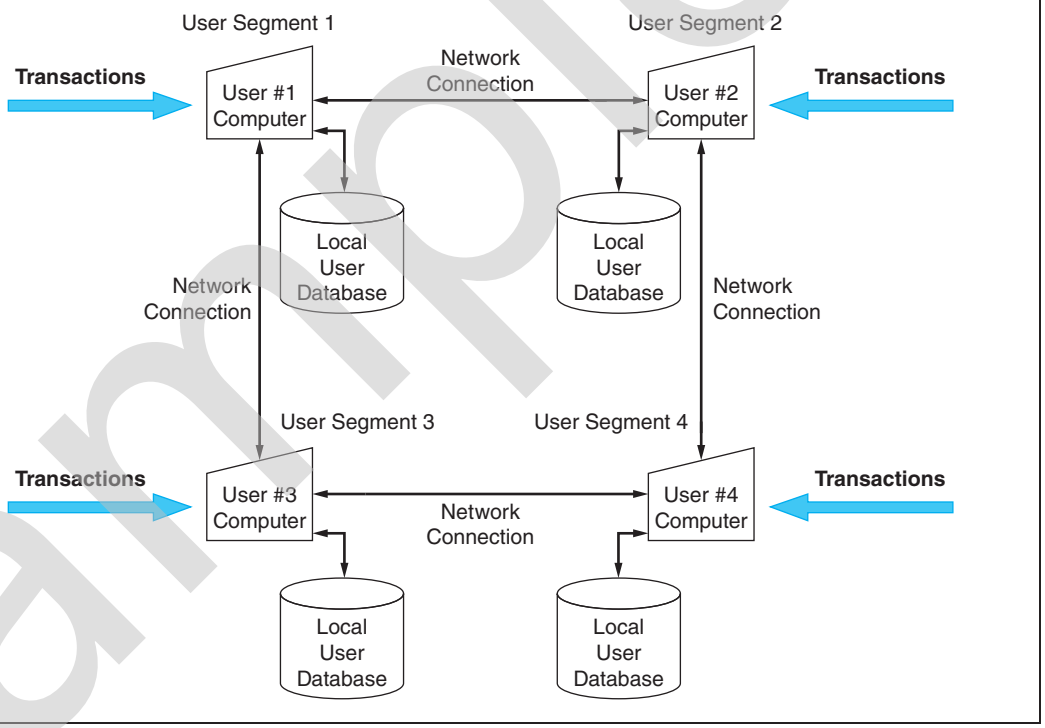


FIGURE 1-8 DISTRIBUTED DATA PROCESSING MODEL



their operations. Unlike in the centralized approach, users in a DDP environment function independently and tend not to share data and information. Any necessary sharing, however, is accomplished through network connections between the users.

Both the centralized and distributed data processing models have their respective benefits, risks, and internal control implications. We will examine these issues in detail in subsequent chapters.

Systems Development and Maintenance

The information system needs of organizations are met by two related functions: systems development and systems maintenance. The systems development function is the process by which organizations acquire information systems. The systems maintenance function is responsible for making changes to existing systems to accommodate changes in user needs. We examine each of these functions separately below.

SYSTEMS DEVELOPMENT. Organizations acquire information systems in two ways: they purchase commercial software and/or they build custom systems in-house from scratch. **Commercial software** is available for both general accounting use and for industry-specific applications, such as medical billing. Commercial software packages are sometimes called **turnkey systems** because they can often be implemented by the user with little or no modification.

The business community has recognized the many advantages of buying commercial systems. Software vendors such as Microsoft, Oracle, and SAP design their products to appeal to a large community of users, which keeps down the unit cost to the customer. Also, by purchasing commercial packages, client companies can acquire effective business solutions that are thoroughly tested, free from errors, and are current with professional standards and technological innovations designed by domain experts. Both small and large firms that have standardized information needs are potential customers for commercial software. Larger organizations with unique information

needs often develop **custom software** through a formal process called the **systems development life cycle**. Creating custom software requires the organization to have an in-house team of qualified and experienced IT professionals consisting of systems analysts, programmers, and database designers. The IT team works with corporate users to assess their information needs, design computer solutions, and physically implement them.

Custom systems are more expensive than commercial packages because the organization must absorb all the development costs, which commercial vendors are able to spread across the entire user population. For example, companies in competitive, fast-moving industries such as telecommunications, pharmaceuticals, and financial services invest hundreds of millions of dollars in custom software. When information needs are unique, however, and no commercial package adequately meets them, custom software is often the only option.

To fill this void some commercial software vendors design their systems in modules that allow flexibility through numerous processing options. Large scale **enterprise resource planning (ERP)** systems are an example of this approach. The base ERP system is comprised of thousands of small program modules. From this vast array of options the IT team selects those modules that support the organization's specific information and data-processing needs. Configuring the system in this way often takes many months, but the result is a customized system with the advantages of a commercial system. ERP key features, benefits, risks, and control issues are discussed in Chapter 11.

SYSTEMS MAINTENANCE. Over the course of the system's life (often several years), a system may be modified many times as user needs change and evolve. Maintenance changes may be trivial, such as modifying the system to produce an additional report, or significant, such as modifying it to execute new accounting rules that impact many different system modules. Between 80 and 90 percent of a system's total cost may be incurred because of maintenance activities.

Systems development and maintenance activities constitute material financial investments in hardware, software, and personnel for many organizations. These activities also represent significant risks that need to be controlled and, consequently, are of concern to management and accountants. We deal with these issues in detail in Chapters 13, 14, and 17.

Database Administration

Centrally organized companies maintain their data resources in a central location that is shared by all authorized end users (refer to Figure 1-7). In this shared-data arrangement, a special independent group—database administration—headed by the database administrator is responsible for the security and integrity of the database. We explore the database concept and the role of the database administrator in Chapter 9.

Network Administration

A **network** is a collection of interconnected computers and communications devices that allows users to communicate, access data and applications, and share information and resources. **Network administration** is responsible for the effective functioning of the software and hardware that constitute the organization's network. This involves configuring, implementing, and maintaining network equipment. In addition, network administration is responsible for monitoring network activity to ensure that the network is being used in accordance with company policies and that it is secure from attack by hackers from outside the organization as well as unauthorized individuals within the organization. Network technologies, security issues, and control techniques are the topics of Chapters 12 and 16.

Outsourcing the IT Function

From this brief discussion we see that the IT segment of an organization comprises highly technical, dynamically changing, and expensive activities. Corporate management has long complained about the administrative burden and high cost associated with managing and maintaining the IT function. In an effort to bring costs under control and to escape their IT headaches, many

corporate executives look to **IT outsourcing**. Under this practice the organization sells its IT resources (hardware, software, and facilities) to a third-party outsourcing vendor such as HP Enterprise Services (formally EDS). The outsourcing organization then leases back IT services from the vendor for a contract period of typically between five and ten years. The company's IT employees are often transferred in such deals and become employees of the outsourcing vendor. Of course, when the vendor takes the IT function off shore, employee transfers are not possible.

A variant of IT outsourcing, called **cloud computing**, is location-independent computing, where shared data centers deliver hosted IT services over the Internet. These services fall into three categories: **software as a service (SaaS)**, **infrastructure as a service (IaaS)**, and **platform as a service (PaaS)**. The concept can be equated to the way in which electricity is delivered to a private home. The homeowner enters into a contract with the local public utility company to deliver electricity as needed. The public utility company may generate some of this electricity, but during high demand periods it will go to the national electric grid to tap into the production of other electricity generators across the country. Similarly, an organization pursuing cloud computing signs a contract with an IT service provider to provide computing resources. When demand exceeds the provider's IT capacity, it acquires additional capacity from data centers in the "cloud" that are connected via the Internet. A potential risk to the client firm is that it does not necessarily know where its data are actually being processed, just as the homeowner does not know where his or her electricity is being generated. The advantage to the client organization is access to whatever computing power it needs, while it pays only for what it uses. Also, cloud computing contracts are flexible and relatively short term. In contrast, traditional outsourcing contracts tend to be fixed price, inflexible, and much longer term.

IT outsourcing is a rapidly growing phenomenon. The departure from tradition that it represents carries both advantages and risks that management and auditors need to recognize. In Chapter 15 we explore these issues in detail.

The Role of Accountants in AIS

Accountants are involved in both the design and the audit of accounting information systems. The final section of this chapter briefly outlines key areas of responsibility; these issues are expanded upon in subsequent chapters.

ACCOUNTANTS AS SYSTEM DESIGNERS

Accountants play a prominent role on systems development teams as **domain experts**. In that capacity they are responsible for many aspects of the conceptual system. This involves specifying certain operational rules, reporting requirements, and framing internal control objectives that the system must achieve. The IT professionals on the team are responsible for the physical system including system architecture, programming, and database design. To illustrate the distinction between conceptual and physical systems, consider the following example:

> *The credit department of a retail business requires information about delinquent accounts from the AR department. This information is used to support decisions made by the credit manager regarding the credit-worthiness of customers.*

The design of the **conceptual system** involves specifying the criteria for identifying delinquent customers and the information that needs to be reported. As the domain expert, the accountant determines the nature of the information required, its sources, its destination, and the accounting rules that need to be applied. The **physical system** includes the **data storage** medium to be used and the method for capturing and presenting the information. IT professionals determine the most economical and effective technologies for accomplishing the task. Hence, systems design is a collaborative effort. Because of the specificity of accounting rules, the implications of material error, and the potential for fraud, the accountant's involvement in systems design is essential and pervasive throughout the development process.

ACCOUNTANTS AS SYSTEM AUDITORS

Accountant's perform audits of business organizations for various reasons, which typically involve the accounting information system. The most common audits are external (attestation) audits, internal (operational) audits, and fraud audits. Each type of audit requires that the **auditor** have a thorough understanding of AIS functions and internal controls.

An external audit is an independent attestation performed by an expert—the auditor—who expresses an opinion in the form of a formal **audit report** regarding the presentation of financial statements. This task, known as the **attest function**, is performed by Certified Public Accountants (CPAs) who work for public accounting firms that are independent of the client organization being audited. The audit objective is to assure the fair presentation of corporate financial statements. This requires auditors to perform tests of the information system's internal controls as well as **substantive tests** of data that reside in the system's databases. External audits are often referred to as *financial audits* and the SEC requires all publicly traded companies to undergo a financial audit annually. CPAs conducting such audits are acting on behalf of outsiders such as stockholders, creditors, government agencies, and the general public.

A critical element in the relationship between auditors and their constituents is the concept of auditor **independence**. Within the context of an audit, independence means that the auditor is free from factors that might influence the auditors' report regarding the financial position of the client firm. Such factors include, but are not limited to, financial interests in the client firm including stock holding or employment outside of the attest service, family ties or other personal relationships with the client, or provision of nonaudit (advisory) services to audit clients. In the absence of independence, the auditor's report would be of little value to its users.

Attest Service versus Advisory Services

An important distinction needs to be made regarding the external auditor's attestation function and the rapidly growing field of advisory services, which many public accounting firms offer. Advisory services are professional services offered by public accounting firms to improve their client organizations' operational efficiency and effectiveness. The domain of advisory services is intentionally unbounded so that it does not inhibit the growth of future services that are currently unforeseen. As examples, advisory services include actuarial advice, business advice, fraud investigation services, information system design and implementation, and internal control assessments for compliance with SOX.

Prior to the passage of SOX, accounting firms were permitted to provide advisory services and attest services concurrently to clients. SOX legislation, however, greatly restricts the types of nonaudit services that auditors may render audit clients. It is now unlawful for a registered public accounting firm that is currently providing attest services for a client to provide the following services:

- bookkeeping or other services related to the accounting records or financial statements of the audit client
- financial information systems design and implementation
- appraisal or valuation services, fairness opinions, or contribution-in-kind reports
- actuarial services
- internal audit outsourcing services
- management functions or human resources
- broker or dealer, investment adviser, or investment banking services
- legal services and expert services unrelated to the audit
- any other service that the Board determines, by regulation, is impermissible.

The IT advisory services units of public accounting firms have different names in different firms, but they all engage in tasks generally known as risk management. These groups often play a dual role within their respective firms; they provide nonaudit clients with IT advisory services and also work with their firm's financial audit staff to perform IT-related **tests of controls** (often called **IT auditing**) as part of the attestation function. Keep in mind that in many cases the purpose of the

task, rather than the task itself, defines the service being rendered. For example, a risk management professional may perform a test of IT controls as an advisory service for a nonaudit client who is preparing for a financial audit by a different public accounting firm. The same professional may perform the same test for an audit client as part of the attest function.

Internal Audits

Internal auditing is an independent appraisal function established within an organization to examine and evaluate its activities. Internal auditors perform a wide range of activities including conducting financial audits, performing IT audits examining an operation's compliance with organizational policies and legal obligations, evaluating operational efficiency, and detecting and pursuing fraud within the firm.

An internal audit is typically conducted by auditors who work for the organization, but this task may be outsourced to other organizations. Internal auditors are often certified as a Certified Internal Auditor (CIA) or a Certified Information Systems Auditor (CISA). While internal auditors self-impose independence to perform their duties effectively, they are employed by the organization and represent its interests. These auditors generally answer to executive management of the organization or the audit committee of the board of directors. The standards, guidance, and certification of internal audits are governed mainly by the Institute of Internal Auditors (IIA) and, to a lesser degree, by the Information Systems Audit and Control Association (ISACA).

External versus Internal Auditors

The characteristic that conceptually distinguishes external auditors from internal auditors is their respective constituencies: while external auditors represent outsiders, internal auditors represent the interests of the organization. Nevertheless, in this capacity, internal auditors often cooperate with and assist external auditors in performing aspects of financial audits. This cooperation is done to achieve audit efficiency and reduce audit fees. For example, a team of internal auditors can perform tests of computer controls under the supervision of a single external auditor.

The independence and competence of the internal audit staff determine the extent to which external auditors may cooperate with and rely on work performed by internal auditors. Some internal audit departments report directly to the controller. Under this arrangement, the internal auditor's independence is compromised, and the external auditor is prohibited by professional standards from relying on evidence provided by them. In contrast, external auditors can rely in part on evidence gathered by internal audit departments that are organizationally independent and report to the board of directors' audit committee (discussed later). A truly independent internal audit staff adds value to the audit process. For example, internal auditors can gather audit evidence throughout a fiscal period, which external auditors may then use at year end to conduct more efficient, less disruptive, and less costly audits of the organization's financial statements.

Fraud Audits

In recent years fraud audits have, unfortunately, increased in popularity as a corporate governance tool. They have been thrust into prominence by a corporate environment in which both employee theft of assets and major financial frauds by management (e.g., Enron, WorldCom) have become rampant. The objective of a fraud audit is to investigate anomalies and gather evidence of fraud that may lead to criminal conviction. Sometimes fraud audits are initiated when corporate management suspects employee fraud. Alternatively, boards of directors may hire fraud auditors to investigate their own executives if theft of assets or financial fraud is suspected. Organizations victimized by fraud usually contract with specialized fraud units of public accounting firms or with companies that specialize in forensic accounting. Typically, fraud auditors have earned the Certified Fraud Examiner (CFE) certification, which is governed by the Association of Certified Fraud Examiners (ACFE).

The Role of the Audit Committee

The boards of directors of publicly traded companies form a subcommittee known as the audit committee that has special responsibilities regarding audits. This committee is usually composed

of three people who should be outsiders (not associated with the families of executive management nor former officers, etc.). With the advent of the SOX, at least one member of the audit committee must be a "financial expert." The audit committee serves as an independent "check and balance" for the internal audit function and liaison with external auditors. One of the most significant changes imposed by SOX has been to the relationship between management and the external auditors. Prior to SOX, external auditors were hired and fired by management. Many believe, with some justification, that this relationship erodes auditor independence when disputes over audit practices arise. SOX mandates that external auditors now report to the audit committee, which hires and fires auditors and resolves disputes.

To be effective, the audit committee must be willing to challenge the internal auditors (or the entity performing that function) as well as management when necessary. Part of the role of committee members is to look for ways to identify risk. For instance, they might serve as a sounding board for employees who observe suspicious behavior or spot fraudulent activities. In general, they become an independent guardian of the entity's assets by whatever means is appropriate. Corporate frauds often have some relationship to audit committee failures. These include lack of independence of audit committee members, lack of experienced members on the audit committee, inactive audit committees, and the total absence of an audit committee.

Designer/Auditor Duality

The accountant's dual roles of designer and auditor draw upon a common skill set. An accountant cannot effectively conduct an audit if he or she does not understand the principles of systems design. The functions involved in a system, the tasks performed by it, and the internal controls that are, or should be, in place are design issues about which auditors routinely gather evidence. Similarly, an accountant cannot properly design a system without a thorough understanding of audit issues and concerns. For example, the designer must understand the nature of a particular audit risk before he or she can plan the design of internal control techniques needed to mitigate the risk. Also, the designer must understand audit objectives regarding evidence gathering so he or she may create a system that facilitates the subsequent extraction of audit evidence.

The accountant's dual responsibility for systems design and auditing has greatly influenced the organization and approach taken in this text. Although primarily an AIS design text, chapter topics are presented from the auditor's perspective. Human activities, manual procedures, and information technologies such as networks, databases, and computer applications that constitute the AIS are presented and discussed within the context of the audit risks they pose and how those risks can be mitigated through internal controls. This approach is followed throughout the remaining chapters of the book.

Summary

The first section of this chapter introduced basic systems concepts and presented a framework for distinguishing between accounting information systems and management information systems. This distinction is related to the types of transactions these systems process. AIS applications process financial transactions, and MIS applications process nonfinancial transactions. The section then presented a general model for accounting information systems. The model is composed of four major tasks that exist in all AIS applications: data collection, data processing, database management, and information generation.

The second section examined the relationship between organizational structure and the information system. It focused on functional segmentation as the predominant method of structuring a business and examined the functions of a typical manufacturing firm. The section presented two general methods of organizing the IT function: the centralized approach and the distributed approach.

The final section of this chapter examined the dual roles of accountants as (1) designers of AIS and (2) auditors of AIS. The IT function is responsible for designing the physical system, and the accounting function is responsible for specifying the conceptual system. An audit is an independent attestation performed by the auditor, who expresses an opinion about the fairness of a company's financial statements. A distinction was drawn between attestation and financial services. Both external and internal auditors conduct IT audits.

Key Terms

accounting information systems (AIS) (3)
attest function (21)
auditor (21)
centralized data processing (17)
cloud computing (20)
commercial software (18)
conceptual system (20)
custom software (19)
data (10)
data collection (10)
data processing (10)
data sources (10)
data storage (20)
database (11)
database management (12)
discretionary reporting (9)
distributed data processing (DDP) (17)
end users (9)
enterprise resource planning (ERP) (19)
feedback (12)
financial transaction (7)
general ledger/financial reporting system (GL/FRS) (7)
general model for AIS (9)
independence (16)
information (10)
information flows (4)
information generation (12)
information system (5)
infrastructure as a service (IaaS) (20)
internal auditing (22)
IT auditing (21)
IT outsourcing (20)
management information system (MIS) (5)
management reporting system (MRS) (7)
network (19)
network administration (19)
nondiscretionary reporting (8)
nonfinancial transactions (7)
physical system (20)
platform as a service (PaaS) (20)
reliability (16)
segments (13)
software as a service (SaaS) (20)
stakeholders (5)
substantive tests (21)
systems development life cycle (19)
tests of controls (21)
trading partners (5)
transaction (5)
transaction processing system (TPS) (7)
turnkey systems (18)

Review Questions

1. What are the four levels of activity in the pyramid representing the business organization? Distinguish between horizontal and vertical flows of information.
2. What is the relationship among data, information, and an information system?
3. Distinguish between AIS and MIS.
4. What are the three cycles of transaction processing systems?
5. What is discretionary reporting?
6. What are the characteristics of good or useful information?
7. What rules govern data collection?
8. What are the levels of data hierarchy?
9. What are the three fundamental tasks of database management?
10. What is feedback, and how is it useful in an information system?
11. What are the fundamental objectives of all information systems?
12. What does stewardship mean, and what is its role in an information system?
13. List five functional areas and their sub-functions.
14. Distinguish the roles of internal and external auditors.
15. What is the role of a database administrator?
16. What is the role of the accounting function in an organization?
17. Distinguish between the centralized and distributed approaches to organizing the IT function.
18. What is distributed data processing?
19. What is an ERP system?
20. What two roles are played by accountants with respect to the information system?

21. Define the term *attest function*.
22. Define the term *financial services*.
23. What is IT auditing?
24. Distinguish between conceptual and physical systems.
25. What is the role of the audit committee of the board of directors?
26. Who initiates a fraud audit within the organization?
27. When can external auditors rely on the work performed by internal auditors?
28. Name the tests that auditors perform to gather evidence.
29. What characteristic conceptually distinguishes internal and external auditing?
30. What is the role of network administration?
31. What is cloud computing?
32. Name the two ways in which organizations acquire information systems.
33. Why are custom systems more expensive than commercial systems?
34. What types of companies are potential customers for commercial software?
35. Briefly explain accounting independence.
36. Why do systems designers need to know anything about auditing?

Discussion Questions

1. Discuss the differences between internal and external users of information and their needs and demands on an information system. Historically, which type of user has the firm catered to most?
2. Comment on the level of detail necessary for operations management, middle management, and stockholders.
3. Distinguish between financial and nonfinancial transactions. Give three examples of each.
4. An information system must meet three fundamental objectives. Discuss why these objectives cannot effectively be met by a common set of information.
5. Do you think transaction processing systems differ significantly between service and manufacturing industries? Are they equally important to both sectors?
6. Discuss the difference between the financial reporting system and general ledger system.
7. Examine Figure 1-4 and discuss where and how problems can arise that can cause the resulting information to be bad or ineffective.
8. Discuss how the elements of efficiency, effectiveness, and flexibility are crucial to the design of an information system.
9. Discuss what is meant by the statement, "The accounting system is a conceptual flow of information that represents physical personnel, machinery, and flows of raw materials and cash through the organization."
10. Discuss the importance of accounting independence in accounting information systems. Give an example of where this concept is important (use an example other than inventory control).
11. Discuss why it is crucial that internal auditors report solely to the audit committee of the board of directors and answer to no other group.
12. Contrast centralized data processing with distributed data processing. How do the roles of end users differ between the two approaches?
13. Discuss how conceptual and physical systems differ and which functions are responsible for each of these systems.
14. Why is an active board of directors audit committee important to an organization?
15. Do you agree with the statement, "The term *IT auditor* should be considered obsolete because it implies a distinction between regular auditors and auditors who examine computerized AIS"? Why or why not?
16. Describe cloud computing and explain how it is similar to obtaining a commodity product.
17. Why is it important to organizationally separate the accounting function from other functions of the organization?
18. What is an external financial audit, and what are the sources of audit evidence?
19. Why do firms outsource their IT functions? Explain the options of traditional IT outsourcing and cloud computing, and how they differ.

Multiple-Choice Questions

1. Which of the following is NOT a financial transaction?
   a. purchase of products
   b. cash receipts
   c. update valid vendor file
   d. sale of inventory
2. The following are subsystems of the accounting information system, EXCEPT the
   a. transaction processing system.
   b. human resources system.
   c. general ledger/financial reporting system.
   d. management reporting system.
3. Which of the following is NOT a purpose of the transaction processing system?
   a. managing and reporting on the status of financial investments
   b. converting economic events into financial transactions
   c. distributing essential information to operations personnel to support their daily operations
   d. recording financial transactions in the accounting records
4. The objectives of the data collection activity of the general model for accounting information systems are to collect data that are
   a. relevant and redundant.
   b. efficient and objective.
   c. efficient and redundant.
   d. efficient and relevant.
5. Which of the following is NOT a characteristic of effective information?
   a. relevance
   b. accuracy
   c. summarization
   d. precision
6. Which of the following is NOT a database management task?
   a. retrieval
   b. storage
   c. summarization
   d. deletion
7. When viewed from the highest to most elemental level, the data hierarchy is
   a. attribute, record, file.
   b. record, attribute, key.
   c. file, record, attribute.
   d. file, record, key.
   e. key, record, file.
8. Which is NOT a source of evidence for an external auditor?
   a. work performed by internal auditors who organizationally report to the controller
   b. tests of controls
   c. substantive tests
   d. work performed by internal auditors who report to the audit committee of the BOD
9. Which of the following is NOT an objective of all information systems?
   a. support for the stewardship function of management
   b. support for management decision making
   c. support for the day-to-day operations of the firm
   d. all of the above are objectives
10. Which of the following best describes the activities of the materials management function?
    a. purchasing, receiving, and inventory control
    b. receiving, sales, distribution, and purchasing
    c. receiving, storage, purchasing, and accounts payable
    d. purchasing, receiving, and storage
    e. purchasing, storage, and distribution
11. Which of the following best describes the activities of the production function?
    a. maintenance, inventory control, and production planning
    b. production planning, quality control, manufacturing, and cost accounting
    c. quality control, production planning, manufacturing, and payroll
    d. maintenance, production planning, storage, and quality control
    e. manufacturing, quality control, and maintenance

12. Which of the following best describes the activities of the accounting function?

a. inventory control, accounts payable, fixed assets, and payroll

b. fixed assets, accounts payable, cash disbursements, and cost accounting

c. purchasing, cash receipts, accounts payable, cash disbursements, and payroll

d. inventory control, cash receipts, accounts payable, cash disbursements, and payroll

e. inventory control, cost accounting, accounts payable, cash disbursements, and payroll

13. Which statement about cloud computing is most true?

a. Cloud computing involves long-term contracts.

b. Cloud computing is location-independent computing.

c. Cloud computing involves an organization selling its IT resources to a vendor and leasing back IT services from the vendor.

d. Cloud computing involves fixed price contracts.

e. Cloud computing involves signing entering into multiple contracts with each IP service provider to create a cloud of resources.

14. Which of the following statements is most accurate?

a. ERP systems are commercial software packages that are sometimes called turnkey systems because they can be implemented by the user with little or no modification.

b. Substantive tests provide evidence focused on the system controls.

c. Public accounting firms that provide attest services are not allowed under SOX to offer IT advisory services.

d. Both small and large firms that have standardized information needs are potential customers for commercial software.

e. External auditors may rely on the work of internal auditors only if they report to the controller or the CEO of the client company.

Problems

1. USERS OF INFORMATION

Classify the following users of information as either:

I—internal user
T—external user: trading partner
S—external user: stakeholder

a. Internal Revenue Service
b. Inventory control manager
c. Board of directors
d. Customers
e. Lending institutions
f. Securities and Exchange Commission
g. Stockholders
h. Chief executive officer
i. Suppliers
j. Bondholders

2. GENERAL MODEL FOR AIS

Redraw the diagram presented in Problem 2. Label each element in the diagram and briefly describe its role and key features.

3. ACCOUNTING INFORMATION SYSTEM ACQUISITION

What is the most likely system acquisition method—commercial software, custom software, or ERP—for each of the following situations? Explain your answers.

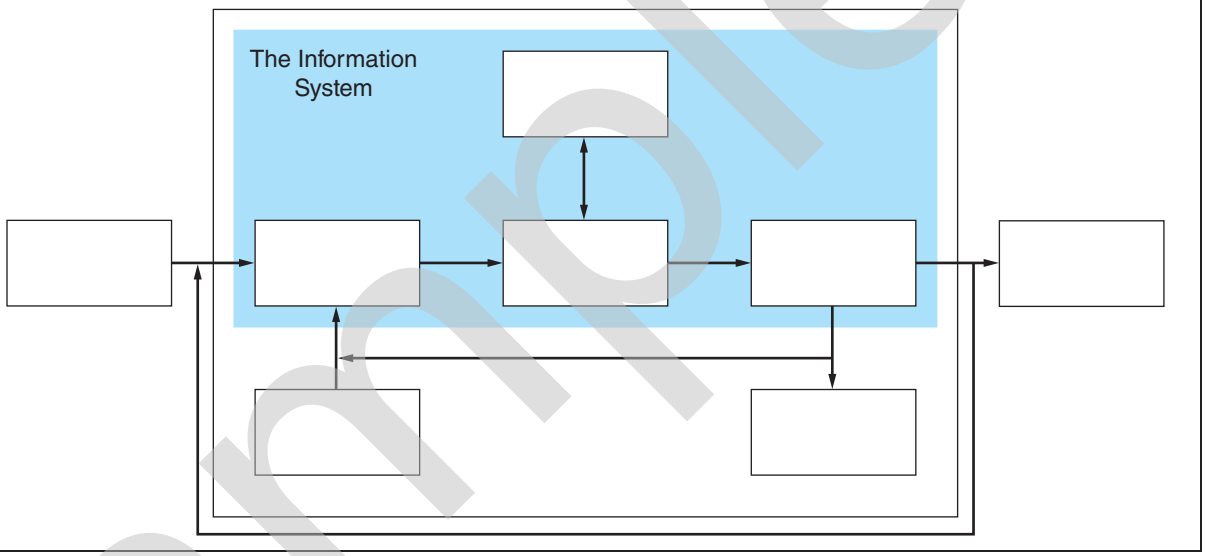
- A heating and air-conditioning supply company with 20 employees that sells standard off-the-shelf products to wholesale customers in a local community needs a system to manage its affairs.
- A major oil company with diverse holdings, complex oil leases, and esoteric accounting practices needs a system that can coordinate its many enterprises.
- A large organization with multiple divisions needs an information system to support its operations. The information needs of the various divisions are diverse, but standard within their respective industries.

4. INFORMATION SYSTEM CATEGORIZATION

Classify the following as tasks performed by either:

TPS—transaction processing system

PROBLEM 2



FRS—financial reporting system
MRS—management reporting system

a. Preparation of balance sheet
b. Capture customer sales order
c. Preparation of variance reports
d. Preparation of budgets
e. Purchase order preparation
f. Summary of inventory purchases by vendor
g. Preparation of comparative sales report by division
h. Preparation of cash disbursements to vendors
i. Annual report preparation
j. Customer billing process
k. Cost-volume-profit analysis

5. ORGANIZATION FUNCTIONS

Based on Figure 1-6 in the text, draw a diagram of functional segments for an oil company that has the following operations:

a. A head office in New York City responsible for international and national marketing, acquisition of leases and contracts, and corporate reporting.
b. Two autonomous regional facilities in Tulsa, Oklahoma, and New Orleans, Louisiana. These facilities are responsible for oil exploration,drilling, refining, storage, and the distribution of petroleum products to corporate service stations throughout the country and abroad.

6. ORGANIZATION FUNCTIONS

Based on Figure 1-6 in the text, draw a diagram of functional segments for a manufacturer of diversified products. The general characteristics of the firm are as follows:

a. The organization produces three unrelated products: lawn and garden furniture for sale in home improvement centers and department stores, plastic packaging products for the electronics and medical supply industries, and paper products (e.g., plates, cups, and napkins) for the fast-food industry.
b. Although the manufacturing facilities are located within a single complex, none of the three products shares the same suppliers, customers, or physical production lines.
c. The organization's functional activities include design, production, distribution, marketing, finance, human resources, and accounting.

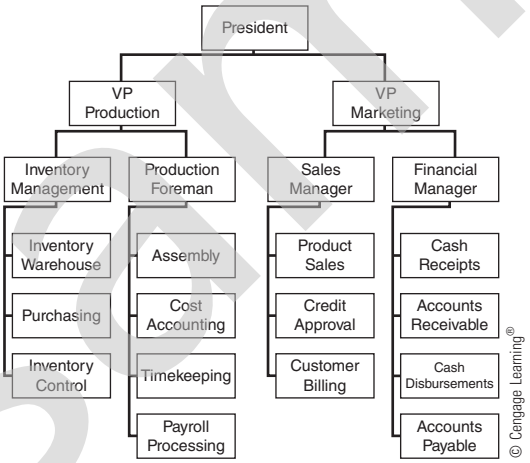
7. FUNCTIONAL SEGMENTATION

The current organizational structure of Blue Sky Company, a manufacturer of small sailboats, is presented below.

Required

a. What operational problems (e.g., inefficiency, errors, or fraud) do you think Blue Sky could experience because of this structure?

b. Draw a new diagram reflecting an improved structure that solves the problems you identified. If necessary, you may add up to two new positions.



8. COMMUNICATIONS

Before the mid-1970s, systems programmers and businesspeople (including accountants) did not communicate well with one another. The programmers were criticized for using too much jargon, and the businesspeople were criticized for not adequately expressing their needs. Efforts have been made to overcome this communication gap, but room for improvement still exists. What problems do you think may result from this communication gap? What can you do to help further close the gap when you enter the workforce?

9. CHARACTERISTICS OF USEFUL INFORMATION

All records in a file must be uniquely identifiable in at least one attribute, which is its primary key. Drawing on your general knowledge of accounting, identify the primary key for the following types of accounting records. To illustrate, the first record is done for you.

Record Type	Primary Key
Accounts Receivable	Customer Number
Accounts Payable	
Inventory	
Customer Sales Orders	
Purchase Orders to vendors	
Cash Receipts (checks) from Customers	
Cash Disbursements (checks) to vendors	
Employee Payroll Earnings Records	

10. DATA ATTRIBUTES

Drawing from your basic accounting knowledge, list the relevant data attributes that constitute the record types below. Identify which attribute is the primary key for the record.

Accounts Payable record
Inventory record
Customer Sales Orders record
Purchase Orders to vendors
Cash Receipts (checks) from customers
Employee Payroll Earnings records

11. ROLE OF INTERNAL AUDIT FUNCTION

Nano Circuits Inc, is a publicly traded company that produces electronic control circuits, which are used in many products. In an effort to comply with SOX, Nano is in the process of establishing an in-house internal audit function, which previously had been outsourced. The company began this process by hiring a Director of Internal Audits. Nano Circuits' CEO recently called a planning meeting to discuss the roles of key corporate participants regarding the implementation and maintenance of internal controls. Central to this decision is the organizational placement of the future internal audit function and to whom the new Director of Internal Audit should report. In addition, Nano Circuits considered the need to reconstitute its Board of Directors Audit Committee. Participants at the meeting included the company president, the chief financial officer, a member of the audit committee, a partner from Nano Circuits external audit firm, and the Director of Internal Audits. Expectations and concerns presented by the meeting participants are summarized below.

CEO: The CEO expressed concern that Nano Circuits complies with SOX and PCAOB requirements and

recommendations. The internal audit function should strengthen the organization's internal control system by developing control policies and procedures and by detecting violations of policies and procedures.

CFO: The CFO saw the role of the internal audit function as one that should be focused primarily on financial issues and therefore, the director of Internal Audits should report to the CFO.

Audit committee member: The committee member felt strongly that the Audit Committee as currently constituted is appropriate and no changes need to be made. Although none of the committee members are trained accountants they all have extensive industry experience, they have all been associated with Nano Circuits in various capacities for many years, and are well qualified to fulfill their policy-oversight responsibilities.

External audit partner: The external audit partner pointed out that the internal audit function should be organized such that it supports a close working relationship with the external auditors. This would include monitoring internal control systems on a continuing basis to provide a body of evidence on which the external auditor can rely.

Director of Internal Audits: The Director of Internal Audits argued that the new IA function should focus more on operational auditing issues, but it also should play a role in the review of internal controls over financial reporting.

Required

a. Describe the role that each of the following areas has in the establishment, maintenance, and evaluation of internal control:
   i. Management
   ii. External auditor
   iii. Internal audit

b. To whom should the Director of Internal Audits report? Explain your answer.

c. Comment on the audit committee member's perspective as to the committee's current composition.

12. INTERNAL AUDITOR INDEPENDENCE

Technical Solutions Inc, is expanding and reorganizing its Internal Audit (IA) function. Currently the Director of Internal Audit, Sharon Kalafut, reports to the corporate controller, who receives and reviews all internal audit reports. Kalafut forwards copies of the internal audit reports to the audit committee of the board of directors and to the manager directly responsible for the function being audited.

An issue of contention among the management team pertains to which department or function the Director of Internal Audits should report. Martin Stevens the CEO wants to ensure that Technical Solutions complies with the SOX and that the internal audit department is structured such that it strengthens the company's internal control system. Also, an overarching objective for the reorganized audit function is that the external auditors are able to rely on the work performed by the internal audit department to a substantial degree. Arguments put forth by interested parties as to where the IA department should be organizationally located are presented below:

- **Chief Operations Officer (COO).** John Sweeney, the COO of Technical Solutions, believes that the Director of IA should report to him. Under this arrangement the IA staff members would be involved in the preparation of policy statements on internal control regarding safeguarding of assets and in the design of business processes.
- **Chief Information Officer (CIO)**. Larry Rich, the CIO, has pushed hard to have the IA function report to him and take on an active role in the design, installation, and initial operation of a new computerized systems. IA staff will be primarily concerned with the design and implementation of internal accounting controls and conduct the evaluation of these controls during the test runs and audits.
- **Corporate Controller**. The controller Linda Johnson, believes the IA group should remain within her functional area. Currently the IA staff performs a number of controller related tasks. These include:
  - Internal auditors reconcile bank statements of the corporation each month. The controller believes this strengthens the internal control function because the internal auditor is not involved in either the receipt or the disbursement of cash.
  - Internal auditors review the annual budget each year for relevance and reasonableness before the budget is approved. At the end of each month, the controller's staff analyzes the variances from budget and prepares explanations of these variances. These variances and explanations are then reviewed by the internal audit staff.
  - Finally, the internal auditors make accounting entries for complex transactions when employees of the accounting department are

not adequately trained to handle such transactions. The controller believes this gives an added measure of assurance to the accurate recording of such transactions.

Required

a. Define independence as it relates to the internal audit function.

b. For each of the proposed tasks to be performed by the IA function, explain whether Technical Solutions' internal audit independence will be materially impaired. Consider each manager's arguments independently.

c. To maintain independence, where should the Director of Internal Audits report? Explain your answer.

CHAPTER

2

Introduction to Transaction Processing

Chapter 1 introduced the transaction processing system (TPS) as an activity consisting of three major subsystems called cycles: the revenue cycle, the expenditure cycle, and the conversion cycle. Even though each cycle performs different specific tasks and supports different objectives, they share common characteristics. For example, all three TPS cycles capture financial transactions, record the effects of transactions in accounting records, and provide information about transactions to users in support of their day-to-day activities. In addition, transaction cycles produce much of the raw data from which management reports and financial statements are derived. Because of their financial impact on the firm, transaction cycles command much of the accountant's professional attention.

The purpose of this chapter is to present some preliminary topics that are common to all three transaction processing cycles. In subsequent chapters, we will draw heavily from this material as we examine the individual subsystems of each cycle in detail. This chapter is organized into six major sections. The first is an overview of transaction processing. This section defines the broad objective of the three transaction cycles and specifies the roles of their individual subsystems. The second section describes the relationship among accounting records, both traditional and digital, in forming an audit trail. The third section describes the key features of flat file and database structures used to store accounting data. The fourth section examines several documentation techniques used to represent systems including manual procedures and the computer components of system. The fifth section addresses alternative transaction processing approaches. It reviews the fundamental features of batch and real-time technologies and their implication for transaction processing. The final section examines data coding schemes and their role in transaction processing.

Learning Objectives

After studying this chapter, you should:

- Understand the broad objectives of transaction cycles.
- Recognize the types of transactions processed by each of the three transaction cycles.
- Know the basic accounting records used in transaction processing systems.
- Understand the relationship between traditional accounting records and their digital equivalents in computer-based systems.
- Be familiar with the documentation techniques used for representing manual procedures and the computer components of systems.
- Understand the differences between batch and real-time processing and the impact of these technologies on transaction processing.
- Be familiar with data coding schemes used in accounting information systems.

An Overview of Transaction Processing

TPS applications process financial transactions. A financial transaction was defined in Chapter 1 as

> *An economic event that affects the assets and equities of the firm, is reflected in its accounts, and is measured in monetary terms.*

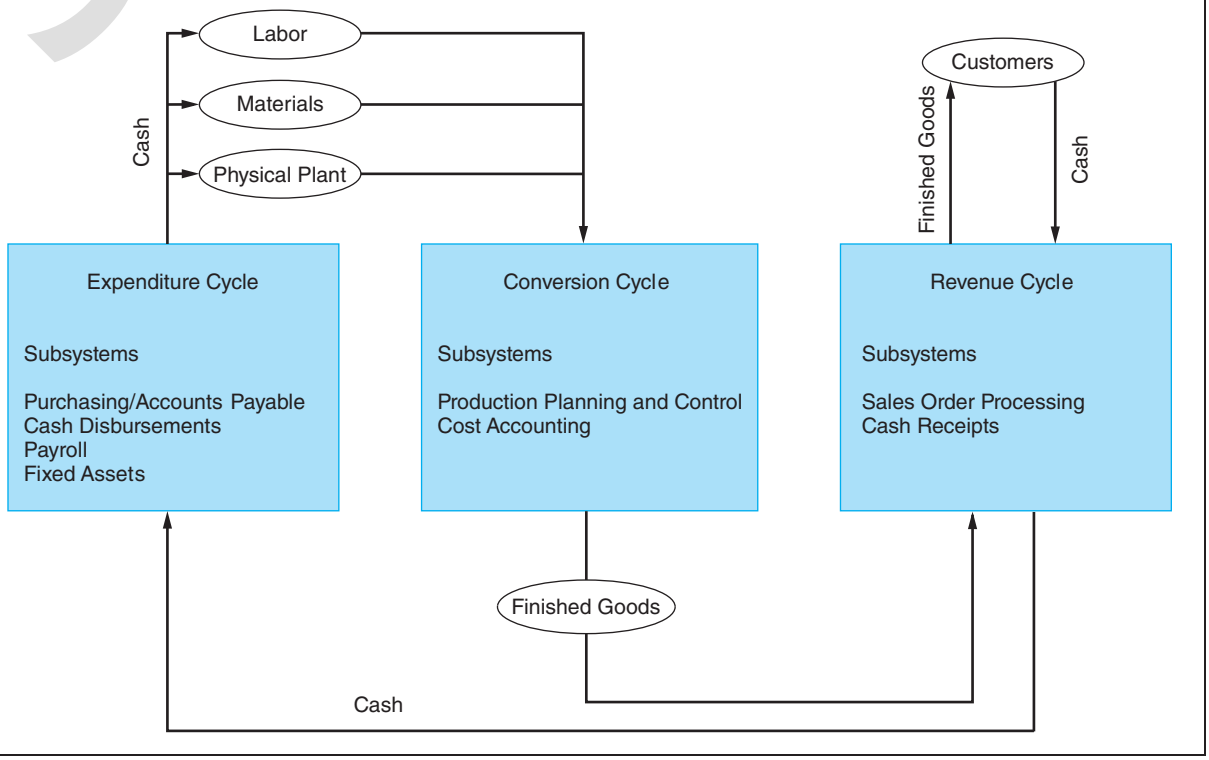
The most common financial transactions are economic exchanges with external parties. These include the sale of goods or services, the purchase of inventory, the discharge of financial obligations, and the receipt of cash on account from customers. Financial transactions also include certain internal events such as the depreciation of fixed assets; the application of labor, raw materials, and overhead to the production process; and the transfer of inventory from one department to another.

Financial transactions are common business events that occur regularly. For instance, thousands of transactions of a particular type (sales to customers) may occur daily. To deal efficiently with such volume, business firms group similar types of transactions into transaction cycles.

TRANSACTION CYCLES

Three transaction cycles process most of the firm's economic activity: the expenditure cycle, the conversion cycle, and the revenue cycle. These cycles exist in all types of businesses—both profit-seeking and not-for-profit types. For instance, every business (1) incurs expenditures in exchange for resources (expenditure cycle), (2) provides value added through its products or services (conversion cycle), and (3) receives revenue from outside sources (revenue cycle). Figure 2-1 shows the relationship of these cycles and the resource flows between them.

FIGURE 2-1 RELATIONSHIP BETWEEN TRANSACTION CYCLES



The Expenditure Cycle

Business activities begin with the acquisition of materials, property, and labor in exchange for cash—the **expenditure cycle**. Figure 2-1 shows the flow of cash from the organization to the various providers of these resources. Most business-to-business (B2B) expenditure transactions are based on a credit relationship between the trading parties. The actual disbursement of cash takes place at some point after the receipt of the goods or services. Days or even weeks may pass between these two events. Thus, from a systems perspective, this transaction has two parts: a physical component (the acquisition of the goods or services) and a financial component (the cash disbursement to the supplier). A separate subsystem of the cycle processes each component. The primary expenditure cycle subsystems are outlined next. Because of the extent of this body of material, two chapters are devoted to a detailed examination. Purchases/accounts payable and cash disbursements systems are the topics of Chapter 5. Payroll and fixed asset systems are examined in Chapter 6.

Purchases/accounts payable (AP) system. *This system recognizes the need to acquire physical inventory (such as raw materials) and places an order with the vendor. When the goods are received, the purchases system records the event by increasing inventory and establishing an account payable to be paid at a later date.*

Cash disbursements system. *When the obligation created in the purchases system becomes due, the cash disbursements system authorizes the payment, disburses the funds to the vendor, and records the transaction by reducing the cash and accounts payable accounts.*

Payroll system. *The payroll system collects labor usage data for each employee, computes the payroll, and disburses paychecks to the employees. Conceptually, payroll is a special-case purchases and cash disbursements system. Because of accounting complexities associated with payroll, most firms have a separate system for payroll processing.*

Fixed asset system. *A firm's fixed asset system processes transactions pertaining to the acquisition, maintenance, and disposal of its fixed assets. These are relatively permanent assets that collectively often represent the organization's largest financial investment. Examples of fixed assets include land, buildings, furniture, machinery, and motor vehicles.*

The Conversion Cycle

The **conversion cycle** is comprised of two major subsystems: the production system and the cost accounting system. The production system involves the planning, scheduling, and control of the physical product through the manufacturing process. This includes determining raw material requirements, authorizing the work to be performed and the release of raw materials into production, and directing the movement of the work-in-process through its various stages of manufacturing. The cost accounting system monitors the flow of cost information including labor, overhead and raw materials related to production. Information this system produces is used for inventory valuation, budgeting, cost control, performance reporting, and management decisions, such as make-or-buy decisions. We examine the basic features of these systems in Chapter 7.

Manufacturing firms convert raw materials into finished products through formal, physical, and observable conversion cycle operations. The conversion cycle in service and retailing establishments, however, may not be formal and observable. Nevertheless, these firms still engage in value added conversion cycle activities that culminate in the development of a salable product or service. These activities include the readying of products and services for market and allocating resources such as depreciation, building amortization, and prepaid expenses to the proper accounting period. Unlike manufacturing firms, merchandising companies do not account for these activities through formal conversion cycle subsystems that track and allocate costs to specific goods. In contrast, some service organizations such as public accounting firms, law firms, and consulting firms do track specific costs (primarily labor) to client accounts in much the same way as a manufacturing cost accounting system would track labor and raw materials to the products they produce.

The Revenue Cycle

Firms sell their goods and services to customers through the **revenue cycle**, which involves processing cash sales, credit sales, and the receipt of cash following a credit sale. Revenue cycle transactions also have a physical and a financial component, which are processed separately. The primary subsystems of the revenue cycle, which are the topics of Chapter 4, are briefly outlined below.

Sales order processing. *The majority of business sales are made on credit and involve tasks such as preparing sales orders, granting credit, shipping products (or rendering of a service) to the customer, billing customers, and recording the transaction in the accounts (accounts receivable, inventory, expenses, and sales).*

Cash receipts. *For credit sales, some period of time (days or weeks) passes between the point of sale and the receipt of cash. Cash receipts processing includes collecting cash, depositing cash in the bank, and recording these events in the accounts (accounts receivable and cash).*

Accounting Records

MANUAL SYSTEMS

This section describes the purpose of each type of **accounting record** used in transaction cycles. We begin with traditional records used in manual systems (documents, journals, and ledgers) and then examine their digital counterparts in computer-based systems.

Documents

Documents serve several purposes in transaction processing. Documents may initiate transaction processing or be the output of a process. They also provide auditors with evidence of economic events. In this section we examine three types of documents: source documents, product documents, and turnaround documents.

SOURCE DOCUMENTS. Economic events result in the creation of some documents at the beginning (the source) of the transaction. These are called **source documents** and are used to capture and formalize transaction data that the transaction cycle uses for processing. Figure 2-2 shows the creation of a source document.

The economic event (in this case the sale) causes the sales clerk to prepare a multipart sales order, which is formal evidence that a sale occurred. Copies of this source document enter the sales system and are used to convey information to various functions, such as billing, shipping, and accounts receivable. The information contained in the sales order triggers specific activities in each of these functions.

PRODUCT DOCUMENTS. Product documents are the result of transaction processing rather than the triggering mechanism for the process. For example, a payroll check to an employee is a product document of the payroll system. Figure 2-3 extends the example in Figure 2-2 to illustrate that the customer's bill is a product document of the sales system. We will study many other examples of product documents in later chapters.

TURNAROUND DOCUMENTS. Turnaround documents are product documents of one system that become source documents for another system. This is illustrated in Figure 2-4. The customer receives a perforated two-part bill or statement. One portion is the actual bill, and the other portion is the remittance advice. Customers remove the remittance advice and return it to the company along with their payment (typically a check). The remittance advice is a turnaround document that contains important information about a customer's account to help the cash receipts system process the payment. One of the problems designers of cash receipts systems face is matching customer payments to the correct customer accounts. Providing this needed information as a product of the sales system ensures accuracy when the cash receipts system processes it.

FIGURE 2-2 CREATION OF A SOURCE DOCUMENT

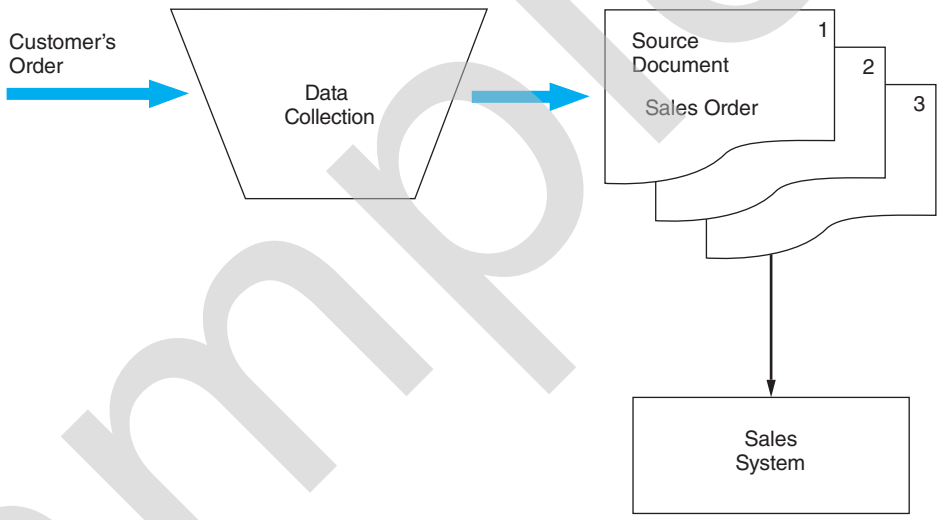
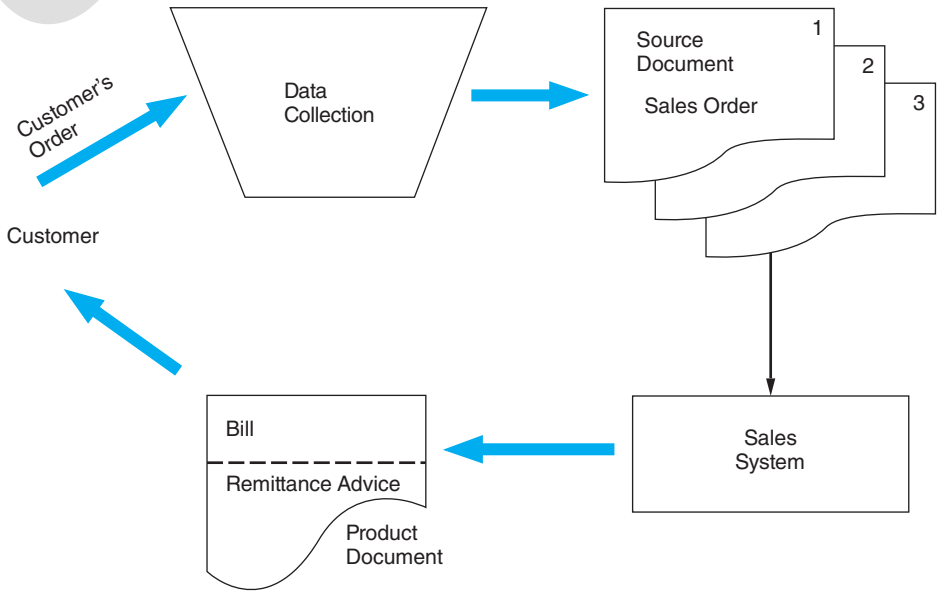


FIGURE 2-3 A PRODUCT DOCUMENT



Journals

A **journal** is a chronological record of a transaction. At some point in the transaction process, when all relevant facts about the transaction are known, the event is recorded in a journal in chronological order. Documents are the primary data source for journals. Figure 2-5 shows a sales order being recorded in the sales journal (see the following discussion on special journals). Each transaction requires a separate journal entry, reflecting the accounts affected and the amounts to be debited

FIGURE 2-4 A TURNAROUND DOCUMENT

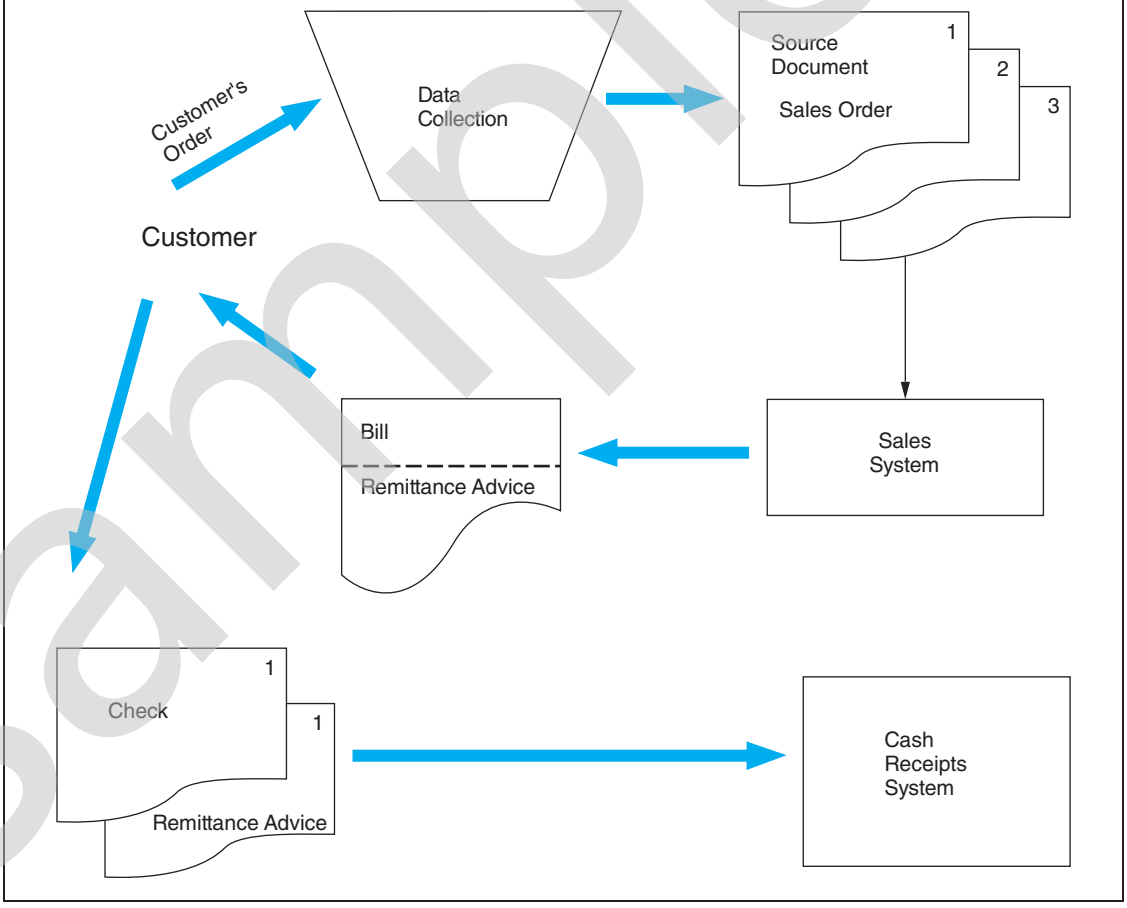
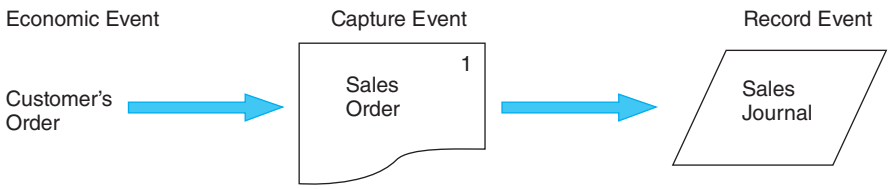


FIGURE 2-5 SALES ORDER RECORDED IN SALES JOURNAL



and credited. There is often a time lag between initiating a transaction and recording it in the accounts. The journal holds a complete record of transactions and thus provides a means for posting to accounts. There are two primary types of journals: special journals and general journals.

SPECIAL JOURNALS. Special journals are used to record specific classes of transactions that occur in high volume. Such transactions can be grouped together in a special journal and processed more efficiently than a general journal permits. Figure 2-6 shows a special journal for recording sales transactions.

FIGURE 2-6 SALES JOURNAL

Date	Customer	Invoice Num.	Acct. Num.	Post	Debit Acct. Rec. #102	Credit Sales #401
Sept. 1	Hewitt Co.	4523	1120		3300	3300
15	Acme Drilling	8821	1298		6825	6825
Oct. 3	Buell Corp.	22987	1030		4000	4000
10	Check Ltd.	66734	1110		8500	8500

As you can see, the sales journal provides a specialized format for recording only sales transactions. At the end of the processing period (month, week, or day), a clerk posts the amounts in the columns to the ledger accounts indicated (see the discussion of ledgers in this chapter). For example, the total sales will be posted to account number 401. Most organizations use several other special journals, including the cash receipts journal, cash disbursements journal, purchases journal, and the payroll journal.

REGISTER. The term **register** is often used to denote certain types of special journals. For example, the payroll journal is often called the payroll register. We also use the term *register*, however, to denote a log. For example, a receiving register is a log of all receipts of raw materials or merchandise ordered from vendors. Similarly, a shipping register is a log that records all shipments to customers.

GENERAL JOURNALS. Firms use the general journal to record nonrecurring, infrequent, and dissimilar transactions. For example, we usually record periodic depreciation and closing entries in the general journal. Figure 2-7 shows one page from a general journal. Note that the columns are nonspecific, allowing any type of transaction to be recorded. The entries are recorded chronologically.

As a practical matter, most organizations have replaced their general journal with a journal voucher system. A journal voucher is actually a special source document that contains a single journal entry specifying the general ledger accounts that are affected. Journal vouchers are used to record summaries of routine transactions, nonroutine transactions, adjusting entries, and closing entries. The total of journal vouchers processed is equivalent to the general journal. Subsequent chapters discuss the use of this technique in transaction processing.

Ledgers

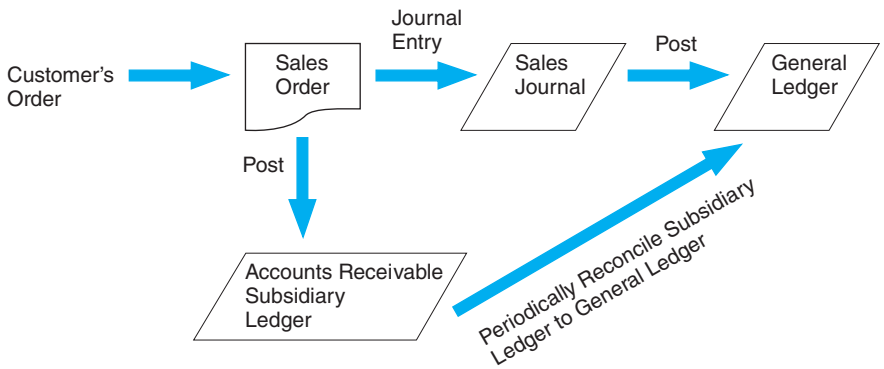
A **ledger** is a book of accounts that reflects the financial effects of the firm's transactions after they are posted from the various journals. While journals show the chronological effect of business activity, ledgers show activity by account type. A ledger indicates the increases, decreases, and current balance of each account. Organizations use this information to prepare financial statements, support daily operations, and prepare internal reports. Figure 2-8 shows the flow of financial information from the source documents to the journal and into the ledgers.

FIGURE 2-7 GENERAL JOURNAL

GENERAL JOURNAL PAGE

	DATE	DESCRIPTION	POST. REF.	DEBIT	CREDIT	
1	Sept. 1, 2009	Depreciation Expense	520	500		1
2		Accumulated Depreciation	210		500	2
3						3
4	Sept. 2, 2009	Insurance Expense	525	120		4
5		Prepaid Insurance	180		120	5
6						6
7	Sept. 3, 2009	Cash	101	1100		7
8		Capital Stock	310		1100	8
9						9
10						10
11						11
12						12

FIGURE 2-8 FLOW OF INFORMATION FROM THE ECONOMIC EVENT TO THE GENERAL LEDGER



There are two basic types of ledgers: (1) general ledgers, which contain the firm's account information in the form of highly summarized control accounts, and (2) subsidiary ledgers, which contain the details of the individual accounts that constitute a particular control account.[1]

1 Not all accounts in the general ledger have corresponding subsidiary accounts. Accounts such as sales and cash typically have no supporting details in the form of a subsidiary ledger.

GENERAL LEDGERS. The general ledger (GL) summarizes the activity for each of the organization's accounts. The general ledger function updates these records from journal vouchers prepared from special journals and other sources located throughout the organization. The general ledger presented in Figure 2-9 shows the beginning balances, the changes, and the ending balances as of a particular date for several different accounts.

FIGURE 2-9 GENERAL LEDGER

Cash ACCOUNT NO. 101

DATE	ITEM	POST. REF.	DEBIT	CREDIT	BALANCE DEBIT	BALANCE CREDIT
Sept. 10		S1	3300		3300	
15		S1	6825		10125	
Oct. 3		S1	4000		14125	
10		CD1		2800	11325	

Accounts Receivable ACCOUNT NO. 102

DATE	ITEM	POST. REF.	DEBIT	CREDIT	BALANCE DEBIT	BALANCE CREDIT
Sept. 1		S1	1400		1400	
8		S1	2605		4005	
15		CR1		1650	2355	

Accounts Payable ACCOUNT NO. 201

DATE	ITEM	POST. REF.	DEBIT	CREDIT	BALANCE DEBIT	BALANCE CREDIT
Sept. 1		P1		20500		20500
10		CD1	2800			17700

FIGURE 2-9 GENERAL LEDGER (*CONTINUED*)

Purchases ACCOUNT NO. *502*

DATE		ITEM	POST. REF.	DEBIT	CREDIT	BALANCE DEBIT	BALANCE CREDIT
Sept.	*1*		P1	*2 0 5 0 0*		*2 0 5 0 0*	

The general ledger provides a single value for each control account, such as accounts payable, accounts receivable, and inventory. This highly summarized information is sufficient for financial reporting, but it is not useful for supporting daily business operations. For example, for financial reporting purposes, the firm's total accounts receivable value must be presented as a single figure in the balance sheet. This value is obtained from the accounts receivable control account in the general ledger. To actually collect the cash this account represents, however, the firm must have certain detailed information about customers that this summary figure does not provide. It must know customers' addresses, which customers owe money, how much each customer owes, when certain customers last made payment, when the next payment is due, and so on. The accounts receivable subsidiary ledger contains these essential details.

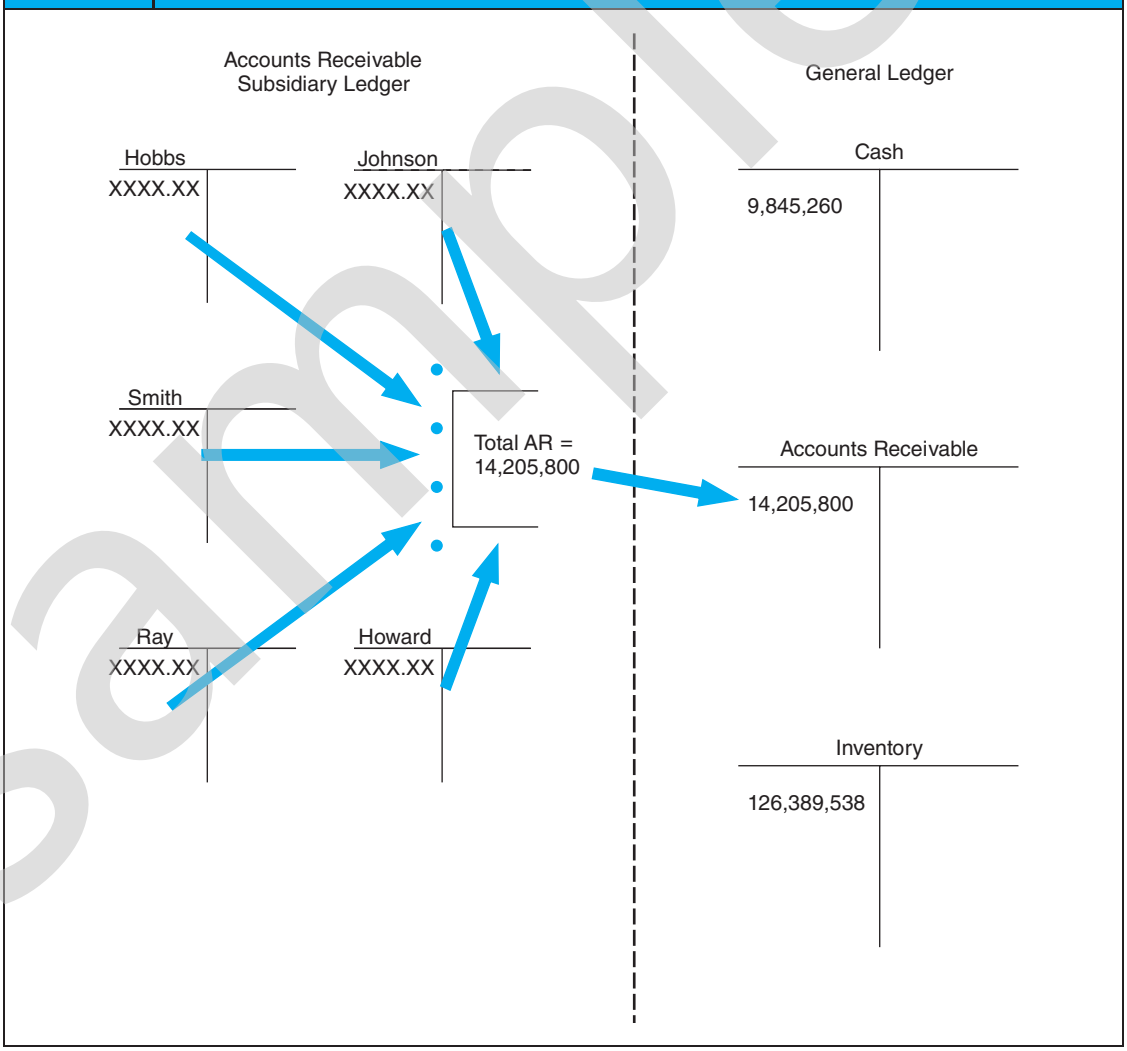
SUBSIDIARY LEDGERS. Subsidiary ledgers are kept in various accounting departments of the firm, including inventory, accounts payable, payroll, and accounts receivable. This separation provides better control and support of operations. Figure 2-10 illustrates that the total of account balances in a subsidiary ledger should equal the balance in the corresponding general ledger control account. Thus, in addition to providing financial statement information, the general ledger is a mechanism for verifying the overall accuracy of accounting data that separate accounting departments have processed. Any event incorrectly recorded in a journal or subsidiary ledger will cause an out-of-balance condition that should be detected during the general ledger update. By periodically reconciling summary balances from subsidiary accounts, journals, and control accounts, the completeness and accuracy of transaction processing can be formally assessed.

THE AUDIT TRAIL

The accounting records described previously provide an **audit trail** for tracing account balances contained in the financial statements back to source documents and the economic events that created them. An audit trail is of utmost importance in the conduct of a financial audit.

The external auditor's responsibility involves, in part, the review of selected accounts and transactions to determine their validity, accuracy, and completeness. Let's assume an auditor wishes to verify the accuracy of a client's AR balance as published in its annual financial statements. The auditor can trace the AR value on the balance sheet to the general ledger AR control account. This balance can then be reconciled with the total for the accounts receivable

FIGURE 2-10 RELATIONSHIP BETWEEN THE SUBSIDIARY LEDGER AND THE GENERAL LEDGER



subsidiary ledger. Rather than examining every transaction that affected the AR account, the auditor will use a sampling technique to examine a representative subset of transactions. Following this approach, the auditor can select a number of accounts from the AR subsidiary ledger and trace these back to the sales journal. From the sales journal, the auditor can identify the specific source documents that initiated the transactions and pull them from the files to verify their validity and accuracy.

The audit of AR often includes a procedure called confirmation. This involves contacting selected customers to determine if the transactions recorded in the accounts actually took place and if customers agree with the recorded balance. Information contained in source documents and subsidiary accounts enables the auditor to identify and locate customers chosen for confirmation. The results from reconciling the AR subsidiary ledger with the control account and from confirming customers' accounts help the auditor form an opinion about the accuracy of accounts receivable as reported on the balance sheet. The auditor performs similar tests on all of the client firm's major accounts and transactions to arrive at an overall opinion about the fair presentation of the financial statement. The audit trail plays an important role in this process.

DIGITAL ACCOUNTING RECORDS

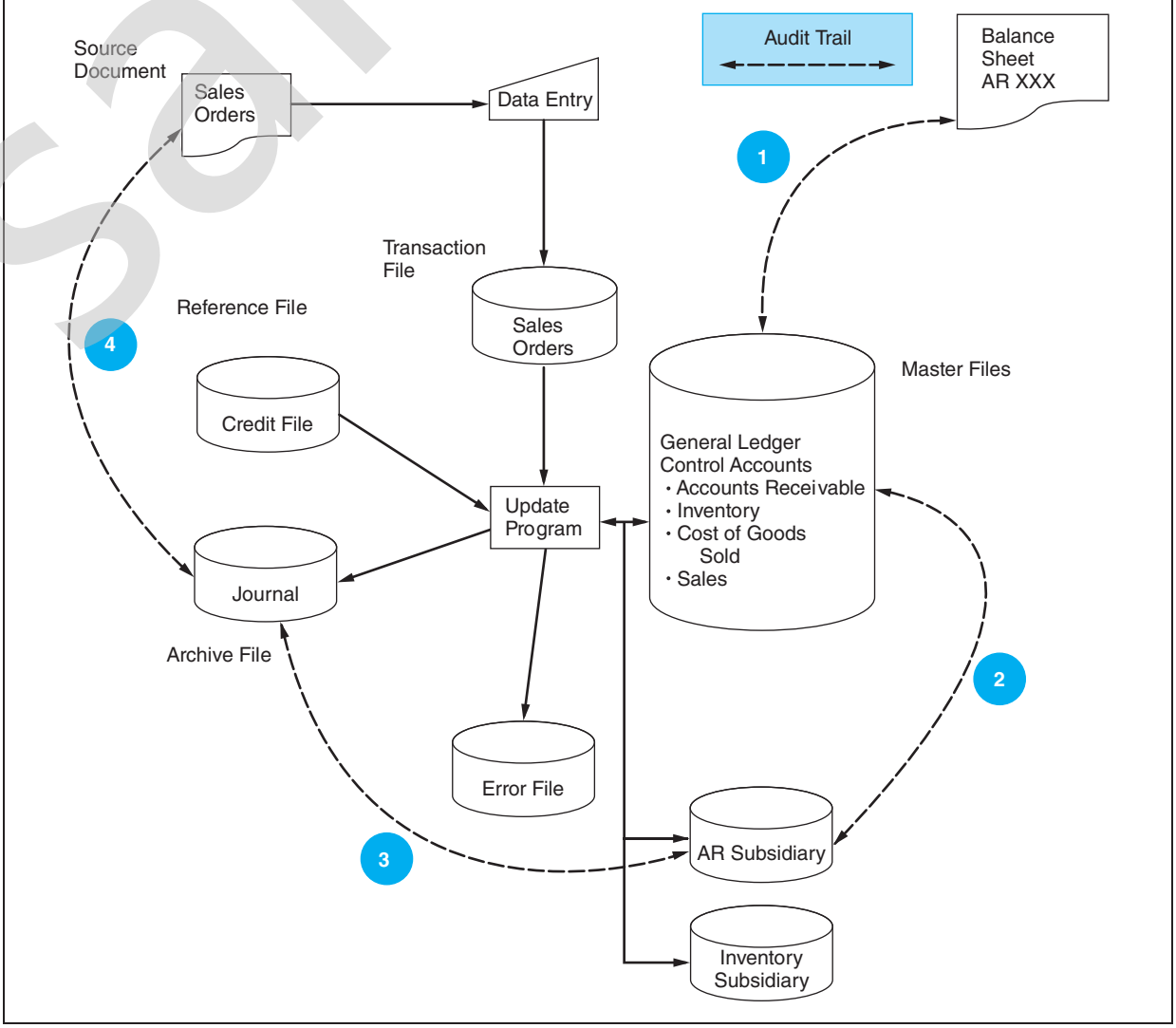
Modern accounting systems store data in four types of digital computer files: master files, transaction files, reference files, and archive files. Figure 2-11 illustrates the relationship between these files in forming an audit trail.

MASTER FILE. A **master file** contains account data. The general ledger and subsidiary ledgers are examples of master files. Data values in master files are updated (changed) by transactions.

TRANSACTION FILE. A **transaction file** is a temporary file of transaction records used to update data in a master file. Sales orders, inventory receipts, and cash receipts are examples of transaction files. The actual file update process is explained later in the chapter.

REFERENCE FILE. A **reference file** stores data that are used as standards for processing transactions. For example, the payroll program may refer to a tax table to calculate the proper amount of withholding taxes for payroll transactions. Other reference files include price lists used for

FIGURE 2-11 DIGITAL ACCOUNTING RECORDS IN A COMPUTER-BASED SYSTEM



preparing customer invoices, lists of authorized suppliers, employee rosters, and customer credit files for approving credit sales. The reference file in Figure 2-11 is a credit history file.

ARCHIVE FILE. An **archive file** contains records of past transactions that are retained for future reference and form an important part of the audit trail. Archive files include journals, prior-period payroll information, lists of former employees, records of accounts written off, and prior-period ledgers.

The Digital Audit Trail

Audit trails among digital records are less observable than those between hard-copy documents, but they still exist. Let's walk through the system represented in Figure 2-11 to illustrate how digital files provide an audit trail. We begin with the capture of the economic event. In this example, sales are recorded manually on source documents. The next step in this process is to convert the source documents to digital form. This is done in the data-entry stage, where the transactions are edited for correctness and a transaction file of sales orders is produced. Some computer systems do not use physical source documents. Instead, transactions are captured directly on digital media.

The next step is to update the various master file subsidiary and GL control accounts that are affected by the transaction. During the update procedure, additional editing of transactions takes place. Some transactions may prove to be in error or invalid for such reasons as incorrect account numbers, insufficient quantities on hand, or customer credit problems. In this example, the system determines the available credit for each customer from the credit file before processing the sale. Any records that are rejected for credit problems are transferred to the error file. The remaining good records are used to update the master files. Only these valid transactions are added to the archive file, which serves as the sales journal. By copying the valid transactions to the journal, the original transaction file is not needed for audit trail purposes. This file can now be erased (scratched) in preparation for the next batch of sales orders.

Like the paper audit trail, this digital audit trail allows transaction tracing. Again, an auditor attempting to evaluate the accuracy of the AR figure published in the balance sheet could do so via the following steps, which are identified in Figure 2-11 with the dotted arrows.

1. Compare the accounts receivable balance in the balance sheet with the master file AR control account balance.
2. Reconcile the AR control figure with the AR subsidiary account total.
3. Select a sample of updated entries made to accounts in the AR subsidiary ledger and trace these to transactions in the sales journal (archive file).
4. From these journal entries, identify specific source documents that can be pulled from their files and verified. If necessary, the auditor can confirm the accuracy and propriety of these source documents by contacting the customers in question.

File Structures

Digital file structures and storage techniques vary widely among transaction processing systems. This is because each file structure was designed to serve a particular task. Some structures are most effective for processing large portions of a master file. For example, on payday, every employee record in the employee payroll master file needs to be processed, because all (or most) employees get paid. Some file structures are better for directly locating and processing a single record in a large file, without having to search through thousands of other records on the file. For example, selecting a specific customer's record, in response to a customer query over the phone, from a customer master file that contains a million records requires a direct access file structure. Unfortunately, no single structure works optimally in all applications; therefore, selecting a data management file structure often involves compromise. The appendix to this chapter presents several examples of file structures and discusses their respective advantages and disadvantages.

File technologies broadly fall into two classes: (1) flat files and (2) databases. The sections that follow examine the general characteristics of each class and illustrate the evolution of data

management systems. The flat-file approach is often associated with so-called **legacy systems**, which are large mainframe systems that were commonplace in the 1960s and 1970s, but still exist today. Most modern system implementations employ database technologies, although flat-file systems are still implemented in special applications. In addition, database technology has been with us since the 1960s, and some legacy systems use early database technologies. Eventually, flat files will probably succumb to databases, but in the meantime, accountants and auditors must deal with both.

THE FLAT-FILE MODEL

The **flat-file model** describes an environment in which individual data files are not related to other files. End users in this environment own their data files rather than share them with other users. Thus, stand-alone applications rather than integrated systems perform data processing.

When multiple users need the same data for different purposes, they must obtain separate data sets structured to their specific needs. Figure 2-12 illustrates how customer sales data might be presented to three different users in a durable goods retailing organization. The accounting function needs customer sales data organized by account number and structured to show outstanding balances. This is used for customer billing, AR maintenance, and financial statement preparation. Marketing needs customer sales history data organized by demographic keys. Marketing uses this for targeting new product promotions and for selling product upgrades. The product services group needs customer sales data organized by products and structured to show scheduled service dates. Such information is used for making after-sales contacts with customers to schedule preventive maintenance and to solicit sales of service agreements.

The data redundancy demonstrated in this example contributes to three significant problems in the flat-file environment: **data storage**, **data updating,** and **currency of information**. These and other problems associated with flat files are discussed in the following sections.

Data Storage

An efficient information system captures and stores data only once and makes this single source available to all users who need it. In the flat-file environment, this is not possible. To meet the private data needs of users, organizations must incur the costs of both multiple collection and multiple storage procedures. Some commonly used data may be duplicated dozens, hundreds, or even thousands of times.

Data Updating

Organizations have a great deal of data stored in files that require periodic updating to reflect changes. For example, a change to a customer's name or address must be reflected in the appropriate master files. When users keep separate files, all changes must be made separately for each user. This adds significantly to the task and the cost of data management.

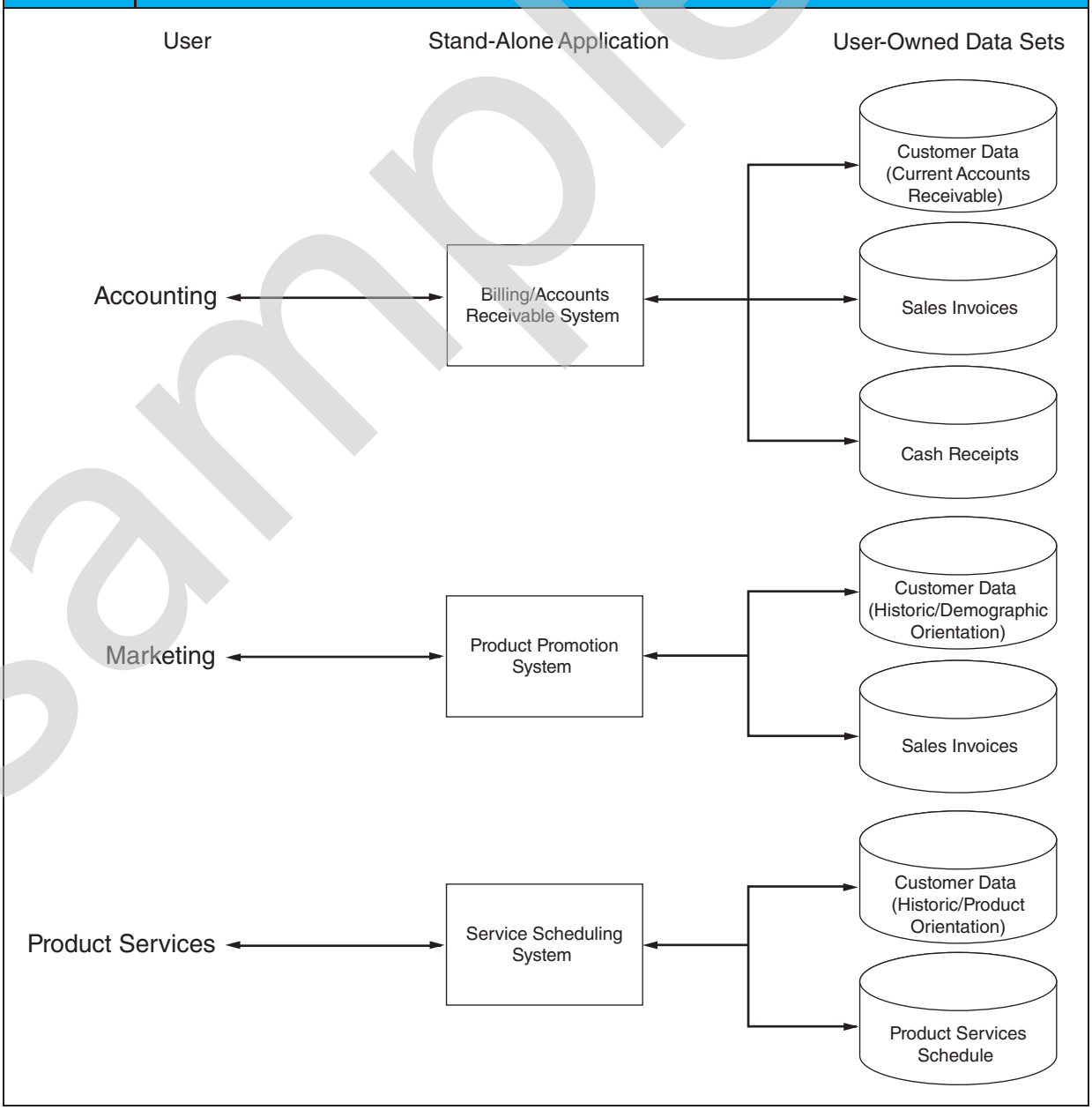
Currency of Information

In contrast to the problem of performing multiple updates is the problem of failing to update all the user files affected by a change in status. If update information is not properly disseminated, the change will not be reflected in some users' data, resulting in decisions based on outdated information.

Task-Data Dependency

Another problem with the flat-file approach is the user's inability to obtain additional information as his or her needs change. This problem is called **task-data dependency**. The user's information set is constrained by the data that he or she possesses and controls. Users act independently rather than as members of a user community. In such an environment, it is difficult to establish a mechanism for the formal sharing of data. Therefore, new information needs tend to be satisfied by procuring new data files. This takes time, inhibits performance, adds to data redundancy, and drives data management costs even higher.

FIGURE 2-12 FLAT-FILE MODEL



Flat Files Limit Data Integration

The flat-file approach is a single-view model. Files are structured, formatted, and arranged to suit the specific needs of the owner or primary user of the data. Such structuring, however, may exclude data needed by other users, thus preventing successful integration of data across the organization. For example, because the accounting function is the primary user of accounting data, these data are often captured, formatted, and stored to accommodate financial reporting and generally accepted accounting principles (GAAP). This structure, however, may be useless to the organization's other (nonaccounting) users of accounting data such as the marketing, finance, production, and engineering functions. These users are presented with three options: (1) do not use

accounting data to support decisions, (2) manipulate and massage the existing data structure to suit their unique needs, or (3) obtain additional private sets of the data and incur the costs and operational problems associated with data redundancy. In spite of these inherent limitations some organizations still make limited use of flat files in their older legacy systems.

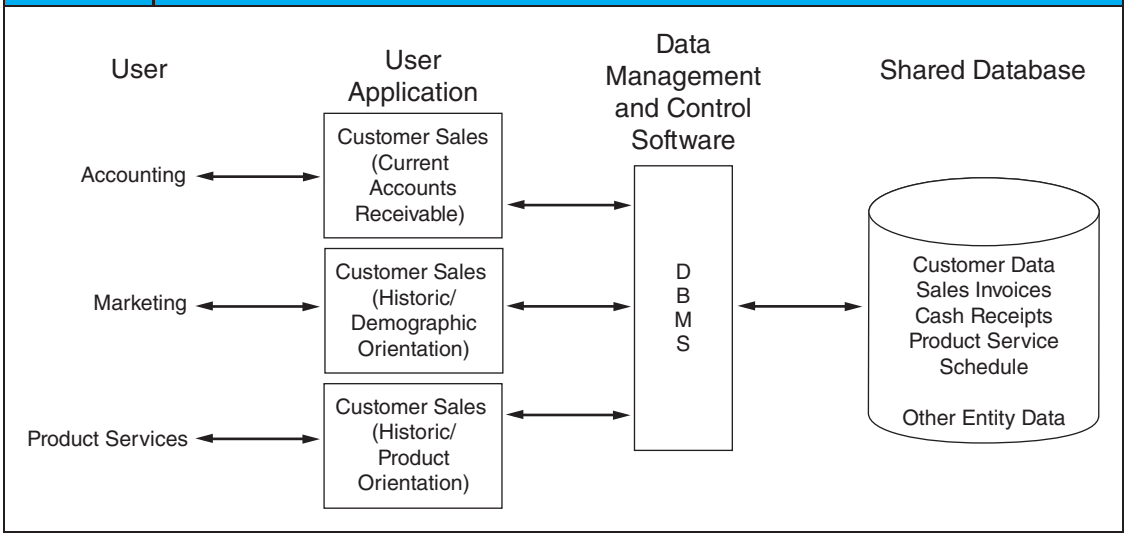
THE DATABASE MODEL

Organizations have overcome some of the problems associated with flat files by implementing the **database model** to data management. Figure 2-13 illustrates how this approach centralizes the organization's data into a common database that is shared by other users. With the organization's data in a central location, all users have access to the data they need to achieve their respective objectives. Access to the data resource is controlled by a **database management system (DBMS)**. The DBMS is a software system that permits users to access authorized data only. The user's application program sends requests for data to the DBMS, which validates and authorizes access to the database in accordance with the user's level of authority. If the user requests data that he or she is not authorized to access, the request is denied. Clearly, the organization's procedures for assigning user authority is an important control issue for auditors to consider.

The most striking difference between the database model and the flat-file model is the pooling of data into a common database that all organizational users share. With access to the full domain of entity data, changes in user information needs can be satisfied without obtaining additional private data sets. Users are constrained only by the limitations of the data available to the entity and the legitimacy of their need to access it. Through data sharing, the traditional problems associated with flat-file systems described previously can be eliminated.

We devote Chapters 9 and 10 to a detailed examination of the relational database model and the process and control issues unique to it. Until then, to simplify discussion in the transaction processing chapters that follow, we make no references to the specific file technology that may be used in the systems presented. The specific file structure employed, whether flat file or databases, is for the most part irrelevant to the process and control issues that are the focus of those chapters. Instead, we will refer to digital data files in generic terms such as *AR subsidiary ledger*, *Accounts Payable Control*, or *Customer Order file*. Similarly, the digital data storage symbols depicted in system flowcharts that follow in this chapter and in subsequent chapters represent generic data files.

FIGURE 2-13 DATABASE MODEL



Documentation Techniques

The old saying that a picture is worth a thousand words is very applicable when it comes to documenting accounting information systems. A written description of a system can be wordy and difficult to follow. Experience shows that visual images convey vital system information more effectively and efficiently than words. Accountants use system documentation routinely, as both systems designers and auditors. The ability to document systems in graphic form is therefore an important skill for accountants to master. Five basic documentation techniques are introduced in this section: data flow diagrams, entity relationship diagrams, system flowcharts, program flowcharts, and record layout diagrams.

DATA FLOW DIAGRAMS AND ENTITY RELATIONSHIP DIAGRAMS

Two commonly used systems design and documentation techniques are the entity relationship diagram and the data flow diagram. This section introduces the principal features of these techniques, illustrates their use, and shows how they are related.

Data Flow Diagrams

The **data flow diagram (DFD)** uses symbols to represent the entities, processes, data flows, and data stores that pertain to a system. Figure 2-14 presents the most commonly used symbol set. DFDs are used to represent systems at different levels of detail from very general to highly

FIGURE 2-14 DATA FLOW DIAGRAM SYMBOL SET

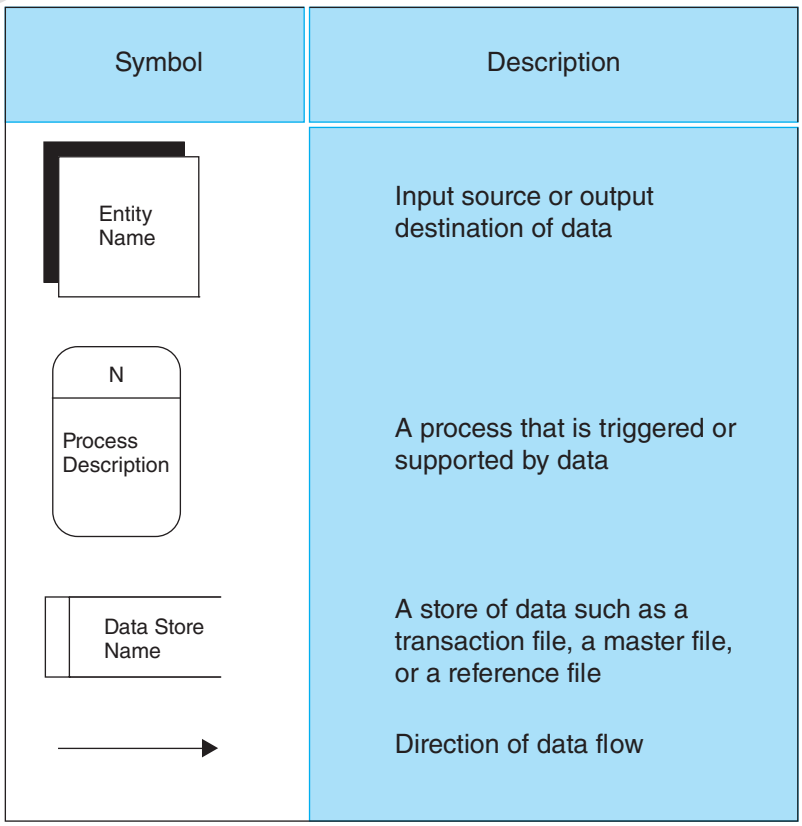
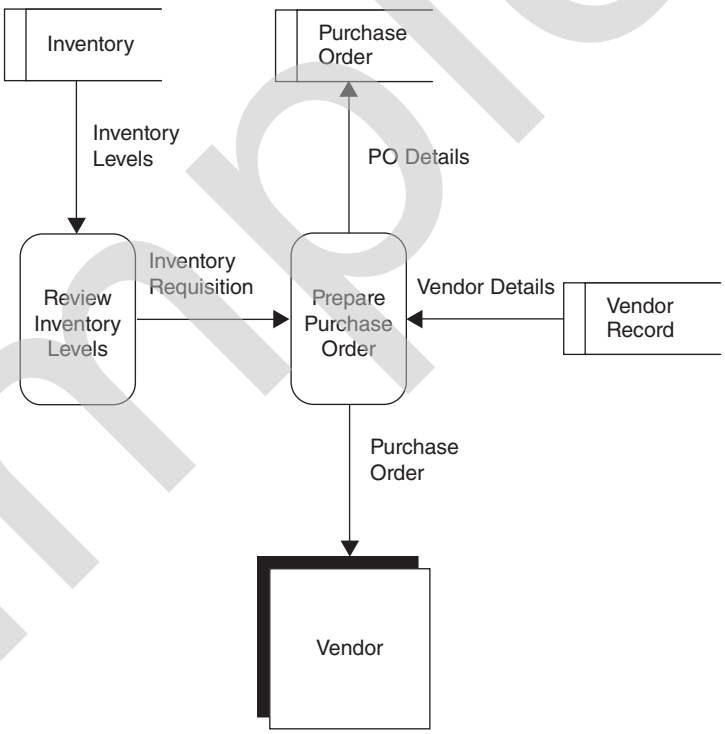


FIGURE 2-15 DATA FLOW DIAGRAM OF PURCHASES SYSTEM



detailed. In Chapter 14, we will study the construction of multilevel DFDs. At this point, a single-level DFD is sufficient to demonstrate its role as a documentation tool. Figure 2-15 provides an example of this.

Entities in a DFD represent objects that lie outside the system being modeled. They are the sources of and destinations for data. These may be other interfacing systems or entities external to the organization. As a matter of convention, entities are labeled as singular nouns on a DFD, such as *customer* or *supplier*. Data stores represent the accounting files and records used in each process, and the labeled arrows represent data flows between processes, data stores, and entities.

Processes in the DFD should be labeled with a descriptive verb such as *Review Inventory Levels*, *Prepare Purchase Order*, *Receive Customer Order*, or *Update Accounts Receivable*. Processes should not be represented as nouns like Inventory Warehouse, Purchases Dept., or Sales Dept. The arrows connecting the DFD objects should be labeled to represent specific flows of data such as Inventory Requisition, Purchase Order, or Sales Order. In addition, each data flow label should be uniquely named; the same label should not be attached to two different flow lines in the same DFD. When data flow into a process and out again (to another process), the data have, in some way, been changed. This is true even if the data have not been physically altered. For example, consider the approval process for a purchase order: A purchase order flows into the process, is reviewed for correctness, approved, and flows out to the next process. While physically the same document, the approved PO is different, as a matter of information content, from the unapproved PO that entered the process. Otherwise, the process serves no purpose.

Systems analysts use DFDs extensively to represent the logical elements of the system. This technique does not, however, depict the physical system. In other words, DFDs show what logical tasks are being performed, but not how they are performed or who (or what) is performing them. For example, the DFD in Figure 2-15 does not show whether the Review Inventory Levels

process is separated physically from the Prepare Purchase Order process, which compliance with internal control objectives would require.

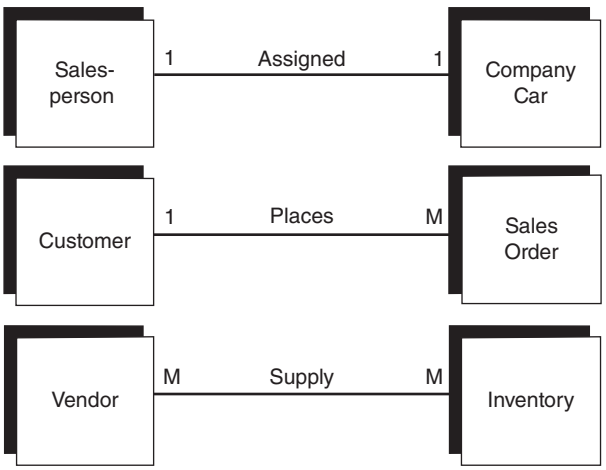
Entity Relationship Diagrams

An **entity relationship (ER) diagram** is a documentation technique used to represent the relationship between business entities. In this context, the term **entity** applies to anything about which the organization captures data. An entity may be a physical resource (automobile, cash, or inventory), an event (customer order, purchase inventory, or receive payment), or an agent (salesperson, customer, or vendor). One common use for ER diagrams is to model an organization's database, which we examine in detail in Chapters 9 and 10.

Figure 2-16 shows the symbol set used in an ER diagram. The square symbol represents entities in the system. The labeled connecting line represents the nature of the relationship between two entities. The degree of the relationship, called **cardinality**, is the numeric mapping between entities such as one-to-one (1:1), one-to-many (1:M), or many-to-many (M:M).[2] Cardinality reflects normal business rules as well as organizational policy. For instance, the 1:1 cardinality in the first example in Figure 2-16 suggests that each salesperson in the organization is assigned one automobile. If instead the organization's policy were to assign a single (one) automobile to more than one (many) salespersons who share it, this policy would be reflected by a 1:M relationship. Similarly, the M:M relationship between vendor and inventory in Figure 2-16 implies that the organization buys the same type of products from one or more vendors. A company policy to buy particular items from a single vendor only would be represented by a 1:M cardinality.

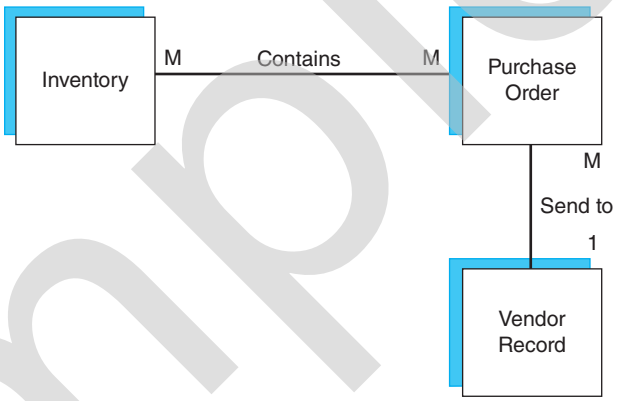
System designers identify organization entities and prepare a model of them, similar to the one presented in Figure 2-17. This **data model** is the blueprint for what ultimately will become the physical database. The data model presented in our example is not, however, sufficiently refined to be the plan for a workable database. Constructing a realistic data model is an advanced topic that involves understanding and applying techniques and rules that are presented in Chapters 9 and 10.

FIGURE 2-16 ENTITY RELATIONSHIP DIAGRAM SYMBOLS



2 We will study variants of these three basic cardinalities in Chapter 9 when we examine data modeling in greater detail. At that time a more precise documentation technique for representing cardinality called *crow's foot notation* will be introduced.

FIGURE 2-17 DATA MODEL



Relationship between ER Diagrams and Data Flow Diagrams

DFDs and ER diagrams document different aspects of systems, but they are related. DFDs model system processes while ER diagrams model the data used in systems. Each data store in a DFD is represented as an entity in a corresponding ER diagram. Figure 2-17 presents the ER diagram for the DFD in Figure 2-15.

SYSTEM FLOWCHARTS

A **system flowchart** is the graphical representation of the *physical* relationships among key elements of a system. These elements may include organizational departments, manual activities, computer programs, hard-copy accounting records (documents, journals, ledgers, and files), and digital records (reference files, transaction files, archive files, and master files).[3] System flowcharts also describe the physical computer media being employed in the system, such as magnetic tape, magnetic disks, and terminals.

The flowcharting examples in the following sections illustrate techniques for representing both manual activities and computer processes. We begin by documenting manual activities and will add computer processes to the system later.

Flowcharting Manual Activities

To demonstrate the flowcharting of manual activities, let's assume that an auditor needs to flowchart a sales order system to evaluate its internal controls and procedures. The auditor will begin by interviewing individuals involved in the sales order process to determine what they do. This information will be captured in a set of written facts similar to those below. Keep in mind that the purpose here is to demonstrate flowcharting. Therefore, for clarity, the system facts are intentionally simplistic.

1. A clerk in the sales department receives a hard-copy customer order by mail and manually prepares four hard copies of a sales order.

3 This terminology is a slight departure from the accounting convention that I have followed in earlier editions of this text in which a distinction is drawn between *document flowcharts* and *system flowcharts*. The term *document flowchart* was coined at a time when systems that exclusively employed manual recording and posting activities, and paper (hard copy) documents, journals, and ledgers were commonplace. Today, few functional systems fall into this category; even basic modern accounting systems incorporate both manual and computer operations. Apart from being obsolete, I have found that the term document flowchart can be misleading for students attempting to master flowcharting. Therefore, in this text we will use the term system flowchart or simply *flowchart* for representing the physical accounting system, whether it is manual, computer-based, or has elements of both.

2. The clerk sends Copy 1 of the sales order to the credit department for approval. The other three copies and the original customer order are filed temporarily, pending credit approval.
3. The credit department clerk validates the customer's order against hard-copy credit records kept in the credit department. The clerk signs Copy 1 to signify approval and returns it to the sales clerk.
4. When the sales clerk receives credit approval, he or she files Copy 1 and the customer order in the department. The clerk sends Copy 2 to the warehouse and Copies 3 and 4 to the shipping department.
5. The warehouse clerk picks the products from the shelves, records the transfer in the hard-copy stock records, and sends the products and Copy 2 to the shipping department.
6. The shipping department receives Copy 2 and the goods from the warehouse, attaches Copy 2 as a packing slip, and ships the goods to the customer. Finally, the clerk files Copies 3 and 4 in the shipping department.

Based on these facts, the auditor can create a flowchart of this partial system. It is important to note that flowcharting is as much an art form as it is a technical skill, giving the flowchart author a great deal of license. Nevertheless, the primary objective should be to provide an unambiguous description of the system. With this in mind, certain rules and conventions need to be observed:

1. The flowchart should be labeled to clearly identify the system that it represents.
2. The correct symbols should be used to represent the various entities in the system.
3. All symbols on the flowchart should be labeled.
4. Lines should have arrowheads to clearly show the process flow direction and sequence of events.
5. If complex processes need additional explanation for clarity, a text description should be included on the flowchart or in an attached document referenced by the flowchart.

LAY OUT THE PHYSICAL AREAS OF ACTIVITY. Remember that a flowchart reflects the physical system, which is represented as vertical columns of events and actions separated by lines of demarcation. Generally, each of these areas of activity is a separate column with a heading. From the written system facts, we see that there are four distinct areas of activity: sales department, credit department, warehouse, and shipping department. The first step in preparing the flowchart is to lay out these areas of activity and label each of them. This step is illustrated in Figure 2-18.

TRANSCRIBE THE WRITTEN FACTS INTO VISUAL FORMAT. At this point we are ready to start visually representing the system facts. The symbols used for this purpose will be selected from the set presented in Figure 2-19. We begin with the first stated fact:

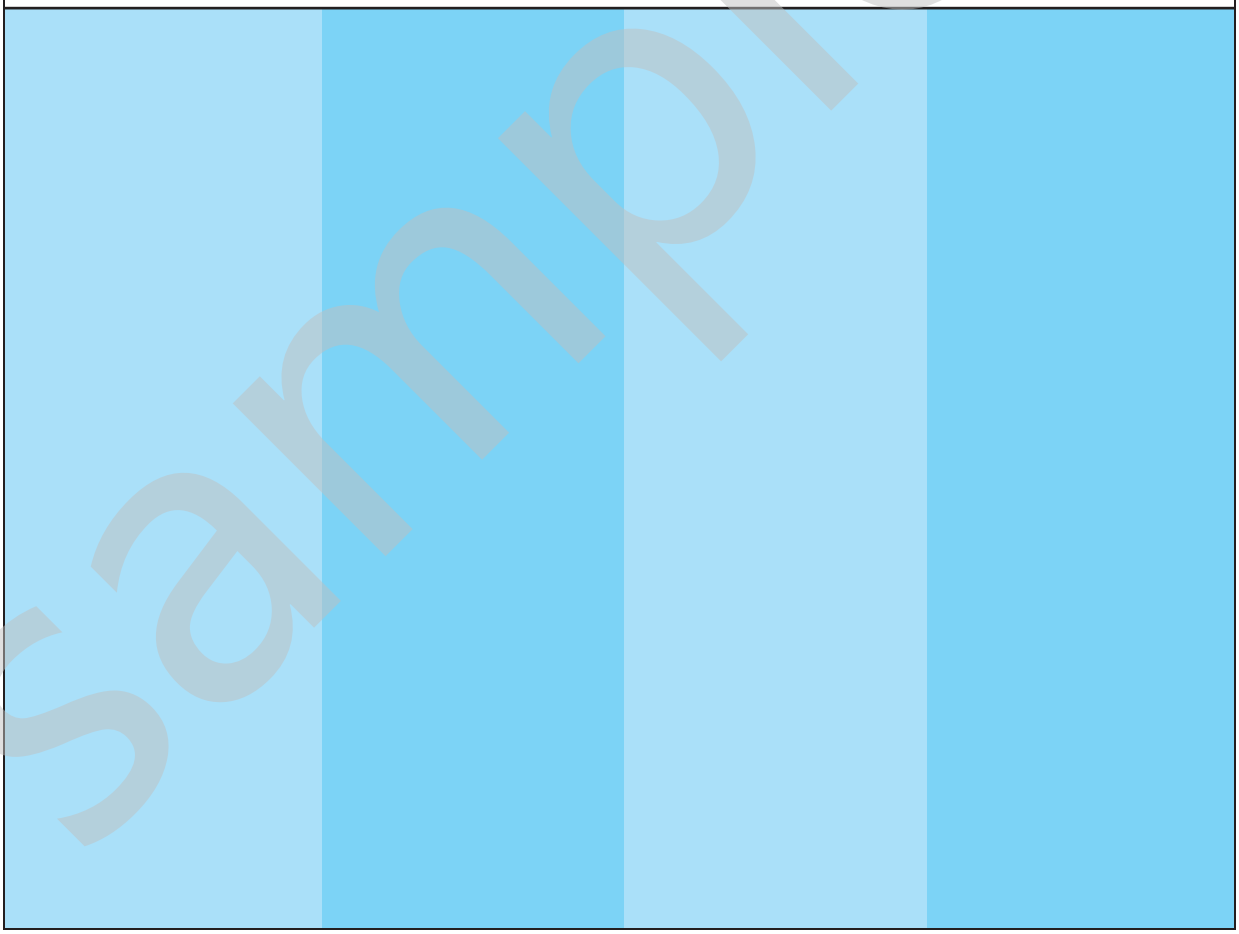
1. *A clerk in the sales department receives a hard-copy customer order by mail and manually prepares four hard copies of a sales order.*

Figure 2-20 illustrates how this fact is represented. The customer is the source of the order but is not part of the system. The oval object is typically used to convey a data source or destination that is separate from the system being flowcharted. The document symbol entering the sales department signifies the hard-copy customer order and is labeled accordingly. The bucket-shaped symbol represents a manual process. In this case, the clerk in the sales department prepares four copies of the sales order. Notice that the clerk's task, not the clerk, is depicted. The arrows between the objects show the direction of flow and the sequence of events.

By transcribing each fact in this way, we systematically construct a flowchart. See how the second and third facts restated below add to the flowchart in Figure 2-21.

2. *The clerk sends Copy 1 of the sales order to the credit department for approval. The other three copies and the original customer order are filed temporarily, pending credit approval.*
3. *The credit department clerk validates the customer's order against hard-copy credit records kept in the credit department. The clerk signs Copy 1 to signify approval and returns it to the sales clerk.*

FIGURE 2-18 FLOWCHART SHOWING AREAS OF ACTIVITY



Two new symbols are introduced in this figure. First, the inverted triangle symbol represents the temporary file mentioned in Fact 2. This is a physical file of paper documents such as a drawer in a filing cabinet or desk. Such files are typically arranged according to a specified order. To signify the filing system used, the file symbol will usually contain an "N" for numeric (invoice number), "C" for chronological (date), or "A" for alphabetic order (customer name). Secondly, the parallelogram shape represents the credit records mentioned in Fact 3. This symbol is used to depict many types of hard-copy accounting records, such as journals, subsidiary ledgers, general ledgers, and shipping logs.

Having laid these foundations, let's now complete the flowchart by depicting the remaining facts.

4. *When the sales clerk receives credit approval, he or she files Copy 1 and the customer order in the department. The clerk sends Copy 2 to the warehouse and Copies 3 and 4 to the shipping department.*
5. *The warehouse clerk picks the products from the shelves, records the transfer in the hard-copy stock records, and sends the products and Copy 2 to the shipping department.*
6. *The shipping department receives Copy 2 and the goods from the warehouse, attaches Copy 2 as a packing slip, and ships the goods to the customer. Finally, the clerk files Copies 3 and 4 in the shipping department.*