



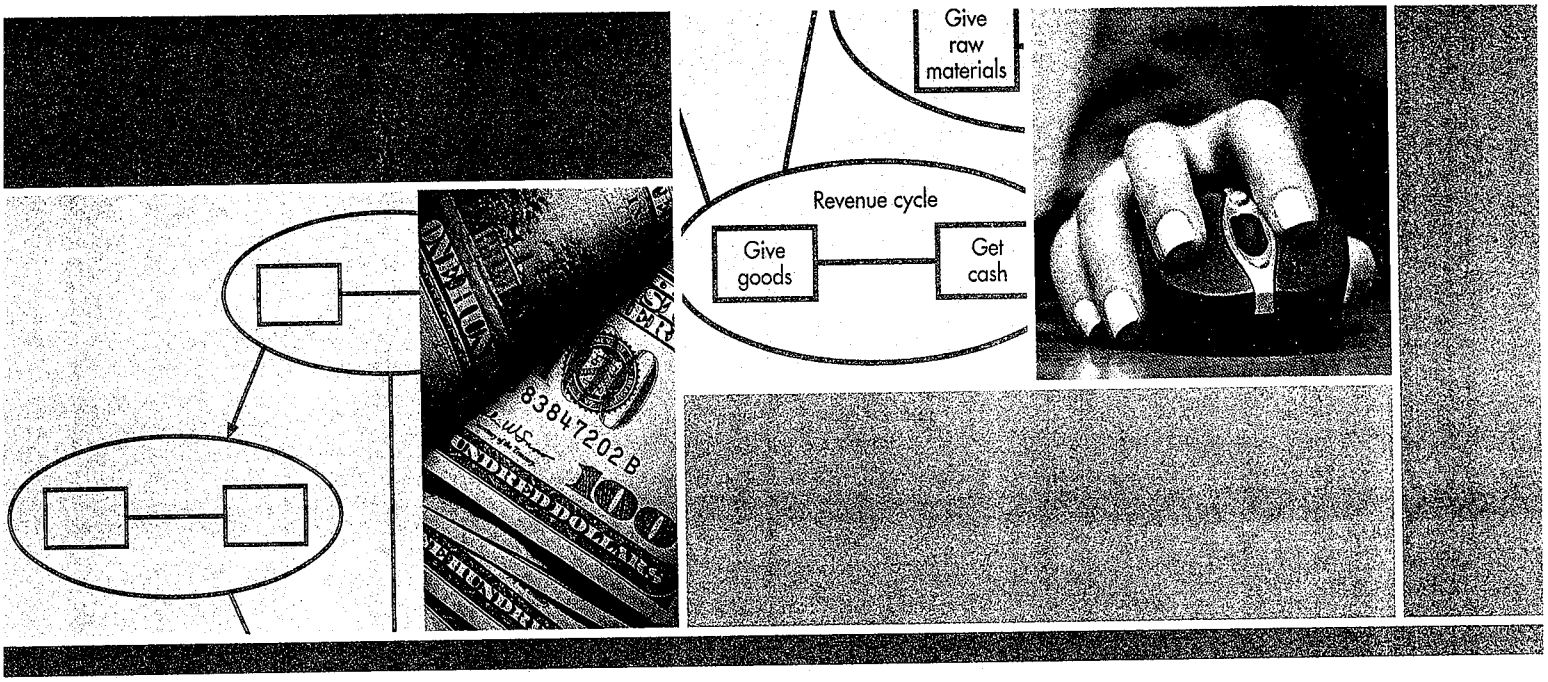
Global Edition

Accounting Information Systems

Twelfth Edition

Marshall B. Romney
Paul J. Steinbart

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ACCOUNTING INFORMATION SYSTEMS

GLOBAL EDITION

TWELFTH EDITION

Marshall B. Romney
Brigham Young University

Paul J. Steinbart
Arizona State University

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Preface

To the Student

The twelfth edition of *Accounting Information Systems* is designed to prepare you for a successful accounting career in public practice, industry, or government. All of you will be users of accounting information systems (AIS). As such, you should participate in the design of those systems. Doing so effectively, however, requires that you have a sound understanding of how they work. In addition to being users, some of you will become managers. Others will become internal and external auditors, and some of you will become consultants. All of these roles require you to understand how accounting information systems work so that you can measure their cost-effectiveness, assess their reliability and the reliability of the information produced, or lead the redesign and implementation of new and better systems. Mastering the material presented in this text will give you the foundational knowledge you need in order to excel at all those tasks.

This text discusses important new information technology (IT) developments, such as virtualization, cloud computing, the use of RFID tags to track inventory, and the adoption of XBRL for financial reporting, because such developments affect business processes and often cause organizations to redesign their accounting systems to take advantage of new capabilities. The focus, however, is not on IT for the sake of IT, but on how IT affects business processes and controls. Indeed, new IT developments not only bring new capabilities, but also often create new threats and affect the overall level of risk. This text will help you understand these issues so that you can properly determine how to modify accounting systems controls to effectively address those new threats and accurately assess the adequacy of controls in those redesigned systems. We also discuss the effect of recent regulatory developments, most notably the Sarbanes–Oxley Act and the upcoming switch from GAAP to IFRS, on the design and operation of accounting systems.

In addition to technology- and regulatory-driven changes, companies are responding to the increasingly competitive business environment by reexamining every internal activity in an effort to reap the most value at the least cost. As a result, accountants are being asked to do more than simply report the results of past activities. They must take a more proactive role in both providing and interpreting financial and nonfinancial information about the organization's activities. Therefore, throughout this text we discuss how accountants can improve the design and functioning of the accounting information system (AIS) so that it truly adds value to the organization.

Key Learning Objectives

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

- The basic activities performed in the major business cycles
- What data need to be collected to enable managers to plan, evaluate, and control the business activities in which an organization engages
- How IT developments can improve the efficiency and effectiveness of business processes
- How to design an AIS to provide the information needed to make key decisions in each business cycle

- The risk of fraud and the motives and techniques used to perpetrate fraud
- The COSO and COSO-ERM models for internal control and risk management, as well as the specific controls used to achieve those objectives
- The Control Objectives for Information and Related Technology (COBIT) framework for the effective governance and control of information systems and how IT affects the implementation of internal controls
- The AICPA's Trust Services framework for ensuring systems reliability by developing procedures to protect the confidentiality of proprietary information, maintain the privacy of personal information collected from customers, assure the availability of information resources, and provide for information processing integrity
- Fundamentals of computer information security
- Goals, objectives, and methods for auditing information systems
- Fundamental concepts of database technology and data modeling and their effect on an AIS
- The tools for documenting AIS work, such as REA diagrams, data flow diagrams, and flowcharting
- The basic steps in the system development process to design and improve an AIS

Features to Facilitate Learning

To help you understand these concepts, the text includes the following features:

1. **Each chapter begins with an integrated case that introduces that chapter's key concepts and topics and identifies several key issues or problems that you should be able to solve after mastering the material presented in that chapter.** The case is referenced throughout the chapter, and the chapter summary presents solutions to the problems and issues raised in the case.
2. **Focus boxes and real-world examples** help you understand how companies are using the latest IT developments to improve their AIS.
3. **Hands-on Excel exercises in many chapters** help you hone your computer skills. Many of these exercises are based on "how-to" tutorials that appeared in recent issues of the *Journal of Accountancy*.
4. **Numerous problems in every chapter** provide additional opportunities for you to demonstrate your mastery of key concepts. Many problems were developed from reports in current periodicals. Other problems were selected from the various professional examinations, including the CPA, CMA, CIA, and SMAC exams.
5. **Cases in each chapter** require more extensive exploration of specific topics.
6. **Chapter quizzes** at the end of each chapter enable you to self-assess your understanding of the material. We also provide detailed explanations about the correct answer to each quiz question.
7. **Extensive use of graphics** enhance your understanding. The text contains hundreds of figures, diagrams, flowcharts, and tables that illustrate the concepts taught in the chapters.
8. **A comprehensive glossary** located at the back of the book makes it easy to look up the definition of the various technical terms used in the text.
9. **Extensive online support** is available at Pearson Education's content-rich, text-supported Web site, at www.pearsonglobaleditions.com/romney.

Content and Organization

This text is divided into five parts, each focused on a major theme.

Part I: Conceptual Foundations of Accounting Information Systems

Part I consists of four chapters that present the underlying concepts fundamental to an understanding of AIS. Chapter 1 introduces basic terminology and discusses how an AIS can add value

to an organization. Chapter 2 provides an overview of basic business processes. It introduces transaction processing in automated systems, presenting basic information processing and data storage concepts. You will see the wide range of data that must be collected by the AIS. This information helps you to understand what an AIS does; as you read the remainder of the book, you will see how advances in IT affect the manner in which those functions are performed. Chapter 3 covers two of the most important tools and techniques used to understand, evaluate, design, and document information systems: data flow diagrams and flowcharts. Chapter 4 introduces the topic of databases, with a particular emphasis on the relational data model and creating queries in Microsoft Access.

Part II: Control and Audit of Accounting Information Systems

The seven chapters in Part II focus on threats to the reliability of AIS and applicable controls for addressing and mitigating the risks associated with those threats. Chapter 5 discusses fraud and explains how and why it occurs. Chapter 6 continues the discussion of fraud, focusing specifically on computer fraud. Chapter 7 uses the COSO framework, including the expanded enterprise risk management (COSO-ERM) model, to discuss the basic concepts of internal control. Chapters 8–10 use both COBIT and the AICPA's Trust Services frameworks to discuss effective governance and control of information systems. Chapter 8 introduces the fundamental concepts of defense-in-depth and the time-based approach to security. The chapter provides a broad survey of a variety of security topics, including access controls, firewalls, encryption, and incident detection and response. Chapter 9 discusses the many specific computer controls used in business organizations to achieve the objectives of ensuring privacy and confidentiality, and it includes a detailed explanation of encryption. Chapter 10 addresses the controls necessary to achieve the objectives of accurate processing of information and ensuring that information is available to managers whenever and wherever they need it. Chapter 11 describes principles and techniques for the audit and evaluation of internal control in a computer-based AIS and introduces the topic of computer-assisted auditing.

Part III: Accounting Information Systems Applications

Part III focuses on how a company's AIS provides critical support for its fundamental business processes. Most large and many medium-sized organizations use enterprise resource planning (ERP) systems to collect, process, and store data about their business processes, as well as to provide information reports designed to enable managers and external parties to assess the organization's efficiency and effectiveness. To make it easier to understand how an ERP system functions, Part III consists of five chapters, each focusing on a particular business process. Chapter 12 covers the revenue cycle, describing all the activities involved in taking customer orders, fulfilling those orders, and collecting cash. Chapter 13 covers the expenditure cycle, describing all the activities involved in ordering, receiving, and paying for merchandise, supplies, and services. Chapter 14 covers the production cycle, with a special focus on the implications of recent cost accounting developments, such as activity-based costing, for the design of the production cycle information system. Chapter 15 covers the human resources management/payroll cycle, focusing primarily on the activities involved in processing payroll. Chapter 16 covers the general ledger and reporting activities in an organization, discussing topics such as XBRL, the balanced scorecard, the switch from GAAP to IFRS, and the proper design of graphs to support managerial decision making. Each of these five chapters explains the three basic functions performed by the AIS: efficient transaction processing, provision of adequate internal controls to safeguard assets (including data), and preparation of information useful for effective decision making.

Part IV: The REA Data Model

Part IV consists of three chapters that focus on the REA data model, which provides a conceptual tool for designing and understanding the database underlying an AIS. Chapter 17 introduces the REA data model and explains how it can be used to design an AIS database. The chapter focuses on modeling the revenue and expenditure cycles. It also demonstrates how the REA model can be used to develop an AIS that not only can generate traditional financial statements and reports but also can more fully meet the information needs of management. Chapter 18 explains how to implement an REA data model in a relational database system and shows how to

query a relational database in order to produce various financial statements and management reports. Chapter 19 explains how to develop REA data models of the production, HR/payroll, and financing cycles. It also discusses a number of advanced modeling issues, such as the acquisition and sale of intangible products and services and rental transactions.

Part V: The Systems Development Process

Part V consists of three chapters that cover various aspects of the systems development process. Chapter 20 introduces the systems development life cycle and discusses the introductory steps of this process (systems analysis, feasibility, and planning). Particular emphasis is placed on the behavioral ramifications of change. Chapter 21 discusses an organization's many options for acquiring or developing an AIS (e.g., purchasing software, writing software, end-user–developed software, and outsourcing) and for speeding up or improving the development process (business process reengineering, prototyping, and computer-assisted software engineering). Chapter 22 covers the remaining stages of the systems development life cycle (conceptual design, physical design, implementation, and operation and maintenance) and emphasizes the interrelationships among the phases.

To the Instructor

This book is intended for use in a one-semester course in accounting information systems at the undergraduate or graduate level. Introductory financial and managerial accounting courses are suggested prerequisites, and an introductory information systems course that covers a computer language or software package is helpful. The book can also be used as the main text in graduate or advanced undergraduate management information systems courses. Indeed, the topics covered in this text provide information systems students with a solid understanding of transaction processing systems that they can then build on as they pursue more in-depth study of specific topics such as databases, data warehouses and data mining, networks, systems analysis and design, computer security, and information system controls.

Enhancements to the Twelfth Edition

The twelfth edition has been extensively revised and rewritten to incorporate recent developments while retaining the features that have made prior editions easy to use. Every chapter has been updated to include current examples of important concepts. Specific changes include the following:

1. More extensive coverage of both fraud and computer fraud, replacing the one chapter in the eleventh edition that covered both topics with two chapters in this new edition.
2. More detailed discussion of internal control frameworks: COSO, COSO-ERM, and COBIT.
3. Updated discussion of information security countermeasures, including the security and control implications associated with virtualization and cloud computing.
4. Additional Excel exercises, based on *Journal of Accountancy* articles, to help students develop the skills used by practitioners.
5. Many new end-of-chapter discussion questions and problems.

Supplemental Resources

As with prior editions, our objective in preparing this twelfth edition has been to simplify the teaching of AIS by enabling you to concentrate on classroom presentation and discussion, rather than on locating, assembling, and distributing teaching materials. To assist you in this process, the following supplementary materials are available to adopters of the text:

- *Solutions Manual* prepared by Marshall Romney at Brigham Young University and Paul John Steinbart at Arizona State University.
- *Instructors Manual/PowerPoint Presentations* prepared by Steven Hornik at the University of Central Florida.
- *PowerPoint Presentations* prepared by Steven Hornik at the University of Central Florida. The twelfth edition includes an entirely new set of PowerPoint slides that makes extensive use of high-quality graphics to illustrate key concepts. The slides do not merely consist of

bullet points taken verbatim from the text, but instead are designed to help students notice and understand important relationships among concepts. The large number of slides provides instructors a great deal of flexibility in choosing which topics they wish to emphasize in class.

- *Test Item File* prepared by Debra Cosgrove at the University of Nebraska–Lincoln.
- *TestGen testing software,* a computerized test item file.

In addition, you can access these supplements from the protected instructor area of www.pearsonglobaleditions.com/romney.

We recognize that you may also wish to use specific software packages when teaching the AIS course. Contact your local rep to learn about bundling options with software packages such as Peachtree or other texts such as *Comprehensive Assurance & Systems Tool: Assurance Practice Set*, 2nd ed.; *Comprehensive Assurance & Systems Tool: Manual AIS Practice Set*, 2nd ed.; *Comprehensive Assurance & Systems Tool: Computerized AIS Practice Set*, 2nd ed., all written by Laura R. Ingraham of San Jose State University and J. Gregory Jenkins, at Virginia Polytechnic Institute and State University.

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Louie Walker, *Metropolitan State College*

We are grateful for permission received from four professional accounting organizations to use problems and unofficial solutions from their past professional examinations in this book. Thanks are extended to the American Institute of Certified Public Accountants for use of the CPA Examination materials, to the Institute of Certified Management Accountants for use of CMA Examination materials, to the Institute of Internal Auditors for use of CIA Examination materials, and to the Society of Management Accountants of Canada for use of SMAC Examination materials.

Of course, any errors in this book remain our responsibility. We welcome your comments and suggestions for further improvement.

Finally, we want to thank our wives and families for their love, support, and encouragement. We also want to thank God for giving us the ability to start and complete this book.

—Marshall B. Romney
Provo, Utah

—Paul John Steinbart
Tempe, Arizona

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International Contributors

Zauwiyah Ahmad, *Multimedia University*

Sami Akabawi, *American University in Cairo*

Erik Rutkens, *Rijksuniveriteit Groningen*

International Reviewers

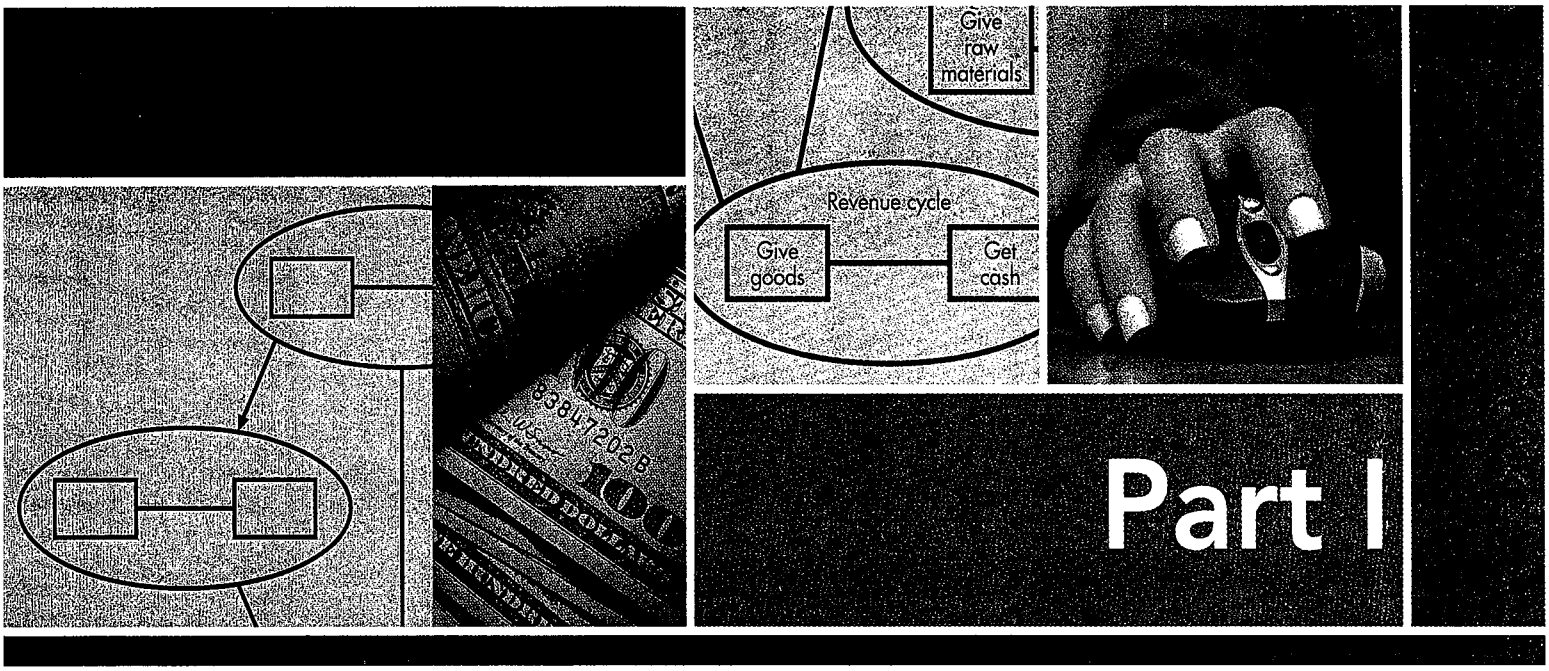
Ezendu Ariwa, *London Metropolitan University*

Mohammad El Hajj, *Lebanese International University*

Charmian Green, *Nelson Mandela Metropolitan University*

Mohammed Hossain, *Qatar University*

Emelin Abdul Wahid, *Universiti Teknologi MARA (Johore Branch)*



Conceptual Foundations of Accounting Information Systems

Chapter 1 Accounting Information Systems: An Overview

Chapter 2 Overview of Transaction Processing and Enterprise Resource Planning (ERP)

Chapter 3 Systems Documentation Techniques

Chapter 4 Relational Databases

Chapter 1

Accounting Information Systems: An Overview

Learning Objectives

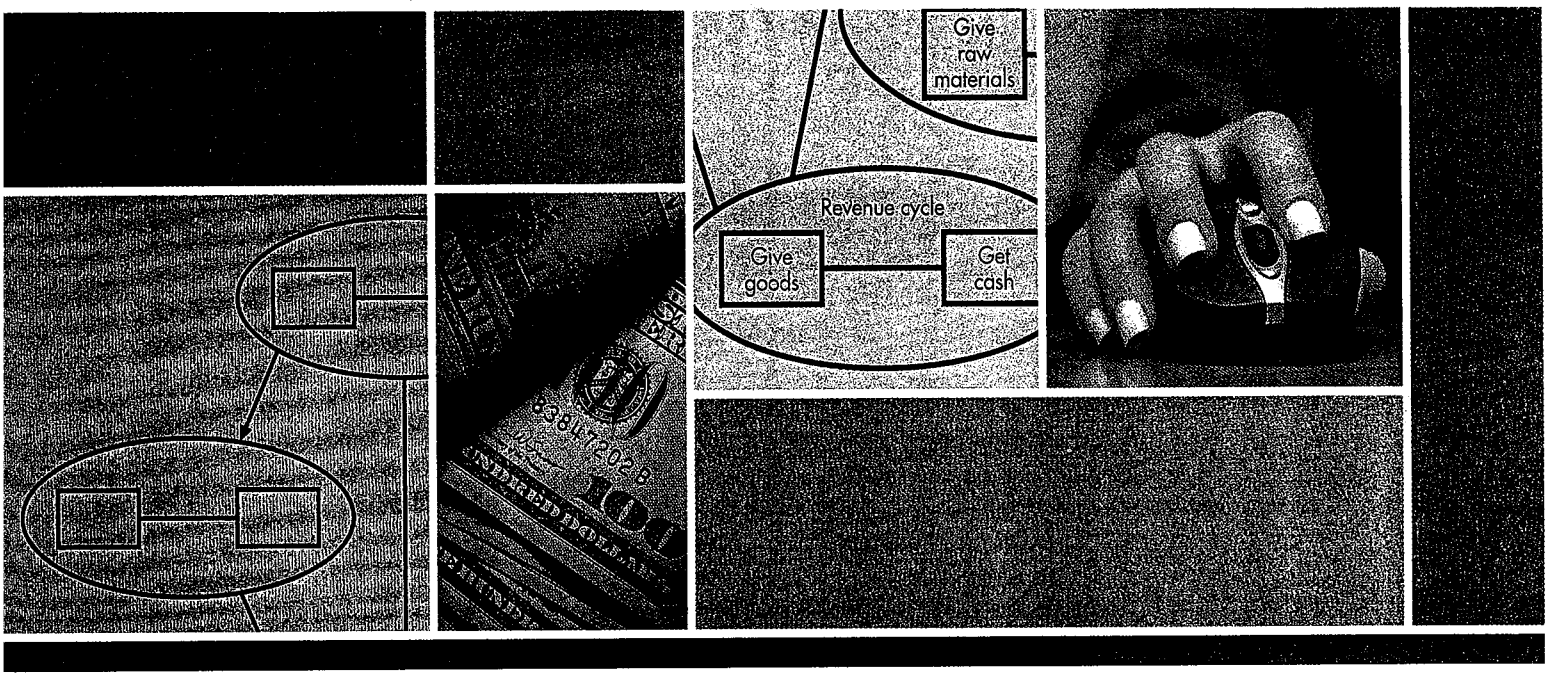
After studying this chapter, you should be able to:

1. Distinguish data from information, discuss the characteristics of useful information, and explain how to determine the value of information.
2. Explain the decisions an organization makes and the information needed to make them.
3. Identify the information that passes between internal and external parties and an AIS.
4. Describe the major business processes present in most companies.
5. Explain what an accounting information system (AIS) is and describe its basic functions.
6. Discuss how an AIS can add value to an organization.
7. Explain how an AIS and corporate strategy affect each other.
8. Explain the role an AIS plays in a company's value chain.

INTEGRATIVE CASE S&S

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

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



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

1. What decisions do they need to make to be successful and profitable? For example:
   a. How should they price products to be competitive yet earn a profit?
   b. Should they extend credit, and, if so, on what terms? How can they accurately track what customers owe and pay?
   c. How should they hire, train, and supervise employees? What compensation and benefits package should they offer? How should they process payroll?
   d. How can they track cash inflows and outflows to avoid a cash squeeze?
   e. What is the appropriate product mix? What inventory quantities should they carry, given their limited showroom space?
2. What information do Scott and Susan need to make those decisions?
   a. What information do the external entities they interact with need?
   b. What information do management and other employees need?
   c. How can they gather, store, and disseminate that information?
3. What business processes are needed, and how should they be carried out?
4. What functionality should be provided on the Web site?

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

Introduction

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

A *system* is a set of two or more interrelated components that interact to achieve a goal. Most systems are composed of smaller subsystems that support the larger system. For example, a college of business is a system composed of various departments, each of which is a subsystem. Moreover, the college itself is a subsystem of the university.

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

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

Information is data that have been organized and processed to provide meaning and improve the decision-making process. As a rule, users make better decisions as the quantity and quality of information increase.

However, there are limits to the amount of information the human mind can absorb and process. ***Information overload*** occurs when those limits are passed, resulting in a decline in decision-making quality and an increase in the cost of providing that information. Information system designers use ***information technology (IT)*** to help decision makers more effectively filter and condense information. For example, Walmart has over 500 terabytes (trillions of bytes) of data in its data warehouse. That is equivalent to 2,000 miles of bookshelves, or about 100 million digital photos. Walmart has invested heavily in IT so it can effectively collect, store, analyze, and manage data to provide useful information.

The ***value of information*** is the benefit produced by the information minus the cost of producing it. Benefits of information are reduced uncertainty, improved decisions, and improved ability to plan and schedule activities. The costs are the time and resources spent to produce and distribute the information. Information costs and benefits can be difficult to quantify, and it is difficult to determine the value of information before it has been produced and utilized. Nevertheless, the expected value of information should be calculated as effectively as possible so that the costs of producing the information do not exceed its benefits.

To illustrate the value of information, consider the case of 7-Eleven. In 1973, a Japanese company licensed the very successful 7-Eleven name from Southland Corporation. As it opened its stores, 7-Eleven Japan invested heavily in IT, but the U.S. stores did not. Each 7-Eleven store in Japan was given a computer that:

- Keeps track of the 3,000 items sold in each store and determines what products are moving, at what time of day, and under what weather conditions.
- Keeps track of what and when customers buy to make sure it has in stock the products most frequently purchased.
- Orders sandwiches and rice dishes from suppliers automatically. Orders are placed and filled three times a day so that stores always have fresh food. In addition, 7-Eleven allows its suppliers to access sales data in their computers so that they can forecast demand.
- Coordinates deliveries with suppliers. This reduces deliveries from 34 to 12 a day, resulting in less clerical receiving time.
- Prepares a color graphic display that indicates which store areas contribute the most to sales and profits.

Average daily sales of 7-Eleven Japan were 30% higher and its operating margins almost double those of its closest competitor. What happened to Southland and its 7-Eleven stores in the United States? Profits declined, and Southland eventually had to file for bankruptcy. Who came to the company's rescue? Along with its parent company, 7-Eleven Japan purchased 64% of Southland.

Table 1-1 presents seven characteristics that make information useful and meaningful.

TABLE 1-1 Characteristics of Useful Information

Relevant	Reduces uncertainty, improves decision making, or confirms or corrects prior expectations.
Reliable	Free from error or bias; accurately represents organization events or activities.
Complete	Does not omit important aspects of the events or activities it measures.
Timely	Provided in time for decision makers to make decisions.
Understandable	Presented in a useful and intelligible format.
Verifiable	Two independent, knowledgeable people produce the same information.
Accessible	Available to users when they need it and in a format they can use.

Information Needs and Business Processes

All organizations need information in order to make effective decisions. In addition, all organizations have certain business processes that they are continuously engaged in. A ***business process*** is a set of related, coordinated, and structured activities and tasks that are performed by a person or by a computer or a machine, and that help accomplish a specific organizational goal.

To make effective decisions, organizations must decide what decisions they need to make, what information they need to make the decisions, and how to gather and process the data needed to produce the information. This data gathering and processing is often tied to the basic business processes in an organization. To illustrate the process of identifying information needs and business processes, let's return to our case study of S&S.

Information Needs

Scott and Susan decide they must understand how S&S functions before they can identify the information they need to manage S&S effectively. Then they can determine the types of data and procedures they will need to collect and produce that information. They created Table 1-2 to summarize part of their analysis. It lists S&S's basic business processes, some key decisions that need to be made for each process, and information they need to make the decisions.

Scott and Susan realize that the list is not exhaustive, but they are satisfied that it provides a good overview of S&S. They also recognize that not all the information needs listed in the right-hand column will be produced internally by S&S. Information about payment terms for merchandise purchases, for example, will be provided by vendors. Thus, S&S must effectively integrate external data with internally generated data so that Scott and Susan can use both types of information to run S&S.

S&S will interact with many external parties, such as customers, vendors, and governmental agencies, as well as with internal parties such as management and employees. To get a better handle on the more important interactions with these parties, they prepared Figure 1-1.

Business Processes

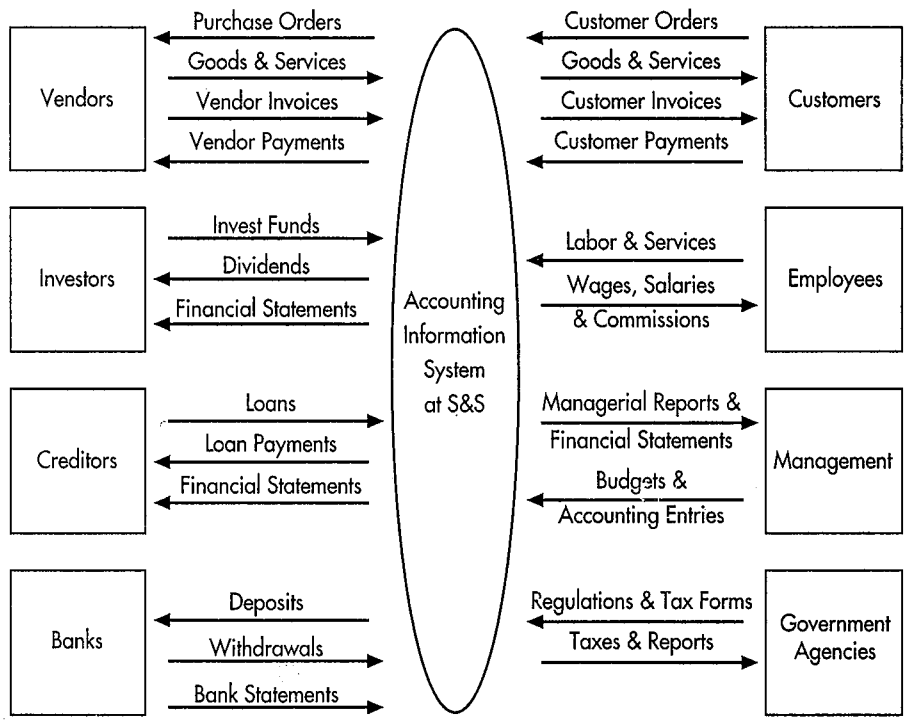
Scott decides to reorganize the business processes listed in Table 1-2 into groups of related transactions. A ***transaction*** is an agreement between two entities to exchange goods or services or any other event that can be measured in economic terms by an organization. Examples include selling goods to customers, buying inventory from suppliers, and paying employees. The process that begins with capturing transaction data and ends with informational output, such as the financial statements, is called ***transaction processing***. Transaction processing is covered in more depth in Chapter 2.

Many business activities are pairs of events involved in a ***give-get exchange***. Most organizations engage in a small number of give-get exchanges, but each type of exchange happens many times. For example, S&S will have thousands of sales to customers every year in exchange for cash. Likewise, S&S will continuously buy inventory from suppliers in exchange for cash.

TABLE 1-2 Overview of S&S's Business Processes, Key Decisions, and Information Needs

Business Processes	Key Decisions	Information Needs
Acquire capital	How much Find investors or borrow funds If borrowing, obtaining best terms	Cash flow projections Pro forma financial statements Loan amortization schedule
Acquire building and equipment	Size of building Amount of equipment Rent or buy Location How to depreciate	Capacity needs Building and equipment prices Market study Tax tables and depreciation regulations
Hire and train employees	Experience requirements How to assess integrity and competence of applicants How to train employees	Job descriptions Applicant job history and skills
Acquire inventory	What models to carry How much to purchase How to manage inventory (store, control, etc.) Which vendors	Market analyses Inventory status reports Vendor performance
Advertising and marketing	Which media Content	Cost analyses Market coverage
Sell merchandise	Markup percentage Offer in-house credit Which credit cards to accept	Pro forma income statement Credit card costs Customer credit status
Collect payments from customers	If offering credit, what terms How to handle cash receipts	Customer account status Accounts receivable aging report Accounts receivable records
Pay employees	Amount to pay Deductions and withholdings Process payroll in-house or use outside service	Sales (for commissions) Time worked (hourly employees) W-4 forms Costs of external payroll service
Pay taxes	Payroll tax requirements Sales tax requirements	Government regulations Total wage expense Total sales
Pay vendors	Whom to pay When to pay How much to pay	Vendor invoices Accounts payable records Payment terms

FIGURE 1-1
Interactions Between S&S and External and Internal Parties



These exchanges can be grouped into five major ***business processes or transaction cycles***:

- The ***revenue cycle***, where goods and services are sold for cash or a future promise to receive cash. This cycle is discussed in Chapter 12.
- The ***expenditure cycle***, where companies purchase inventory for resale or raw materials to use in producing products in exchange for cash or a future promise to pay cash. This cycle is discussed in Chapter 13.
- The ***production*** or ***conversion cycle***, where raw materials are transformed into finished goods. This cycle is discussed in Chapter 14.
- The ***human resources/payroll cycle***, where employees are hired, trained, compensated, evaluated, promoted, and terminated. This cycle is discussed in Chapter 15.
- The ***financing cycle***, where companies sell shares in the company to investors and borrow money and where investors are paid dividends and interest is paid on loans.

These cycles process a few related transactions repeatedly. For example, most revenue cycle transactions are either selling goods or services to customers or collecting cash for those sales. Figure 1-2 shows the main transaction cycles and the give-get exchange inherent in each cycle.

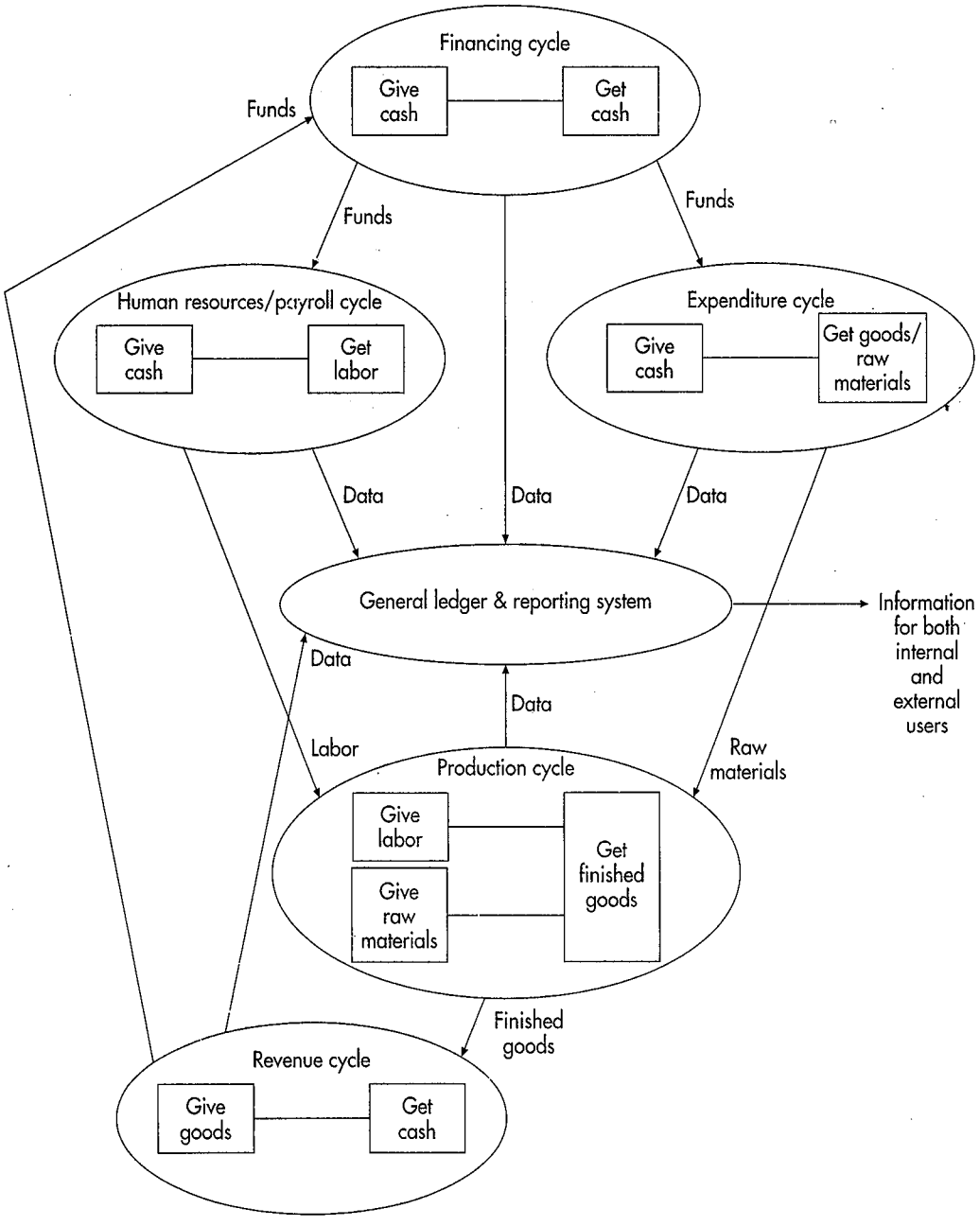


FIGURE 1-2
The AIS and Its Subsystems

These basic give-get exchanges are supported by a number of other business activities. For example, S&S may need to answer a number of customer inquiries and check inventory levels before it can make a sale. Likewise, it may have to check customer credit before a credit sale is made. Accounts receivable will have to be increased each time a credit sale is made and decreased each time a customer payment is received. Table 1-3 lists the major activities in each transaction cycle.

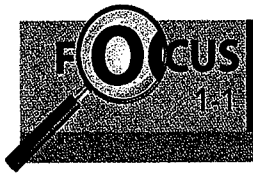
TABLE 1-3 Common Cycle Activities

Transaction Cycle	Major Activities in the Cycle
Revenue	Receive and answer customer inquiries Take customer orders and enter them into the AIS Approve credit sales Check inventory availability Initiate back orders for goods out of stock Pick and pack customer orders Ship goods to customers or perform services Bill customers for goods shipped or services performed Update (increase) sales and accounts receivable Receive customer payments and deposit them in the bank Update (reduce) accounts receivable Handle sales returns, discounts, allowances, and bad debts Prepare management reports Send appropriate information to the other cycles
Expenditure	Request that goods and services be purchased Prepare, approve, and send purchase orders to vendors Receive goods and services and complete a receiving report Store goods Receive vendor invoices Update (increase) accounts payable Approve vendor invoices for payment Pay vendors for goods and services Update (reduce) accounts payable Handle purchase returns, discounts, and allowances Prepare management reports Send appropriate information to the other cycles
Human Resources/Payroll	Recruit, hire, and train new employees Evaluate employee performance and promote employees Discharge employees Update payroll records Collect and validate time, attendance, and commission data Prepare and disburse payroll Calculate and disburse taxes and benefit payments Prepare employee and management reports Send appropriate information to the other cycles
Production	Design products Forecast, plan, and schedule production Request raw materials for production Manufacture products Store finished products Accumulate costs for products manufactured Prepare management reports Send appropriate information to the other cycles
Financing	Forecast cash needs Sell stock/securities to investors Borrow money from lenders Pay dividends to investors and interest to lenders Retire debt Prepare management reports Send appropriate information to the other cycles

Notice that the last activity listed in Table 1-3 for each transaction cycle is "Send appropriate information to the other cycles." Figure 1-2 shows how these various transaction cycles relate to one another and interface with the ***general ledger and reporting system***, which is used to generate information for both management and external parties. The general ledger and reporting system is discussed in more depth in Chapter 16.

In many accounting software packages, the various transaction cycles are implemented as separate modules. Not every organization needs to implement every module. Retail stores like S&S, for example, do not have a production cycle and would not implement that module. Moreover, some types of organizations have unique requirements. Financial institutions, for example, have demand deposit and installment-loan cycles that relate to transactions involving customer accounts and loans, respectively. In addition, the nature of a given transaction cycle differs across different types of organizations. For example, the expenditure cycle of a service company, such as a public accounting or a law firm, does not involve processing transactions related to the purchase, receipt, and payment for merchandise that will be resold to customers.

Each transaction cycle can include many different business processes or activities. Each business process can be relatively simple or quite complex. Focus 1-1 shows how SA Kargo's attention to continuously improving its business processes has helped it expand its operations globally.



Information Systems Are Key to Success at SA Kargo Sdn Bhd

SA Kargo Sdn Bhd, a Malaysian freight-forwarding company, was registered as a private limited company in 1991. The company started its operations as a small-scale business with minimum financing. After more than a decade of continuous commitment to its mission of becoming an internationally recognized freight forwarder, the company has successfully expanded its operations to seven major ports in Malaysia, placing the company as one of the main players in the shipping, transportation, and warehousing industry. The company has also spread its operations to the United Kingdom and the United States.

The strength of the company lies in its ability to provide complete logistic services that include transportation (via air, land, and sea), packing and removals, and express courier services. With a strong staff of 105 people, the company has embarked on more challenging jobs and has successfully secured contracts with government bodies and agencies and with companies in various industries, including textiles, computers, electronics, leather, automobiles, and aviation.

The success of SA Kargo lies in the information systems it utilizes. Appropriate information systems are fundamental in the design of innovative solutions that enable clients to streamline their operations, improve efficiencies, and maximize service levels. To this end, the company has adopted three main systems that address its main operations and costing process:

- **A customs information system.** This system is provided by the Malaysian Customs Department for the purpose of online customs declaration. The system eliminates the need for paper-based forms, which the company previously had to purchase at a cost from the National Printing Agency. This has resulted in significant cost savings to the company.
- **A global positioning system (GPS).** This system enables the monitoring and control of transport vehicles. The movement of each vehicle can be tracked at any time during the transportation of goods, and the system can provide accurate information to executives and clients. The system also provides a means of control whereby the company can monitor the fuel consumption of each vehicle. By using this system, the company can check fuel consumption against the distance traveled for each shipment, and therefore any inconsistencies will be highlighted. This system prevents employees from stealing fuel or using the vehicles for personal use. The system also offers additional safety features, including a panic button that will automatically alert the company should there be any emergency or vehicle breakdown.
- **An office automation system (OAS).** This is a job-costing system that enables employees to create job numbers and record shipment data. The system enables executives to monitor costs and the movement of each shipment and provides the company with initial profit and loss projections. The system provides data on a real-time basis.

With the strategic implementation of current technologies, SA Kargo has been able to establish partnerships with reputable agents and partners in the United States and Europe. With these partnerships, the company successfully carries out its business activities on a global front while at the same time providing local businesses with immediate access to international markets.

After preparing Tables 1-2 and 1-3 and Figures 1-1 and 1-2, Scott and Susan believe that they understand S&S well enough to begin shopping for an information system. Susan recalled a previous employer that had several separate information systems, because their software was not designed to accommodate the information needs of all managers. She also vividly recalled attending one meeting where she witnessed the negative effects of having multiple systems. The head of marketing had one report on year-to-date sales by product, the production manager had a different report that contained different sales figures, and the controller's report, which was produced by the general ledger system, had yet a third version of year-to-date sales. Over an hour was wasted trying to reconcile those different reports! Susan vowed that she would make sure that S&S did not ever find itself in such a mess. She would make sure that any system selected would have the capability to integrate both financial and nonfinancial data about S&S's various business processes so that everyone could pull information from the same system.

Accounting Information Systems

It has often been said that accounting is the language of business. If that is the case, then an ***accounting information system (AIS)*** is the intelligence—the information-providing vehicle—of that language.

Accounting is a data identification, collection, and storage process as well as an information development, measurement, and communication process. By definition, accounting is an information system, since an AIS collects, records, stores, and processes accounting and other data to produce information for decision makers. This is illustrated in Figure 1-3.

An AIS can be a paper-and-pencil manual system, a complex system using the latest in IT, or something in between. Regardless of the approach taken, the process is the same. The AIS must collect, enter, process, store, and report data and information. The paper and pencil or the computer hardware and software are merely the tools used to produce the information.

This text does not distinguish an AIS from other information systems. Instead, our viewpoint is that the AIS can and should be the organization's primary information system and that it provides users with the information they need to perform their jobs.

There are six components of an AIS:

1. The *people* who use the system
2. The *procedures and instructions* used to collect, process, and store data
3. The *data* about the organization and its business activities
4. The *software* used to process the data
5. The *information technology infrastructure*, including the computers, peripheral devices, and network communications devices used in the AIS
6. The *internal controls and security measures* that safeguard AIS data

These six components enable an AIS to fulfill three important business functions:

1. Collect and store data about organizational activities, resources, and personnel. Organizations have a number of business processes, such as making a sale or purchasing raw materials, which are repeated frequently.
2. Transform data into information so management can plan, execute, control, and evaluate activities, resources, and personnel. Decision making is discussed in detail later in this chapter.
3. Provide adequate controls to safeguard the organization's assets and data. Control concepts are discussed in detail in Chapters 5–11.

Since accounting data comes from an AIS, AIS knowledge and skills are critical to an accountant's career success. Interacting with an AIS is one of the most important activities that accountants perform. Other important AIS-related activities include designing internal control

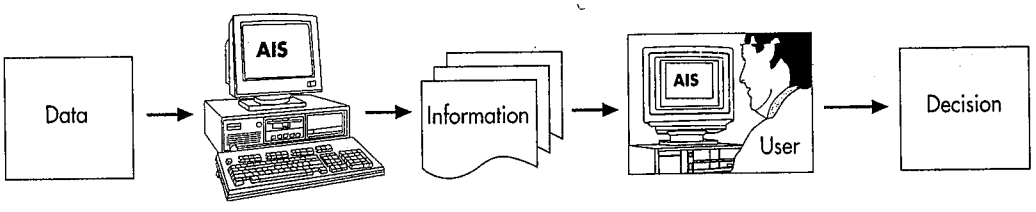


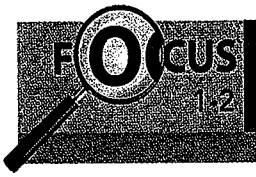
FIGURE 1-3
An AIS Processes Data to Produce Information for Decision Makers

systems and business process improvements, topics covered in detail in the book. Focus 1-2 explains a specialty to designate that certain CPAs have an in-depth knowledge of AIS topics.

How an AIS Can Add Value to an Organization

A well-designed AIS can add value to an organization by:

1. *Improving the quality and reducing the costs of products or services.* For example, an AIS can monitor machinery so operators are notified immediately when performance falls outside acceptable quality limits. This helps maintain product quality, reduces waste, and lowers costs.
2. *Improving efficiency.* For example, timely information makes a just-in-time manufacturing approach possible, as it requires constant, accurate, up-to-date information about raw materials inventories and their locations.
3. *Sharing knowledge.* Sharing knowledge and expertise can improve operations and provide a competitive advantage. For example, CPA firms use their information systems to share best practices and to support communication between offices. Employees can search the corporate database to identify experts to provide assistance for a particular client; thus, a CPA firm's international expertise can be made available to any local client.
4. *Improving the efficiency and effectiveness of its supply chain.* For example, allowing customers to directly access inventory and sales order entry systems can reduce sales and marketing costs, thereby increasing customer retention rates.
5. *Improving the internal control structure.* An AIS with the proper internal control structure can protect systems from fraud, errors, system failures, and disasters.
6. *Improving decision making.* Improved decision making is vitally important and is discussed below in more detail.



CITP—An IT Specialty Designation for CPAs

The American Institute of Certified Public Accountants (AICPA) offers several specialty designations for CPAs. The CITP (Certified Information Technology Professional) designation reflects the AICPA's recognition of the importance of information technology and its interrelationship with accounting. A CITP possesses a broad range of technological knowledge and understands how organizations use IT to achieve their business objectives.

There are many reasons to earn the CITP certification:

- Because only CPAs can be CITPs, this certification further differentiates you from others in the marketplace.
- It affirms your value as an IT specialist and increases your value to your employer or clients.
- It is a great "calling card" for IT people who want to be leaders in industry, public practice, government, or academia.
- It opens the doors to new technology-related roles and opportunities.
- Automatic membership in the IT Section, which allows you to meet, share best practices, network, and communicate with other CITPs. You can also receive monthly CITP newsletters and other communications, attend monthly CITP Webinars, and access exclusive CITP resources and content on the IT Center Web site.

To qualify for the CITP designation, you must be a CPA and a member of the AICPA. You must earn 100 points in the areas of business experience, lifelong learning, and an optional exam. Candidates must earn a minimum of 15 points, up to a maximum of 75 points, in the area of business experience. The number of points awarded depends on the number of hours spent working in the following areas in the three-year period preceding application for the CITP designation:

- IT Strategic Planning
- Information Systems Management
- Systems Architecture
- Business Applications and E-Business
- Security, Privacy, and Contingency Planning
- Systems Development, Acquisition, and Project Management
- Systems Auditing and Internal Control
- Databases and Database Management

You must also earn a minimum of 30 points, up to a maximum of 70 points, in lifelong learning, which includes continuing education, additional degrees, and obtaining or maintaining other technology-related certifications.

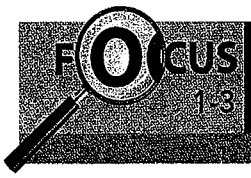
Candidates who have earned at least 60 points in business experience and lifelong learning can earn 40 points by passing an exam that covers the eight previously mentioned topical areas.

Decision making is a complex, multistep activity: identify the problem, collect and interpret information, evaluate ways to solve the problem, select a solution methodology, and implement the solution. An AIS can provide assistance in all phases of decision making. Reports can help to identify potential problems. Decision models and analytical tools can be provided to users. Query languages can gather relevant data to help make the decision. Various tools, such as graphical interfaces, can help the decision maker interpret decision model results, evaluate them, and choose among alternative courses of action. In addition, the AIS can provide feedback on the results of actions.

An AIS can help improve decision making in several ways:

- It can identify situations requiring management action. For example, a cost report with a large variance might stimulate management to investigate and, if necessary, take corrective action.
- It can reduce uncertainty and thereby provide a basis for choosing among alternative actions.
- It can store information about the results of previous decisions, which provides valuable feedback that can be used to improve future decisions. For example, if a company tries a particular marketing strategy and the information gathered indicates that it did not succeed, the company can use that information to select a different marketing strategy.
- It can provide accurate information in a timely manner. For example, Walmart has an enormous database that contains detailed information about sales transactions at each of its stores. It uses this information to optimize the amount of each product carried at each store.
- It analyzes sales data to discover items that are purchased together, and it uses such information to improve the layout of merchandise to encourage additional sales of related items. In a similar vein, Amazon.com uses its database of sales activity to suggest additional books for customers to purchase.

Focus 1-3 discusses how information technology adds value to UPS.



The Use of Technology by UPS

UPS used to invest heavily in training its employees to perform tasks in less time but spent little money on IT. Today, because of the value added to its business, UPS spends well over $1 billion a year on IT. That is much more than it spends on trucks and about as much as it spends on airplanes. UPS has 4,700 employees devoted to developing and maintaining proprietary software and a Web site that 20 million people visit each day. Its 15 mainframe computers and 9,000 servers allow UPS customers to control each shipment (16 million a day) from the time a delivery order is initiated to the time it arrives at its destination. Here is how the system works:

- Customers use UPS software or the UPS Web site to initiate a delivery. They create, print, and attach labels to their shipment containing detailed sender information and the time the shipment should arrive.
- They schedule a pickup time electronically.
- The UPS system routes the label information to the distribution center closest to the shipment's destination.
- At the distribution center, proprietary software uses the destination, desired arrival time, traffic and weather conditions, and street information (one-way streets, etc.) to create the most efficient delivery route. Drivers have handheld computers with a global positioning system (GPS) that guide their routes.
- The system creates a label that specifies where to put the shipment on the delivery truck so the earliest shipments are nearest the driver. Drivers average 100 pickups and deliveries a day, and boxes loaded out of order can delay the driver up to 30 minutes.
- Customers can use the UPS Web site to reroute or track their shipment. The GPS allows UPS to predict accurately the shipment's approximate arrival time.
- The handheld computer is programmed to beep at the driver if a shipment is delivered to the wrong address or forgotten.

UPS's commitment to IT has produced dramatic results. Recent system improvements allowed drivers to make seven to nine more stops each day, reduced the number of miles UPS drives each year by 1.9 million, and saved over $600 million per year in operating costs.

However, UPS is not congratulating itself on how well it has used IT to improve its business. The UPS system is a work in progress. UPS continues to innovate and find ways to use IT to become even more efficient and better serve the customer.

Source: Corey Dade, "How UPS Went from Low-Tech to an IT Power—and Where It's Headed Next," *The Wall Street Journal*, July 24, 2006, R4.

The AIS and Corporate Strategy

Since most organizations have limited resources, it is important to identify the AIS improvements likely to yield the greatest return. Making a wise decision requires an understanding of the organization's overall business strategy. To illustrate, consider the results of a *CIO* magazine survey of five hundred Chief Information Officers. Asked to identify the three most important skill sets for a CIO, over 75% put strategic thinking and planning on their list.

Figure 1-4 shows three factors that influence the design of an AIS: developments in IT, business strategy, and organizational culture. It is also important to recognize that the design of the AIS can also influence the organization's culture by controlling the flow of information within the organization. For example, an AIS that makes information easily accessible and widely available is likely to increase pressures for more decentralization and autonomy.

IT developments can affect business strategy. For example, the Internet has profoundly affected the way many activities are performed, significantly affecting both strategy and strategic positioning. The Internet dramatically cuts costs, thereby helping companies to implement a low-cost strategy. If every company used the Internet to adopt a low-cost strategy, then the effects might be problematic. Indeed, one possible outcome may be intense price competition among firms, with the likely result that most of the cost savings provided by the Internet get passed on to the industry's customers, rather than being retained in the form of higher profits. Moreover, because every company can use the Internet to streamline its activities, a company is unlikely to gain a sustainable long-term competitive advantage.

Many other technological advances affect company strategy and provide an opportunity to gain a competitive advantage. An example is ***predictive analysis***, which uses data warehouses and complex algorithms to forecast future events, based on historical trends and calculated probabilities. Predictive analysis provides an educated guess of what one may expect to see in the near future, allowing companies to make better business decisions and improve their processes. FedEx uses predictive analysis to predict, with 65% to 90% accuracy, how customers respond to price changes and new services. Blue Cross Blue Shield of Tennessee uses a neural-based predictive model to predict the health care that specific patients will need, the severity of illnesses, and organ failures. Stock market analysts are using predictive analysis to predict short-term trends in the stock market.

An organization's AIS plays an important role in helping it adopt and maintain a strategic position. Achieving a close fit among activities requires that data be collected about each activity. It is also important that the information system collect and integrate both financial and nonfinancial data about the organization's activities.

The Role of the AIS in the Value Chain

To provide value to their customers, most organizations perform a number of different activities. Figure 1-5 shows that those activities can be conceptualized as forming a ***value chain*** consisting of five ***primary activities*** that directly provide value to customers:

1. ***Inbound logistics*** consists of receiving, storing, and distributing the materials an organization uses to create the services and products it sells. For example, an automobile manufacturer receives, handles, and stores steel, glass, and rubber.
2. ***Operations*** activities transform inputs into final products or services. For example, assembly line activities convert raw materials into a finished car.

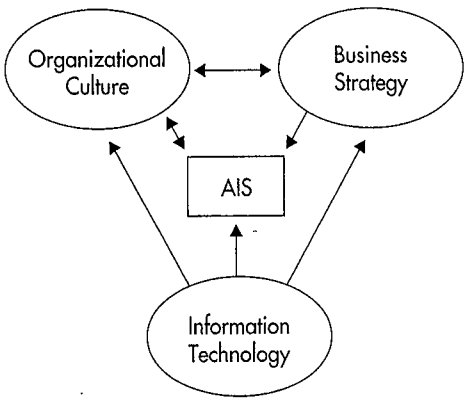
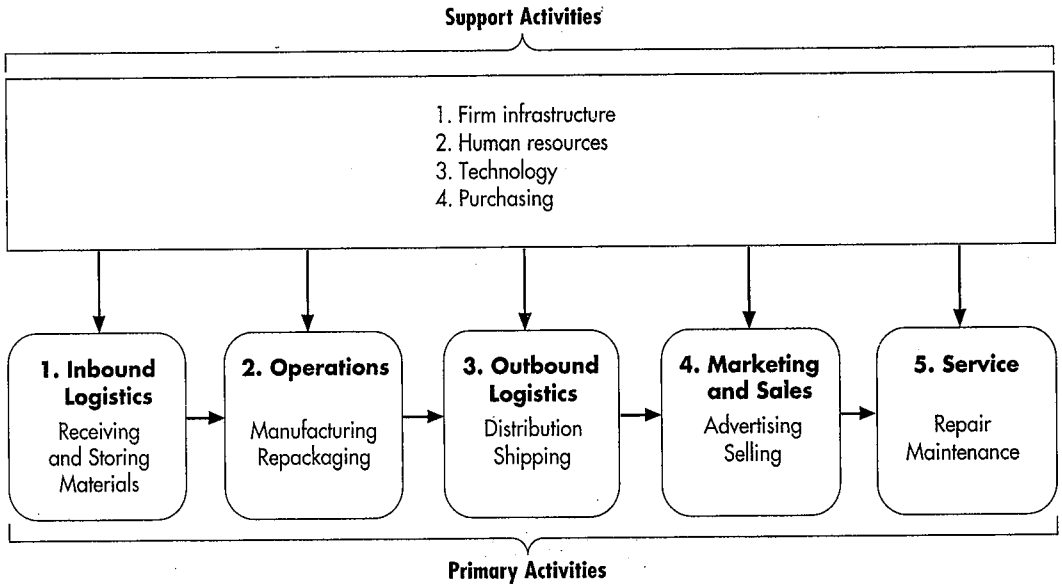


FIGURE 1-4
Factors Influencing Design of the AIS

FIGURE 1-5
The Value Chain



3. *Outbound logistics* activities distribute finished products or services to customers. An example is shipping automobiles to car dealers.
4. *Marketing and sales* activities help customers buy the organization's products or services. Advertising is an example of a marketing and sales activity.
5. *Service* activities provide post-sale support to customers. Examples include repair and maintenance services.

Support activities allow the five primary activities to be performed efficiently and effectively. They are grouped into four categories:

1. *Firm infrastructure* is the accounting, finance, legal, and general administration activities that allow an organization to function. The AIS is part of the firm infrastructure.
2. *Human resources* activities include recruiting, hiring, training, and compensating employees.
3. *Technology* activities improve a product or service. Examples include research and development, investments in IT, and product design.
4. *Purchasing* activities procure raw materials, supplies, machinery, and the buildings used to carry out the primary activities.

Using IT to redesign supply chain systems yields tremendous benefits and cost savings. For example, Tennessee Valley Authority, a power generator, reengineered its supply chain and created an enterprisewide system that provides up-to-the-minute information, rather than the "current once a day" system that it replaced. The new system replaced 20 smaller and incompatible systems, reduced head count by 89 people, and saved $270 million in its first five years.

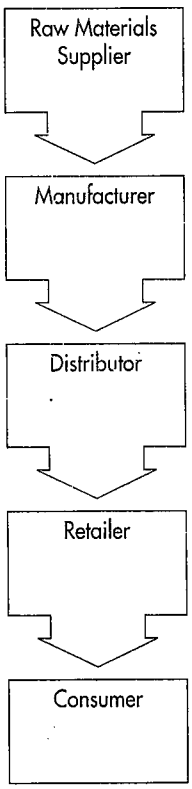


FIGURE 1-6
The Supply Chain

An organization's value chain is a part of a larger system called a ***supply chain***. As shown in Figure 1-6, a manufacturing organization interacts with its suppliers and distributors. By paying attention to its supply chain, a company can improve its performance by helping the others in the supply chain to improve their performance. For example, S&S can improve its purchasing and inbound logistics activities by implementing a more efficient just-in-time inventory management system that reduces its costs and minimizes the capital tied up in inventory. S&S can reap additional benefits if it links its new systems with its suppliers so they can perform their primary value chain activities more efficiently. For example, by providing more detailed and timely information about its inventory needs, S&S suppliers can more efficiently plan their production schedules. Part of the resultant cost reduction can be passed on to S&S in the form of lower product costs.

The problems created by an ineffective supply chain are illustrated by Limited Brands. Limited experienced explosive growth, including acquisitions of other retail companies such as Victoria's Secret and Abercrombie & Fitch. These acquisitions left Limited with a tangled web of over 60 incompatible information systems. The problems came to a head one night when 400 trailers converged on a distribution center parking lot that could fit only 150 trailers. The trailers blocked traffic along all the highways around the distribution center and caused countless traffic and community

problems. No one in Limited knew where all the trailers came from, what the merchandise was, or where it was to be sent. Chaos reigned for some time, until the merchandise could be routed to stores and other distribution centers. Limited solved many of its problems by installing a new, integrated system that greatly improved its supply chain processes and technologies. Developing the new system was not easy. Limited has over a thousand suppliers and sells its merchandise using various platforms, including retail stores, the Internet, catalogs, and third-party retailers.

Summary and Case Conclusion

Susan and Scott reflected on what they had done to try and understand what decisions S&S would need to make and the information needed to make them. They had begun by obtaining an understanding of S&S's basic business processes and of the key decisions that must be made to operate the business effectively. They followed that with an analysis of the internal and external parties that the AIS would have to interact with and the information the AIS would have to provide them.

Since S&S is a retail merchandising company, its business processes could be described in terms of four basic transaction cycles:

1. The *revenue cycle* encompasses all transactions involving sales to customers and the collection of cash receipts for those sales.
2. The *expenditure cycle* encompasses all transactions involving the purchase of and payment for the merchandise sold by S&S, as well as other services it consumes, such as rent and utilities.
3. The *human resources/payroll cycle* encompasses all the transactions involving the hiring, training, and payment of employees.
4. The *financing cycle* encompasses all transactions involving the investment of capital in the company, borrowing money, payment of interest, and loan repayments.

These four cycles interface with the *general ledger and reporting system*, which consists of all activities related to the preparation of financial statements and other managerial reports.

Scott and Susan will need a well-designed AIS to provide the information they need to effectively plan, manage, and control their business. Their AIS must be able to process data about sales and cash receipts, purchasing and paying for merchandise and services, payroll and tax-related transactions, and acquiring and paying for fixed assets. The company's AIS must also provide the information needed to prepare financial statements.

Fortunately, there are many computer-based accounting packages available for the retail industry. As they begin looking at various software packages, however, Scott and Susan quickly learn that considerable accounting knowledge is required to choose the one that will best fit their business. Because neither has an accounting background, Scott and Susan decide that their next task will be to hire an accountant.

Key Terms

system 24
goal conflict 24
goal congruence 24
data 24
information 24
information overload 24
information technology (IT) 24
value of information 24
business process 25
transaction 25
transaction processing 25
give-get exchange 25
business processes or transaction cycles 27
revenue cycle 27
expenditure cycle 27
production (conversion) cycle 27
human resources/payroll cycle 27
financing cycle 27
general ledger and reporting system 29
accounting information system (AIS) 30
predictive analysis 33
value chain 33
primary activities 33
support activities 34
supply chain 34

AIS IN ACTION

Chapter Quiz

1. Data differ from information in which way?
   a. Data are output, and information is input.
   b. Information is output, and data are input.
   c. Data are meaningful bits of information.
   d. There is no difference.

2. Which of the following is NOT a characteristic that makes information useful?
   a. It is reliable. b. It is timely. c. It is inexpensive. d. It is relevant.

3. Which of the following is a primary activity in the value chain?
   a. purchasing
   b. accounting
   c. post-sales service
   d. human resource management

4. Which transaction cycle includes interactions between an organization and its suppliers?
   a. revenue cycle
   b. expenditure cycle
   c. human resources/payroll cycle
   d. general ledger and reporting system

5. Which of the following is NOT a means by which information improves decision making?
   a. increases information overload
   b. reduces uncertainty
   c. provides feedback about the effectiveness of prior decisions
   d. identifies situations requiring management action

6. In the value chain concept, upgrading IT is considered what kind of activity?
   a. primary activity
   b. support activity
   c. service activity
   d. structured activity

7. In which cycle does a company ship goods to customers?
   a. production cycle
   b. financing cycle
   c. revenue cycle
   d. expenditure cycle

8. Which of the following is a function of an AIS?
   a. reducing the need to identify a strategy and strategic position
   b. transforming data into useful information
   c. allocating organizational resources
   d. automating all decision making

9. A firm, its suppliers, and its customers collectively form which of the following?
   a. supply chain b. value chain c. ERP system d. AIS

10. A report telling how well all approved vendors have performed in the prior 12 months is information that is MOST needed in which business process?
    a. paying vendors
    b. acquiring inventory
    c. selling merchandise
    d. paying employees

Discussion Questions

1.1. The value of information is the difference between the benefits realized from using that information and the costs of producing it. Would you, or any organization, ever produce information if its expected costs exceeded its benefits? If so, provide some examples. If not, why not?

1.2. Can the characteristics of useful information listed in Table 1-1 be met simultaneously? Or does achieving one mean sacrificing another?

1.3. You and a few of your classmates decided to become entrepreneurs. You came up with a great idea for a new mobile phone application that you think will make lots of money. Your business plan won second place in a local competition, and you are using the $10,000 prize to support yourselves as you start your company.
   a. Identify the key decisions you need to make to be successful entrepreneurs, the information you need to make them, and the business processes you will need to engage in.
   b. Your company will need to exchange information with various external parties. Identify the external parties, and specify the information received from and sent to each of them.

1.4. How do an organization's business processes and lines of business affect the design of its AIS? Give several examples of how differences among organizations are reflected in their AIS.

1.5. Figure 1-4 shows that organizational culture and the design of an AIS influence one another. What does this imply about the degree to which an innovative system developed by one company can be transferred to another company?

1.6. Figure 1-4 shows that developments in IT affect both an organization's strategy and the design of its AIS. How can a company determine whether it is spending too much, too little, or just enough on IT?

1.7. Apply the value chain concept to S&S. Explain how it would perform the various primary and support activities.

1.8. Information technology enables organizations to easily collect large amounts of information about employees. Discuss the following issues:
   a. To what extent should management monitor employees' e-mail?
   b. To what extent should management monitor which Web sites employees visit?
   c. To what extent should management monitor employee performance by, for example, using software to track keystrokes per hour or some other unit of time? If such information is collected, how should it be used?
   d. Should companies use software to electronically "shred" all traces of e-mail?
   e. Under what circumstances and to whom is it appropriate for a company to distribute information it collects about the people who visit its Web site?

Problems



1.1. Information technology is continually changing the nature of accounting and the role of accountants. Write a two-page report describing what you think the nature of the accounting function and the accounting information system in a large company will be like in the year 2020.



1.2. The annual report is considered by some to be the single most important printed document that companies produce. In recent years, annual reports have become large documents. They now include such sections as letters to the stockholders, descriptions of the business, operating highlights, financial review, management discussion and analysis, a discussion of company internal controls, segment reporting, inflation data, and the basic financial statements. The expansion has been due in part to a general increase in the degree of sophistication and complexity in accounting standards and disclosure requirements for financial reporting.

The expansion also is reflective of the change in the composition and level of sophistication of users. Current users include not only stockholders but also financial and securities analysts, potential investors, lending institutions, stockbrokers, customers, employees, and—whether the reporting company likes it or not—competitors. Thus, a report that was originally designed as a device for communicating basic financial information now attempts to meet the diverse needs of an ever-expanding audience.

Users hold conflicting views on the value of annual reports. Some argue that they fail to provide enough information, whereas others believe that disclosures in annual reports

have expanded to the point where they create information overload. Others argue that the future of most companies depends on acceptance by the investing public and by its customers; therefore, companies should take this opportunity to communicate well-defined corporate strategies.

Required

a. Identify and discuss the basic factors of communication that must be considered in the presentation of the annual report.
b. Discuss the communication problems a corporation faces in preparing the annual report that result from the diversity of the users being addressed.
c. Select two types of information found in an annual report, other than the financial statements and accompanying footnotes, and describe how they are helpful to the users of annual reports.
d. Discuss at least two advantages and two disadvantages of stating well-defined corporate strategies in the annual report.
e. Evaluate the effectiveness of annual reports in fulfilling the information needs of the following current and potential users: shareholders, creditors, employees, customers, and financial analysts.
f. Annual reports are public and accessible to anyone, including competitors. Discuss how this affects decisions about what information should be provided in annual reports. *(CMA Examination, adapted)*

1.3. United Services Automotive Association (USAA) is one of the largest diversified financial services companies in the United States, with close to $75 billion in assets under management. One reason for its success is the use of IT to lower costs and improve customer service. USAA operates one of the most advanced and successful information systems in the world. It communicates with its widely scattered customers, mostly military officers and their families, primarily by e-mail, phone, and its Web site.

Early on, USAA made a strategic choice to become one of the more technology-intensive companies in the world. It views IT as a strategic weapon and uses it in several ways, including the following:

- When customers call from their homes, offices, or cell phones, USAA personnel greet them personally by name. Unlike many diversified companies, a customer representative can handle inquires and transactions about all of USAA's products using a highly integrated database.
- USAA uses its extensive database to keep track of minute details, such as which auto parts are fixed most frequently. It also uses its database to find ways to reduce claims costs. For example, USAA discovered that repair shops would rather charge up to $300 to replace a windshield with punctures than to charge $40 to repair it. USAA began offering to waive the deductible if the owners would repair the windshield rather than replace it.
- USAA spent extensively to develop an image-processing system that digitizes all paper documents sent in by claimants (over 25 million a year). It takes only a few keystrokes for a policy service representative to retrieve pictures of all the documents in a customer's file. The system can sort and prioritize documents so that employees are always working on the most important and urgent tasks.
- USAA offers its customers remote deposit capture using scanning technology. It was the first U.S. bank to implement a remote deposit capture application for the iPhone. The iPhone application allows customers to take pictures of the front and back of each check and submit them electronically for deposit.
- USAA is a world leader in mobile banking. Customers can use their cell phones and other mobile devices to access and execute banking, investment, stock trading, and insurance applications such as filing claims. Customers can also use USAA's two-way text-messaging system to send messages and receive text alerts and real-time information. They can also access person-to-person payment applications as well as social networking and personal financial management tools connected to bank accounts. Over 70% of USAA's logins are from cell phone users.

Required

a. Why should USAA collect data on which auto parts are fixed most frequently? What could it do with this data?
b. Even though USAA offered to waive the deductible, the repair shops still managed to convince 95% of the owners to replace rather than repair their damaged windshields. How could USAA use its AIS to persuade more shop owners to repair rather than replace their windows?
c. How does the image-processing system at USAA add value to the organization?
d. How do the remote deposit capture and mobile banking system at USAA add value to the organization?
e. Do an Internet search and find out what other advancements USAA has introduced. Write a brief paragraph on each new application or other newsworthy item you find (maximum limit of three applications or items).

1.4. Matching

Match the description listed in the right column with the information characteristic listed in the left column.

____ 1. Relevant	a. The report was carefully designed so that the data contained in the report became information to the reader.
____ 2. Reliable	b. The manager was working one weekend and needed to find some information about production requests for a certain customer. He was able to find the report on the company's network.
____ 3. Complete	c. The data in a report was checked by two clerks working independently.
____ 4. Timely	d. An accounts receivable aging report included all customer accounts.
____ 5. Understandable	e. A report was checked by three different people for accuracy.
____ 6. Verifiable	f. An accounts receivable aging report is used in credit-granting decisions.
____ 7. Accessible	g. An accounts receivable aging report was received before the credit manager had to make a decision whether to extend credit to a customer.

1.5. The Howard Leasing Company is a privately held, medium-sized business that purchases school busses and leases them to school districts, churches, charitable organizations, and other businesses. To better serve its customers and, more important, to protect its investment in the busses, Howard operates a large maintenance facility to maintain and repair leased vehicles. Howard's annual sales for last year were $37 million, with a net income of $2.9 million. Howard employs approximately 150 people.



You were recently hired by Howard, and you are eager to prove your worth to the company. Your supervisor just called you into her office and asked you to prepare an accounts receivable aging report as of the end of the year for use in the upcoming audit of the company's financial statements.

Required

a. What is an accounts receivable aging report?
b. Why is an accounts receivable aging report needed for an audit?
c. What is an accounts receivable aging report used for in normal company operations?
d. What data will you need to prepare the report?
e. Where will you collect the data you need to prepare the report?
f. How will you collect the necessary data for the report?

g. What will the report look like (i.e., how will you organize the data collected to create the information your supervisor needs for the audit)? Prepare an accounts receivable aging report in Excel or another spreadsheet package.
h. How will you distribute the report? How many copies will you make? Who should receive the copies? What security features will you implement?



1.6. Based on Walmart's success in the United States, many expected the company to quickly dominate the British market after it bought the Asda grocery chain in 1999. That has not happened; Walmart's market share in groceries is a little more than half that of its biggest competitor, Tesco. Initially, Tesco's sales and net income rose significantly while Walmart's sales and net income increased at a much slower rate. More recently, Walmart has made small gains in market share, and Tesco has had small decreases.

Walmart found out that Tesco is a formidable worldwide competitor. Tesco operates almost 2,400 stores in Britain in four different formats. It has a very successful operation in Central Europe, and it has expanded to the United States with Fresh & Easy stores. In Korea, Tesco's 174 stores are thriving while Walmart gave up after an eight-year effort to succeed and sold its 16 stores.

One of the biggest reasons for Tesco's success is its use of technology. In 1995, Tesco started a loyalty card program, called Clubcard, and over 80% of its shoppers are members. Shoppers fill out an application in the store and receive a plastic card and a key fob in the mail that is scanned before they make a purchase. Tesco gathers massive amounts of data about its customers' 15 million purchases each week. Sales data are analyzed and turned into information that provides Tesco with a significant competitive advantage.

As traditional advertising loses effectiveness, these large stores of data allow Tesco to find new and creative ways to market its products.

Required

a. What kind of information do you think Tesco gathers?
b. How do you think Tesco has motivated over 22 million customers to sign up for its Clubcard program?
c. What can Tesco accomplish with the Clubcard data it collects? Think in terms of strategy and competitive advantage.
d. What are some of the disadvantages to the Clubcard program?
e. Do an Internet search to find out how Tesco is doing in comparison to Walmart and other grocers and retailers. Write a few paragraphs explaining your findings.

1.7. Have you ever imagined having one electronic device that does everything you would ever need? Mobile phone makers in Japan have gone beyond the imagining phase. Cell phones in Japan are becoming more versatile than ever. Newer models of cell phones contain a myriad of applications and can do many of the things that a personal computer (PC) can do. PCs are also able to function as phones. A small but growing number of professionals are trading in their laptops for handheld computers. Cell phone manufacturers in the United States and elsewhere are quickly catching up to their Japanese counterparts.

Required

a. What commercial activities can be done with a cell phone? With a cell phone/PC combination device? What do you do when you're on your cell phone? What do you expect to be doing in five years?
b. How can businesses utilize this technology to attract more customers, sell more products, advertise their products, facilitate the sale of products, and conduct and manage their businesses more efficiently and effectively?
c. What are some problems or drawbacks you can see with using these devices in business?

1.8. Classify each of the following items as belonging in the revenue, expenditure, human resources/payroll, production, or financing cycle.
a. Purchase raw materials
b. Pay off mortgage on a factory

c. Hire a new assistant controller
d. Establish a $10,000 credit limit for a new customer
e. Pay for raw materials
f. Disburse payroll checks to factory workers
g. Record goods received from a vendor
h. Update the allowance for doubtful accounts
i. Decide how many units to make next month
j. Complete a picking ticket for a customer order
k. Record factory employee timecards
l. Sell concert tickets
m. Draw on line of credit
n. Send new employees to a business ethics course
o. Pay utility bills
p. Pay property taxes on an office building
q. Pay federal payroll taxes
r. Sell a DVD player
s. Collect payments on customer accounts
t. Obtain a bank loan
u. Pay sales commissions
v. Send an order to a vendor
w. Put purchased goods into the warehouse

Case 1-1 Ackoff's Management Misinformation Systems

The Web site for this book contains an adaption of Russell L. Ackoff's classic article "Management Misinformation Systems" from *Management Science*. In the article, Ackoff identified five common assumptions about information systems and then explained why he disagreed with them.

Required

Read the five assumptions, contentions, and Ackoff's explanations. For each of the five assumptions, decide whether you agree or disagree with Ackoff's contentions. Prepare a report in which you defend your stand and explain your defense.

AIS IN ACTION SOLUTIONS

Quiz Key

1. Data differ from information in which way?
   a. Data are output, and information is input. [Incorrect. Data are facts and figures that, once organized, can become information. Therefore, data are inputs, and information is output.]
   ▶ b. Information is output, and data are input. [Correct.]
   c. Data are meaningful bits of information. [Incorrect. Information is organized and processed data that provide meaning.]
   d. There is no difference. [Incorrect. There is a difference. Data are unorganized facts and figures. Information is meaningful, organized, and processed data.]

2. Which of the following is NOT a characteristic that makes information useful?
   a. It is reliable. [Incorrect. This is one of the information characteristics listed in Table 1-1 on page 25.]
   b. It is timely. [Incorrect. This is one of the information characteristics listed in Table 1-1 on page 25.]

▶ c. It is inexpensive. [Correct. This is NOT one of the information characteristics listed in Table 1-1 on page 25.]
d. It is relevant. [Incorrect. This is one of the information characteristics listed in Table 1-1 on page 25.]

3. Which of the following is a primary activity in the value chain?
a. purchasing [Incorrect. This is a support activity.]
b. accounting [Incorrect. This is a firm infrastructure support activity.]
▶ c. post-sales service [Correct. Service is a primary activity.]
d. human resource management [Incorrect. This is a support activity.]

4. Which transaction cycle includes interactions between an organization and its suppliers?
a. revenue cycle [Incorrect. The revenue cycle involves interactions between an organization and its customers.]
▶ b. expenditure [Correct.]
c. human resources/payroll cycle [Incorrect. The human resources/payroll cycle involves interactions between an organization and its employees, government, and potential hires.]
d. general ledger and reporting system [Incorrect. The general ledger and reporting system receives summary information from all cycles.]

5. Which of the following is NOT a means by which information improves decision making?
▶ a. increases information overload [Correct. Decision makers receiving too much information have difficulty incorporating all of the information into their decision framework, and, as a result, decision quality can be reduced rather than improved.]
b. reduces uncertainty [Incorrect. More reliable information leads to less uncertainty and thus better decisions.]
c. provides feedback about the effectiveness of prior decisions [Incorrect. Knowledge of effective and ineffective decisions can lead to better decisions in the future.]
d. identifies situations requiring management action [Incorrect. Identifying the need for management action can lead to improved decision making.]

6. In the value chain concept, upgrading IT is considered what kind of activity?
a. primary activity [Incorrect. Investing in IT is a support activity.]
b. support activity [Correct. Technology activities, including investing in IT, are considered a support activity.]
c. service activity [Incorrect. The value chain includes only primary and support activities. A service activity is a type of primary activity.]
d. structured activity [Incorrect. The value chain includes only primary and support activities. A structured activity is neither a primary nor a secondary activity.]

7. In which cycle does a company ship goods to customers?
a. production cycle [Incorrect. The production cycle involves the transformation of raw materials into finished goods.]
b. financing cycle [Incorrect. The financing cycle deals with interactions between an organization and its lenders and owners.]
▶ c. revenue cycle [Correct. The revenue cycle involves interactions between an organization and its customers, such as shipping them goods.]
d. expenditure cycle [Incorrect. The expenditure cycle involves interactions between an organization and its suppliers.]

8. Which of the following is a function of an AIS?
a. reducing the need to identify a strategy and strategic position [Incorrect. An AIS does not reduce the need to identify a strategy. It provides information to executives for the purpose of making strategic decisions.]
▶ b. transforming data into useful information [Correct. This is one of the primary functions of an AIS.]

c. allocating organizational resources [Incorrect. Decision makers allocate resources, and the purpose of the AIS is to provide information to the decision makers so that they can make the allocation.]
d. automating all decision making [Incorrect. The AIS provides information to decision makers; it is not designed to automate all decision making.]

9. A firm, its suppliers, and its customers collectively form which of the following?
▶ a. supply chain [Correct. The supply chain is made up of the firm, its suppliers, and customers.]
b. value chain [Incorrect. The value chain is made up of primary and support activities within the firm.]
c. ERP system [Incorrect. An ERP system integrates all aspects of an organization's activities into one system.]
d. AIS [Incorrect. The AIS is made up of the human and capital resources within an organization that are responsible for collecting and processing transactions and preparing financial information.]

10. A report telling how well all approved vendors have performed in the prior 12 months is information that is MOST needed in which business process?
a. paying vendors [Incorrect. To pay a vendor, a company needs to know whether merchandise ordered was received in good condition. They do not need a 12-month history of vendor performance.]
▶ b. acquiring inventory [Correct. Companies want to acquire inventory from companies that have performed well in the past. A vendor performance report would disclose whether the vendor shipped inventory on time, whether the inventory was of the requested quality, whether the prices were as agreed upon, etc.]
c. selling merchandise [Incorrect. A 12-month history of vendor performance is usually not very helpful in trying to sell products to customers. More important would be customer tastes and preferences, customer credit status, etc.]
d. paying employees [Incorrect. It is very rare for an employee's pay to be based on a 12-month history of vendor performance. More important are hours worked, annual salary, sales figures to calculate commissions, etc.]

Chapter 2

Overview of Transaction Processing and Enterprise Resource Planning Systems

Learning Objectives

After studying this chapter, you should be able to:

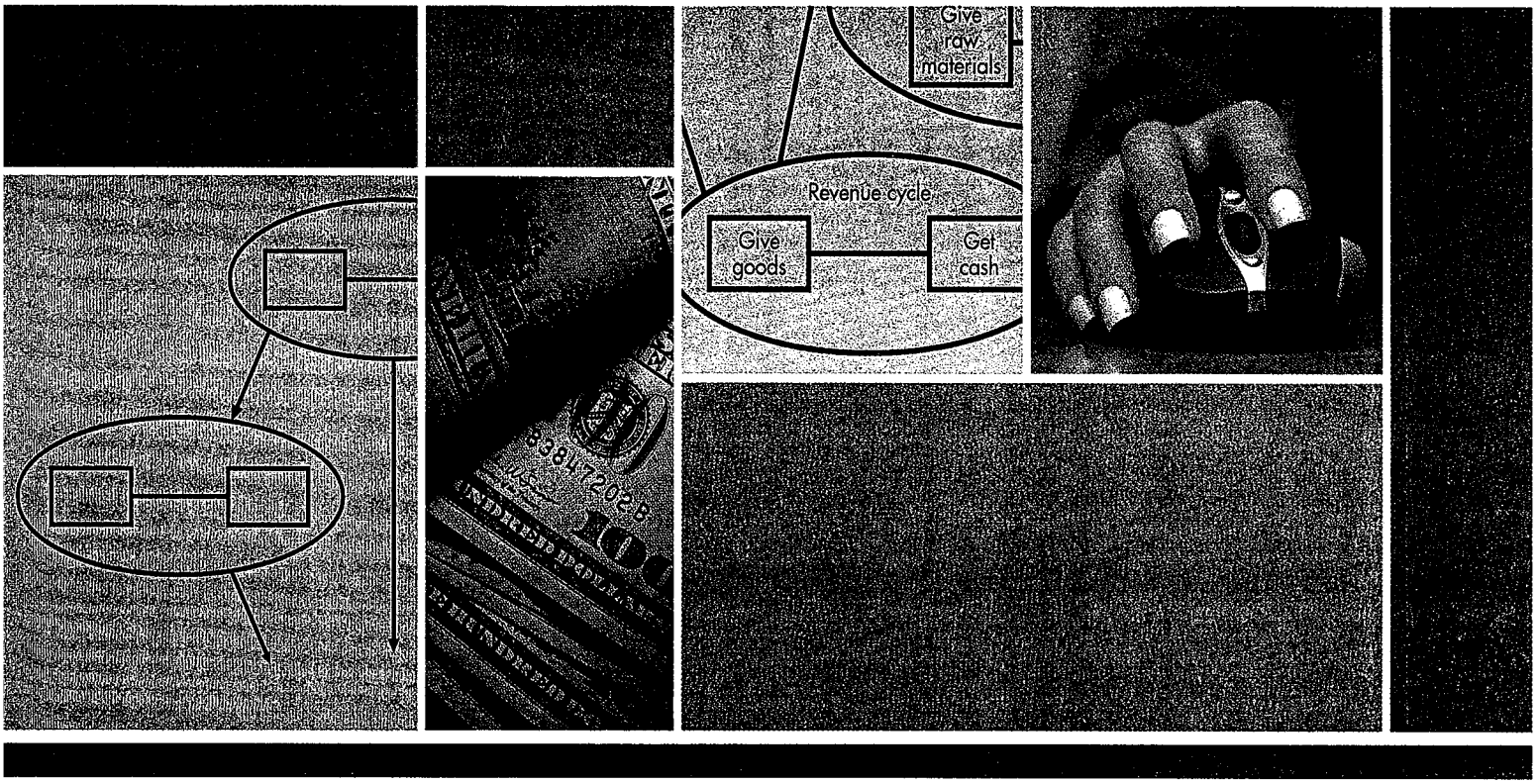
1. Describe the four parts of the data processing cycle and the major activities in each.
2. Describe documents and procedures used to collect and process transaction data.
3. Describe the ways information is stored in computer-based information systems.
4. Discuss the types of information that an AIS can provide.
5. Discuss how organizations use enterprise resource planning (ERP) systems to process transactions and provide information.

INTEGRATIVE CASE S&S

The grand opening of S&S is two weeks away. Scott Parry and Susan Gonzalez are working long hours to make the final arrangements for the store opening. Most of the employees have already been hired; training is scheduled for next week.

Susan has ordered inventory for the first month. The store is being remodeled and will have a bright, cheery decor. All seems to be in order—all, that is, except the accounting records.

Like many entrepreneurs, Scott and Susan have not given as much thought to their accounting records as they have to other parts of their business. Recognizing they need qualified accounting help, they hired a full-time accountant, Ashton Fleming. Scott and Susan think Ashton is perfect for the job because of his three



years of experience with a national CPA firm. Ashton is looking forward to working for S&S because he has always wanted to be involved in building a company from the ground up.

During Ashton's first day on the job, Susan gives him the invoices for the inventory she purchased and a folder with their bank loan documentation, with the first payment due after the grand opening. She also hands him a folder containing information on rental payments, utilities, and other expenses. Susan tells Ashton that she and Scott know little about accounting and he will run the accounting end of S&S. She adds that the only thing they have done so far is to open a checking account for S&S and that they have kept the check register updated to monitor their cash flow.

Scott explains that the sales staff is paid a fixed salary and commissions and that all other employees are paid hourly rates. Employees are paid every two weeks, with their first paychecks due next week. Ashton asks Scott what accounting software the company is using. Scott replies that he and Susan have not had time to tackle that aspect yet. Scott and Susan looked at some of the popular packages but quickly realized that they did not know enough about accounting to make an intelligent choice. Scott then tells Ashton that his first task should be to purchase whatever accounting software he thinks will be best for S&S.

After Scott leaves, Ashton feels both excited and a little nervous about his responsibility for creating an AIS for S&S. Although Ashton has audited many companies, he has never organized a company's books and is unsure how to go about it. A million questions run through his head. Here are just a few of them:

1. How should I organize the accounting records so that financial statements can be easily produced?
2. How am I going to collect and process data about all of S&S's transactions?
3. How do I organize all the data that will be collected?

4. How should I design the AIS so that the information provided is reliable and accurate?
5. How can I design procedures to ensure that they meet all government obligations, such as remitting sales, income, and payroll taxes?

Introduction

This chapter is divided into two major sections. The first section discusses the data processing cycle and its role in organizing business activities and providing information to users. It explains how organizations capture and enter data about business activities into their AIS and how companies process data and transform it into useful information. It also discusses basic data storage concepts, showing how data are stored for further use. Finally, information output is discussed, including the different ways information is provided to users.

The second section discusses the role of the information system in modern organizations and introduces the concept of an enterprise resource planning (ERP) system. An ERP can help integrate all aspects of a company's operations with its traditional AIS. This section also describes the significant advantages of an ERP as well as significant challenges that must be overcome to implement an ERP system.

Transaction Processing: The Data Processing Cycle

Accountants and other system users play a significant role in the data processing cycle. For example, they interact with systems analysts to help answer questions such as these: What data should be entered and stored by the organization, and who should have access to them? How should data be organized, updated, stored, accessed, and retrieved? How can scheduled and unanticipated information needs be met? To answer these and related questions, the data processing concepts explained in this chapter must be understood.

One important AIS function is to process company transactions efficiently and effectively. In manual (non-computer-based) systems, data are entered into journals and ledgers maintained on paper. In computer-based systems, data are entered into computers and stored in files and databases. The operations performed on data to generate meaningful and relevant information are referred to collectively as the ***data processing cycle***. As shown in Figure 2-1, this process consists of four steps: data input, data storage, data processing, and information output.

Data Input

The first step in processing input is to capture transaction data and enter them into the system. The data capture process is usually triggered by a business activity. Data must be collected about three facets of each business activity:

1. Each activity of interest
2. The resource(s) affected by each activity
3. The people who participate in each activity

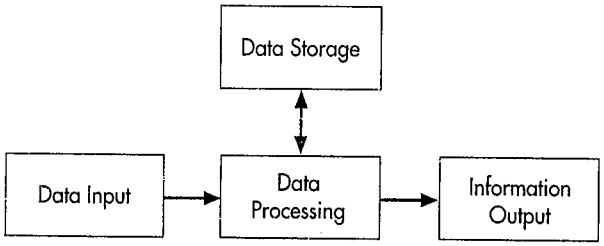


FIGURE 2-1
The Data Processing Cycle

For example, the most frequent revenue cycle transaction is a sale, either for cash or on credit. S&S may find it useful to collect the following data about a sales transaction:

- Date and time the sale occurred
- Employee who made the sale and the checkout clerk who processed the sale
- Checkout register where the sale was processed
- Item(s) sold
- Quantity of each item sold
- List price and actual price of each item sold
- Total amount of the sale
- Delivery instructions
- For credit sales: customer name, customer bill-to and ship-to addresses

Historically, most businesses used paper ***source documents*** to collect data about their business activities. They later transferred that data into the computer. When the data is entered using computer screens, they often retain the same name and basic format as the paper source document it replaced. Table 2-1 lists some common transaction cycle activities and the source document or form used to capture data about that event. Examples of many of these documents can be found in Chapters 12 through 16. For example, a purchase order, used to request merchandise from suppliers, is shown in Chapter 13.

Turnaround documents are company output sent to an external party, who often adds data to the document, and then are returned to the company as an input document. They are in machine-readable form to facilitate their subsequent processing as input records. An example is a utility bill that is sent to the customer, returned with the customer's payment, and read by a special scanning device when it is returned.

Source data automation devices capture transaction data in machine-readable form at the time and place of their origin. Examples include ATMs used by banks, point-of-sale (POS) scanners used in retail stores, and bar code scanners used in warehouses.

The second step in processing input is to make sure captured data are accurate and complete. One way to do this is to use source data automation or well-designed turnaround documents and data entry screens. Well-designed documents and screens improve accuracy and completeness by providing instructions or prompts about what data to collect, grouping logically related pieces of information close together, using checkoff boxes or pull-down menus to present the available options, and using appropriate shading and borders to clearly separate data items. Data input screens usually list all the data the user needs to enter. Sometimes these screens resemble source documents, and users fill out the screen the same way they would a paper source document.

Users can improve control either by purchasing prenumbered source documents or by having the system automatically assign a sequential number to each new transaction. Prenumbering

TABLE 2-1 Common Business Activities and Source Documents

Business Activity	Source Document
Revenue Cycle	
Take customer order	Sales order
Deliver or ship order	Delivery ticket or bill of lading
Receive cash	Remittance advice or remittance list
Deposit cash receipts	Deposit slip
Adjust customer account	Credit memo
Expenditure Cycle	
Request items	Purchase requisition
Order items	Purchase order
Receive items	Receiving report
Pay for items	Check or electronic funds transfer
Human Resources Cycle	
Collect employee withholding data	W-4 form
Record time worked by employees	Time cards
Record time spent on specific jobs	Job time tickets or time sheet

simplifies verifying that all transactions have been recorded and that none of the documents has been misplaced. (Imagine trying to balance a checkbook if the checks were not prenumbered.)

The third step in processing input is to make sure company policies are followed, such as approving or verifying a transaction. For example, S&S would not want to sell goods to a customer who was not paying his bills or to sell an item for immediate delivery that was out of stock. These problems are prevented by programming the system to check a customer's credit limit and payment history, as well as inventory status, before confirming a customer sale.

Data Storage

A company's data are one of its most important resources. However, the mere existence of relevant data does not guarantee that they are useful. To function properly, an organization must have ready and easy access to its data. Therefore, accountants need to understand how data are organized and stored in an AIS and how they can be accessed. In essence, they need to know how to manage data for maximum corporate use.

Imagine how difficult it would be to read a textbook if it were not organized into chapters, sections, paragraphs, and sentences. Now imagine how hard it would be for S&S to find an invoice if all documents were randomly dumped into file cabinets. Fortunately, information in an AIS is organized for easy and efficient access. This section explains basic data storage concepts and definitions.

LEDGERS Cumulative accounting information is stored in general and subsidiary ledgers. A ***general ledger*** contains summary-level data for every asset, liability, equity, revenue, and expense account. A ***subsidiary ledger*** contains detailed data for any general ledger account with many individual subaccounts. For example, the general ledger has an accounts receivable account that summarizes the total amount owed to the company by all customers. The subsidiary accounts receivable ledger has a separate record for each individual customer, with detailed information such as name, address, purchases, payments, account balance, and credit limit. Subsidiary ledgers are often used for accounts receivable, inventory, fixed assets, and accounts payable.

The general ledger account corresponding to a subsidiary ledger is called a ***control account***. The relationship between the general ledger control account and the total of individual subsidiary ledger account balances helps maintain the accuracy of AIS data. Specifically, the sum of all subsidiary ledger account balances should equal the amount in the corresponding general ledger control account. Any discrepancy between them indicates that a recording error has occurred.

CODING TECHNIQUES Data in ledgers is organized logically using coding techniques. ***Coding*** is the systematic assignment of numbers or letters to items to classify and organize them.

- With ***sequence codes***, items are numbered consecutively to account for all items. Any missing items cause a gap in the numerical sequence. Examples include prenumbered checks, invoices, and purchase orders.
- With a ***block code***, blocks of numbers are reserved for specific categories of data. For example, S&S reserved the following numbers for major product categories:

Product Code	Product Type
1000000–1999999	Electric range
2000000–2999999	Refrigerator
3000000–3999999	Washer
4000000–4999999	Dryer

Users can identify an item's type and model using the code numbers. Other examples include ledger account numbers (blocked by account type), employee numbers (blocked by department), and customer numbers (blocked by region).

- ***Group codes***, which are two or more subgroups of digits used to code items, are often used in conjunction with block codes. If S&S uses a seven-digit product code number, the group coding technique might be applied as follows.

Digit Position	Meaning
1–2	Product line, size, style
3	Color
4–5	Year of manufacture
6–7	Optional features

There are four subcodes in the product code, each with a different meaning. Users can sort, summarize, and retrieve information using one or more subcodes. This technique is often applied to general ledger account numbers.

- With ***mnemonic codes***, letters and numbers are interspersed to identify an item. The mnemonic code is derived from the description of the item and is usually easy to memorize. For example, Dry300W05 could represent a low end (300), white (W) dryer (Dry) made by Whirlpool (05).

The following guidelines result in a better coding system. The code should:

- Be consistent with its intended use, which requires that the code designer determine desired system outputs prior to selecting the code.
- Allow for growth. For example, don't use a three-digit employee code for a fast-growing company with 950 employees.
- Be as simple as possible to minimize costs, facilitate memorization and interpretation, and ensure employee acceptance.
- Be consistent with the company's organizational structure and across the company's divisions.

CHART OF ACCOUNTS A great example of coding is the ***chart of accounts***, which is a list of the numbers assigned to each general ledger account. These account numbers allow transaction data to be coded, classified, and entered into the proper accounts. They also facilitate the preparation of financial statements and reports, because data stored in individual accounts can easily be summed for presentation.

However, data stored in summary accounts cannot be easily analyzed and reported in more detail. Consequently, it is important that the chart of accounts contain sufficient detail to meet an organization's information needs. To illustrate, consider the consequences if S&S were to use only one general ledger account for all sales transactions. It would be easy to produce reports showing the total amount of sales for a given time period, but it would be very difficult to prepare reports separating cash and credit sales. Indeed, the only way to produce these latter reports would be to go back to original sales records to identify the nature of each sales transaction. If S&S used separate general ledger accounts for cash and credit sales, then reports showing both types of sales could be easily produced. Total sales could also be easily reported by summing each type of sale.

Table 2-2 shows the chart of accounts Ashton developed for S&S. Each account number is three digits long. The first digit represents the major account category and indicates where it appears on S&S's financial statements. Thus, all current assets are numbered in the 100s, noncurrent assets are numbered in the 200s, and so on.

The second digit represents the primary financial subaccounts within each category. Again, the accounts are assigned numbers to match the order of their appearance in financial statements (in order of decreasing liquidity). Thus, account 120 represents accounts receivable, and account 150 represents inventory.

The third digit identifies the specific account to which the transaction data will be posted. For example, account 501 represents cash sales, and account 502 represents credit sales. Similarly, accounts 101 through 103 represent the various cash accounts used by S&S.

A chart of accounts is tailored to the nature and purpose of an organization. For example, the chart of accounts for S&S indicates that the company is a corporation. In contrast, a partnership would include separate capital and drawing accounts for each partner, instead of common stock and retained earnings. Likewise, because S&S is a retail organization, it has only one type of general ledger inventory account. A manufacturing company, in contrast,

TABLE 2-2 Sample Chart of Accounts for S&S

Account Code	Account Name	Account Code	Account Name
100–199	Current Assets	400–499	Equity Accounts
101	Checking Account	400	Common Stock
102	Savings Account	410	Retained Earnings
103	Petty Cash		
120	Accounts Receivable	500–599	Revenues
125	Allowance for Doubtful Accounts	501	Cash Sales
130	Notes Receivable	502	Credit Sales
150	Inventory	510	Sales Returns & Allowances
160	Supplies	511	Sales Discounts
170	Prepaid Rent	520	Interest Revenue
180	Prepaid Insurance	530	Miscellaneous Revenue
200–299	Noncurrent Assets	600–799	Expenses
200	Land	600	Cost of Goods Sold
210	Buildings	611	Wages Expense
215	Accumulated Depreciation—Buildings	612	Commissions Expense
230	Equipment	613	Payroll Tax Expense
235	Accumulated Depreciation—Equipment	620	Rent Expense
240	Furniture & Fixtures	630	Insurance Expense
245	Accumulated Depreciation—Furniture & Fixtures	640	Supplies Expense
250	Other Assets	650	Bad Debt Expense
		701	Depreciation Expense—Buildings
300–399	Liabilities	702	Depreciation Expense—Equipment
300	Accounts Payable	703	Depreciation Expense—Furniture & Fixtures
310	Wages Payable	710	Income Tax Expense
321	Employee Income Tax Payable		
322	FICA Tax Payable	900–999	
323	Federal Unemployment Tax Payable	910	Summary Accounts
324	State Unemployment Tax Payable		Income Summary
330	Accrued Interest Payable		
360	Other Liabilities		

would have separate general ledger accounts for raw materials, work in process, and finished goods inventories.

Ashton left gaps in S&S's chart of accounts to allow for additional accounts. For example, when S&S has excess cash to invest in marketable securities, a new general ledger account can be created and assigned the number 110. When S&S opens stores in the future, he will add three digits to the chart of accounts to represent each store in the chain, so that S&S can track items in each store.

Subsidiary ledger accounts often have longer account codes than general ledger accounts. At S&S, each account receivable will have a seven-digit code. The first three digits are 120, the code for accounts receivable. The next four digits identify up to 10,000 individual customers.

JOURNALS Transaction data are often recorded in a journal before they are entered into a ledger. A journal entry shows the accounts and amounts to be debited and credited. A ***general journal*** is used to record infrequent or nonroutine transactions, such as loan payments and end-of-period adjusting and closing entries. A ***specialized journal*** records large numbers of repetitive transactions such as sales, cash receipts, and cash disbursements.

Table 2-3 is a sample sales journal. All transaction information is recorded in one line, with every entry a debit to accounts receivable and a credit to sales. There is no need to write an explanation of each entry, as is the case with general journal entries. Given the high number of daily sales transactions, the time saved by recording these transactions in a sales journal, rather than in the general journal, is considerable.

The Post Ref column indicates when transactions are posted to the appropriate ledger. In a manual system, ledgers are books; hence, the phrase "keeping the books" refers to the process of maintaining the ledgers.

Figure 2-2 shows how to journalize and post sales transactions. First, each credit sale is recorded in the sales journal. Then each sales journal entry is posted to the appropriate customer account in the accounts receivable subsidiary ledger (note the arrow linking the $1,876.50 sale to KDR Builders in the sales journal to the debit for $1,876.50 in the accounts receivable subsidiary ledger). Periodically, the total of all sales journal entries is posted to the general ledger (note the arrow showing the daily sales journal total of $15,511.00 posted to both the Accounts Receivable and the Credit Sales general ledger accounts).

AUDIT TRAIL Figure 2-2 shows how the posting references and document numbers provide an audit trail. An ***audit trail*** is a traceable path of a transaction through a data processing system from point of origin to final output, or backwards from from final output to point of origin. It is used to check the accuracy and validity of ledger postings. Observe that the SJ5 posting reference for the $15,511 credit to the sales account in the general ledger refers to page 5 of the sales journal. By checking page 5 of the sales journal, it is possible to verify that $15,511 represents the total credit sales recorded on October 15. Similarly, the posting reference for the $1876.50 debit to the KDR Builders' account in the subsidiary accounts receivable ledger also refers to page 5 of the sales journal as the source of that entry. Furthermore, note that the sales journal lists the invoice numbers for each individual entry. This provides the means for locating and examining the appropriate source documents in order to verify that the transaction occurred and it was recorded accurately.

COMPUTER-BASED STORAGE CONCEPTS An ***entity*** is something about which information is stored, such as employees, inventory items, and customers. Each entity has ***attributes***, or characteristics of interest, that are stored, such as a pay rate and address. Each type of entity possesses the same set of attributes. For example, all employees possess an employee number, pay rate, and home address. The specific values for those attributes will differ. For example, one employee's pay rate might be $12.00 an hour, whereas another's might be $12.25.

TABLE 2-3 Sample Sales Journal

Sales Journal					Page 5
Date	Invoice Number	Account Debited	Account Number	Post Ref.	Amount
Oct. 15	151	Brown Hospital Supply	120-035	✓	798.00
15	152	Greenshadows Hotel Suites	120-122	✓	1,267.00
15	153	Heathrow Apartments	120-057	✓	5,967.00
15	154	LMS Construction	120-173	✓	2,312.50
15	155	Gardenview Apartments	120-084	✓	3,290.00
15	156	KDR Builders	120-135	✓	1,876.50
		TOTAL	120/502		15,511.00

FIGURE 2-2
Recording and Posting a Credit Sale

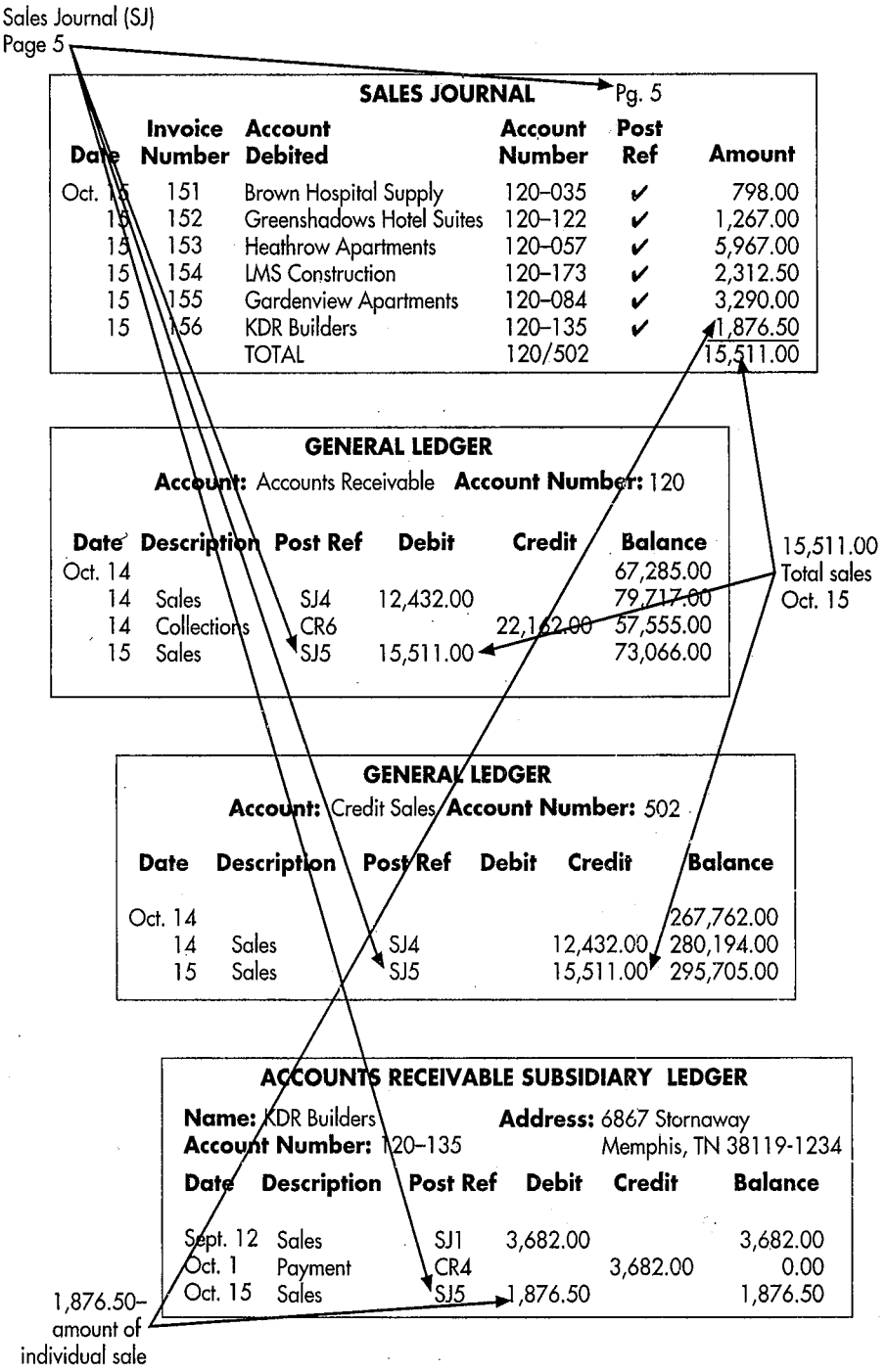


Figure 2-3 shows that computers store data in a *field*. The fields containing data about entity attributes constitute a *record*. In Figure 2-3, each row represents a different record, and each column represents an attribute. Each intersecting row and column in Figure 2-3 is a field within a record, the contents of which are called a *data value*.

A *file* is a group of related records. A *master file*, like a ledger in a manual AIS, stores cumulative information about an organization. The inventory and equipment master files store information about important organizational resources. The customer, supplier, and employee master files store information about important agents with whom the organization interacts.

Master files are permanent; they exist across fiscal periods. However, individual master file records may change frequently. For example, individual customer accounts balances are updated to reflect new sales transactions and payments received. Periodically, new records are added to or removed from a master file, for example, when a new customer is added or a former customer deleted.

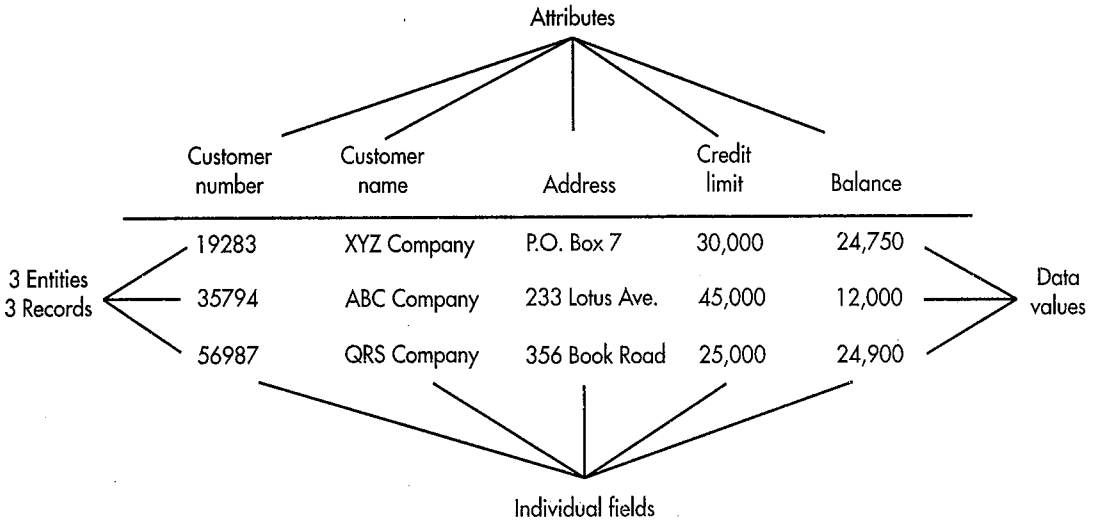


FIGURE 2-3
Data Storage Elements

This accounts receivable file stores information about three separate entities: XYZ Company, ABC Company, and QRS Company. As a result, there are three records in the file. Five separate attributes are used to describe each customer: customer number, customer name, address, credit limit, and balance. There are, therefore, five separate fields in each record. Each field contains a data value that describes an attribute of a particular entity (customer). For example, the data value 19283 is the customer number for the XYZ Company.

A ***transaction file*** contains records of individual business transactions that occur during a specific time. It is similar to a journal in a manual AIS. For example, S&S will have a daily sales transaction file and a cash receipts file. Both files will update individual customer account balances in the customer master file. Transaction files are not permanent and may not be needed beyond the current fiscal period. However, they are usually maintained for a specified period for backup purposes.

A set of interrelated, centrally coordinated files is referred to as a ***database***. For example, the accounts receivable file might be combined with customer, sales analysis, and related files to form a customer database. Chapter 4 discusses database technology.

Data Processing

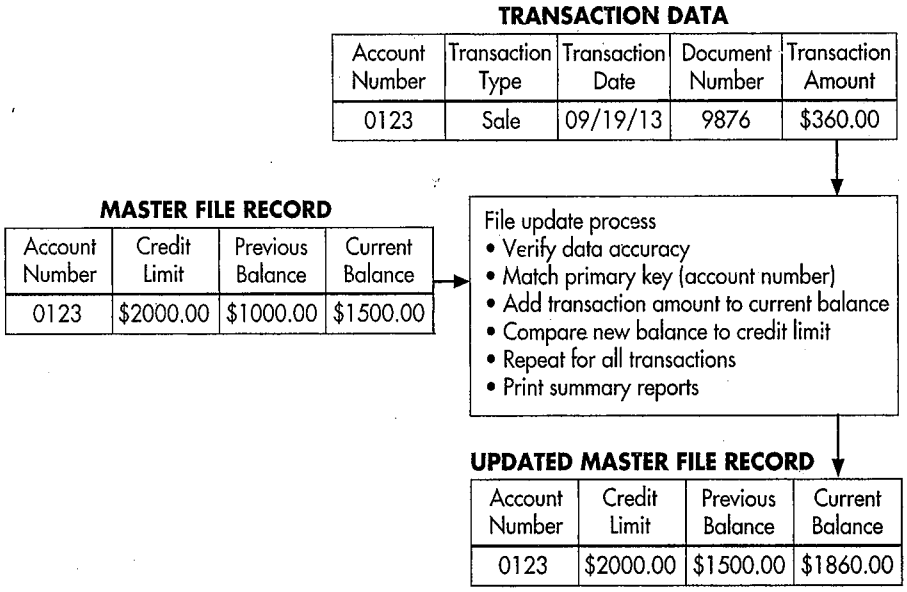
Once business activity data have been entered into the system, they must be processed to keep the databases current. The four different types of data processing activities, referred to as CRUD, are as follows:

1. ***Creating*** new data records, such as adding a newly hired employee to the payroll database.
2. ***Reading,*** retrieving, or viewing existing data.
3. ***Updating*** previously stored data. Figure 2-4 depicts the steps required to update an accounts receivable record with a sales transaction. The two records are matched using the account number. The sale amount ($360) is added to the account balance ($1,500) to get a new current balance ($1,860).
4. ***Deleting*** data, such as purging the vendor master file of all vendors the company no longer does business with.

Updating done periodically, such as daily, is referred to as ***batch processing***. Although batch processing is cheaper and more efficient, the data are current and accurate only immediately after processing. For that reason, batch processing is used only for applications, such as payroll, that do not need frequent updating and that naturally occur or are processed at fixed time periods.

Most companies update each transaction as it occurs, referred to as ***online, real-time processing*** because it ensures that stored information is always current, thereby increasing its decision-making usefulness. It is also more accurate because data input errors can be corrected in real time or refused. It also provides significant competitive advantages. For example, FedEx updated its mission statement to include the phrase "Positive control of each package will be maintained by

FIGURE 2-4
The Accounts Receivable File Update Process



utilizing real-time electronic tracking and tracing systems." With FedEx's system, employees and customers can track the exact location of each package and estimate its arrival time.

A combination of the two approaches is online batch processing, where transaction data are entered and edited as they occur and stored for later processing. Batch processing and online, real-time processing are summarized in Figure 2-5.

Information Output

The final step in the data processing cycle is information output. When displayed on a monitor, output is referred to as "soft copy." When printed on paper, it is referred to as "hard copy." Information is usually presented in one of three forms: a document, a report, or a query response.

Documents are records of transaction or other company data. Some, such as checks and invoices, are transmitted to external parties. Others, such as receiving reports and purchase requisitions, are used internally. Documents can be printed out, or they can be stored as electronic images in a computer. For example, Toys 'R' Us uses electronic data interchange to communicate with its suppliers. Every year it processes over half a million invoices electronically, thereby eliminating paper documents and dramatically reducing costs and errors. This has resulted in higher profits and more accurate information.

Reports are used by employees to control operational activities and by managers to make decisions and to formulate business strategies. External users need reports to evaluate company profitability, judge creditworthiness, or comply with regulatory requirements. Some reports, such as financial statements and sales analyses, are produced on a regular basis. Others are produced on an exception basis to call attention to unusual conditions. For example, S&S could have its system produce a report to indicate when product returns exceed a certain percentage of sales. Reports can also be produced on demand. For example, Susan could produce a report to identify the salesperson who sold the most items during a specific promotional period.

The need for reports should be periodically assessed, because they are often prepared long after they are needed, wasting time, money, and resources. For example, NCR Corporation reduced the number of reports from 1,200 to just over 100. Another company eliminated 6 million pages of reports, a stack four times higher than its 41-story headquarters building. One 25-page report took five days to prepare and sat unread.

A database *query* is used to provide the information needed to deal with problems and questions that need rapid action or answers. A user enters a request for a specific piece of information; it is retrieved, displayed, or analyzed as requested. Repetitive queries are often developed by information systems specialists. One-time queries are often developed by users. Some companies, such as Wal-Mart, allow suppliers to access their databases to help them better serve Wal-Mart's needs. Suppliers can gauge how well a product is selling in every Wal-Mart store in the world and maximize sales by stocking and promoting items that are selling well.

Additional information about system output is contained in Chapters 12 to 16.

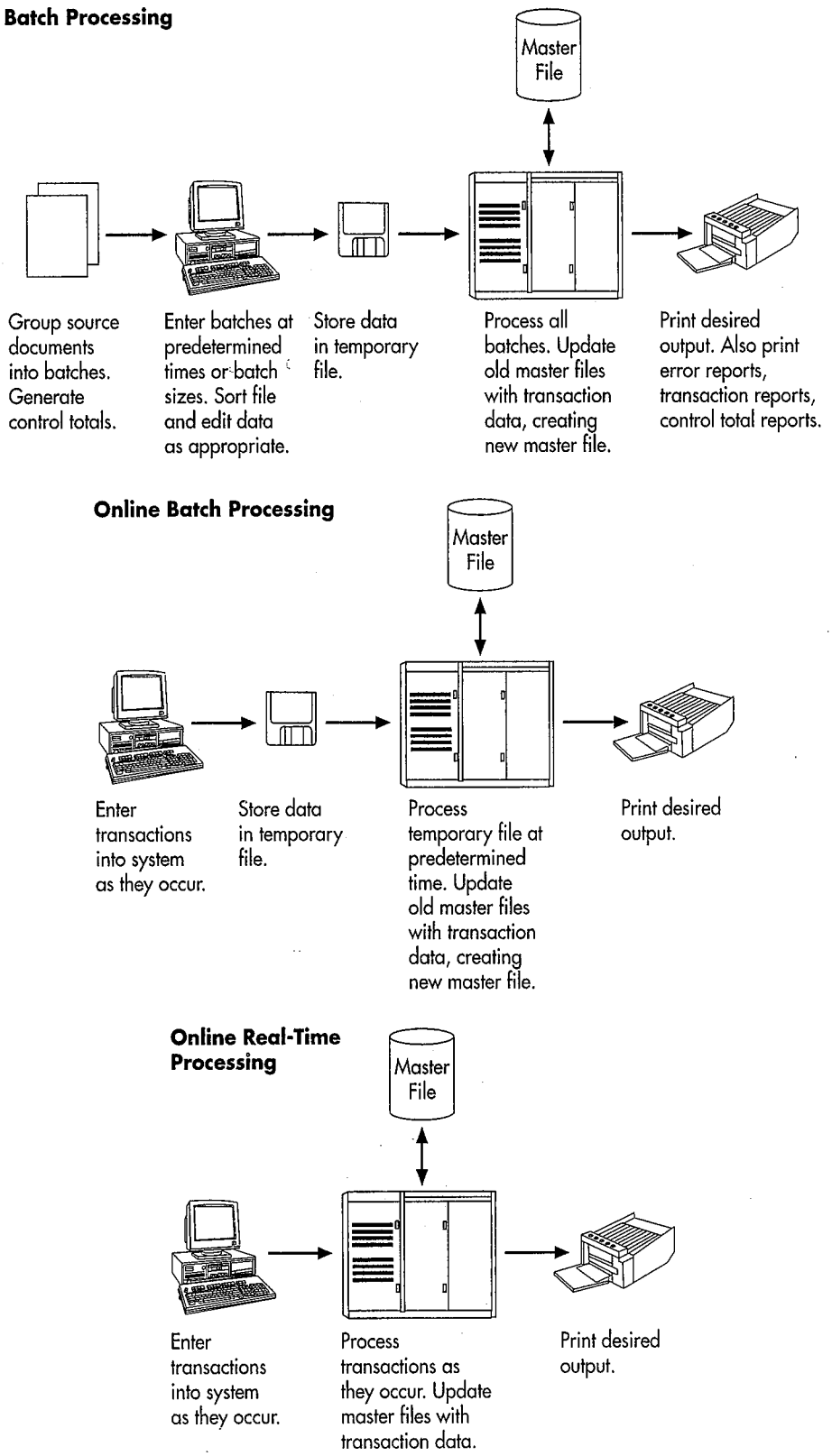


FIGURE 2-5
Batch and Online Processing

Enterprise Resource Planning (ERP) Systems

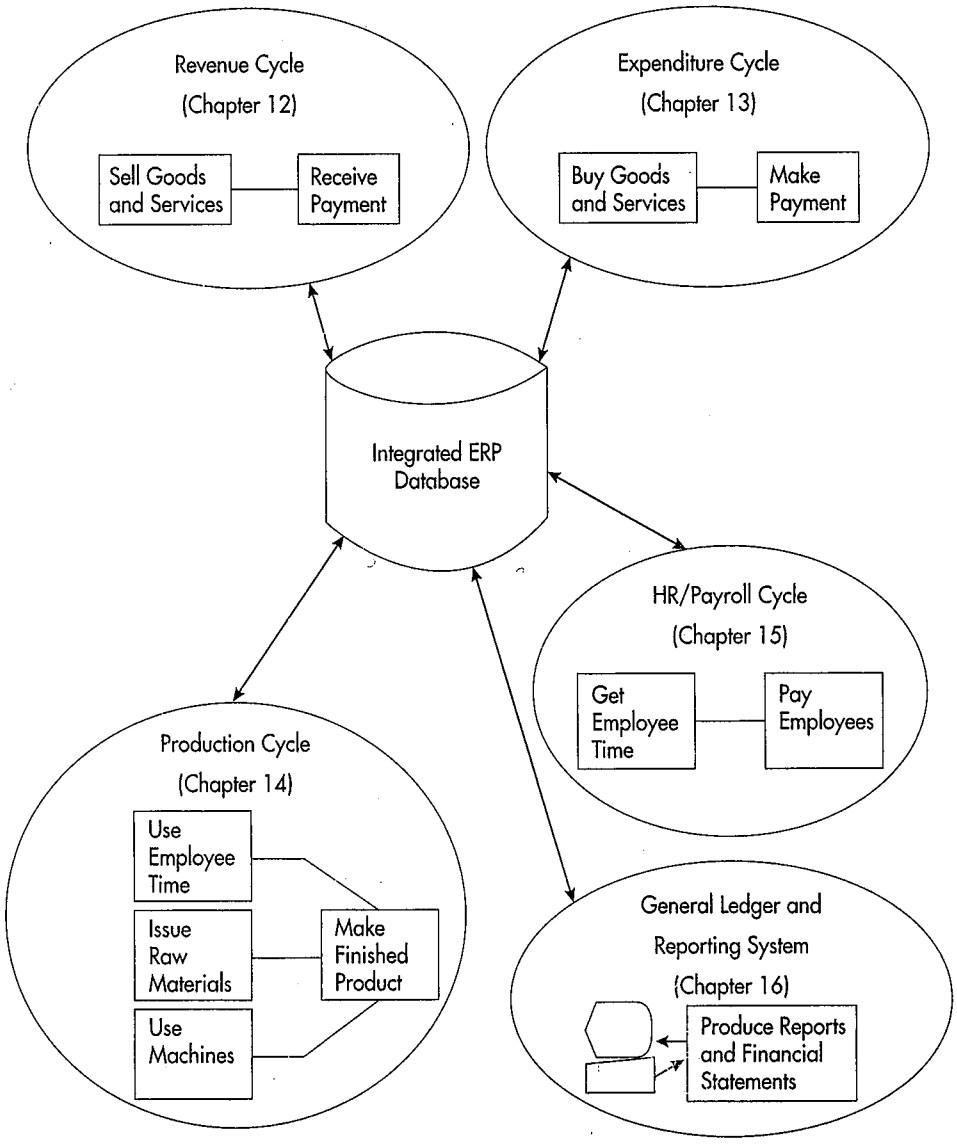
Traditionally, the AIS has been referred to as a transaction processing system because its only concern was financial data and accounting transactions. For example, when a sale took place, the AIS would record a journal entry showing only the date of the sale, a debit to either cash or accounts receivable, and a credit to sales. Other potentially useful nonfinancial information about the sale, such as the time of day that it occurred, would traditionally be collected and

processed outside the AIS. Consequently, many organizations developed additional information systems to collect, process, store, and report information not contained in the AIS. Unfortunately, the existence of multiple systems creates numerous problems and inefficiencies. Often the same data must be captured and stored by more than one system, which not only results in redundancy across systems but also can lead to discrepancies if data are changed in one system but not in others. In addition, it is difficult to integrate data from the various systems.

Enterprise resource planning (ERP) systems overcome these problems as they integrate all aspects of a company's operations with a traditional AIS. Most large and many medium-sized organizations use ERP systems to coordinate and manage their data, business processes, and resources. The ERP system collects, processes, and stores data and provides the information managers and external parties need to assess the company.

As shown in Figure 2-6, a properly configured ERP system uses a centralized database to share information across business processes and coordinate activities. This is important because an activity that is part of one business process often triggers a complex series of activities throughout many different parts of the organization. For example, a customer order may necessitate scheduling additional production to meet the increased demand. This may trigger an order to purchase more raw materials. It may also be necessary to schedule overtime or hire temporary help. Well-designed ERP systems provide management with easy access to up-to-date information about all of these activities in order to plan, control, and evaluate the organization's business processes more effectively.

FIGURE 2-6
Integrated ERP System



ERP systems are modular, with each module using best business practices to automate a standard business process. This modular design allows businesses to add or delete modules as needed. Typical ERP modules include:

- Financial (general ledger and reporting system)—general ledger, accounts receivable, accounts payable, fixed assets, budgeting, cash management, and preparation of managerial reports and financial statements
- Human resources and payroll—human resources, payroll, employee benefits, training, time and attendance, benefits, and government reporting
- Order to cash (revenue cycle)—sales order entry, shipping, inventory, cash receipts, commission calculation
- Purchase to pay (disbursement cycle)—purchasing, receipt and inspection of inventory, inventory and warehouse management, and cash disbursements
- Manufacturing (production cycle)— engineering, production scheduling, bill of materials, work-in-process, workflow management, quality control, cost management, and manufacturing processes and projects
- Project management—costing, billing, time and expense, performance units, activity management
- Customer relationship management—sales and marketing, commissions, service, customer contact, and call center support
- System tools—tools for establishing master file data, specifying flow of information, access controls, and so on

An ERP system, with its centralized database, provides significant advantages:

- An ERP provides an integrated, enterprise-wide, single view of the organization's data and financial situation. Storing all corporate information in a single database breaks down barriers between departments and streamlines the flow of information.
- Data input is captured or keyed once, rather than multiple times, as it is entered into different systems. Downloading data from one system to another is no longer needed.
- Management gains greater visibility into every area of the enterprise and greater monitoring capabilities. Employees are more productive and efficient because they can quickly gather data from both inside and outside their own department.
- The organization gains better access control. An ERP can consolidate multiple permissions and security models into a single data access structure.
- Procedures and reports are standardized across business units. This standardization can be especially valuable with mergers and acquisitions because an ERP system can replace the different systems with a single, unified system.
- Customer service improves because employees can quickly access orders, available inventory, shipping information, and past customer transaction details.
- Manufacturing plants receive new orders in real time, and the automation of manufacturing processes leads to increased productivity.

ERP systems also have significant disadvantages:

- Cost. ERP hardware, software, and consulting costs range from $50 to $500 million for a Fortune 500 company and upgrades can cost $50 million to $100 million. Midsized companies spend between $10 and $20 million.
- Amount of time required. It can take years to select and fully implement an ERP system, depending on business size, number of modules to be implemented, degree of customization, the scope of the change, and how well the customer takes ownership of the project. As a result, ERP implementations have a very high risk of project failure.
- Changes to business processes. Unless a company wants to spend time and money customizing modules, they must adapt to standardized business processes as opposed to adapting the ERP package to existing company processes. The failure to map current business processes to existing ERP software is a main cause of ERP project failures.
- Complexity. This comes from integrating many different business activities and systems, each having different processes, business rules, data semantics, authorization hierarchies, and decision centers.

- Resistance. Organizations that have multiple departments with separate resources, missions, profit and loss, and chains of command may believe that a single system has few benefits. It also takes considerable training and experience to use an ERP system effectively, and employee resistance is a major reason why many ERP implementations do not succeed. It is not easy to convince employees to change how they do their jobs, train them in new procedures, master the new system, and persuade them to share sensitive information. Resistance, and the blurring of company boundaries, can cause problems with employee morale, accountability, and lines of responsibility.

Reaping the potential benefits of ERP systems and mitigating their disadvantages requires conscious effort and involvement by top management. Top management's commitment to and support for the necessary changes greatly increase the chances of success.

Because ERP systems are complex and expensive, choosing one is not an easy task. In doing so, you must take great care to ensure that the ERP system has a module for every critical company process and that you are not paying for software modules that you do not need. One way to choose a suitable system is to select a package designed for your industry. Although cost is a huge concern, buying too cheaply can cost more in the long run if the system does not meet your needs, because modification costs can be quite high. You can minimize the risk of buying the wrong package by researching the best ERP vendors. There are many ERP vendors, the two largest being SAP and Oracle. Other leading vendors are The Sage Group, Microsoft, and Infor.

Because it is too difficult for most companies to implement ERP software by themselves, they often hire an ERP vendor or a consulting company to do it for them. These firms usually provide three types of services: consulting, customization, and support. For most midsized companies, implementation costs range from the list price of the ERP user licenses to twice that amount. Large companies with multiple sites often spend three to five times the cost of the user license.

Because many processes automatically trigger additional actions in other modules, proper configuration is essential. This requires a sound understanding of all major business processes and their interactions so they can be defined. Examples include setting up cost/profit centers, credit approval policies, and purchase approval rules. In the configuration process, companies balance the way they want the system to operate with the way it lets them operate. If the way an ERP module operates is unacceptable, the company can modify the module. Alternatively, it can use an existing system and build interfaces between it and the ERP system. Both options are time consuming, costly, and result in fewer system integration benefits. In addition, the more customized a system becomes, the more difficult it is to communicate with suppliers and customers. To make configuration easier, ERP vendors are developing built-in "configuration" tools to address most customers' needs for system changes.

The importance of sound internal controls in an ERP cannot be overstated. The integrated nature of ERP systems means that unless every data item is validated and checked for accuracy at the time of initial entry, errors will automatically propagate throughout the system. Thus, data entry controls and access controls are essential. Most managers and employees see and have access to only a small portion of the system. This segregation of duties provides sound internal control. It is important to separate responsibility for custody of assets, authorization of activities that affect those assets, and recording information about activities and the status of organizational assets.

Summary and Case Conclusion

Ashton is aware that Scott and Susan plan to open additional stores in the near future and want to develop a Web site to conduct business over the Internet. Based on this information, Ashton will select an accounting package that will satisfy S&S's current and anticipated future needs. The software should be able to take care of all data processing and data storage tasks. Ashton will also make sure that the software can interface with the source data automation devices he wants to use to capture most data input. The software must be capable of producing a full set of financial reports and be flexible enough to produce other useful information the company will need to be successful. Finally, Ashton realized his next step would be to select the software and produce some documentation of how the system worked.

Key Terms

data processing cycle 46
source documents 47
turnaround documents 47
source data automation 47
general ledger 48
subsidiary ledger 48
control account 48
coding 48
sequence code 48
block code 48
group code 48
mnemonic code 49
chart of accounts 49
general journal 51
specialized journal 51
audit trail 51
entity 51
attribute 51
field 52
record 52
data value 52
file 52
master file 52
transaction file 53
database 53
batch processing 53
online, real-time processing 53
document 54
report 54
query 54
enterprise resource planning (ERP) system 56

AIS IN ACTION

Chapter Quiz

1. Which of the following is NOT a step in the data processing cycle?
   a. data collection
   b. data input
   c. data storage
   d. data processing

2. All of the information (name, GPA, major, etc.) about a particular student is stored in the same _____.
   a. file b. record c. attribute d. field

3. Which of the following would contain the total value of all inventory owned by an organization?
   a. source document
   b. general ledger
   c. cash budget

4. Which of the following is most likely to be a general ledger control account?
   a. accounts receivable
   b. petty cash
   c. prepaid rent
   d. retained earnings

5. Which of the following documents is most likely to be used in the expenditure cycle?
   a. sales orders
   b. credit memo
   c. receiving report
   d. job time ticket

6. Which of the following is LEAST likely to be a specialized journal?
   a. sales journal
   b. cash receipts journal
   c. prepaid insurance journal
   d. cash disbursements journal

7. How does the chart of accounts list general ledger accounts?
   a. alphabetical order
   b. chronological order
   c. size order
   d. the order in which they appear in financial statements

8. Which of the following is NOT an advantage of an ERP system?
   a. better access control
   b. standardization of procedures and reports
   c. improved monitoring capabilities
   d. simplicity and reduced costs

9. Records of company data sent to an external party and then returned to the system as input are called _____.
   a. turnaround documents
   b. source data automation documents
   c. source documents
   d. external input documents

10. Recording and processing information about a transaction at the time it takes place is referred to as which of the following?
    a. batch processing
    b. online, real-time processing
    c. captured transaction processing
    d. chart of accounts processing

Discussion Questions

2.1. Table 2-1 lists some of the documents used in the revenue, expenditure, and human resources cycle. What kinds of input or output documents or forms would you find in the production (also referred to as the conversion) cycle?

2.2. With respect to the data processing cycle, explain the phrase "garbage in, garbage out." How can you prevent this from happening?

2.3. What kinds of documents are most likely to be turnaround documents? Do an Internet search to find the answer and to find example turnaround documents.

2.4. The data processing cycle in Figure 2-1 is an example of a basic process found throughout nature. Relate the basic input/process/store/output model to the functions of the human body.

2.5. Some individuals argue that accountants should focus on producing financial statements and leave the design and production of managerial reports to information systems specialists. What are the advantages and disadvantages of following this advice? To what extent should accountants be involved in producing reports that include more than just financial measures of performance? Why?

Problems

2.1. The chart of accounts must be tailored to an organization's specific needs. Discuss how the chart of accounts for the following organizations would differ from the one presented for S&S in Table 2-2.
    a. university
    b. bank
    c. government unit (city or state)
    d. manufacturing company
    e. expansion of S&S to a chain of two stores

2.2. Ollie Mace is the controller of SDC, an automotive parts manufacturing firm. Its four major operating divisions are heat treating, extruding, small parts stamping, and machining. Last year's sales from each division ranged from $150,000 to $3,000,000. Each division is physically and managerially independent, except for the constant surveillance of Sam Dilley, the firm's founder.

The AIS for each division evolved according to the needs and abilities of its accounting staff. Mace is the first controller to have responsibility for overall financial management. Dilley wants Mace to improve the AIS before he retires in a few years so that it will be easier to monitor division performance. Mace decides to redesign the financial reporting system to include the following features:

- It should give managers uniform, timely, and accurate reports of business activity. Monthly reports should be uniform across divisions and be completed by the fifth day of the following month to provide enough time to take corrective actions to affect the next month's performance. Company-wide financial reports should be available at the same time.
- Reports should provide a basis for measuring the return on investment for each division. Thus, in addition to revenue and expense accounts, reports should show assets assigned to each division.

- The system should generate meaningful budget data for planning and decision-making purposes. Budgets should reflect managerial responsibility and show costs for major product groups.

Mace believes that a new chart of accounts is required to accomplish these goals. He wants to divide asset accounts into six major categories, such as current assets and plant and equipment. He does not foresee a need for more than 10 control accounts within each of these categories. From his observations to date, 100 subsidiary accounts are more than adequate for each control account.

No division has more than five major product groups. Mace foresees a maximum of six cost centers within any product group, including both the operating and nonoperating groups. He views general divisional costs as a non-revenue-producing product group. Mace estimates that 44 expense accounts plus 12 specific variance accounts would be adequate.

Required

Design a chart of accounts for SDC. Explain how you structured the chart of accounts to meet the company's needs and operating characteristics. Keep total account code length to a minimum, while still satisfying all of Mace's desires. *(CMA Examination, adapted)*

2.3. An audit trail enables a person to trace a source document to its ultimate effect on the financial statements or work back from financial statement amounts to source documents. Describe in detail the audit trail for the following:
a. Purchases of inventory
b. Sales of inventory
c. Employee payroll

2.4. Your nursery sells various types and sizes of trees, bedding plants, vegetable plants, and shrubs. It also sells fertilizer and potting soil. Design a coding scheme for your nursery.

2.5. Match the following terms with their definitions.

Term	Definition
___ a. data processing cycle	1. Contains summary-level data for every asset, liability, equity, revenue, and expense account
___ b. source documents	2. Items are numbered consecutively to account for all items; missing items cause a gap in the numerical sequence
___ c. turnaround documents	3. Path of a transaction through a data processing system from point of origin to final output, or backwards from final output to point of origin
___ d. source data automation	4. List of general ledger account numbers; allows transaction data to be coded, classified, and entered into proper accounts; facilitates preparation of financial statements and reports
___ e. general ledger	5. Contents of a specific field, such as "George" in a name field
___ f. subsidiary ledger	6. Portion of a data record that contains the data value for a particular attribute, like a cell in a spreadsheet
___ g. control account	7. Company data sent to an external party and then returned to the system as input
___ h. coding	8. Used to record infrequent or nonroutine transactions

____ i. sequence code	9. Characteristics of interest that need to be stored
____ j. block code	10. The steps a company must follow to efficiently and effectively process data about its transactions
____ k. group code	11. Something about which information is stored
____ l. mnemonic code	12. Stores cumulative information about an organization; like a ledger in a manual AIS
____ m. chart of accounts	13. Contains detailed data for any general ledger account with many individual subaccounts
____ n. general journal	14. Contains records of individual business transactions that occur during a specific time period
____ o. specialized journal	15. Updating each transaction as it occurs
____ p. audit trail	16. Devices that capture transaction data in machine-readable form at the time and place of their origin
____ q. entity	17. Used to record large numbers of repetitive transactions
____ r. attribute	18. Set of interrelated, centrally coordinated files
____ s. field	19. Two or more subgroups of digits are used to code items
____ t. record	20. Updating done periodically, such as daily
____ u. data value	21. Systematic assignment of numbers or letters to items to classify and organize them
____ v. master file	22. Letters and numbers, derived from the item description, are interspersed to identify items; usually easy to memorize
____ w. transaction file	23. Initial record of a transaction that takes place; usually recorded on preprinted forms or formattted screens
____ x. database	24. Fields containing data about entity attributes; like a row in a spreadsheet
____ y. batch processing	25. Sets of numbers are reserved for specific categories of data
____ z. online, real-time processing	26. The general ledger account corresponding to a subsidiary ledger, where the sum of all subsidiary ledger entries should equal the amount in the general ledger account

2.6. For each of the following scenarios, identify which data processing method (batch or online, real-time) would be the most appropriate.

a. Make an airline reservation
b. Register for a university course
c. Prepare biweekly payroll checks
d. Process an order through an e-commerce Web site
e. Prepare a daily bank deposit
f. Preparation of customer bills by a local utility
g. Accumulate daily costs from a production run of a single automobile part
h. Identify the replacement drill bit size for a bit broken during a recent production run



2.7. On the following Web sites, you will find several online demonstrations for the SAP and Oracle ERP systems. Visit these Web sites and explore their content by doing the following:
   a. The SAP Web site is www.sap.com/solutions. Search the site for corporate videos, and watch two of them. Explore the industries, services, solutions, and platforms that SAP offers. Read several of the articles, such as the ones about customer successes.
   b. The Oracle Web site is www.oracle.com/solutions/mid/demo.html. Explore the Web site just as you explored the SAP site.

Required

After viewing the Web sites, and based on your reading of the chapter, write a two-page paper that describes how an ERP can connect and integrate the revenue, expenditure, human resources/payroll, and financing cycles of a business.

2.8. Which of the following actions update a master file and which would be stored as a record in a transaction file?
   a. Update customer address change
   b. Update unit pricing information
   c. Record daily sales
   d. Record payroll checks
   e. Change employee pay rates
   f. Record production variances
   g. Record sales commissions
   h. Change employee office location
   i. Update accounts payable balance
   j. Change customer credit limit
   k. Change vendor payment discount terms
   l. Record purchases

2.9. You were hired to assist Ashton Fleming in designing an accounting system for S&S. Ashton has developed a list of the journals, ledgers, reports, and documents that he thinks S&S needs (see Table 2-4). He asks you to complete the following tasks:
   a. Specify what data you think should be collected on each of the following four documents: sales invoice, purchase order, receiving report, employee time card.

TABLE 2-4 Documents, Journals, and Ledgers for S&S

Title	Purpose
Documents	
Sales Invoice	Record cash and credit sales of merchandise
Service Invoice	Record sales of repair services
Delivery Ticket	Record delivery of merchandise to customers
Monthly Statement	Inform customers of outstanding account balances
Credit Memo	Support adjustments to customer accounts for sales returns and allowances and sales discounts; also support write-off of uncollectible accounts
Purchase Order	Order merchandise from vendors
Receiving Report	Record receipt of merchandise from vendors, indicating both quantity and condition of items received
Time Card	Record time worked by employees
Specialized Journals	
Sales	Record all credit sales
Cash Receipts	Record cash sales, payments from customers, and other cash receipts
Purchases	Record all purchases from vendors
Cash Disbursements	Record all cash disbursements
General Journal	Record infrequent, nonroutine transactions; also record adjusting and closing entries
Subsidiary Ledgers	
Accounts Receivable	Maintain details about amounts due from customers
Accounts Payable	Maintain details about amounts due to vendors
Inventory	Maintain details about each inventory item
Fixed Assets	Maintain details about each piece of equipment and other fixed assets
General Ledger	Maintain details about all major asset, liability, equity, revenue, and expense accounts

b. Design a report to manage inventory.
c. Design a report to assist in managing credit sales and cash collections.
d. Visit a local office supply store and identify what types of journals, ledgers, and blank forms for various documents (sales invoices, purchase orders, etc.) are available. Describe how easily they could be adapted to meet S&S's needs.

Case 2-1 Bar Harbor Blueberry Farm

The Bar Harbor Blueberry Farm is a family-owned, 200-acre farm that grows and sells blueberries to grocery stores, blueberry wholesalers, and small roadside stands. Bar Harbor has 25 full-time employees and hires 150 to 200 seasonal workers for the harvest.

For the past six summers, you have picked berries for Bar Harbor. When you graduated, you were hired full-time as the accountant/office manager. Until now, Bar Harbor kept most of its accounting records in a big file box. Jack Phillips, the owner, would like a more organized approach to the farm's accounting records. He asked you to establish a proper set of books. You decide to start by establishing appropriate journals and ledgers for these transactions.

Presented below are a set of vendor invoices and a few partially completed journals and ledgers. Your job is to record these transactions and update the appropriate ledgers. Be sure to leave a proper audit trail. You may also use Excel, Great Plains, Peachtree, QuickBooks, or another accounting software package of your choosing to complete this problem.

Vendor Invoices

Date	Supplier Invoice	Supplier Name	Supplier Address	Amount
March 7	AJ34	Bud's Soil Prep	PO Box 34	$2,067.85
March 11	14568	Osto Farmers Supply	45 Main	$ 67.50
March 14	893V	Whalers Fertilizer	Route 34	$5,000.00
March 21	14699	Osto Farmers Supply	45 Main	$3,450.37
March 21	10102	IFM Wholesale	587 Longview	$4,005.00
March 24	10145	IFM Wholesale	587 Longview	$ 267.88

Purchases Journal

Page 1

Date	Supplier	Supplier Invoice	Account Number	Post Ref	Amount
March 7	Bud's Soil Prep	AJ34			$2,067.85

General Ledger

Accounts Payable — Account Number: 300

Date	Description	Post Ref	Debit	Credit	Balance
March 1	Balance Forward				$18,735.55

General Ledger

Purchases — Account Number: 605

Date	Description	Post Ref	Debit	Credit	Balance
March 1	Balance Forward				$54,688.49

Accounts Payable Subsidiary Ledger

Account No: 23 — Bud's Soil Prep — PO Box 34 — Terms: 2/10, Net 30

Date	Description	Debit	Credit	Balance

Account No: 24 — Terms: 2/10, Net 30

Date	Description	Debit	Credit	Balance

Account No: 36 — Terms: 2/10, Net 30

Date	Description	Debit	Credit	Balance

Account No: 38 — Terms: 2/10, Net 30

Date	Description	Debit	Credit	Balance

AIS IN ACTION SOLUTIONS

Quiz Key

1. Which of the following is NOT a step in the data processing cycle?
   ▶ a. data collection [Correct. Data collection is a part of data input and is therefore not a step in the data processing cycle.]
   b. data input [Incorrect. Data input is the first step in the data processing cycle. This is the step where data is captured, collected, and entered into the system.]
   c. data storage [Incorrect. Data storage is the data processing cycle step where data is stored for future use by the company.]
   d. data processing [Incorrect. Data processing is the data processing cycle step where stored data is updated with new input data.]

2. All of the information (name, GPA, major, etc.) about a particular student is stored in the same _____.
   a. file [Incorrect. A file is designed to include information about many students.]
   ▶ b. record [Correct. A record should include all information maintained by the system about a particular entity, such as a student.]
   c. attribute [Incorrect. An attribute is a descriptor or a characteristic of an entity—in this example, the student's major is an attribute.]
   d. field [Incorrect. A field represents a data storage space—in this example, an accounting student would have "Accounting" stored in the major field.]

3. Which of the following would contain the total value of all inventory owned by an organization?
   a. source document [Incorrect. A source document contains data about a particular event or transaction.]
   ▶ b. general ledger [Correct. The general ledger maintains summary information on inventory and every other general ledger account.]
   c. cash budget [Incorrect. A cash budget provides information only on projected cash inflows and outflows.]

4. Which of the following is most likely to be a general ledger control account?
   ▶ a. accounts receivable [Correct. Accounts receivable is typically made up of many individual customer accounts maintained in a subsidiary ledger. The total of all individual customer accounts in the subsidiary ledger is maintained in the accounts receivable control account in the general ledger.]
   b. petty cash [Incorrect. Petty cash is made up of only one account.]
   c. prepaid rent [Incorrect. A subsidiary ledger containing multiple prepaid rent accounts is usually not necessary.]
   d. retained earnings [Incorrect. Retained earnings is typically comprised of only one account.]

5. Which of the following documents is most likely to be used in the expenditure cycle?
   a. sales order [Incorrect. The sales order is a revenue cycle document that captures the information about a customer's order.]
   b. credit memo [Incorrect. A credit memo is a revenue cycle document that is used to give a credit to a customer for damaged or returned goods.]
   ▶ c. receiving report [Correct. A receiving report is an expenditure cycle document that is used to record the receipt of goods from suppliers. Companies pay their suppliers based on the goods received and recorded on the receiving report.]
   d. job time ticket [Incorrect. A job time ticket is a production cycle document that is used to record time spent on specific jobs.]

6. Which of the following is LEAST likely to be a specialized journal?
   a. sales journal [Incorrect. A specialized journal is used to record large numbers of repetitive transactions. Most companies have a large number of sales.]
   b. cash receipts journal [Incorrect. A specialized journal is used to record large numbers of repetitive transactions. Most companies have a large number of cash receipts.]
   ▶ c. prepaid insurance journal [Correct. A specialized journal is used to record large numbers of repetitive transactions, and most companies have very few prepaid insurance transactions.]
   d. cash disbursements journal [Incorrect. A specialized journal is used to record large numbers of repetitive transactions. Most companies have a large number of cash disbursements.]

7. How does the chart of accounts list general ledger accounts?
   a. alphabetical order [Incorrect. General ledger accounts are listed in the order in which they appear in the financial statements, not in alphabetical order.]
   b. chronological order [Incorrect. General ledger accounts are listed in the order in which they appear in the financial statements, not according to the date they were created.]
   c. size order [Incorrect. General ledger accounts are listed in the order in which they appear in the financial statements, not according to their size.]
   ▶ d. the order in which they appear in financial statements [Correct.]

8. Which of the following is NOT an advantage of an ERP system?
   a. better access control [Incorrect. Better access control is an advantage because an ERP can consolidate multiple permissions and security models into a single data access structure.]
   b. standardization of procedures and reports [Incorrect. Standardization of procedures and reports is an advantage because procedures and reports can be standardized across business units and in mergers and acquisitions they can replace the different systems with a single, unified system.]
   c. improved monitoring capabilities [Incorrect. Improved monitoring capabilities are an advantage because management gains greater visibility into every area of the enterprise that allows them to better monitor the organization.]
   ▶ d. simplicity and reduced costs [Correct. ERP systems are quite complex and costly; they do not offer the advantages of simplicity and reduced costs.]

9. Records of company data sent to an external party and then returned to the system as input are called _____.
   ▶ a. turnaround documents [Correct. For example, a utility bill is sent to a customer, who then returns the bill with payment.]
   b. source data automation documents [Incorrect. Source data automation is the capturing of input data in machine-readable form.]
   c. source documents [Incorrect. Source documents collect data about business activities.]
   d. external input documents [Incorrect. These documents originate from external sources.]

10. Recording and processing information about a transaction at the time it takes place is referred to as which of the following?
   a. batch processing [Incorrect. Batch processing involves processing transactions in groups or batches all at the same time.]
   ▶ b. online, real-time processing [Correct. Online, real-time processing involves processing transactions as they occur.]
   c. captured transaction processing [Incorrect. This is not a recognized transaction processing method.]
   d. chart of accounts processing [Incorrect. The chart of accounts, although typically updated every so often, is not a transaction processing method.]

Chapter 3

Systems Documentation Techniques

Learning Objectives

After studying this chapter, you should be able to:

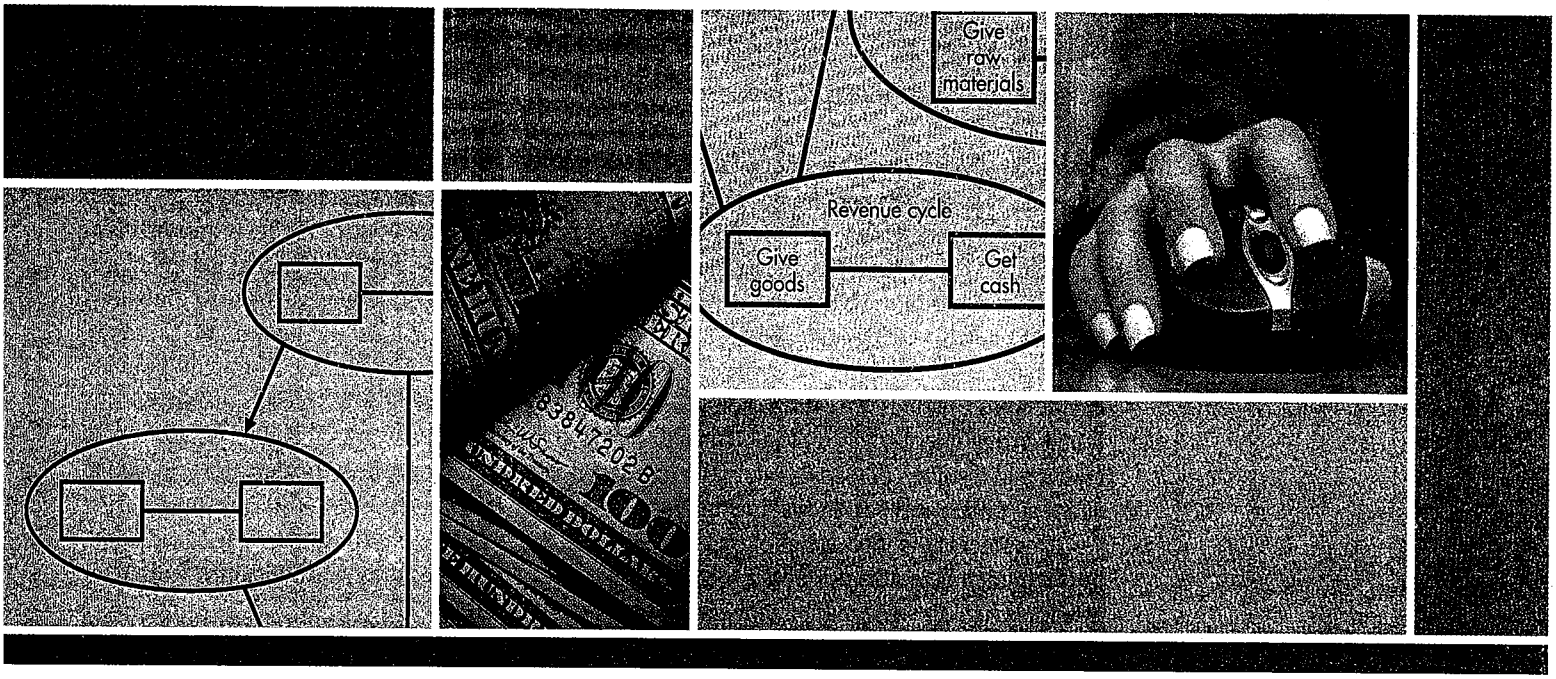
1. Prepare and use data flow diagrams to understand, evaluate, and document information systems.
2. Prepare and use flowcharts to understand, evaluate, and document information systems.

INTEGRATIVE CASE S&S

What a hectic few months it has been for Ashton Fleming! He helped S&S get started, helped get S&S through its weeklong grand opening, and was swamped with processing all the transactions from the highly successful grand opening. Because of its rapid growth, S&S has outgrown the initial rudimentary AIS that Ashton selected. Lacking time and expertise, Ashton has engaged Computer Applications (CA), a systems consulting firm, to help S&S select and install a new and more powerful AIS.

During Ashton's first meeting with Kimberly Sierra, CA's manager, she asked about S&S's system requirements and management's expectations. Ashton had yet to think through these issues, so he could not answer her specifically. When she asked how S&S's system worked, Ashton plunged into a discussion about the use of various company documents, but Kimberly seemed unable to absorb his detailed explanations. Ashton thought that part of his discussion was helpful, but overall it was irrelevant to the issue at hand.

Ashton came away impressed by CA and Kimberly. He also realized the need to understand S&S's information requirements more clearly. From his days as an auditor, Ashton knew the value of good system documentation in helping unfamiliar users both understand and evaluate a system. Good system documentation would be a big help to him and Kimberly, as well as to Scott and Susan as they evaluate the current and proposed systems.



After sharing his conclusions with Susan and Scott, they enthusiastically approved Ashton's plan to document the current and proposed systems. They supported his taking a leadership role in moving toward a new system and were especially interested in diagrams or charts that would document the existing system and help them understand and evaluate it.

Introduction

Documentation encompasses the narratives, flowcharts, diagrams, and other written materials that explain how a system works. This information covers the who, what, when, where, why, and how of data entry, processing, storage, information output, and system controls. Popular means of documenting a system include diagrams, flowcharts, tables, and other graphical representations of information. These are supplemented by a ***narrative description*** of the system, a written step-by-step explanation of system components and interactions. In this chapter, we explain two common systems documentation tools: data flow diagrams and flowcharts.

Documentation tools are important on the following levels:

1. At a minimum, you must be able to *read* documentation to determine how a system works.
2. You may need to *evaluate* internal control systems documentation to identify strengths and weaknesses and recommend improvements. Or, you may need to evaluate documentation for a proposed system to determine whether it meets the company's needs.
3. More skill is needed to *prepare* internal control documentation or documentation that shows how an existing or proposed system operates.

This chapter discusses the following documentation tools:

1. *Data flow diagram (DFD),* a graphical description of data sources, flows, processes, storage, and destinations
2. *Document flowchart,* a graphical description of the flow of documents and information between departments or areas of responsibility
3. *System flowchart,* a graphical description of the relationship among the input, processing, and output in an information system
4. *Program flowchart,* a graphical description of the sequence of logical operations a computer performs as it executes a program

Accountants use documentation techniques extensively. Auditing standards require that independent auditors understand the automated and manual internal control procedures an entity uses.

One good way to gain this understanding is to use flowcharts to document the internal control system, because such graphic portrayals more readily reveal weaknesses and strengths.

The Sarbanes-Oxley Act (SOX) of 2002 requires an internal control report in public company annual reports that (1) states that management is responsible for establishing and maintaining an adequate internal control structure and (2) assesses the effectiveness of the company's internal controls. SOX also specifies that a company's auditor must evaluate management's assessment of the company's internal control structures and attest to its accuracy. The auditor's attestation should include a specific notation about significant defects or material noncompliance found during internal control tests. This means that both the company and its auditors have to document and test the company's internal controls. To do so, they must be able to prepare, evaluate, and read different types of documentation, such as flowcharts.

Documentation tools are also used extensively in the systems development process. In addition, the team members who develop information systems applications often change, and documentation tools help the new team members get up to speed quickly.

According to one study, 62.5% of information systems professionals use DFDs and 97.6% use flowcharts. Over 92% of users were satisfied with the use of both DFDs and flowcharts and use both.

Documentation is easier to prepare and revise when a software package is used. Once a few basic commands are mastered, users can quickly and easily prepare, store, revise, and print presentation-quality documentation.

The documentation tools in this chapter are used throughout the book. They are also tested on professional examinations, and learning about them better prepares you for these examinations.

Data Flow Diagrams

A *data flow diagram (DFD)* graphically describes the flow of data within an organization. It uses the symbols shown in Figure 3-1 to represent four basic elements: data sources and destinations, data flows, transformation processes, and data stores. For example, Figure 3-2 shows that the input to process C is data flow B, which comes from data source A. The outputs of process C are data flows D and E. Data flow E is sent to data destination J. Process F uses data flows D and G as input and produces data flows I and G as output. Data flow G comes from and returns to data store H. Data flow I is sent to data destination K.

Figure 3-3 assigns specific titles to each of the processes depicted in Figure 3-2. Figures 3-2 and 3-3 will be used to examine the four basic elements of a DFD in more detail.

A ***data source*** and a ***data destination*** are entities that send or receive data that the system uses or produces. An entity can be both a source and a destination. They are represented by squares, as illustrated by items A (customer), J (bank), and K (credit manager) in Figure 3-3.

FIGURE 3-1
Data Flow Diagram Symbols

Symbol	Name	Explanation
	Data sources and destinations	The people and organizations that send data to and receive data from the system are represented by square boxes. Data destinations are also referred to as *data sinks*.
	Data flows	The flow of the data into or out of a process is represented by curved or straight lines with arrows.
	Transformation processes	The processes that transform data from inputs to outputs are represented by circles. They are often referred to as *bubbles*.
	Data stores	The storage of data is represented by two horizontal lines.

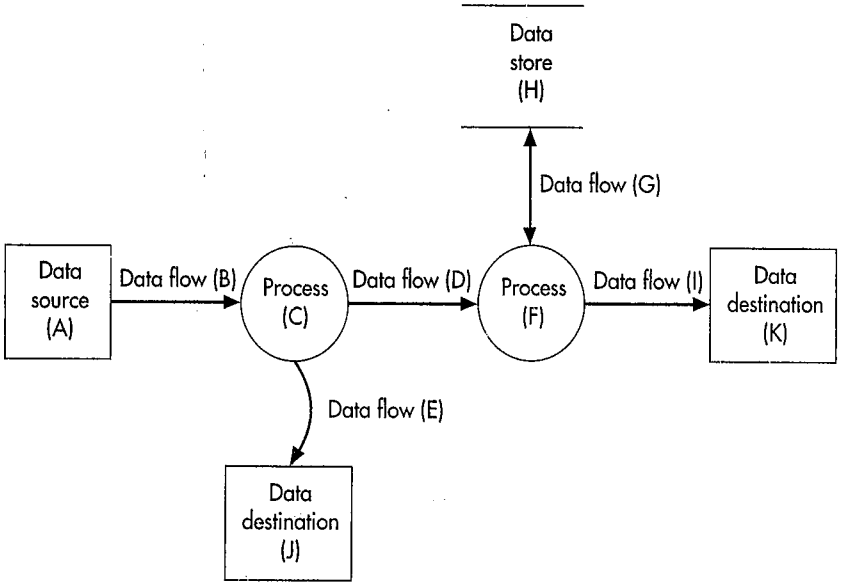


FIGURE 3-2
Basic Data Flow Diagram Elements

A ***data flow*** is the movement of data among processes, stores, sources and destinations. Data that pass between data stores and a source or destination must go through a data transformation process. Data flows are labeled to show what information is flowing. The only exception is data flow between a process and a data store, such as data flow G in Figure 3-3, because the data flow is usually obvious. In data flow G, data from the accounts receivable file is retrieved, updated, and stored back in the file. Other data flows in Figure 3-3 are B (customer payment), D (remittance data), E (deposit), and I (receivables information).

If two or more data flows move together, a single line is used. For example, data flow B (customer payment) consists of a payment and remittance data. Process 1.0 (process payment) splits them and sends them in different directions. The remittance data (D) is used to update accounts receivable records, and the payment (E) is deposited in the bank. If the data flow separately, two lines are used. For example, Figure 3-4 shows two lines because customer inquiries (L) do not always accompany a payment (B). If represented by the same data flow, the separate elements and their different purposes are obscured, and the DFD is more difficult to interpret.

Processes represent the transformation of data. Figure 3-3 shows that process payment (C) splits the customer payment into the remittance data and the check, which is deposited in the bank. The update receivables process (F) uses remittance (D) and accounts receivable (H) data to update receivable records and send receivables information to the credit manager.

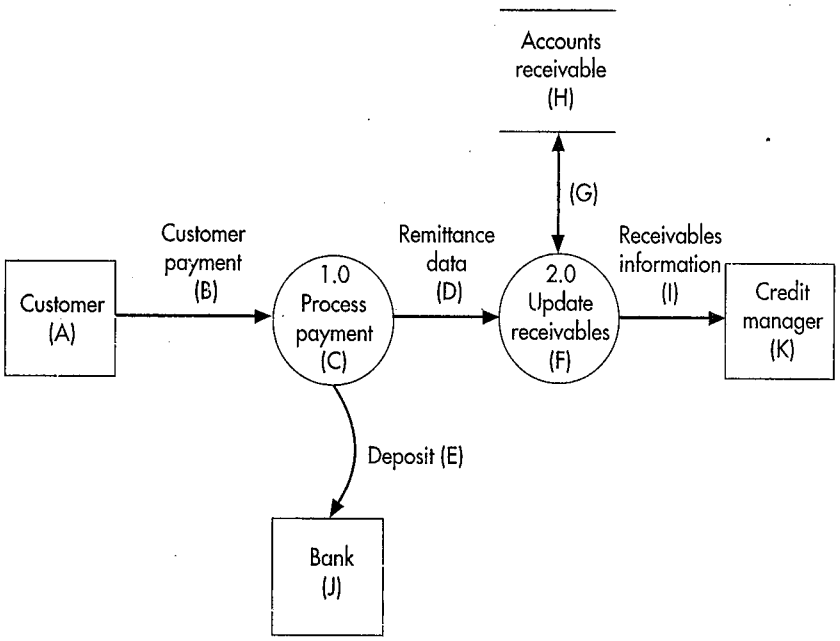
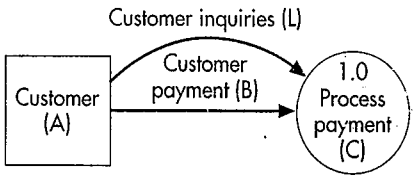


FIGURE 3-3
Data Flow Diagram of Customer Payment Process

FIGURE 3-4
Splitting Customer Payments and Inquiries



A *data store* is a repository of data. DFDs do not show the physical storage medium (such as a server or paper) used to store the data. As shown in Figure 3-3, data stores (H) are represented by horizontal lines, with the name of the file written inside the lines.

Subdividing the DFD

DFDs are subdivided into successively lower levels to provide ever-increasing amounts of detail, because few systems can be fully diagrammed on one sheet of paper. Also, users have differing needs, and a variety of levels can better satisfy differing requirements.

The highest-level DFD is referred to as a ***context diagram*** because it provides the reader with a summary-level view of a system. It depicts a data processing system and the entities that are the sources and destinations of system inputs and outputs. For example, Ashton drew Figure 3-5 to document payroll processing procedures at S&S. The payroll processing system receives time card data from different departments and employee data from human resources. The system processes these data and produces (1) tax reports and payments for governmental agencies, (2) employee paychecks, (3) a payroll check deposited in the payroll account at the bank, and (4) payroll information for management.

Ashton used the description of S&S's payroll processing procedures in Table 3-1 to decompose the context diagram into successively lower levels, each with an increasing amount of detail. Read this description and determine the following:

- How many major data processing activities are involved?
- What are the data inputs and outputs of each activity (ignoring all references to people, departments, and document destinations)?

The narrative in Table 3-1 describes five data processing activities:

1. Updating the employee/payroll master file (first paragraph).
2. Handling employee compensation (second, fifth, and sixth paragraphs). Later in this chapter, you will see a breakdown of this activity into smaller parts in a lower-level DFD.
3. Generating management reports (third paragraph).

FIGURE 3-5
Context Diagram for S&S Payroll Processing

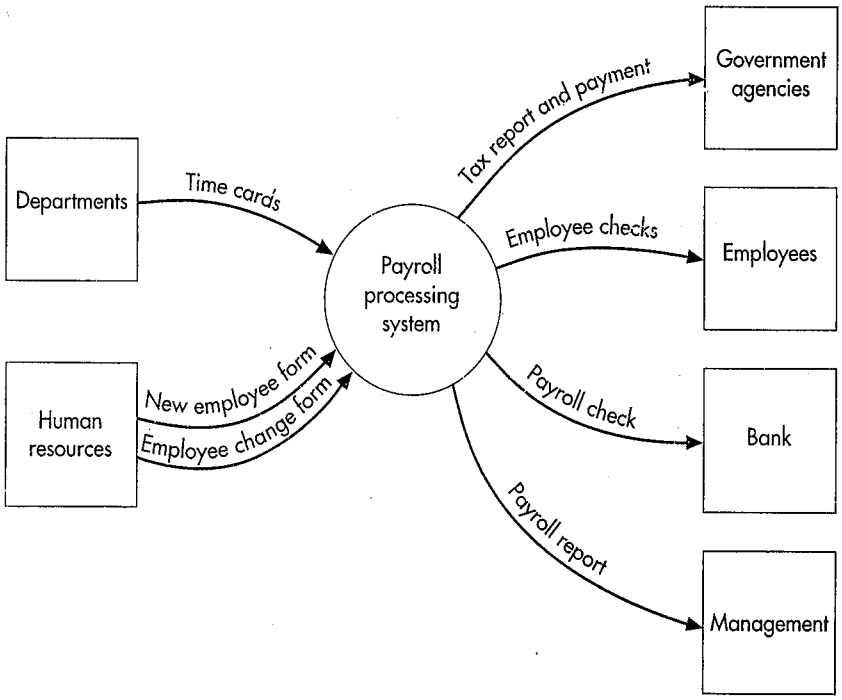


TABLE 3-1 Narrative Description of Payroll Processing at S&S

When employees are hired, they complete a new-employee form. When a change to an employee's payroll status occurs, such as a raise or a change in the number of exemptions, the human resources department completes an employee change form. A copy of these forms is sent to payroll. These forms are used to create or update the records in the employee/payroll file and are then stored in the file. Employee records are stored alphabetically.

Some S&S employees are paid a salary, but most are hourly workers who record their time on time cards. At the end of each pay period, department managers send the time cards to the payroll department. The payroll clerk uses the time card data, data from the employee file (such as pay rate and annual salary), and the appropriate tax tables to prepare a two-part check for each employee. The clerk also prepares a two-part payroll register showing gross pay, deductions, and net pay for each employee. The clerk updates the employee file to reflect each employee's current earnings. The original copy of the employee paychecks is forwarded to Susan. The payroll register is forwarded to the accounts payable clerk. The time cards and the duplicate copies of the payroll register and paychecks are stored by date in the payroll file.

Every pay period, the payroll clerk uses the data in the employee/payroll file to prepare a payroll summary report for Susan so that she can control and monitor labor expenses. This report is forwarded to Susan, with the original copies of the employee paychecks.

Every month, the payroll clerk uses the data in the employee/payroll file to prepare a two-part tax report. The original is forwarded to the accounts payable clerk, and the duplicate is added to the tax records in the payroll file. The accounts payable clerk uses the tax report to prepare a two-part check for taxes and a two-part cash disbursements voucher. The tax report and the original copy of each document are forwarded to Susan. The duplicates are stored by date in the accounts payable file.

The accounts payable clerk uses the payroll register to prepare a two-part check for the total amount of the employee payroll and a two-part disbursements voucher. The original copy of each document is forwarded to Susan, and the payroll register and the duplicates are stored by date in the accounts payable file.

Susan reviews each packet of information she receives, approves it, and signs the checks. She forwards the cash disbursements vouchers to Ashton, the tax reports and payments to the appropriate governmental agency, the payroll check to the bank, and the employee checks to the employees. She files the payroll report chronologically.

Ashton uses the payroll tax and the payroll check cash disbursement vouchers to update the general ledger. He then cancels the journal voucher by marking it "posted" and files it numerically.

4. Paying taxes (fourth paragraph).
5. Posting entries to the general ledger (last paragraph).

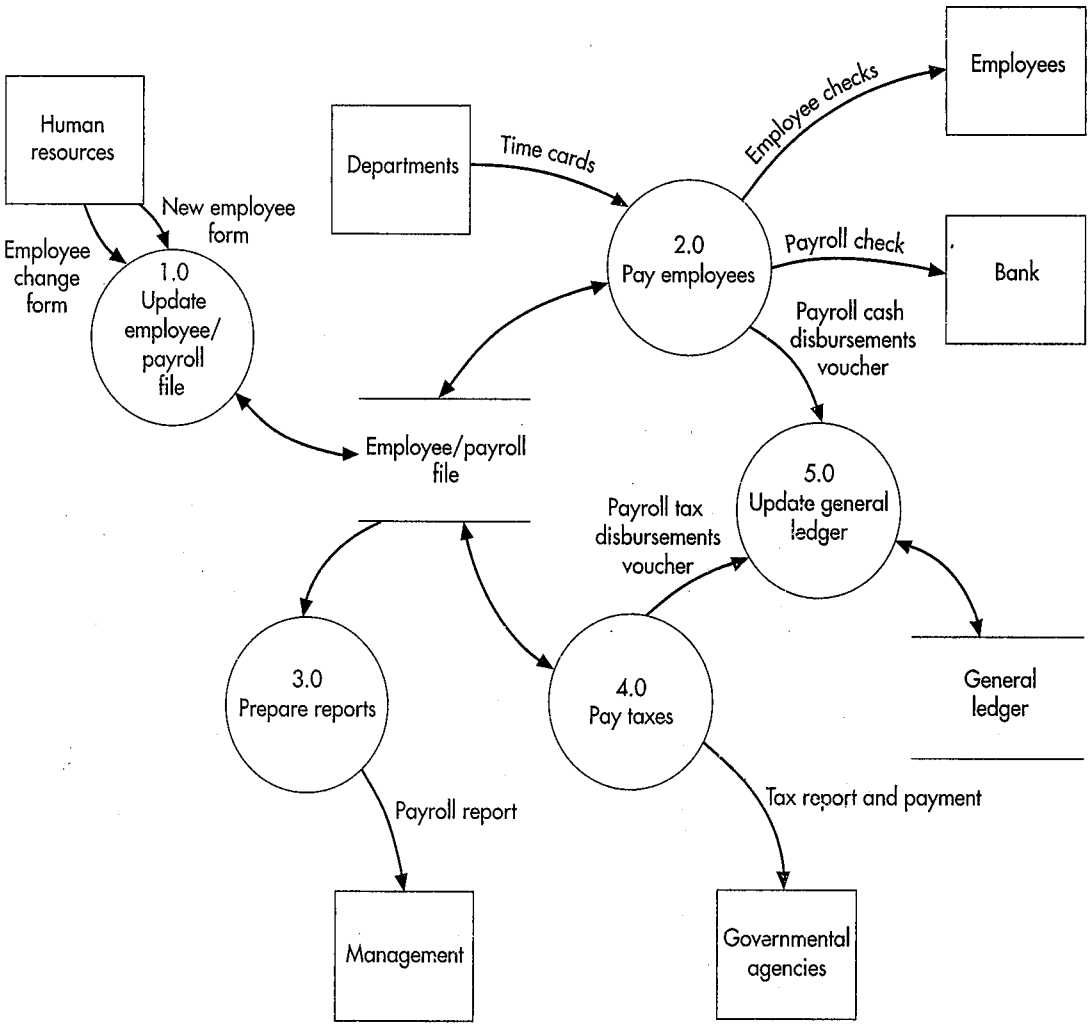
The five activities and all data inflows and outflows are shown in Table 3-2.

Ashton exploded his context diagram and created the Level 0 DFD (called level 0 because there are zero meaningful decimal points—1.0, 2.0, etc.) shown in Figure 3-6. Notice that some data inputs and outputs have been excluded from this DFD. For example, in process 2.0, the data inflows and outflows that are not related to an external entity or to another process are not depicted (tax tables and payroll register). These data flows are internal to the "pay employees" activity and are shown on the next DFD level.

TABLE 3-2 Activities and Data Flows in Payroll Processing at S&S

Activities	Data Inputs	Data Outputs
Update employee/payroll file	New employee form Employee change form	Updated employee/payroll file
Pay employees	Time cards Employee/payroll file Tax rates table	Employee checks Payroll register Updated employee/payroll file Payroll check Payroll cash disbursements voucher
Prepare reports	Employee/payroll file	Payroll report
Pay taxes	Employee/payroll file	Tax report Tax payment Payroll tax cash disbursements voucher Updated employee/payroll file
Update general ledger	Payroll tax cash disbursements voucher Payroll cash disbursements voucher	Updated general ledger

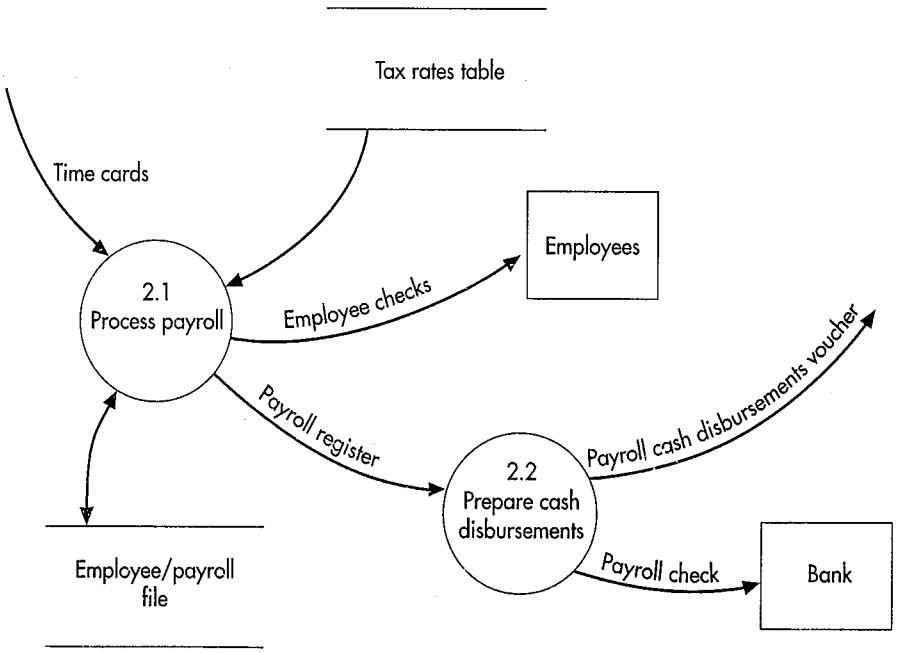
FIGURE 3-6
Level 0 DFD for S&S payroll processing

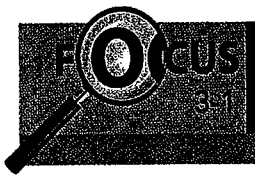


Ashton exploded process 2.0 (pay employees) to create a Level 1 DFD (it has one meaningful decimal place—2.1, 2.2, etc.). Figure 3-7 provides more detail about the data processes involved in paying employees, and it includes the tax rates table and the payroll register data flow omitted from Figure 3-6. In a similar fashion, each of the Figure 3-6 processes could be exploded, using a Level 1 DFD, to show a greater level of detail.

Some general guidelines for developing DFDs are shown in Focus 3-1.

FIGURE 3-7
Level 1 DFD for Process 2.0 in S&S Payroll Processing





Guidelines for Drawing a DFD

1. **Understand the system.** Observe organization information flows, and interview the individuals who use and process the data.
2. **Ignore certain aspects of the system.** A DFD is a diagram of the origins, flow, transformation, storage, and destinations of data. All control processes and actions are ignored. Only very important error paths are included; unimportant error paths are ignored. Determining how the system starts and stops is not shown.
3. **Determine system boundaries.** Determine what to include and exclude. Include all relevant data elements in the DFD, because excluded items will not be considered during system development.
4. **Develop a context diagram.** A context diagram depicts system boundaries. In the diagram's center is a circle with the name of the system. Outside entities the system interacts with directly are in boxes on either side, connected by data flows depicting the data passed between them. DFDs in successively more detail depict data flows in the system.
5. **Identify data flows.** Identify all data flows entering or leaving the system's boundary, including where the data originate and its final destination. A significant movement of information is usually a data flow. All data flows come from and go to a transformation process, a data store (file), or a source or destination. Data flows can move in two directions, shown as a line with arrows on both ends (see G in Figure 3-3).
6. **Group data flows.** A data flow can consist of one or more pieces of datum. Data elements that always flow together should be grouped together and shown as one data flow until they are separated. If the data do not always flow together, show them as separate data flows.
7. **Identify transformation processes.** Place a circle wherever work is required to transform one data flow into another. All transformation processes should have one or more incoming and outgoing data flows.
8. **Group transformation processes.** Transformation processes that are logically related or occur at the same time and place should be grouped together. Never combine unrelated items into a single transformation process. If data are not processed together, or are sometimes processed differently, then separate them.
9. **Identify all files or data stores.** Identify each temporary or permanent data repository, and identify each data flow into and out of it.
10. **Identify all data sources and destinations.** Include them on the DFD.
11. **Name all DFD elements.** Except for data flows into or out of data stores (the data store name is usually sufficient to identify the data flow), data elements should be given unique and descriptive names representing what is known about them. Naming data flows first forces you to concentrate on the all-important data flows, rather than on the processes or stores. Processes and data stores typically take their names from the data inflows or outflows. Choose active and descriptive names, such as "update inventory" and "validate transaction," rather than "input data" or "update process." Process names should include action verbs such as *update*, *edit*, *prepare*, *reconcile*, and *record*.
12. **Subdivide the DFD.** A cluttered DFD is hard to read and understand. If you have more than five to seven processes on a page, decompose the context diagram into high-level processes. Explode these high-level processes into successively lower-level processes.
13. **Give each process a sequential number.** Giving each process a sequential number (lower to higher) helps readers navigate among the DFD levels.
14. **Repeat the process.** Work through data flows several times. Each subsequent pass helps refine the diagram and identify the fine points. Organize the DFD to flow from top to bottom and from left to right.
15. **Prepare a final copy.** Do not allow data flow lines to cross over each other; if necessary, repeat a data store or destination. Place the name of the DFD, the date prepared, and the preparer's name on each page.

Flowcharts

A *flowchart* is an analytical technique used to describe some aspect of an information system in a clear, concise, and logical manner. Flowcharts use a standard set of symbols to describe pictorially the transaction processing procedures a company uses and the flow of data through a system. The symbols used to create flowcharts are shown in Figure 3-8.

Flowcharting was introduced by industrial engineers in the 1950s as a way of (1) recording how business processes are performed and documents flow and (2) analyzing how to improve processes and document flows. Soon internal auditors began using flowcharts in operational audits to better understand their company's business processes. Later, external auditors began

using flowcharts to evaluate their clients' internal controls. Flowcharts became even more important when the Sarbanes-Oxley Act required companies to document their business processes and internal controls.

Flowcharts have significant advantages. A pictorial representation is much easier to understand than a narrative description. Both the auditor and the business owner can use the flowchart as a working tool during discussions. For an experienced flowcharter using a computerized drawing tool, flowcharts provide an easy way to capture and record data during interviews, and they can be easily and quickly revised.

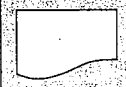
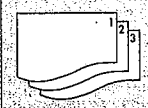
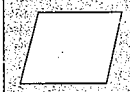
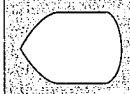
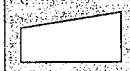
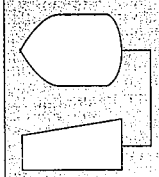
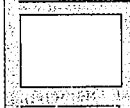
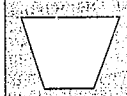
Flowcharts do have some disadvantages. Some people do not like or understand them. Many are poorly drawn and therefore not as helpful as they should be. They are time-consuming to prepare if the flowcharter is not trained properly.

Early flowcharts were drawn using a flowcharting template, a piece of hard, flexible plastic on which symbols have been die cut. Most flowcharts are now drawn using a software program such as Visio. Flowcharts can also be drawn using Microsoft Word, Excel, or PowerPoint.

Flowcharting symbols are divided into four categories, as shown in Figure 3-8:

1. ***Input/output symbols*** represent devices or media that provide input to or record output from processing operations.
2. ***Processing symbols*** show what types of devices are used to process data or indicate when processing is performed manually.
3. ***Storage symbols*** represent the devices used to store data.
4. ***Flow and miscellaneous symbols*** indicate the flow of data, where flowcharts begin or end, where decisions are made, and when to add explanatory notes to flowcharts.

FIGURE 3-8
Common flowcharting symbols

Symbol	Name	Explanation
Input/Output Symbols		
	Document	A document or report.
	Multiple copies of one document	Illustrated by overlapping the document symbol and printing the document number on the face of the document in the upper right corner
	Input/output; Journal/ledger	Any input or output function on a program flowchart. Also used to represent accounting journals and ledgers in a document flowchart
	Display	Information displayed by an online output device such as a terminal, monitor, or screen
	Online keying	Data entry by online devices, such as a terminal or personal computer
	Terminal or personal computer	The display and online keying symbols are used together to represent terminals, personal computers, and other electronic devices capable of both input and output
	Transmittal tape	Manually prepared control totals; used for control purposes to compare to computer-generated totals
Processing Symbols		
	Computer processing	A computer-performed processing function; usually results in a change in data or information
	Manual operation	A processing operation performed manually

Symbol	Name	Explanation
	Auxiliary operation	A processing function performed by a device that is not a computer
	Off-line keying	An operation utilizing an off-line keying device (e.g., key to disk, off-line cash register)
Storage Symbols		
	Magnetic disk/drive	Data stored on a magnetic disk or drive
	Magnetic tape	Data stored on a magnetic tape
N	File	File of documents manually stored and retrieved; following letters indicate file-ordering sequence: N = numerically, A = alphabetically, D = by date
Flow and Miscellaneous Symbols		
	Document or processing flow	Direction of processing or document flow; normal flow is down and to the right
	Data/ information flow	Direction of data/information flow; often used to show data copied from one document to another
	Communication link	Transmission of data from one geographic location to another via communication lines
	On-page connector	Connects the processing flow on the same page; its usage avoids lines crisscrossing a page
	Off-page connector	An entry from, or an exit to, another page
	Terminal	A beginning, end, or point of interruption in a process or program; also used to indicate an external party
	Decision	A decision-making step; used in a program flowchart to show branching to alternative paths
	Annotation	Addition of descriptive comments or explanatory notes as clarification

FIGURE 3-8
(continued)

Document Flowcharts

A ***document flowchart*** illustrates the flow of documents and information among areas of responsibility within an organization. They trace a document from its cradle to its grave, showing where each document originates, its distribution, its purpose, its disposition, and everything that happens as it flows through the system.

A document flowchart is particularly useful in analyzing internal control procedures. Document flowcharts that describe and evaluate internal controls are often referred to as ***internal control flowcharts***. They can reveal system weaknesses or inefficiencies, such as inadequate communication flows, unnecessary complexity in document flows, or procedures responsible for causing wasteful delays. Document flowcharts prepared as part of the systems design process should be included in system documentation.

The document flowchart that Ashton developed for the payroll process at S&S, as described in Table 3-1 and 3-2, is shown in Figure 3-9.

General guidelines for preparing flowcharts that are readable, clear, concise, consistent, and understandable are presented in Focus 3-2 (see page 80).

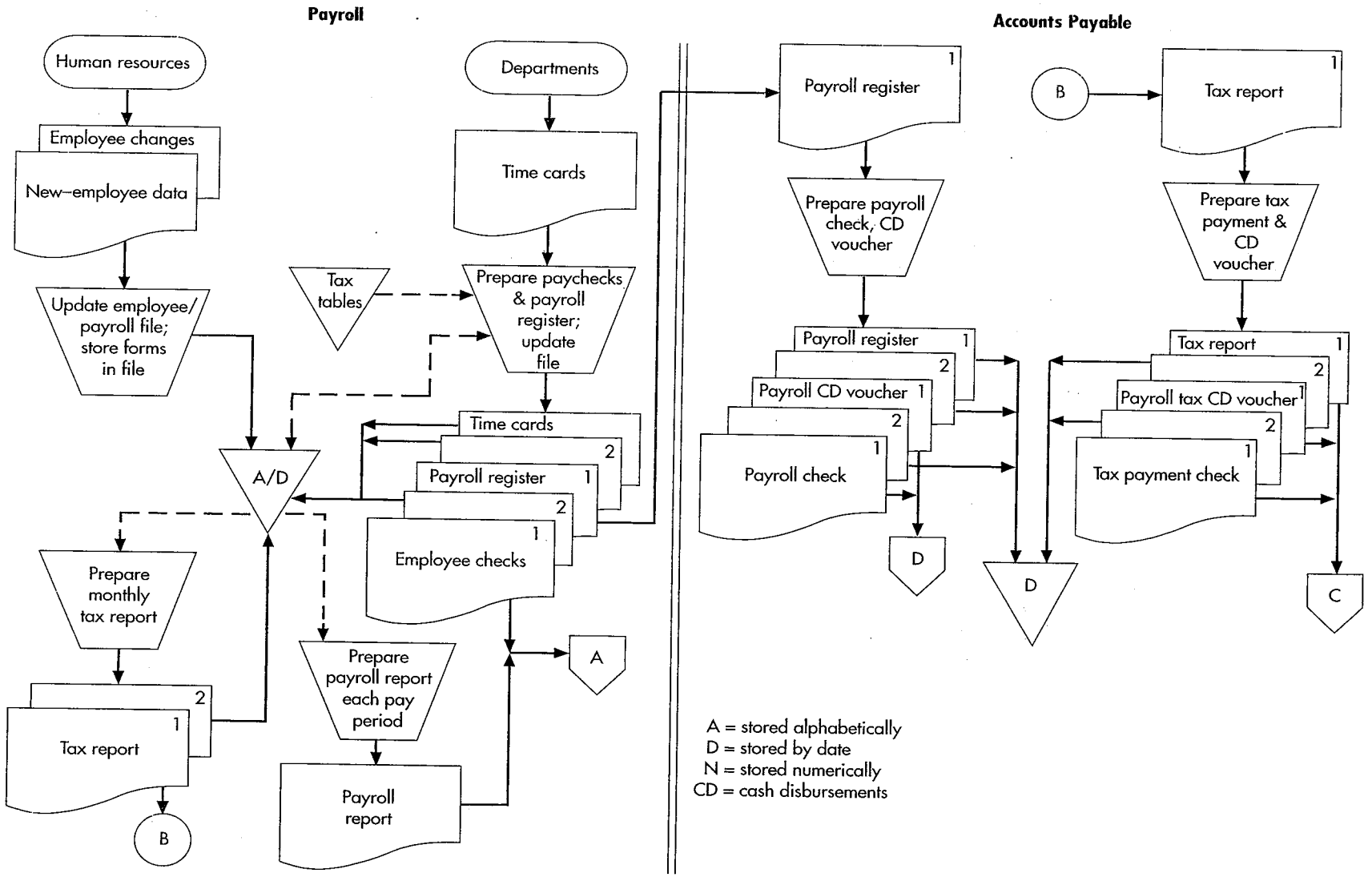


FIGURE 3-9
Document Flowchart of Payroll Processing at S&S

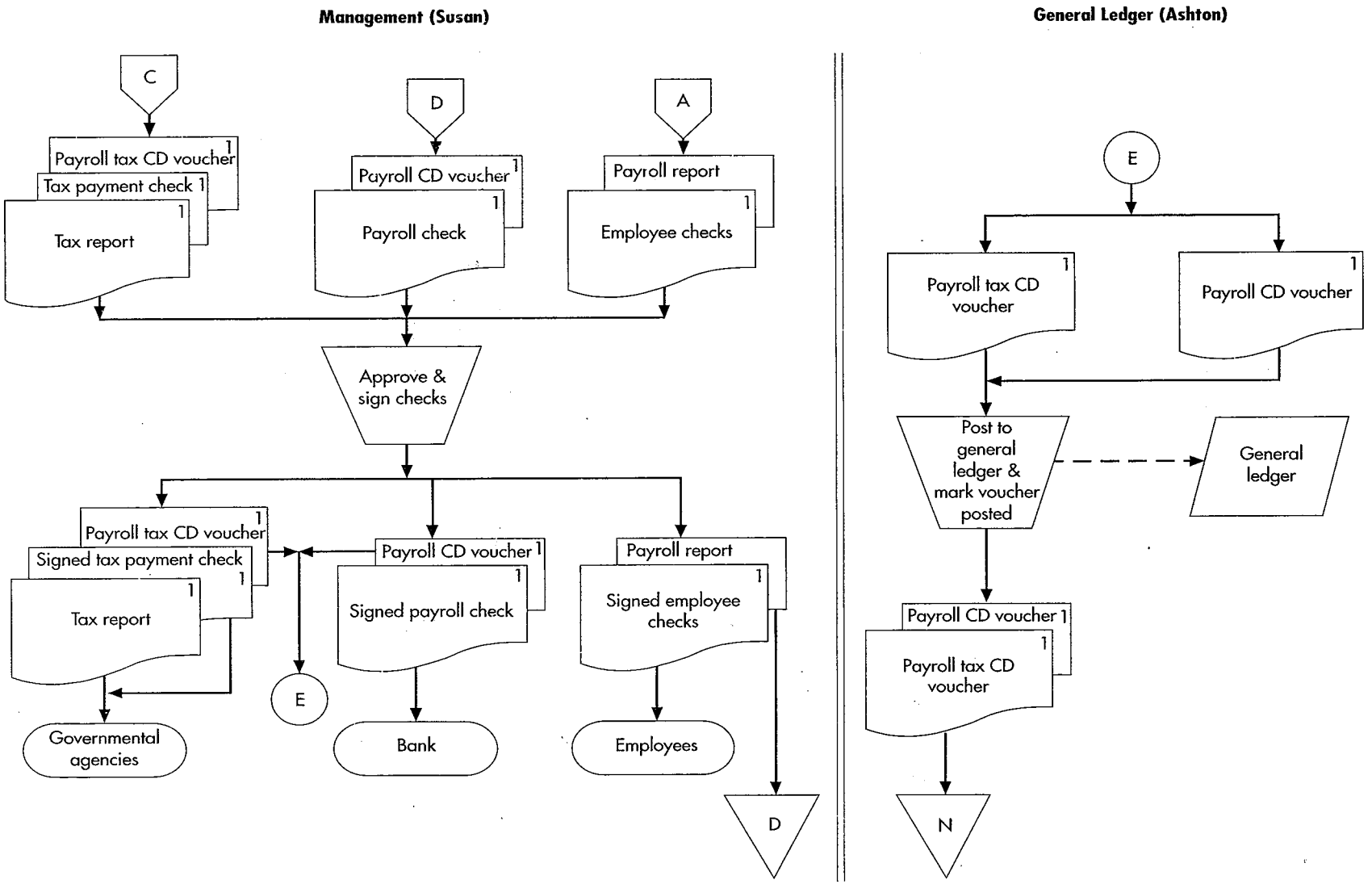


FIGURE 3-9
(continued)

FOCUS 3-2 Guidelines for Preparing Flowcharts

1. **Understand a system before flowcharting it.** Interview users, developers, auditors, and management, or have them complete a questionnaire. Read a narrative description of the system, or walk through system transactions.
2. **Identify the entities to be flowcharted.** Identify departments, job functions, and external parties. Identify documents and information flows, as well as the activities or processes performed on the data.
3. **Divide the flowchart into columns.** When several departments or functions need to be shown, divide the flowchart into columns and label each one. Flowchart the activities of each entity in its respective column.
4. **Flowchart the normal flow of operations.** Ensure that all procedures and processes are in proper order. Identify exception procedures using the annotation symbol.
5. **Organize flowchart.** Design the flowchart so that information flows from top to bottom and from left to right.
6. **Give the flowchart a clear beginning and ending.** Designate where each document originates, and show the final disposition of all documents so that there are no loose ends that leave the reader dangling.
7. **Use standard flowcharting symbols drawn with a template or a computer.**
8. **Clearly label all symbols.** Write a description of the input, process, or output inside the symbol. If the description will not fit, use the annotation symbol.
9. **Multiple copies of documents.** For multiple copies of a document, place document numbers in the top right-hand corner of the symbol. The number should accompany the symbol as it moves through the system.
10. **Manual processing symbol.** Each manual processing symbol should have an input and an output. Do not directly connect two documents, except when moving from one column to another. When a document is moved to another column, it is often best to show the document in both.
11. **Page connectors.** Use off-page connectors to move from one flowchart page to another. Consider using on-page connectors to avoid excess flow lines and thereby produce a neat-looking page. Clearly label all connectors to avoid confusion.
12. **Use arrowheads on all flow lines.** Do not assume the reader will know the direction of the flow.
13. **Multiple pages.** If a flowchart cannot fit on a single page, clearly label the pages as follows: 1 of 3, 2 of 3, and so on.
14. **Show documents or reports in the column where they are created.** Then show them moving to another column for further processing.
15. **Files.** Show data entered into or retrieved from a computer file as passing through a processing operation (a computer program) first. Draw a line from a document to a file to indicate that it is being filed. A manual process is not needed to show a document entering a file.
16. **Draw a rough sketch of the flowchart.** Be more concerned with capturing content than with making a perfect drawing. Few systems can be flowcharted in a single draft.
17. **Redesign the flowchart.** Avoid clutter and a large number of crossed lines.
18. **Verify the flowchart's accuracy.** Review it with the people familiar with the system. Be sure all uses of flowcharting conventions are consistent.
19. **Draw a final copy of the flowchart.** Place the flowchart name, date, and preparer's name on each page.

System Flowcharts

System flowcharts depict the relationships among system input, processing, and output. A system flowchart begins by identifying system inputs and their origins. The input is followed by the processing performed on the data. The resulting new information is the output component, which can be stored for later use, displayed on a screen, or printed on paper. In many instances, the output from one process is an input to another.

The sales processing system flowchart in Figure 3-10 represents Ashton's proposal to capture sales data using state-of-the-art sales terminals. These terminals will edit the sales data and print a customer receipt. All sales data will be stored in a sales data file on a disk. At the end of each day, the data will be forwarded to S&S's computers, where it will be summarized and batch totals will be printed. A batch total is the sum of a numerical item contained in each transaction being processed. An example is total sales for all sales transactions. The summary data will then be processed, and batch totals will again be generated and printed. These amounts will be compared with the batch totals generated prior to processing, and all errors and exceptions will be reconciled. The accounts receivable, inventory, and sales marketing databases and the general ledger will be updated. Users can access the files at any time by using an inquiry processing

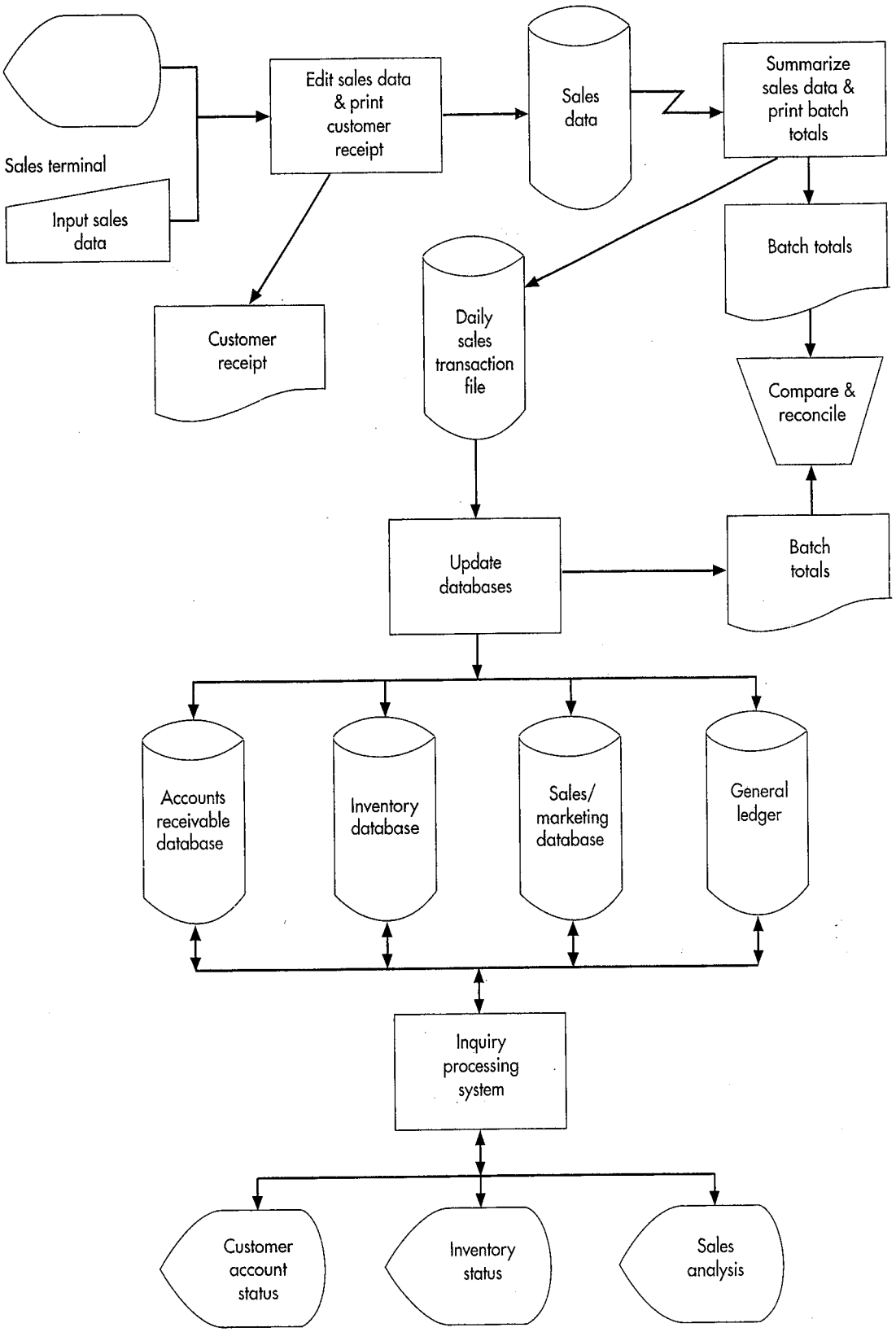


FIGURE 3-10
System Flowchart of Sales Processing at S&S

system. This system will produce standard reports and allow users to access the data needed for special analyses.

System flowcharts are an important systems analysis, design, and evaluation tool. They are universally employed in systems work and provide an immediate form of communication among workers. The system flowchart is an excellent vehicle for describing information flows and procedures within an AIS.

Program Flowcharts

A *program flowchart* illustrates the sequence of logical operations performed by a computer in executing a program. The relationship between system and program flowcharts is shown in Figure 3-11. A program flowchart describes the specific logic used to perform a process shown on a system flowchart.

Program flowcharts employ a subset of the symbols shown in Figure 3-8. Once designed and approved, the program flowchart serves as the blueprint for coding the computer program.

Summary and Case Conclusion

Ashton prepared the DFDs and flowcharts of S&S's payroll processing system (Figures 3-6, 3-7, and 3-9) to document and explain the operation of the existing system. He was pleased to see that Scott and Susan were able to grasp the essence of the system from this documentation. The DFDs indicated the logical flow of data, and the flowcharts illustrated the physical dimensions of the system: The origin and final disposition and the interworkings of the documents in each department were clear.

Susan and Scott agreed that Ashton should document the remainder of the system. The documentation would help all of them understand the current system. It would also help Ashton and the consultants design the new system. In fact, the payroll documentation had already helped them identify a few minor changes they wanted to make in their system. Using the information from Figure 3-9, Susan now understands why the payroll clerk sometimes had to borrow the only copy of the payroll report that was prepared. She thus recommended that a second copy be made and kept in the payroll department. Susan also questioned the practice of keeping all the payroll records in one employee/payroll file. To keep the file from becoming unwieldy, she recommended that it be divided into three files: personal employee data, pay period documentation, and payroll tax data. A discussion with the payroll clerk verified that this approach would make payroll processing easier and more efficient.

Over the next few weeks, Ashton documented the remaining accounting cycles. This process helped him identify inefficiencies and unneeded reports. He also found that some system documents were inadequately controlled. In addition, he got several ideas about how an automated system could help him reengineer the business processes at S&S. By substituting technology for human effort, outdated processes and procedures could be eliminated to make the system more effective.

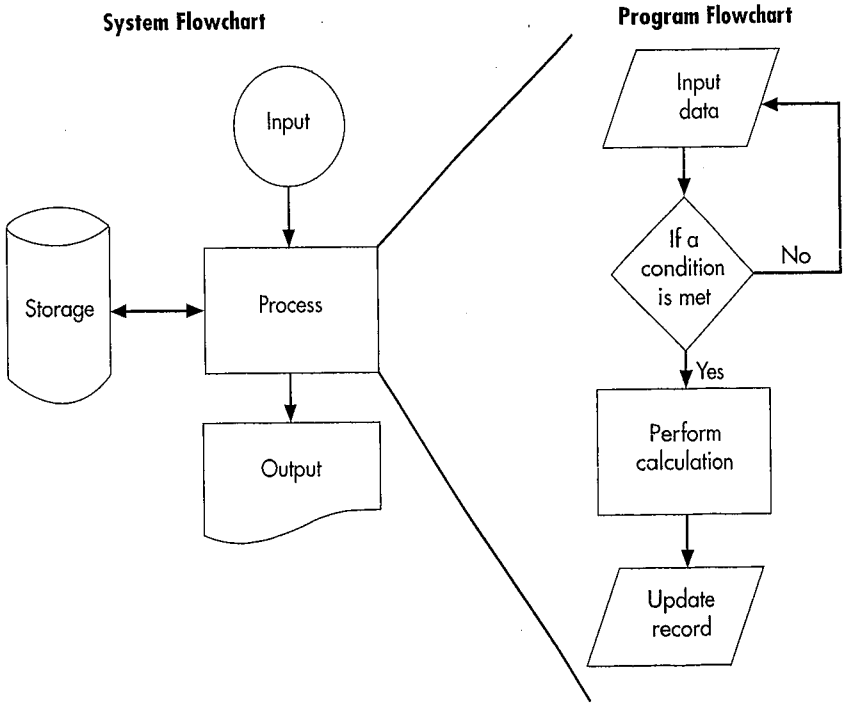


FIGURE 3-11
Relationship Between System and Program Flowcharts

When Ashton completed his analysis and documentation of the current system, Susan and Scott asked him to continue his work in designing a new system. To do that, Ashton must thoroughly understand the information needs of the various employees in the company. Then he can design a new system using the tools that were explained in this chapter. Systems development is discussed in Chapters 20 through 22).

Key Terms

documentation 69
narrative description 69
data flow diagram (DFD) 70
data source 70
data destination 70
data flow 71
process 71
data store 72
context diagram 72
flowchart 75
document flowchart 77
internal control flowchart 77
system flowchart 80
program flowchart 82

AIS IN ACTION

Chapter Quiz

1. A DFD is a representation of which of the following?
   a. relationship among modules, data, and programs of an AIS
   b. flow of data in an organization
   c. decision rules in a computer program
   d. computer hardware configuration

2. Documentation methods such as DFDs and flowcharts save both time and money, adding value to an organization.
   a. True b. False

3. Which of the following statements is FALSE?
   a. Flowcharts make use of many symbols.
   b. A flowchart emphasizes the flow of documents or records containing data.
   c. DFDs help convey the timing of events.
   d. Both a and b are false.

4. A DFD consists of the following four basic elements: data sources and destinations, data flows, transformation processes, and data stores. Each is represented on a DFD by a different symbol.
   a. True b. False

5. Which of the following is NOT one of the guidelines that should be followed in naming DFD data elements?
   a. Process names should include action verbs such as *update*, *edit*, *prepare*, and *record*.
   b. Make sure the names describe all the data or the entire process.
   c. Name only the most important DFD elements.
   d. Choose active and descriptive names.

6. The documentation skills that accountants require vary with their job function. However, they should at least be able to do which of the following?
   a. Read documentation to determine how the system works.
   b. Critique and correct documentation that others prepare.
   c. Prepare documentation for a newly developed information system.
   d. Teach others how to prepare documentation.

7. Which of the following statements is FALSE?
   a. A flowchart is an analytical technique used to describe some aspect of an information system in a clear, concise, and logical manner.
   b. Flowcharts use a standard set of symbols to describe pictorially the flow of documents and data through a system.
   c. Flowcharts are easy to prepare and revise when the designer utilizes a flowcharting software package.
   d. A system flowchart is a narrative representation of an information system.
   e. A program flowchart shows the logic used in computer programs.

8. Which of the following flowcharts illustrates the flow of information among areas of responsibility in an organization?
   a. program flowchart
   b. computer configuration chart
   c. system flowchart
   d. document flowchart

9. Which of the following is NOT one of the recommended guidelines for making flowcharts more readable, clear, concise, consistent, and understandable?
   a. Divide the flowchart into columns with labels.
   b. Flowchart all information flows, especially exception procedures and error routines.
   c. Design the flowchart so that flow proceeds from top to bottom and from left to right.
   d. Show the final disposition of all documents to prevent loose ends that leave the reader dangling.
   e. Make sure that each manual processing symbol has an input and an output.

10. How are data sources and destinations represented in a data flow diagram?
    a. as a square
    b. as a curved arrow
    c. as a circle
    d. as two parallel lines
    e. none of the above

Comprehensive Problem

Accuflow Cash Disbursements Process

SoftData, a vendor, sends an invoice to Accuflow for data warehousing support services. The invoice is sent directly to Megan Waters, the accounts payable clerk, who manually records the invoice in the accounts payable subsidiary ledger. Once the invoice is recorded, it is forwarded to Stan Phillips, the cash disbursements clerk, for processing. Stan prepares a check to pay the invoice and sends the check and invoice to John Sterling, the company treasurer. John approves and signs the check and cancels the invoice. John then mails the check back to SoftData and returns the canceled invoice to Stan for recording in the cash disbursements journal and filing. Once a week, Megan manually posts disbursements from the cash disbursements journal to the accounts payable subsidiary ledger.

Required

Prepare a document flowchart, a context diagram, a level 0 data flow diagram, and a level 1 data flow diagram for the Accuflow cash disbursement process. To maximize learning from this problem, do your best to solve it before looking at the solution at the end of the chapter.

Discussion Questions

3.1. Identify the DFD elements in the following narrative: A customer purchases a few items from a local grocery store. Jill, a salesclerk, enters the transaction in the cash register and takes the customer's money. At closing, Jill gives both the cash and the register tape to her manager.

3.2. Do you agree with the following statement: "Any one of the systems documentation procedures can be used to adequately document a given system"? Explain.

3.3. Compare the guidelines for preparing flowcharts and DFDs. What general design principles and limitations are common to both documentation techniques?

3.4. Your classmate asks you to explain flowcharting conventions using real-world examples. Draw each of the major flowchart symbols from memory, placing them into one of four categories: input/output, processing, storage, and flow and miscellaneous. For each symbol, suggest several uses.

Problems



3.1. Prepare flowcharting segments for each of the following operations:
   a. processing transactions stored on magnetic tape to update a master file stored on magnetic tape
   b. processing transactions stored on magnetic tape to update a database stored on a magnetic disk
   c. converting source documents to magnetic tape using a computer-based optical character reader (OCR)
   d. processing OCR documents online to update a database on magnetic disk
   e. reading data from a magnetic disk into the computer to be printed on a report
   f. using a computer or terminal to key data from source documents to a file stored on a magnetic disk
   g. manually sorting and filing invoices numerically
   h. using a terminal to enter source document data and send it to a remote location where an online processing system records it in a database stored on magnetic disk
   i. a scheduled automatic backup of an internal hard drive to an external hard drive
   j. using a terminal to query customer sales data maintained on a magnetic disk
   k. entering employee hours recorded on time cards in the payroll transaction file maintained on disk and updating wage data maintained on the payroll master file
   l. using a terminal to access a price list maintained on disk to complete a purchase order. An electronic copy of the purchase order is sent to the vendor and a backup copy is printed and filed by vendor name
   m. updating an airline reservation on a Web-based airline reservation system from a home computer

3.2. The Happy Valley Utility Company uses turnaround documents in its computerized customer accounting system. Meter readers are provided with preprinted computer forms, each containing the account number, name, address, and previous meter readings. Each form also contains a formatted area in which the customer's current meter reading can be marked in pencil. After making their rounds, meter readers turn in batches of these documents to the computer data preparation department, where they are processed by a mark-sense document reader that transfers their contents to magnetic tape.

This magnetic tape file is used as input for two computer runs. The first run sorts the transaction records on the tape into sequential order by customer account number. On the second run, the sorted transaction tape is processed against the customer master file, which is stored on a magnetic disk. Second-run outputs are (1) a printed report listing summary information and any erroneous transactions detected by the computer and (2) customer bills printed in a special OCR-readable font. Bills are mailed, and customers are requested to return the stub portion along with payment.

Customer payments are received in the mailroom and checked for consistency against the returned remittance stubs. Checks are then sent to the cashier's office. The mailroom provides the computer data preparation department with three sets of records: (1) stubs with compatible amounts, (2) stubs with differing amounts, and (3) a list of amounts received from customers, without stubs. For the latter two types of records, data preparation personnel use a special off-line keying device to prepare corrected stubs. An

OCR document reader reads all the stubs and sends the data to the company's computer. The computer updates the customer master file to post the payment amounts. Two printed outputs from this second process are (1) reports listing erroneous transactions and summary information and (2) past-due customer balances.

Required

a. Draw a system flowchart of the billing operations, commencing with the computer preparation of the meter reading forms and ending with the mailing of customer bills.
b. Draw a system flowchart depicting customer payments processing, starting with the mailroom operations and ending with the two printed reports.

3.3. The Dewey Construction Company processes its payroll transactions to update both its payroll master file and its work-in-process master file in the same computer run. Both files are stored on magnetic disk.

Job time tickets are keyed onto a tape using an off-line key-to-tape encoder. The tape is then processed to update the files. The processing run also produces a payroll register on magnetic tape, employee paychecks and earnings statements, and a printed report listing error transactions and summary information.

Required

Prepare a system flowchart of the process described.

3.4. Prepare a document flowchart to reflect how ANGIC Insurance Company processes its casualty claims. The process begins when the claims department receives a notice of loss from a claimant. The claims department prepares and sends the claimant four copies of a proof-of-loss form on which the claimant must detail the cause, amount, and other aspects of the loss. The claims department also initiates a record of the claim, which is sent with the notice of loss to the data processing department, where it is filed by claim number.

The claimant must fill out the proof-of-loss forms with an adjuster's assistance. The adjuster must concur with the claimant on the estimated amount of loss. The claimant and adjuster each keep one copy of the proof-of-loss form. The adjustor files his copy numerically. The adjustor sends the first two copies to the claims department. Separately, the adjuster submits a report to the claims department, confirming the estimates on the claimant's proof-of-loss form.

The claims department authorizes a payment to the claimant, forwards a copy of the proof-of-loss form to data processing, and files the original proof-of-loss form and the adjuster's report alphabetically. The data processing department prepares payment checks and mails them to the customers, files the proof-of-loss form with the claim record, and prepares a list of cash disbursements, which it transmits to the accounting department.

3.5. Beccan Company is a discount tire dealer operating 25 retail stores in the metropolitan area. The company operates a centralized purchasing and warehousing facility and employs a perpetual inventory system. All purchases of tires and related supplies are placed through the company's central purchasing department to optimize quantity discounts. The tires and supplies are received at the central warehouse and distributed to the retail stores as needed. The perpetual inventory system at the central facility maintains current inventory records, designated reorder points, and optimum order quantities for each type and size of tire and other related supplies. Beccan uses the following five documents in its inventory control system.

- **Retail stores requisition.** The retail stores submit a retail store requisition to the central warehouse when they need tires or supplies. The warehouse shipping clerks fill the orders from inventory and authorize store deliveries.
- **Purchase requisition.** The inventory control clerk prepares a purchase requisition when the quantity on hand for an item falls below the designated reorder point and forwards it to the purchasing department.
- **Purchase order.** The purchasing department prepares a purchase order when items need to be ordered and submits it to an authorized vendor.

- **Receiving report.** The warehouse department prepares a receiving report when ordered items are received from vendors. The receiving clerk indicates the vendor's name and the date and quantity of the shipment received.
- **Invoice.** An invoice is received from vendors, specifying the amounts Beccan owes.

The following departments are involved in Beccan's inventory control system:

- **Inventory control department.** Responsible for the maintenance of all perpetual inventory records, including quantity on hand, reorder point, optimum order quantity, and quantity on order for each item carried.
- **Warehouse department.** Maintains the physical inventory of all items carried in stock. All orders from vendors are received (receiving clerk) and all distributions to retail stores are filled (shipping clerks) in this department.
- **Purchasing department.** Places all orders for items needed by the company.
- **Accounts payable department.** Maintains all open accounts with vendors and other creditors, in addition to processing payments.

Required

a. Prepare a document flowchart that indicates the interaction and use of these documents among all departments at Beccan Company's central facility. It should provide adequate internal control over the receipt, issuance, replenishment, and payment of tires and supplies. You may assume that there are a sufficient number of document copies to ensure that the perpetual inventory system has the necessary basic internal controls.
b. Using the flowcharting conventions discussed in Focus 3-2, critique the instructor provided CMA solution. List all the ways the CMA solution violates those flowcharting guidelines. *(CMA Examination, adapted)*

3.6. As the internal auditor for No-Wear Products, you have been asked to document the company's payroll processing system. Based on your documentation, No-Wear hopes to develop a plan for revising the current system to eliminate unnecessary delays in paycheck processing. The head payroll clerk explained the system:

> The payroll processing system at No-Wear Products is fairly simple. Time data are recorded in each department using time cards and clocks. It is annoying, however, when people forget to punch out at night, and we have to record their time by hand. At the end of the period, our payroll clerks enter the time card data into a payroll file for processing. Our clerks are pretty good—though I've had to make my share of corrections when they mess up the data entry.
>
> Before the payroll file is processed for the current period, human resources sends us personnel changes, such as increases in pay rates and new employees. Our clerks enter this information into the payroll file. Usually, when mistakes get back to us, it's because human resources is recording the wrong pay rate or an employee has left and the department forgets to remove the record.
>
> The data are processed and individual employee paychecks are generated. Several reports are generated for management—though I don't know what they do with them. In addition, the government requires regular federal and state withholding reports for tax purposes. Currently, the system generates these reports automatically, which is nice.

Required

a. Prepare a context diagram and level 0 DFD to document the payroll processing system at No-Wear Products.
b. Prepare a document flowchart to document the payroll processing system at No-Wear Products.

3.7. Ashton Fleming has decided to document and analyze the accounts payable process at S&S so the transition to a computerized system will be easier. He also hopes to improve

any weaknesses he discovers in the system. In the following narrative, Ashton explains what happens at S&S:

> Before S&S pays a vendor invoice, the invoice must be matched against the purchase order used to request the goods and the receiving report that the receiving department prepares. Because all three of these documents enter the accounts payable department at different times, a separate alphabetical file is kept for each type of document. The purchase orders that are forwarded from purchasing are stored in a purchase order file. The receiving reports are stored in a receiving report file. When vendor invoices are received, the accounts payable clerk records the amount due in the accounts payable file and files the invoices in the vendor invoice file.
>
> S&S pays all accounts within 10 days to take advantage of early-payment discounts. When it is time to pay a bill, the accounts payable clerk retrieves the vendor invoice, attaches the purchase order and the receiving report, and forwards the matched documents to Ashton Fleming.
>
> Ashton reviews the documents to ensure they are complete, prepares a two-part check, forwards all the documents to Susan, and records the check in the cash disbursements journal.
>
> Susan reviews the documents to ensure that they are valid payables and signs the checks. She forwards the check to the vendor and returns the documents and the check copy to the accounts payable clerk. The clerk files the documents alphabetically in a paid invoice file. At the end of every month, the accounts payable clerk uses the accounts payable ledger to prepare an accounts payable report that is forwarded to Susan. After she is finished with the report, Susan files it chronologically.

Required

a. Prepare a context diagram and a level 0 DFD to document accounts payable processing at S&S.
b. Prepare a document flowchart to document accounts payable processing at S&S.

3.8. Since opening its doors in Hawaii two years ago, Oriental Trading has enjoyed tremendous success. Oriental Trading purchases textiles from Asia and resells them to local retail shops. To keep up with the strong demand, Oriental Trading is expanding its local operations, including a new information system to handle the tremendous increase in purchases.

The following is a summary of your interviews with department supervisors who interact with the acquisition/payment system:

> A purchase requisition is sent from the inventory system to Sky Ishibashi, a purchasing department clerk . Sky prepares a purchase order using the vendor and inventory files and mails it to the vendor. The vendor returns a vendor acknowledgment to Sky indicating receipt of the purchase order. Sky then sends a purchase order notification to Elei Mateaki, an accounts payable clerk.
>
> When the receiving department accepts vendor goods, the inventory system sends Elei a receiving report. Elei also receives invoices from the various vendors. He matches the invoices with the purchase order notification and the receiving report and updates the accounts payable master file. Elei then sends a payment authorization to the accounting department. There, Andeloo Nonu prepares and mails a check to the vendor. When the check is issued, the system automatically updates the accounts payable master file and the general ledger.

Required

a. Develop a context diagram and a level 0 DFD of the acquisition/payment system at Oriental Trading.
b. Prepare a document flowchart to document the acquisition/payment system at Oriental Trading.

3.9. Ashton Fleming has asked you to develop a comprehensive DFD for the cash receipts system. Ashton's narrative of the system follows:

> Customer payments include cash received at the time of purchase and payments received in the mail. At day's end, the treasurer endorses all checks and prepares a

deposit slip for the checks and the cash. A clerk deposits the checks, cash, and deposit slip at the local bank each day. When checks are received as payment for accounts due, a remittance slip is included with the payment. The remittance slips are used to update the accounts receivable file at the end of the day. The remittance slips are stored in a file drawer by date.

Every week, a cash receipts report and an aged trial balance are generated using the accounts receivable ledger. The cash receipts report is sent to Scott and Susan. A copy of the aged trial balance is sent to the credit and collections department.

Required

a. Develop a context diagram and a level 0 DFD for the cash receipts system at S&S.
b. Prepare a document flowchart for the cash receipts system at S&S.

3.10. A mail-order skin and body care company advertises in magazines. Magazine subscribers initiate most orders by completing and sending coupons directly to the company. The firm also takes orders by phone, answers inquiries about products, and handles payments and cancellations of orders. Products that have been ordered are sent either directly to the customer or to the company's regional offices that handle the required distribution. The mail-order company has three basic data files, which contain customer mailing information, product inventory information, and billing information based on invoice number. During the next few years, the company expects to become a multimillion-dollar operation. Recognizing the need to computerize much of the mail-order business, the company has begun the process by calling you.

Required

Draw a context diagram and at least two levels of DFDs for the preceding operations.

3.11. The local college requires that each student complete a registration request form and mail or deliver it to the registrar's office. A clerk enters the request into the system. The system checks the accounts receivable subsystem to ensure that no fees are owed. Next, for each course, the system checks the student transcript to ensure that he or she has completed the course prerequisites. Then the system checks class position availability and adds the student's Social Security number to the class list.



The report back to the student shows the result of registration processing: If the student owes fees, a bill is sent and the registration is rejected. If prerequisites for a course are not fulfilled, the student is notified and that course is not registered. If the class is full, the student request is annotated with "course closed." If a student is accepted into a class, then the day, time, and room are printed next to the course number. Student fees and total tuition are computed and printed on the form. Student fee information is interfaced to the accounts receivable subsystem. Course enrollment reports are prepared for the instructors.

Required

a. Prepare a context diagram and at least two levels of DFDs for this operation.
b. Prepare a document flowchart for this operation.

3.12. Charting, Inc., a new audit client of yours, processes its sales and cash receipts documents in the following manner:

1. *Payment on account.* Each morning a mail clerk in the sales department opens the mail and prepares a remittance advice (showing customer and amount paid) if one is not received. The checks and remittance advices are forwarded to the sales department supervisor, who reviews each check and forwards the checks and remittance advices to the accounting department supervisor.

   The accounting department supervisor, who also functions as credit manager (approving new credit and credit limits), reviews all checks for payments on past-due accounts. He forwards the checks and remittance advices to the accounts receivable clerk, who arranges the advices in alphabetical order. The remittance advices are posted directly to the accounts receivable ledger. The checks are endorsed and the

total is posted to the cash receipts journal. The remittance advices are filed chronologically. After receiving the cash from the previous day's cash sales, the accounts receivable clerk prepares the daily deposit slip in triplicate. The third copy of the deposit slip is filed by date, and the second copy and the original accompany the bank deposit.

2. *Sales.* Sales clerks prepare sales invoices in triplicate. The original and the second copy are presented to the cashier. The sales clerk retains the third copy in the sales book. When a sale is for cash, the customer pays the sales clerk, who gives the money to the cashier with the invoice copies.

   The cashier approves a credit sale from an approved credit list after the sales clerk prepares the three-part invoice. After receiving the cash or approving the invoice, the cashier validates the original copy of the sales invoice and gives it to the customer. At the end of each day, the cashier recaps the sales and cash received and forwards the cash and the second copy of the sales invoices to the accounts receivable clerk.

   The accounts receivable clerk balances the cash received with cash sales invoices and prepares a daily sales summary. The credit sales invoices are posted to the accounts receivable ledger, and then all invoices are sent to the inventory control clerk in the sales department for posting to the inventory control cards. After posting, the inventory control clerk files all invoices numerically. The accounts receivable clerk posts the daily sales summary to the cash receipts and sales journals and files the sales summaries by date.

   The cash from cash sales is combined with the cash received on account to make up the daily bank deposit.

3. *Bank deposits.* The bank validates the deposit slip and returns the second copy to the accounting department, where the accounts receivable clerk files it by date.

   Monthly bank statements are reconciled promptly by the accounting department supervisor and filed by date.

Required

You recognize weaknesses in the existing system and believe a document flowchart would be beneficial in evaluating the client's internal control in preparing for your examination of the financial statements.

a. Complete the flowchart given in Figure 3-12, for sales and cash receipts of Charting, Inc., by labeling the appropriate symbols and indicating information flows.
b. Using the guidelines for preparing flowcharts in Focus 3-2 and the flowcharting symbols shown in Figure 3-8, critique the flowchart shown in Figure 3-12. List the ways the flowchart violates the guidelines or uses improper symbols. *(CPA Examination, adapted)*

3.13. A partially completed flowchart appears in Figure 3-13. The flowchart depicts the credit sales activities of the Bottom Manufacturing Corporation.

When a customer's purchase order is received, a six-part sales order is prepared and distributed as follows:

Copy 1—Billing copy, to billing department

Copy 2—Shipping copy, to shipping department

Copy 3—Credit copy, to credit department

Copy 4—Stock request copy, to credit department

Copy 5—Customer copy, to customer

Copy 6—Sales order copy, filed in sales order department

When each copy of the sales order reaches the appropriate department or destination, it calls for specific internal control procedures and related documents. Some procedures and related documents are indicated on the flowchart; others are labeled by the letters *a* to *r*.

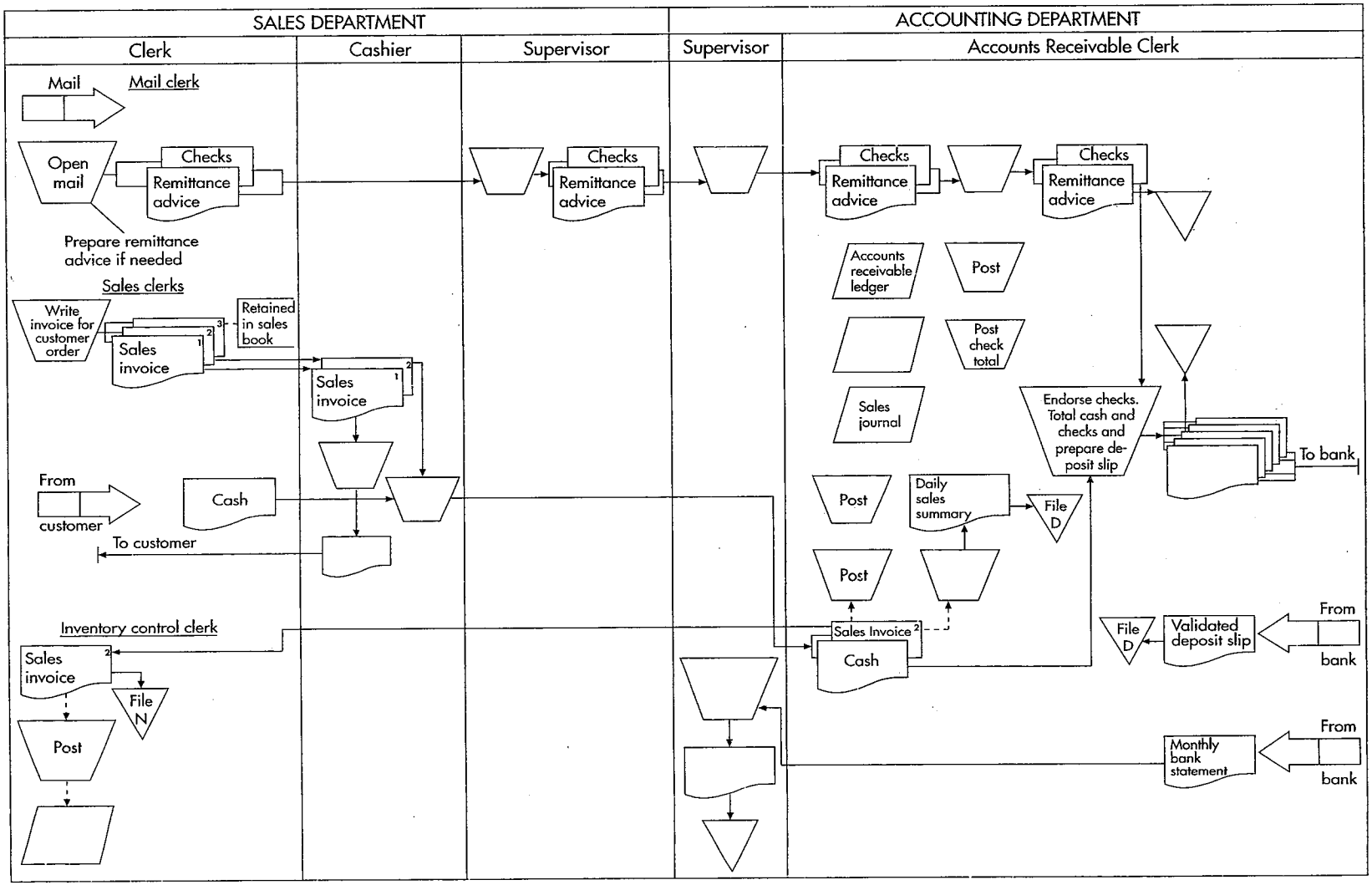


FIGURE 3-12
Charting, Inc., Flowchart for Sales and Cash Receipts

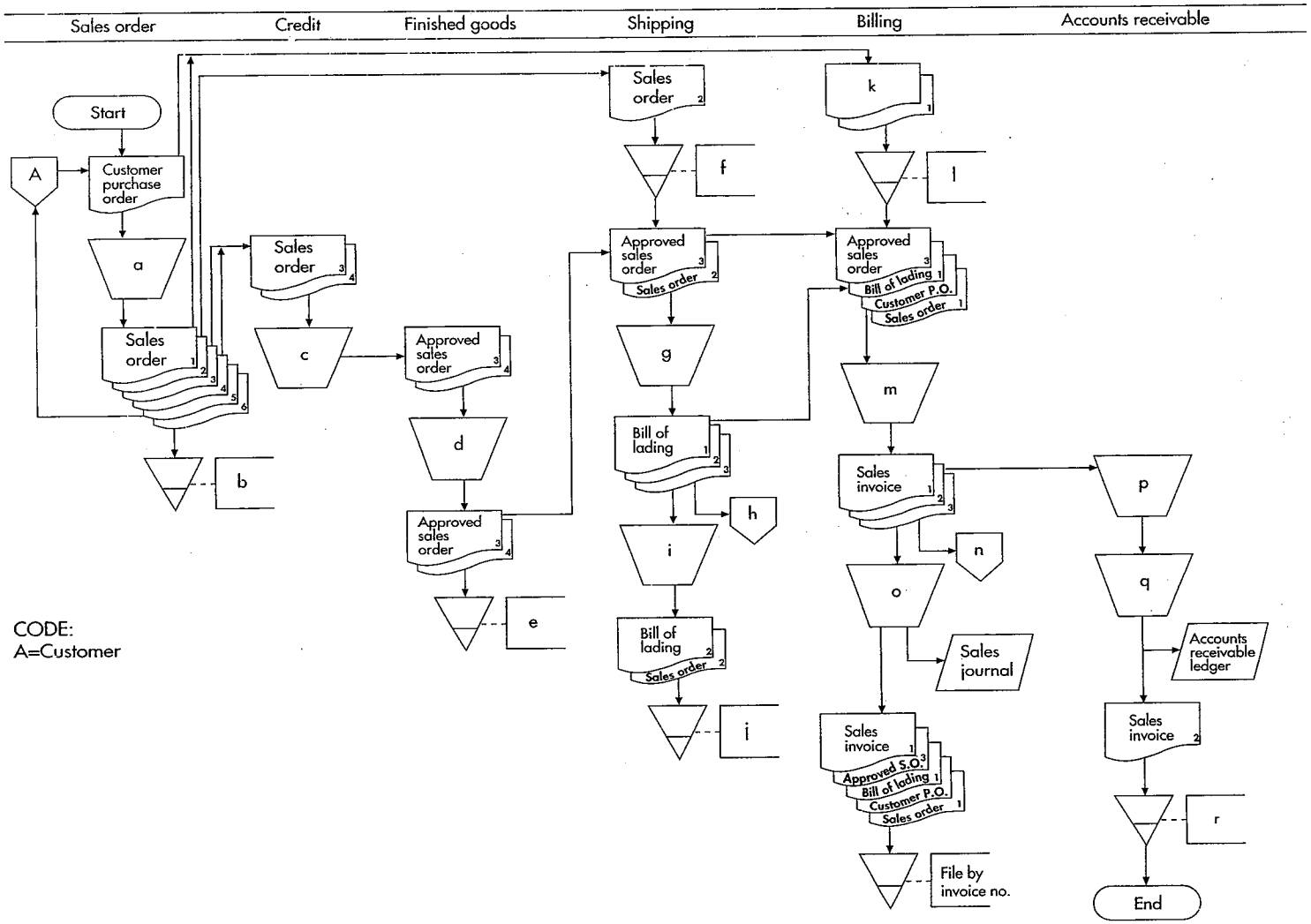


FIGURE 3-13
Bottom Manufacturing Corporation Flowchart of Credit Sales Activities

Required

a. List the procedures or the internal documents that are labeled letters *c* to *r* in the flowchart of Bottom Manufacturing Corporation's charge sales system. Organize your answer as follows (Note that the explanations of the letters *a* and *b* in the flowchart are entered as examples):

Flowchart Symbol Letter	Procedures or Internal Document
a	Prepare six-part sales order.
b	File by order number.

b. Using the guidelines for preparing flowcharts in Focus 3-2 and the flowcharting symbols shown in Figure 3-8, critique the flowchart shown in Figure 3-13. List the ways the flowchart violates the guidelines or uses improper symbols. *(CPA Examination, adapted)*

3.14. Prepare a context diagram and a level 0 data flow diagram for each of the following situations.



a. Prepare and file a tax return with the tax owed to the Internal Revenue Service.
b. A customer pays an invoice with a check. Accounts receivable is updated to reflect the payment. The check is recorded and deposited into the bank.
c. A customer places an online order to purchase merchandise. The order is approved, filled, and sent to the customer with an invoice.
d. An inventory request is received by the purchasing department. The purchasing department prepares and sends a purchase order to the appropriate vendor.
e. A vendor invoice is received, reviewed, and compared against the appropriate purchase order, then paid and filed.
f. A bill of lading for ordered inventory is received from a vendor, recorded, checked against the appropriate purchase order, and filed.

3.15. Melanie is doing a study on various weight-loss plans and needs to determine an individual's weight status by calculating his body mass index. To calculate a person's body mass index, height must be measured in meters and weight measured in kilograms. The index is calculated by dividing a person's weight by the square of his height. The result is then compared to the following scale to determine the person's weight status: Below 18.5 = underweight; 18.5–24.5 = normal weight; over 25.0 = overweight. Five hundred people have agreed to participate in Melanie's study. With so many calculations to perform, she would like a computer program that will do this calculation for her. She decides to prepare a flowchart to help her properly design the computer program.



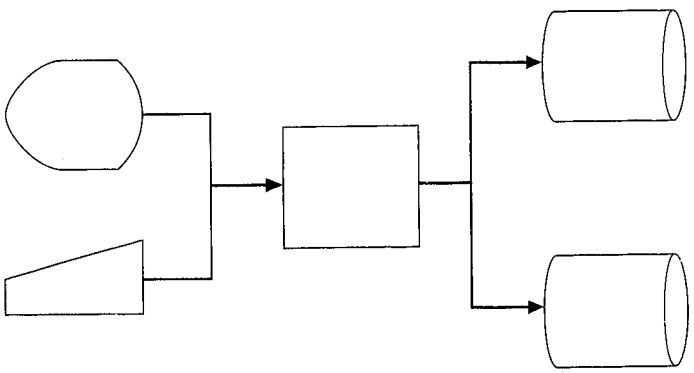
Required

Prepare a program flowchart to help Melanie program this process.

3.16. Match the flowchart, context diagram, or data flow diagram segments in the right column to an appropriate description in the left column.

1. Statements are prepared and sent to customers from data contained in the accounts receivable data store.

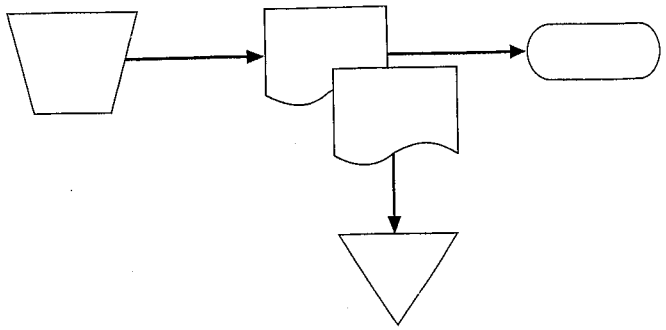
A.



(continued)

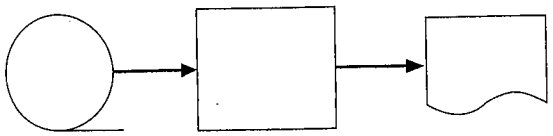
2. A customer sends a sales invoice to the accounts payable process.

B.



3. A check is manually prepared from data on a vendor invoice.

C.



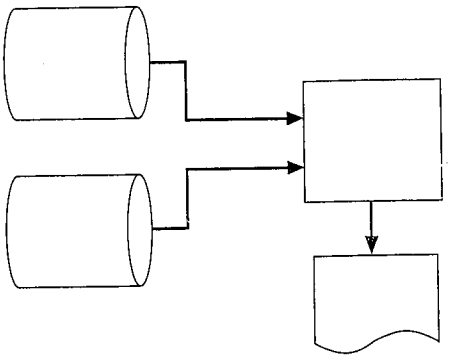
4. The cash receipt process updates the cash receipts data store.

D.



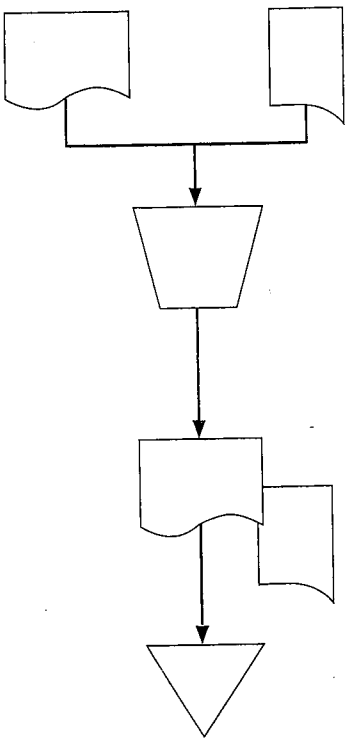
5. A sales invoice is manually prepared and sent to a customer.

E.



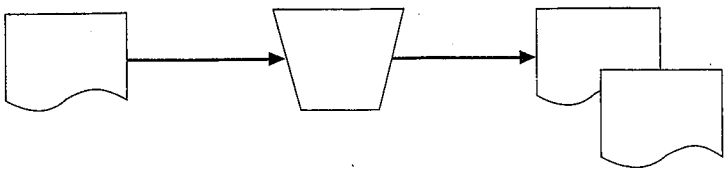
6. A report is prepared from data stored on magnetic tape.

F.



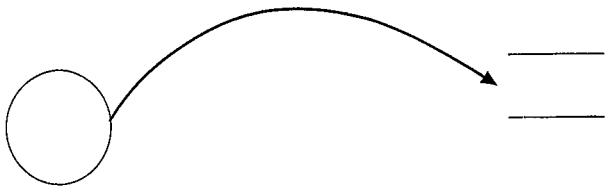
7. Billing data are entered online and used to update the sales order file and the customer master file.

G.



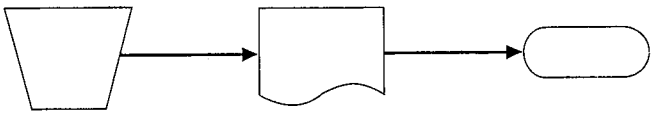
8. Data from a cancelled invoice are used to update the cash disbursements ledger.

H.



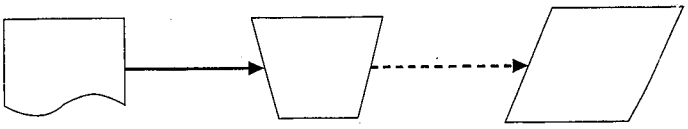
9. A sales order is prepared manually. Copy 1 is sent to the warehouse, and copy 2 is filed.

I.



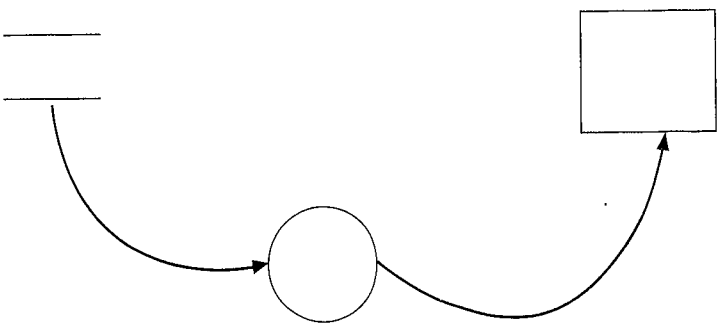
10. An accounts receivable aging report is prepared from the accounts receivable master file and the cash receipts master file, both stored on disk.

J.



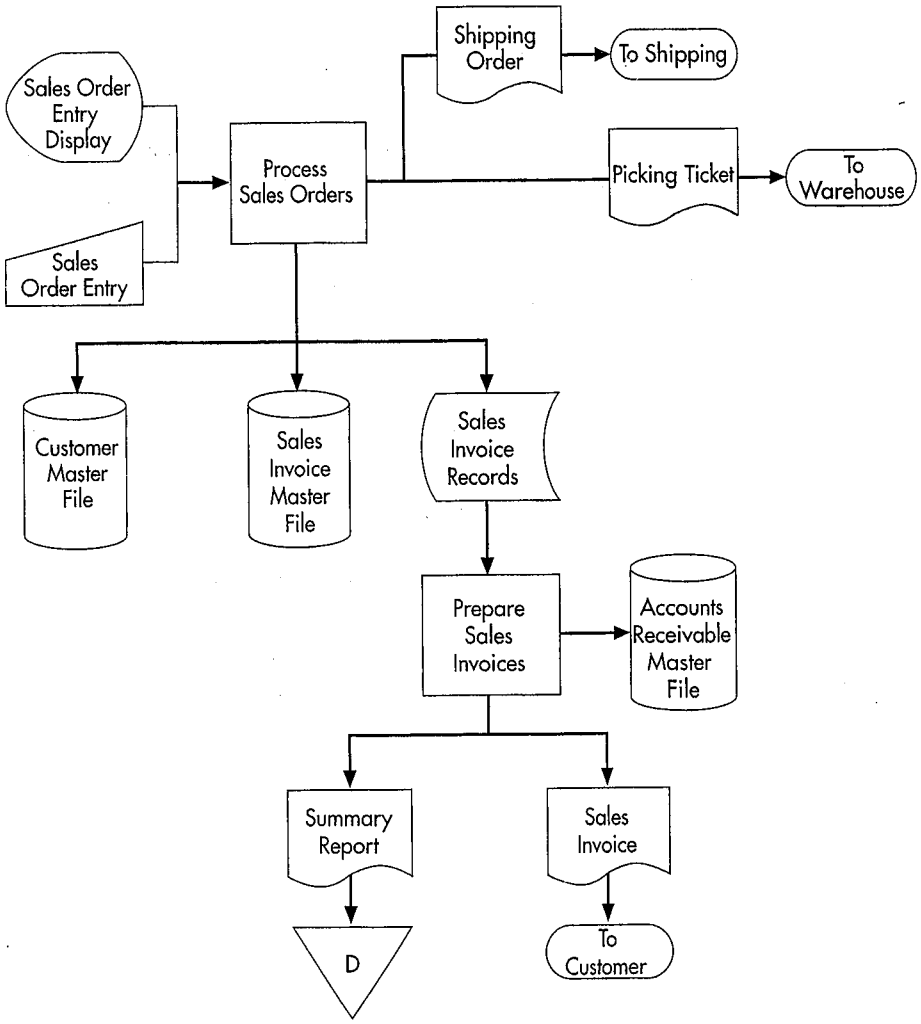
11. An error listing and batch total are compared and filed.

K.



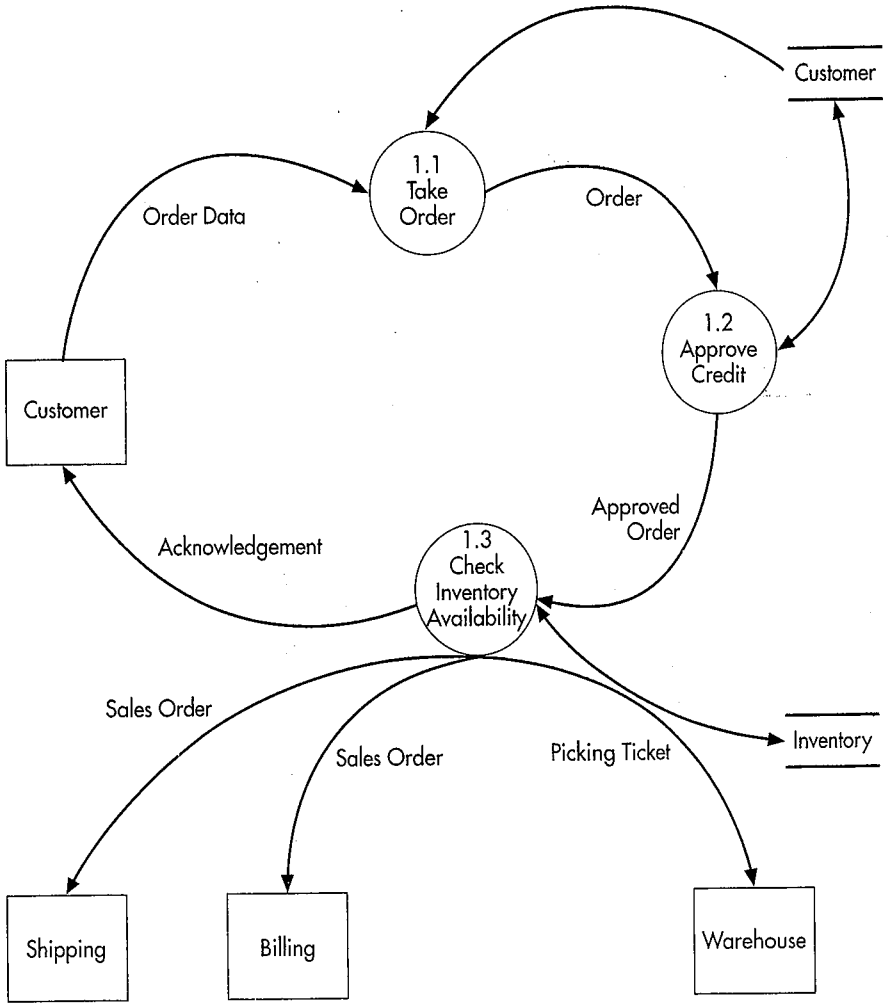


3.17. Replicate the following flowchart in Visio, Microsoft Word, Microsoft Excel, or some other documentation software package.



3.18. Replicate the following data flow diagram in Visio, Microsoft Word, Microsoft Excel, or some other documentation software package.





Case 3-1 Dub 5

You are the systems analyst for the Wee Willie Williams Widget Works (also known as Dub 5, which is a shortened version of 5 Ws). Dub 5 has been producing computer keyboard components for more than 20 years and has recently signed an exclusive 10-year contract to provide the keyboards for all Dell personal computers. As the systems analyst, you have been assigned the task of developing a level 0 DFD for Dub 5's order processing system. You have finished gathering all the information you need to develop the first-pass DFD and now want to complete the diagram.

Customer orders, which are all credit sales, arrive via e-mail and by phone. When an order is processed, a number of other documents are prepared. You have diagrammed the overall process and the documents produced, as shown in the context diagram shown below.

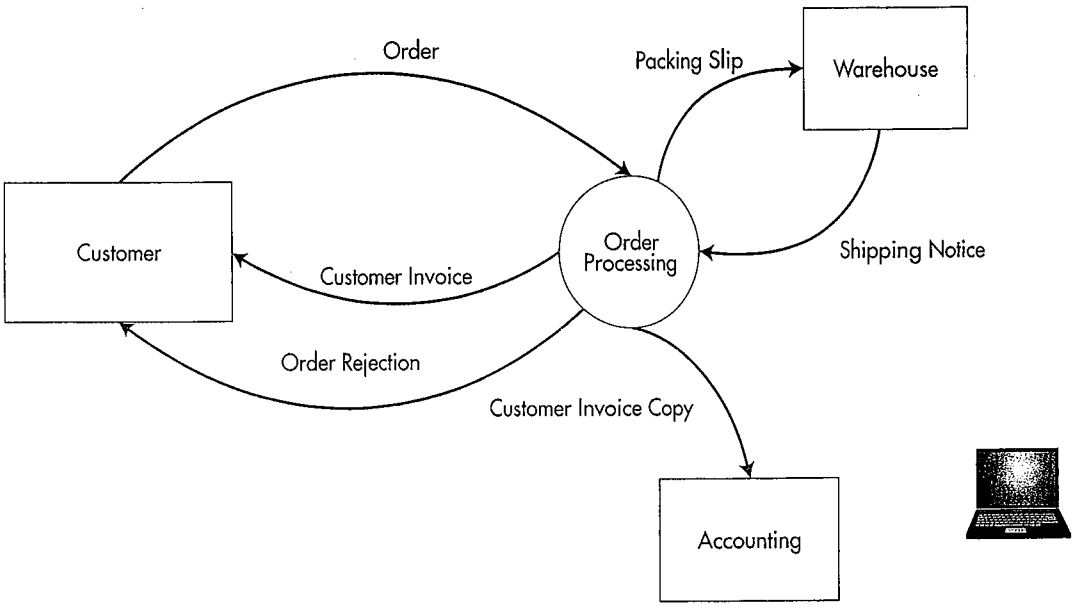
The following documents are created:

- Order processing creates a packing slip, which the warehouse uses to fill the order.
- A customer invoice is prepared and sent once the goods have been shipped.
- When orders are not accepted, an order rejection is sent to the customer, explaining why the order cannot be filled.
- A receivables notice, which is a copy of the customer invoice, is sent to the accounting department so accounts receivable records can be updated.

After reviewing your notes, you write the following narrative summary:

> When an order comes in, the order processing clerk checks the customer's credit file to confirm credit approval and ensure that the amount falls within the credit limit. If either of these conditions is not met, the order is sent to the credit department. If an order meets both conditions, the order-processing clerk enters it into the system on a standard order form. The information on the form is used to update the company's customer file (in which the name, address, and other information are stored), and the form is placed in the company's open order file.
>
> When the credit department receives a rejected order, the credit clerk determines why the order has been rejected. If the credit limit has been exceeded, the customer is notified that the merchandise will be shipped as soon as Dub 5 receives payment. If the customer has not been approved for credit, a credit application is sent to the customer along with a notification that the order will be shipped as soon as credit approval is granted.
>
> Before preparing a packing slip, the system checks the inventory records to determine whether the company has the products ordered on hand. If the items are in stock, a packing slip is prepared and sent to the warehouse.
>
> Once notification of shipped goods has been received from the warehouse, a customer invoice is prepared. A copy is filed by the order processing department, another is sent to the customer, and another is sent to the accounting department so that accounts receivables can be updated. A note is placed in the customer file indicating that the invoice has been sent.

From the information presented, complete a Level 0 DFD for order processing and a Level 1 DFD for the credit review process for Dub 5.



AIS IN ACTION SOLUTIONS

Quiz Key

1. A DFD is a representation of which of the following?
   a. relationship among modules, data, and programs of an AIS [Incorrect. A flowchart represents the relationship among modules, data, and programs.]
   ▶ b. flow of data in an organization [Correct.]
   c. decision rules in a computer program [Incorrect. A DFD is a graphical representation of how data move through an organization. Decision rules are objective statements specific to computer programs.]
   d. computer hardware configuration [Incorrrect. This relates to how various parts of a computer fit together.]

2. Documentation methods such as DFDs and flowcharts save both time and money, adding value to an organization.
   ▶ a. True [Correct. A picture is worth a thousand words: An individual may learn more and learn it more quickly by studying the DFD or flowchart of a system than by reading a narrative description of the same system.]
   b. False [Incorrect]

3. Which of the following statements is FALSE?
   a. Flowcharts make use of many symbols. [Incorrect. The statement is true. See Figure 3-8 for an illustration of the many symbols used in flowcharts.]
   b. A document flowchart emphasizes the flow of documents or records containing data. [Incorrect. The statement is true. The reason it is called a document flowchart is that it shows the flow of documents or records containing data.]
   ▶ c. DFDs help convey the timing of events. [Correct. DFDs show data movement, but not necessarily the timing of the movement.]
   d. Both a and b are false. [Incorrect. As explained above, a and b are true statements.]

4. A DFD consists of the following four basic elements: data sources and destinations, data flows, transformation processes, and data stores. Each is represented on a DFD by a different symbol.
   ▶ a. True [Correct. The four elements of DFDs are illustrated in Figure 3-1.]
   b. False [Incorrect]

5. Which of the following is NOT one of the guidelines that should be followed in naming DFD data elements?
   a. Process names should include action verbs such as *update*, *edit*, *prepare*, and *record*. [Incorrect. Action verbs should be used to name process data elements. See item 11 in Focus 3-1.]
   b. Make sure the names describe all the data or the entire process. [Incorrect. Data element names should reflect what is known about the element. See item 11 in Focus 3-1.]
   ▶ c. Name only the most important DFD elements. [Correct. All data elements should be named, with the exception of data flows into data stores, when the inflows and outflows make naming the data store redundant. See item 11 in Focus 3-1.]
   d. Choose active and descriptive names. [Incorrect. Active and descriptive names should be used in naming data elements. See item 11 in Focus 3-1.]

6. The documentation skills that accountants require vary with their job function. However, all accountants should at least be able to do which of the following?
   ▶ a. Read documentation to determine how the system works. [Correct. All accountants should at least be able to read and understand system documentation.]
   b. Critique and correct documentation that others prepare. [Incorrect. Although senior accountants may critique and correct documentation prepared by junior accountants, at a minimum all accountants need to be able to read and understand documentation.]

c. Prepare documentation for a newly developed information system. [Incorrect. Some accountants may need to develop internal control documentation, but system developers and analysts normally prepare systems documentation.]
d. Teach others how to prepare documentation. [Incorrect. Most accountants will not be asked to teach documentation skills.]

7. Which of the following statements is FALSE?
a. A flowchart is an analytical technique used to describe some aspect of an information system in a clear, concise, and logical manner. [Incorrect. This is the definition of a flowchart given previously in the text.]
b. Flowcharts use a standard set of symbols to describe pictorially the flow of documents and data through a system. [Incorrect. The symbols used for flowcharting are shown in Figure 3-8.]
c. Flowcharts are easy to prepare and revise when the designer utilizes a flowcharting software package. [Incorrect. There are a number of good flowcharting software packages that make it easy to draw and modify flowcharts.]
▶ d. A system flowchart is a narrative representation of an information system. [Correct. A flowchart is a graphical rather than a narrative representation of an information system.]
e. A program flowchart shows the logic used in computer programs. [Incorrect. A program flowchart illustrates program logic and the structure of the program.]

8. Which of the following flowcharts illustrates the flow of information among areas of responsibility in an organization?
a. program flowchart [Incorrect. A program flowchart documents a computer program.]
b. computer configuration chart [Incorrect. A computer configuration chart illustrates how computer hardware is arranged and implemented.]
c. system flowchart [Incorrect. A system flowchart illustrates the relationship among inputs, processes, and outputs of a system, not areas of responsibility.]
▶ d. document flowchart [Correct. A document flowchart traces the life of a document from its cradle to its grave as it works its way through the areas of responsibility within an organization.]

9. Which of the following is NOT one of the recommended guidelines for making flowcharts more readable, clear, concise, consistent, and understandable?
a. Divide the flowchart into columns with labels. [Incorrect. Dividing the flowchart into columns helps make it more readable, clear, concise, consistent, and understandable. See item 3 in Focus 3-2.]
▶ b. Flowchart all information flows, especially exception procedures and error routines. [Correct. Including all exception procedures and error routines clutters the flowchart and makes it difficult to read and understand. See item 4 in Focus 3-2.]
c. Design the flowchart so that flow proceeds from top to bottom and from left to right. [Incorrect. Flowcharts should be prepared so that they are read like a book. See item 5 in Focus 3-2.]
d. Show the final disposition of all documents to prevent loose ends that leave the reader dangling. [Incorrect. All documents should be placed either in a file or sent to another entity. See item 6 in Focus 3-2.]
e. Make sure that each manual processing symbol has an input and an output. [Incorrect. A manual process must have an input and an output. Without an input, nothing can be processed; and without an output, there is no evidence of processing. See item 10 in Focus 3-2.]

10. How are data sources and destinations represented in a data flow diagram?
▶ a. as a square [Correct. See Figure 3-1.]
b. as a curved arrow [Incorrect. A curved arrow represents a data flow. See Figure 3-1.]
c. as a circle [Incorrect. A circle represents a process. See Figure 3-1.]
d. as two parallel lines [Incorrect. Two parallel lines represent a data store. See Figure 3-1.]
e. as none of the above [Incorrect. Option a is correct.]

Comprehensive Problem Solution



Flowchart

The first step in preparing a document flowchart is to become familiar with the problem. The next step is to identify the primary actors or major players. In this problem there are three major players: Megan Waters (accounts payable clerk), Stan Phillips (cash disbursement clerk), and John Sterling (treasurer). Since we are documenting Accuflow's cash disbursement process, we are not interested in the internal workings of the vendor, SoftData. As a result, we do not include it as one of our major players. Now that we have identified the major players, we can list their functions in Table 3-3. Note that forwarding to and receiving from the next major player are not considered functions in preparing document flowcharts.

We will now explain, step by step, how to create the document flowchart solution for Accuflow shown in Figure 3-14. To document the functions of the three major players, divide the document flowchart into three columns, one for each player. It is usually best to arrange the columns in the order in which they occur and to use the primary function of the major player as the column name. Because the accounts payable clerk receives the invoice from the vendor, we place her in the first column. After the accounts payable clerk records the invoice, she sends it to the cash disbursements clerk, who prepares a check and sends it to the treasurer. Therefore, the cash disbursements clerk should be in the second column, and the treasurer should be in the last column, as illustrated in Figure 3-14.

Because the process begins with an invoice from an external party (a vendor), a terminal symbol with the term "From Vendor" is placed in the upper left portion of the Accounts Payable Clerk column. Next, a document symbol with the words "Vendor Invoice" printed inside it is placed below the terminal symbol. An arrow representing the document's flow and the order of operations connects the two symbols.

According to the narrative, Megan manually records the invoice in the accounts payable subsidiary ledger. Thus, a manual process symbol with the words "Record Invoice" is placed below the invoice document symbol, and the two symbols are connected with an arrow. Then, a journal/ledger symbol, also called an input/output symbol, is placed to the side of the manual process. Because only information from the invoice is used to update the accounts payable subsidiary ledger, a dotted arrow is used to connect the two symbols. A new vendor invoice symbol is drawn below the record invoice symbol.

Because the vendor invoice moves from the accounts payable clerk to the cash disbursements clerk, the vendor invoice symbol is placed at the top of the cash disbursements column with an arrow connecting the two representations of the same document. We redraw the vendor invoice symbol in the cash disbursements clerk column to make the flowchart easier to read.

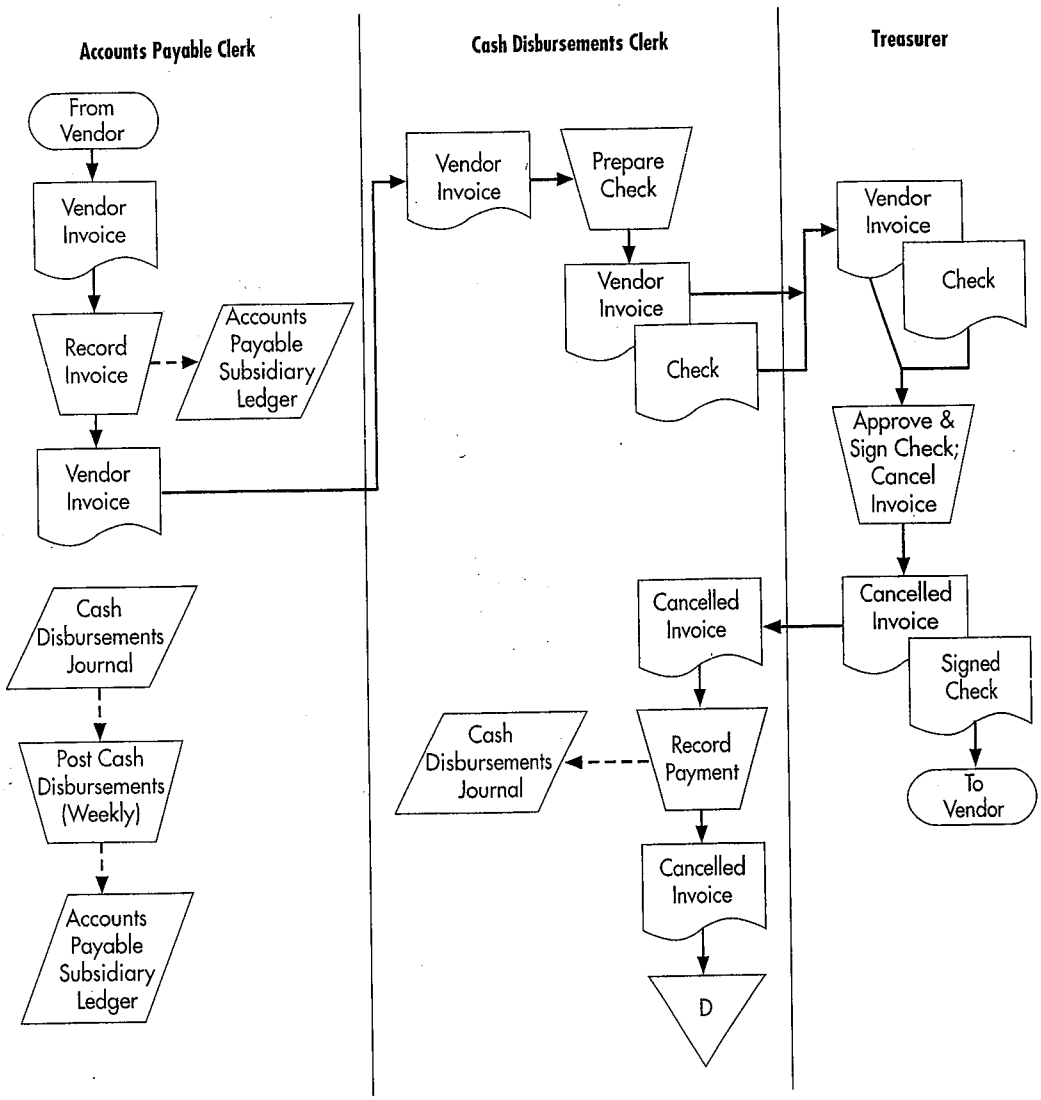
To show that the cash disbursement clerk prepares a check to pay the vendor invoice, a manual process symbol with "Prepare Check" inside it is placed next to the vendor invoice. We could have placed it below the invoice symbol but put it beside it to save space. Two document symbols are placed below the manual process for the vendor invoice and the newly prepared check.

The cash disbursements clerk then sends the invoice and check to the treasurer. As a result, the vendor invoice and check appear in the Treasurer column. A manual symbol with "Approve & Sign Check; Cancel Invoice" inside is used to show that the check is signed and the invoice is cancelled. The documents are again shown in the flowchart, this time with new titles (Cancelled Invoice and Signed Check) to show the changed nature of the documents. The treasurer sends the signed check to the vendor, which is illustrated using a terminal symbol with words "To Vendor" written in it.

TABLE 3-3 Accuflow's Table of Functions

Accounts Payable Clerk (Megan Waters)	Cash Disbursements Clerk (Stan Phillips)	Treasurer (John Sterling)
Receives invoice	Prepares check	Approves and signs check
Records invoice	Records cash disbursement	Cancels invoice
Posts cash disbursement	Files cancelled invoice	Mails check

FIGURE 3-14
Accuflow's Document Flowchart



The cancelled invoice is used to record the cash disbursement in the cash disbursements journal, so it is sent back to the middle column (Cash Disbursements). A manual process symbol with "Record Payment" inside it and a dotted arrow are used to show that the disbursement is recorded in the cash disbursements journal, represented by a journal/ledger symbol. To illustrate that the cancelled invoice is filed by date, it is shown, using appropriate arrows, as exiting the record payment manual process and entering a file. A "D" is placed in the file symbol to indicate that the documents are filed by date.

Each week, the accounts payable clerk manually posts entries from the cash disbursements journal to the accounts payable subsidiary ledger. To show this, the cash disbursements journal symbol is reproduced in the accounts payable clerk column, and a manual process symbol with the words "Post Cash Disbursements (Weekly)" is placed under it. Dotted arrows show information from this journal being entered into the accounts payable subsidiary ledger.

This completes the document flowchart for the Accuflow Company's cash disbursements process.

Context Diagram

A context diagram is an overview of the information process being documented. As such, a context diagram includes a single transformation process (circle or bubble) and the data sources and data destinations that send or receive data directly from the transformation process. Thus, the first step in preparing a context diagram is to draw a single circle or bubble and then label it with a name that best describes the process being documented. In this case, "Cash Disbursements System" effectively describes the process (see Figure 3-15).

The next step is to draw and label squares for the entities that either send data to the cash disbursements process or receive data from the cash disbursements process. In this example, there is

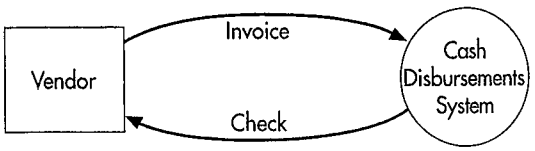


FIGURE 3-15
Accuflow's Context Diagram

a single entity—the vendor that acts as both a source and a destination of data to/from the cash disbursements process. In other processes, an outside entity could be just a source or a destination of data, and there could be more than one source or destination of data.

The last step is to connect the process (circle) with the source/destination (square) with arrows representing data flows. In this case, we have two arrows representing an invoice sent to Accuflow's cash disbursement process and a check sent to the vendor from Accuflow.

Level 0 Data Flow Diagram

In the context diagram, we saw the entire cash disbursements process in one bubble. In a level 0 DFD, we break down the cash disbursements process into its major functions. In reading the narrative, we find the following five primary steps in the cash disbursements process at Accuflow:

1. Receive vendor invoice and record payable
2. Prepare the check
3. Sign and send the check and cancel the invoice
4. Record the cash disbursement
5. Post the cash disbursements to the accounts payable ledger

Each of these processes is represented by a circle or bubble in Figure 3-16. Since this is the level 0 DFD, we assign each of these processes a real number, with the first digit after the decimal point being a zero. We also place the circles in the order that the data should flow in the process. As a result, "Receive and Record Invoice" is assigned process 1.0, "Prepare Check" is assigned process 2.0, "Approve and Sign Check" is 3.0, "Record Cash Disbursement" is 4.0, and "Post Cash Disbursement to Accounts Payable Ledger" is 5.0. This numbering system allows us to

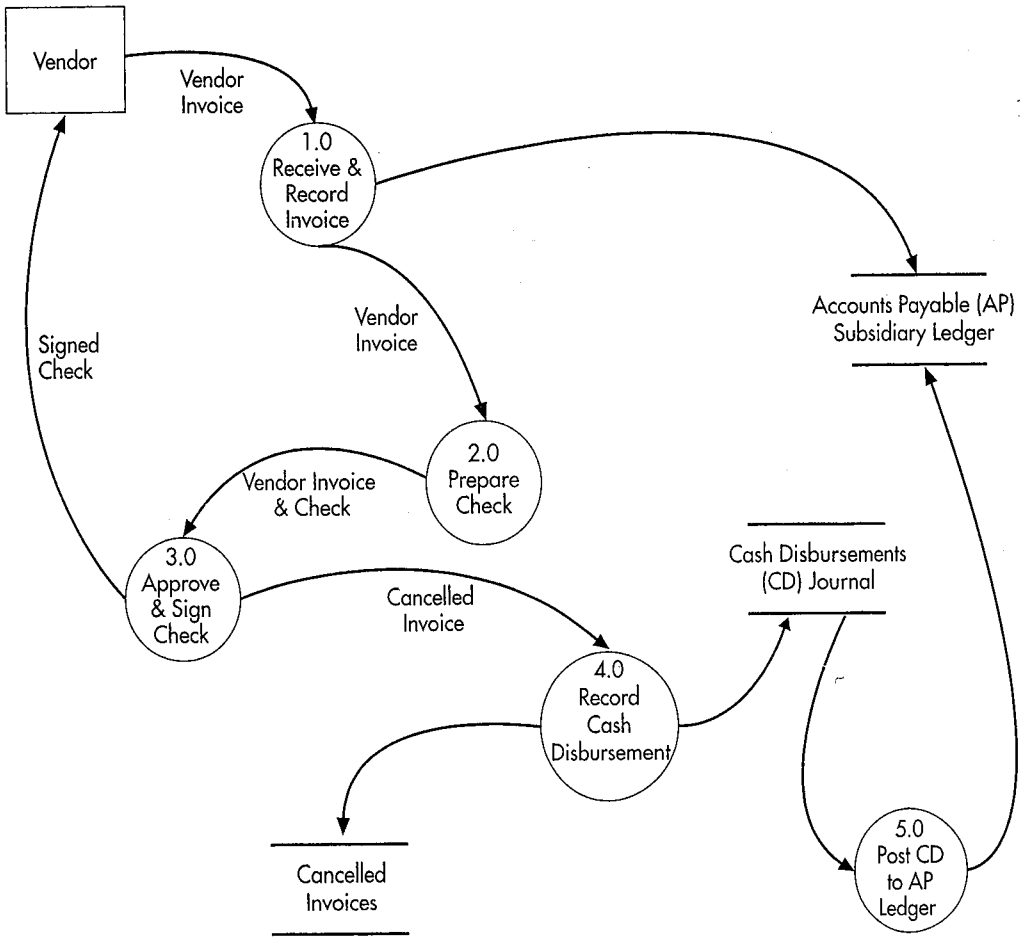


FIGURE 3-16
Accuflow's Level 0 Data Flow Diagram

decompose these processes into more detailed subprocesses and still keep a consistent numbering system. Thus, if we needed to decompose process 3.0 to a more detailed level, we could assign subprocess bubbles as 3.1, 3.2, 3.3, etc. We can even provide greater detail by decomposing process 3.1 into subprocesses 3.1.1, 3.1.2, 3.1.3, etc.

Next, we place the data sources and data destinations on the level 0 DFD. Because we had only one data source and destination (i.e., the vendor), we draw a square and label it "Vendor." It is very important that we reconcile back to the context diagram when we prepare the different levels of DFDs. That is, the same data sources and destinations that appeared on the context diagram must also appear on the level 0 DFD. No new data sources and destinations may appear on the level 0 DFD. If, when preparing the level 0 DFD, you discover that a data source/destination is necessary to document the system properly, then you must revise the context diagram with the new data source/destination, because the context diagram should represent the entire process.

Once the data source/destinations and processes are drawn, we then connect them by drawing the arrows between the appropriate symbols. These arrows represent the data moving or flowing from one process to another and from one source or destination to or from a particular process. Accordingly, we have a vendor invoice moving from the vendor to the "Receive and Record Invoice" process and from that process to the "Prepare Check" process. The vendor invoice and a check move from the "Prepare Check" process to the "Approve and Sign Check" process. We also have arrows leaving process 3.0 to represent the signed check being sent to the vendor and the cancelled invoice going to process 4.0, "Record Cash Disbursements."

Some processes require that data be stored. As a result, we also draw any necessary files or data stores. The level 0 DFD is the first time data stores appear in a DFD set. (Note: Data stores should not be represented on a context diagram.) Data store labels should identify the data being sent to or from it. As a result, labeling the data flows to or from data stores is normally unnecessary. Data stores are prepared by drawing two parallel lines and inserting the name of the data store between the parallel lines.

In Figure 3-16 we have three data stores: the cash disbursements journal, accounts payable subsidiary ledger, and the cancelled invoices data store. Because the cash disbursements journal is updated in process 4.0, a data flow is sent from the process 4.0 circle to the cash disbursements journal data store. To show that the accounts payable ledger is updated when invoices are received (process 1.0), an arrow is drawn from that process to the accounts payable ledger. To show that accounts payable is updated with data from the cash disbursements journal (process 5.0), a data flow arrow is drawn from the cash disbursements data store to process 5.0, and another data flow arrow is drawn from process 5.0 to the accounts payable subsidiary ledger data store. The update takes place weekly, but unlike document flowcharts, a DFD does not indicate the timing of data flows.

Level 1 Data Flow Diagram

When additional detail is needed to document data flows, a process bubble may be decomposed further. As indicated in Focus 3-1, to be clear, understandable, and easy to read, a DFD should contain no more than seven process bubbles. In the Accuflow example, we broke the company's data flows into five main processes. Each of these five processes can be further decomposed. To illustrate this, we will decompose process 3.0. The narrative indicates that the treasurer approves and signs the prepared check, sends it to the vendor, and cancels the invoice to prevent duplicate payments. Therefore, we will break down process 3.0 into process 3.1 (approve and sign check), 3.2 (send check to vendor), and 3.3 (cancel invoice). To display the three processes, we draw three circles and label them as shown on Figure 3-17. We also draw the data flows and label them. Notice that the vendor data source/destination is not needed on the level 1 DFD since it is already shown on level 0. Since it would clutter the DFD, and because we are showing greater detail on the level 1 than on the level 0 for one particular process, we do not replicate all of the processes and data stores in the level 0 DFD.

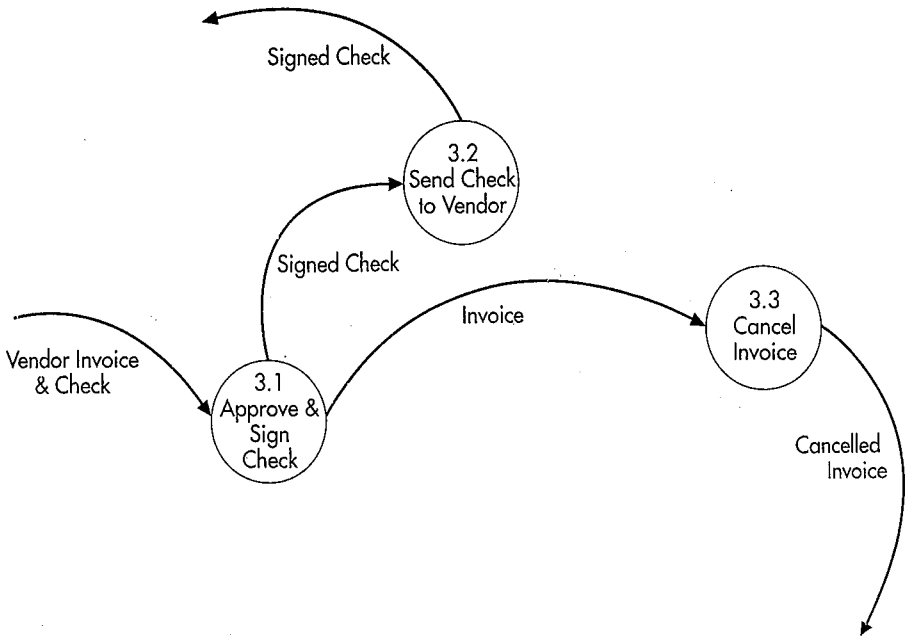


FIGURE 3-17
Accuflow's Level 1 Data Flow Diagram

Chapter 4

Relational Databases

Learning Objectives

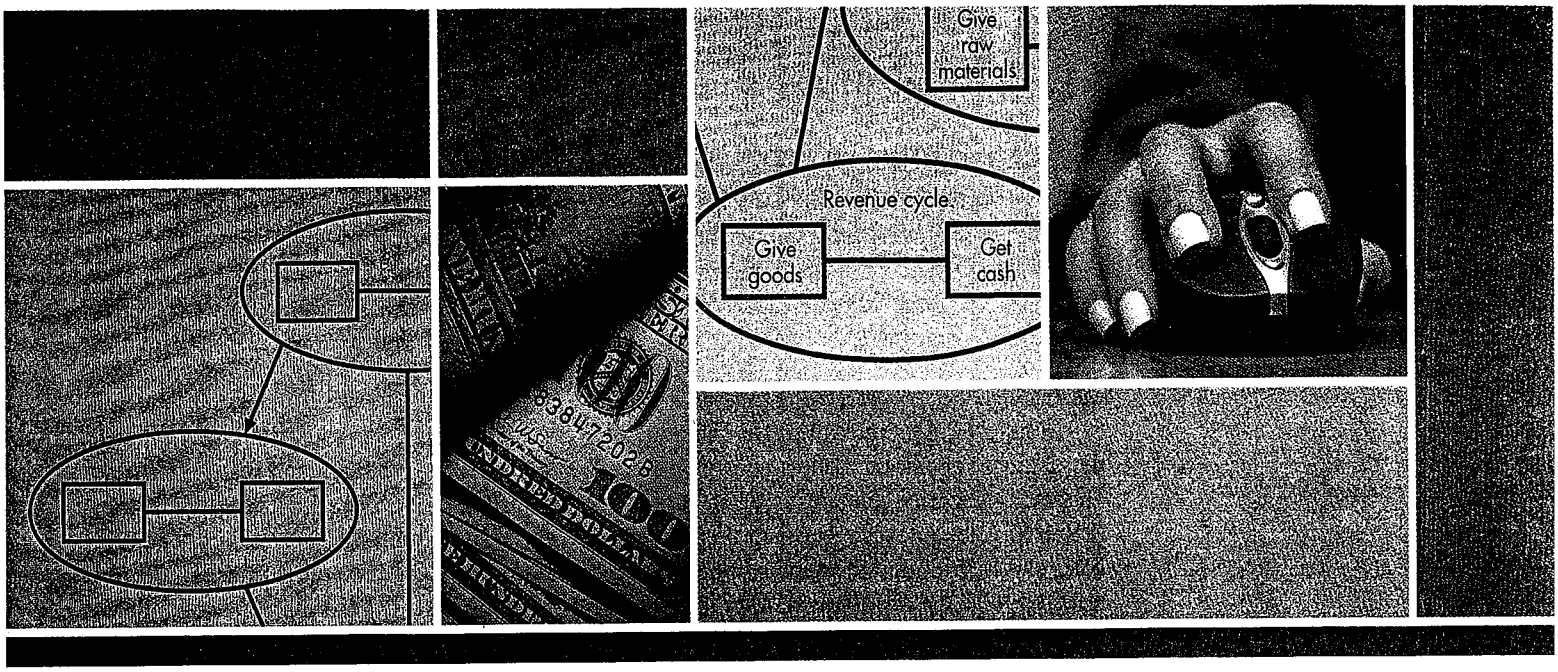
After studying this chapter, you should be able to:

1. Explain the importance and advantages of databases, as well as the difference between database systems and file-based legacy systems.
2. Explain the difference between logical and physical views of a database.
3. Explain fundamental concepts of database systems such as DBMS, schemas, the data dictionary, and DBMS languages.
4. Describe what a relational database is and how it organizes data.
5. Create a set of well-structured tables to store data in a relational database.
6. Perform simple queries using the Microsoft Access database.

INTEGRATIVE CASE S&S

S&S is very successful and operates five stores and a popular Web site. Ashton Fleming believes that it is time to upgrade S&S's AIS so that Susan and Scott can easily access the information they need to run their business. Most new AISs are based on a relational database. Since Ashton knows that Scott and Susan are likely to have questions, he prepared a brief report that explains why S&S's new AIS should be a relational database system. His report addresses the following questions:

1. What is a database system, and how does it differ from file-oriented systems?
2. What is a *relational* database system?
3. How do you design a well-structured set of tables in a relational database?
4. How do you query a relational database system?



Introduction

Relational databases underlie most modern integrated AISs. This chapter and Chapters 17 through 19 explain how to participate in the design and implementation of a database. This chapter defines a database, with the emphasis on understanding the relational database structure. Chapter 17 introduces two tools accountants use to design databases—entity-relationship diagramming and REA data modeling—and demonstrates how to use them to build an AIS data model. Chapter 18 explains how to implement an REA data model and how to produce the information needed to manage an organization. Chapter 19 discusses advanced data modeling and database design issues.

Files versus Databases

To appreciate the power of databases, it is important to understand how data are stored in computer systems. Figure 4-1 shows a data hierarchy. Information about the attributes of a customer, such as name and address, are stored in fields. All the fields containing data about one entity (e.g., one customer) form a record. A set of related records, such as all customer records, forms a file (e.g., the customer file). A set of interrelated, centrally coordinated files forms a *database*.

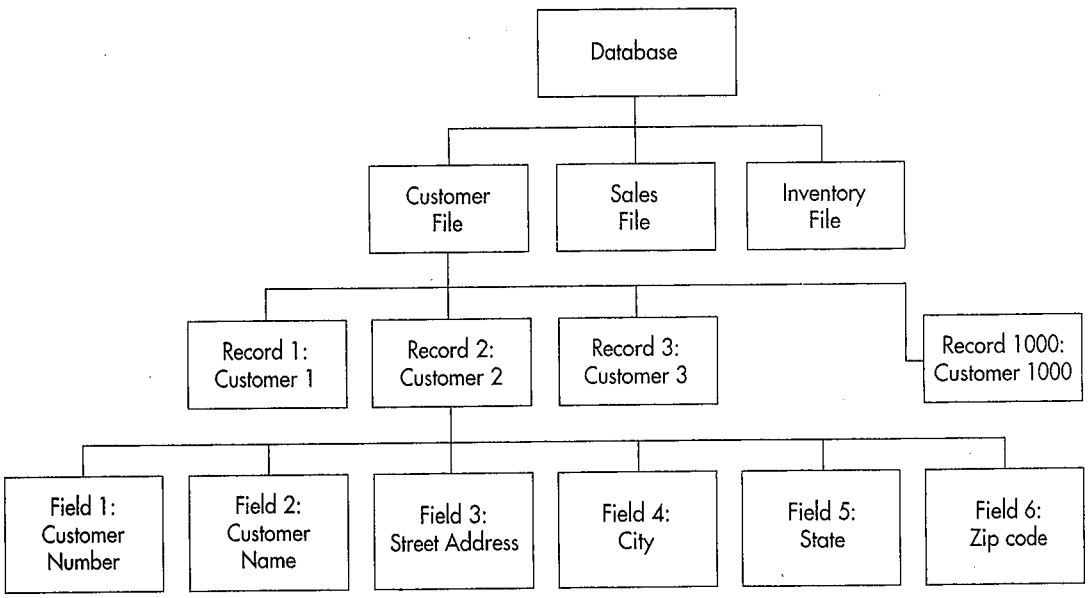


FIGURE 4-1
Basic Elements of Data Hierarchy

Databases were developed to address the proliferation of master files. For many years, companies created new files and programs each time a need for information arose. Bank of America once had 36 million customer accounts in 23 separate systems. This proliferation created problems such as storing the same data in two or more master files, as shown in Figure 4-2. This made it difficult to integrate and update data and to obtain an organization-wide view of data. It also created problems because the data in the different files were inconsistent. For example, a customer's address may have been correctly updated in the shipping master file but not the billing master file.

Figure 4-2 illustrates the differences between file-oriented systems and database systems. In the database approach, data is an organizational resource that is used by and managed for the entire organization, not just the originating department. A ***database management system (DBMS)*** is the interface between the database and the various application programs. The database, the DBMS, and the application programs that access the database through the DBMS are referred to as the ***database system***. The ***database administrator (DBA)*** is responsible for the database.

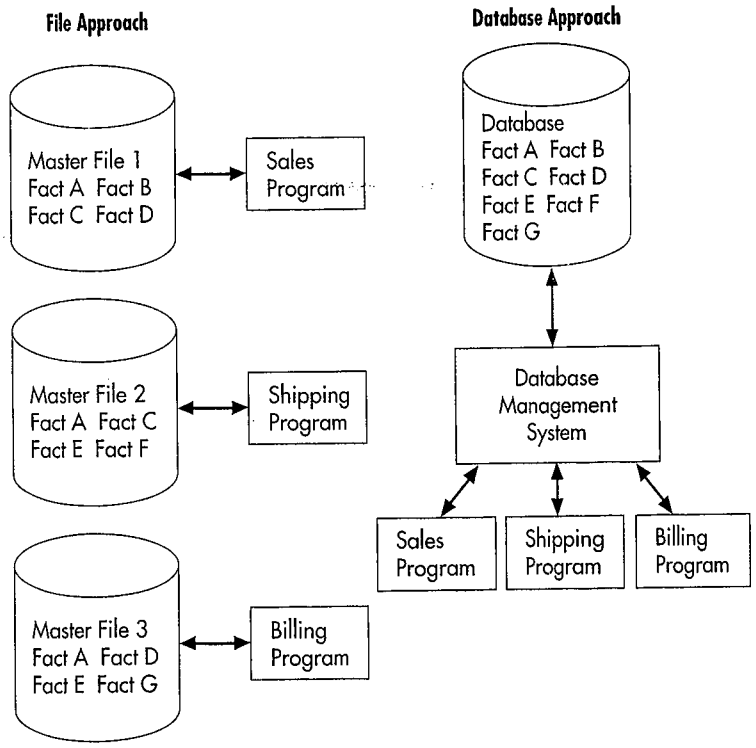
Using Data Warehouses for Business Intelligence

In today's fast-paced global economy, management must constantly reevaluate financial and operating performance in light of strategic goals and quickly alter plans as needed. Since strategic decision making requires access to large amounts of historical data, organizations are building separate databases called data warehouses. A ***data warehouse*** contains both detailed and summarized data for a number of years and is used for analysis rather than transaction processing. It is not unusual for data warehouses to contain hundreds of terabytes of data.

Data warehouses do not replace transaction processing databases; they complement them by providing support for strategic decision making. Since data warehouses are not used for transaction processing, they are usually updated periodically rather than in real time. Whereas transaction processing databases minimize redundancy and maximize the efficiency of updating them to reflect the results of current transactions, data warehouses are purposely redundant to maximize query efficiency.

Using a data warehouse for strategic decision making is often referred to as ***business intelligence***. There are two main techniques used in business intelligence: online analytical processing (OLAP) and data mining. ***Online analytical processing (OLAP)*** is using queries to guide the investigation of hypothesized relationships in data. For example, a manager may analyze

FIGURE 4-2
File-Oriented Systems Versus Database Systems



supplier purchases for the last three years. This may be followed by additional queries that "drill down" to lower levels by, for example, grouping purchases by different items and by fiscal periods. ***Data mining*** is using sophisticated statistical analysis, including artificial intelligence techniques such as neural networks, to "discover" unhypothesized relationships in the data. For example, credit card companies use data mining to identify usage patterns indicative of fraud. Similarly, data mining techniques can identify previously unknown relationships in sales data that can be used in future promotions.

Proper controls are needed to reap significant benefits from data warehousing. Data validation controls are needed to ensure that data warehouse input is accurate. Verifying the accuracy, called scrubbing the data, is often one of the most time-consuming and expensive steps in creating a data warehouse. It is also important to control access to the data warehouse as well as to encrypt the data stored in the data warehouse. Finally, it is important to regularly backup copies of the data warehouse and store them securely.

Bank of America created a customer information database to provide customer service, marketing analysis, and managerial information. It was the largest in the banking industry, with over 600 billion characters of data. It contained all bank data on checking and savings accounts; real estate, consumer, and commercial loans; ATMs; and bankcards. Although the bank spends $14 million a year to maintain the data warehouse, it is worth the cost. Queries that formerly averaged two hours took only five minutes. Minutes after Los Angeles suffered an earthquake, the bank sorted its $28 billion mortgage loan portfolio by Zip code, identified loans in the earthquake area, and calculated its potential loan loss.

The Advantages of Database Systems

Virtually all mainframes and servers use database technology, and database use in personal computers is growing rapidly. Most accountants are involved with databases through data entry, data processing, querying, or auditing. They also develop, manage, or evaluate the controls needed to ensure database integrity. Databases provide organizations with the following benefits:

- *Data integration.* Master files are combined into large "pools" of data that many application programs access. An example is an employee database that consolidates payroll, personnel, and job skills master files.
- *Data sharing.* Integrated data are more easily shared with authorized users. Databases are easily browsed to research a problem or obtain detailed information underlying a report. The FBI, which does a good job of collecting data but a poor job of sharing it, is spending eight years and $400 million to integrate data from their different systems.
- *Minimal data redundancy and data inconsistencies.* Because data items are usually stored only once, data redundancy and data inconsistencies are minimized.
- *Data independence.* Because data and the programs that use them are independent of each other, each can be changed without changing the other. This facilitates programming and simplifies data management.
- *Cross-functional analysis.* In a database system, relationships, such as the association between selling costs and promotional campaigns, can be explicitly defined and used in the preparation of management reports.

The Importance of Good Data

Incorrect database data can lead to bad decisions, embarrassment, and angry users. For example:

- A company sent half its mail-order catalogs to incorrect addresses. A manager finally investigated the large volume of returns and customer complaints. Correcting customer address in the database saved the company $12 million a year.
- Valparaiso, Indiana, used the county database to develop its tax rates. After the tax notices were mailed, a huge error was discovered: A $121,900 home was valued at $400 million and caused a $3.1 million property tax revenue shortfall. As a result, the city, the school district, and governmental agencies had to make severe budget cuts.

The Data Warehousing Institute estimates that bad data cost businesses over $600 billion a year in unnecessary postage, marketing costs, and lost customer credibility. It is estimated that over

25% of business data is inaccurate or incomplete. In a recent survey, 53% of 750 information technology (IT) professionals said their companies experienced problems due to poor-quality data.

Managing data gets harder every year: The quantity of data generated and stored doubles every 18 months. To avoid outdated, incomplete, or erroneous data, management needs policies and procedures that ensure clean, or scrubbed, data. The Sarbanes-Oxley Act states that top executives face prosecution and jail time if a company's financial data are not in order. Preventing and detecting bad data are discussed in more detail in Chapters 5 through 11.

Database Systems

Logical and Physical Views of Data

In file-oriented systems, programmers must know the physical location and layout of records. Figure 4-3 shows a ***record layout*** of an accounts receivable file. Suppose a programmer wants a report showing customer number, credit limit, and current balance. To write the program, she must understand the location and length of the fields needed (i.e., record positions 1 through 10 for customer number) and the format of each field (alphanumeric or numeric). The process becomes more complex if data from several files are used.

Database systems overcome this problem by separating the storage of the data from the use of data elements. The database approach provides two separate views of the data: the physical view and the logical view. The ***logical view*** is how people conceptually organize and understand the data. For example, a sales manager views all customer information as being stored in a table. The ***physical view*** refers to how and where data are physically arranged and stored in the computer system.

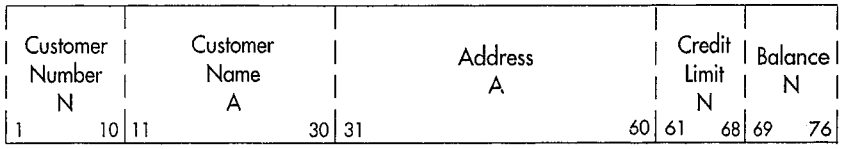
As shown in Figure 4-4, database management (DBMS) software links the way data are physically stored with each user's logical view of the data. The DBMS allows users to access, query, or update the database without reference to how or where data are physically stored. Separating the logical and physical views of data also means that users can change their logical view of data without changing the way data are physically stored. Likewise, the database administrator can change physical storage to improve system performance without affecting users or application programs.

Schemas

A *schema* describes the logical structure of a database. There are three levels of schemas: the conceptual, the external, and the internal. Figure 4-5 shows the relationships among these three levels. The ***conceptual-level schema***, the organization wide view of the *entire* database, lists all data elements and the relationships among them. The ***external-level schema*** consists of individual user views of portions of the database, each of which is referred to as a ***subschema***. The ***internal-level schema***, a low-level view of the database, describes how the data are stored and accessed, including record layouts, definitions, addresses, and indexes. Figure 4-5 connects each of the levels with bidirectional arrows to represent schema mappings. The DBMS uses the mappings to translate a user's or a program's request for data (expressed in terms of logical names and relationships) into the indexes and addresses needed to physically access the data.

At S&S, the conceptual schema for the revenue cycle database contains data about customers, sales, cash receipts, sales personnel, cash, and inventory. External subschemas are derived from this schema, each tailored to the needs of different users or programs. Each subschema can prevent access to those portions of the database that do not apply to it. For example,

FIGURE 4-3
Accounts Receivable File Record Layout



A = alphanumeric field
N = numeric field

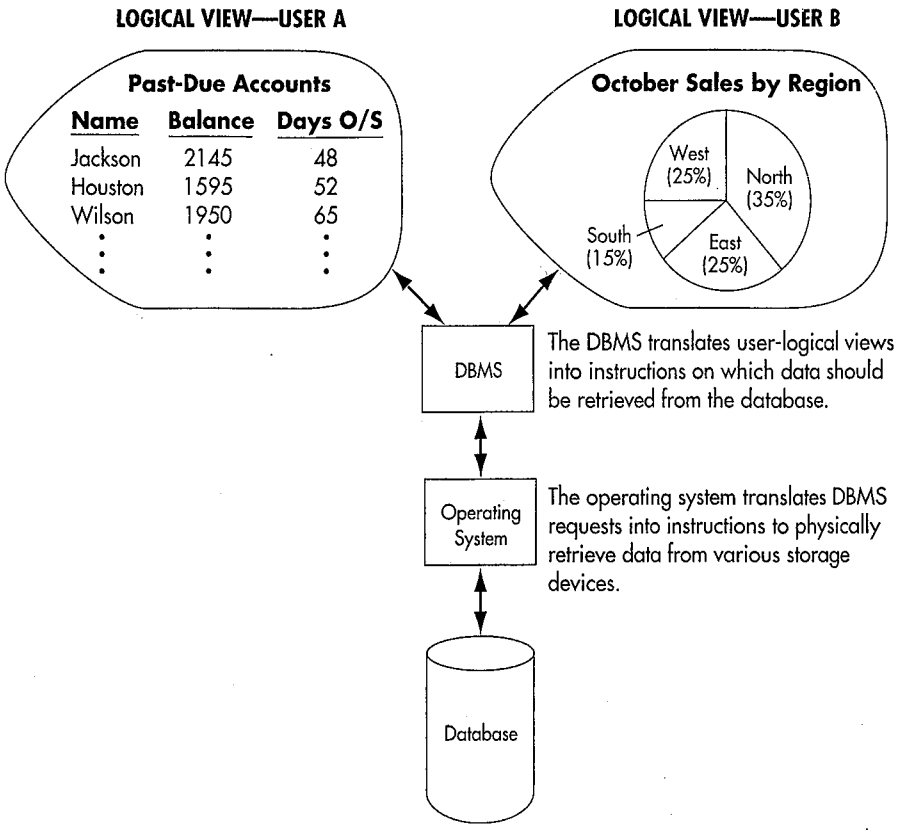


FIGURE 4-4
Function of the DBMS: To Support Multiple Logical Views of Data

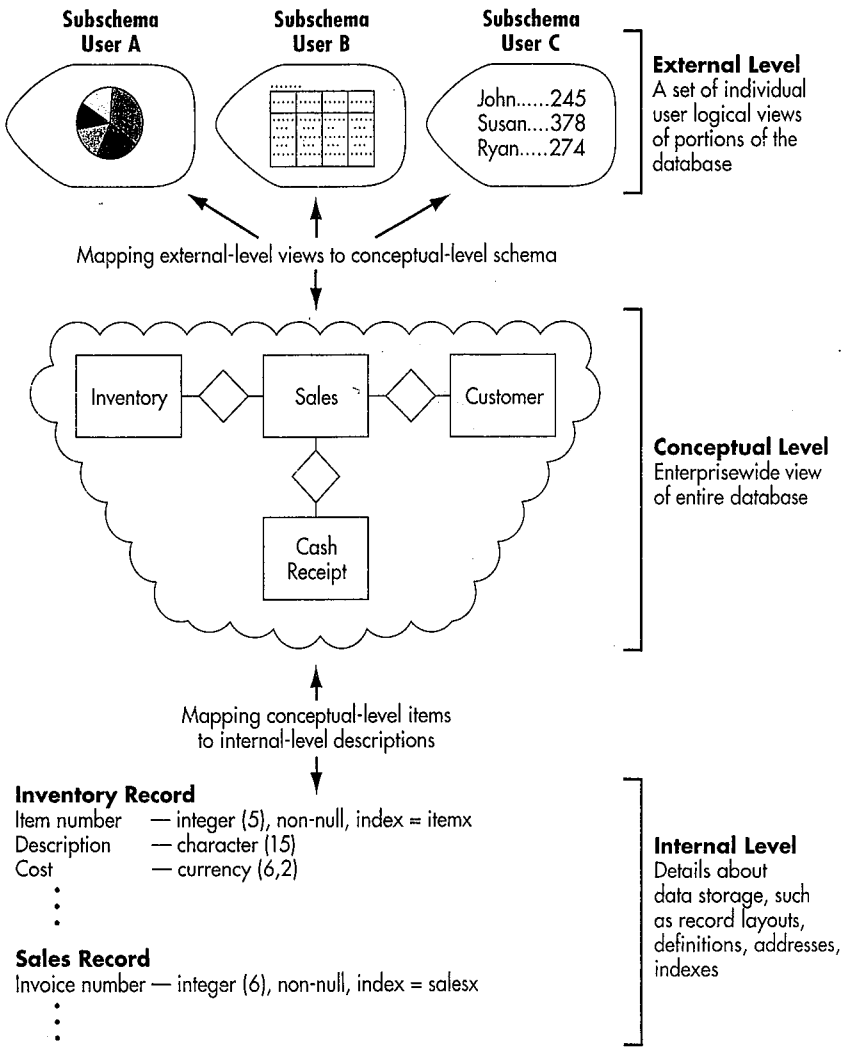


FIGURE 4-5
Three Levels of Schemas

the sales order entry subschema includes data about customer credit limits, current balances, and inventory quantities and prices. It would not include the cost of inventory or bank account balances.

The Data Dictionary

A *data dictionary* contains information about the structure of the database. As shown in Table 4-1, for each data element stored in the database, there is a record in the dictionary describing it. The DBMS maintains the data dictionary, whose inputs include new or deleted data elements and changes in data element names, descriptions, or uses. Outputs include reports for programmers, designers, and users such as (1) programs or reports using a data item, (2) synonyms for the data elements in a file, and (3) data elements used by a user. These reports are used for system documentation, for database design and implementation, and as part of the audit trail.

DBMS Languages

A DBMS has several languages. The ***data definition language (DDL)*** builds the data dictionary, creates the database, describes logical views for each user, and specifies records or field security constraints. The ***data manipulation language (DML)*** changes database content, including data element updates, insertions, and deletions. The ***data query language (DQL)*** contains powerful, easy-to-use commands that enable users to retrieve, sort, order, and display data. A ***report writer*** simplifies report creation. Users specify the data elements they want printed, and the report writer searches the database, extracts the data elements, and prints them in the user-specified format. The DQL and report writer are available to users. The DDL and DML should be restricted to authorized administrators and programmers.

Relational Databases

A DBMS is characterized by the logical ***data model***, or abstract representation of database contents, upon which it is based. As most new DBMSs are relational databases, this chapter focuses primarily on them. The ***relational data model*** represents conceptual- and external-level schemas as if data are stored in tables like the one shown in Table 4-2. The data are actually stored not in tables, but in the manner described in the internal-level schema.

Each row in a table, called a ***tuple*** (rhymes with *couple*), contains data about a specific occurrence of the type of entity represented by that table. Each column contains data about an attribute of that entity. For example, each row in Table 4-2 contains data about a particular inventory item that S&S carries, and each column contains data about specific inventory attributes, such as description, color, and price. Similarly, each row in a customer table contains data about a specific customer, and each column contains data about customer attributes, such as name and address.

Types of Attributes

A *primary key* is the database attribute, or combination of attributes, that uniquely identifies a specific row in a table. The primary key in Table 4-2 is Item Number as it uniquely identifies each merchandise item that S&S sells. Usually, the primary key is a single attribute. In some tables, two or more attributes are needed to identify uniquely a specific row in a table. The primary key of the Sales-Inventory table in Table 4-5 is the combination of Sales Invoice # and Item #.

A *foreign key, which* is an attribute that is a primary key in another table, is used to link tables. Customer # in Table 4-5 is the primary key in the Customer table and a foreign key in the Sales table. In the Sales table, Customer # links a sale to data about the customer who made the purchase, as contained in the Customer table (see arrows connecting tables).

Other nonkey attributes in a table store important information about that entity. The inventory table in Table 4-2 contains information about the description, color, vendor number, quantity on hand, and price of each item S&S carries.

TABLE 4-1 Example of a Data Dictionary

Data Element Name	Description	Records in Which Contained	Source	Field Length	Field Type	Programs in Which Used	Outputs in Which Contained	Authorized Users	Other Data Names
Customer number	Unique identifier of each customer	A/R record, customer record, sales analysis record	Customer number listing	10	Numeric	A/R update, customer file update, sales analysis update, credit analysis	A/R aging report, customer status report, sales analysis report, credit report	No restrictions	None
Customer name	Complete name of customer	Customer record	Initial customer order	20	Alphanumeric	Customer file update, statement processing	Customer status report, monthly statement	No restrictions	None
Address	Street, city, state, and Zip code	Customer record	Credit application	30	Alphanumeric	Customer file update, statement processing	Customer status report, monthly statement	No restrictions	None
Credit limit	Maximum credit that can be extended to customer	Customer record, A/R record	Credit application	8	Numeric	Customer file update, A/R update, credit analysis	Customer status report, A/R aging report, credit report	D. Dean R. Dalebout H. Heaton	CR_limit
Balance	Balance due from customer on credit purchases	A/R record, sales analysis record	Various sales and payment transactions	8	Numeric	A/R update, sales analysis update, statement processing, credit analysis	A/R aging report, sales analysis report, monthly statement, credit report	G. Burton B. Heninger S. Summers	Cust_bal

TABLE 4-2 Sample Inventory Table for S&S

Inventory : Table

Item Number	Description	Color	Vendor Number	Quantity on Hand	Price
1036	Refrigerator	White	10023	12	1199
1038	Refrigerator	Almond	10023	7	1299
1039	Refrigerator	Hunter Green	10023	5	1499
2061	Range	White	10011	6	799
2063	Range	Black	10011	5	999
3541	Washer	White	10008	15	499
3544	Washer	Black	10008	10	699
3785	Dryer	White	10019	12	399
3787	Dryer	Almond	10019	8	499

Record: 10 of 10

Designing a Relational Database for S&S, Inc.

In a manual accounting system, S&S would capture sales information on a preprinted sales invoice that provides both a logical and physical view of the data collected. Physical storage of sales invoice data is simple; S&S stores a copy of the invoice in a file cabinet.

Storing the same data in a computer is more complex. Suppose S&S wanted to store five sales invoices (numbered 101 to 105) electronically. On several invoices, a customer buys more than one item. Let us look at the effects of several ways of storing this information.

1: Store All Data in One Uniform Table. S&S could store sales data in one table, as illustrated in Table 4-3. This approach has two disadvantages. First, it stores lots of redundant data. Examine invoice 102 in Table 4-3. Because three inventory items are sold, invoice and customer data (columns 1–9) are recorded three times. Likewise, inventory descriptions and unit prices are repeated each time an item is sold. Because sales volumes are high in a retail store (remember, Table 4-3 represents only five invoices), such redundancy makes file maintenance unnecessarily time-consuming and error-prone.

Second, problems occur when invoice data are stored in one table. The first is called an *update anomaly*, because data value updates are not correctly recorded. Changing a customer's address involves searching the entire table and changing every occurrence of that customer's address. Overlooking even one row creates an inconsistency, because multiple addresses would exist for the same customer. This could result in unnecessary duplicate mailings and other errors.

An *insert anomaly* occurs in our example because there is no way to store information about prospective customers until they make a purchase. If prospective customer data is entered before a purchase is made, the Sales Invoice # column would be blank. However, the sales invoice number is the primary key for Table 4-3 and cannot be blank, as it uniquely identifies the record.

A *delete anomaly* occurs when deleting a row has unintended consequences. If a customer had one purchase of a single item, deleting that row erases all data about that customer.

2: Vary the Number of Columns. An alternative to Table 4-3 is to record sales invoice and customer data once and add additional columns to record each item sold. Table 4-4 illustrates this approach. Although this reduces data redundancy and eliminates some anomalies associated with Table 4-3, it has drawbacks. S&S would have to decide in advance how many item numbers to leave room for in each row (that is, how many columns to put in the table; note in Table 4-4 that to store each additional item requires five additional columns—Item, Quantity, Description, Unit Price, and Extended Amount). If room is left for four items (20 columns), how would data about a sale involving eight items (40 columns) be stored? If room is left for eight items, however, there will be a great deal of wasted space, as is the case for sales invoices 103 and 104.

TABLE 4-3 Example of Storing All Sales Data for S&S in One Table

Sales : Table

Sales Invoice #	Date	Salesperson	Customer #	Invoice Total	Customer Name	Street	City	State	Item #	Quantity	Description	Unit Price	Extended Amount
101	10/15/2015	J. Buck	151	1447	D. Ainge	123 Lotus Lane	Phoenix	AZ	10	2	Television	499	998
101	10/15/2015	J. Buck	151	1447	D. Ainge	123 Lotus Lane	Phoenix	AZ	50	1	Microwave	449	449
102	10/15/2015	S. Knight	152	4394	G. Kite	40 Quatro Road	Mesa	AZ	10	1	Television	499	499
102	10/15/2015	S. Knight	152	4394	G. Kite	40 Quatro Road	Mesa	AZ	20	3	Freezer	699	2097
102	10/15/2015	S. Knight	152	4394	G. Kite	40 Quatro Road	Mesa	AZ	30	2	Refrigerator	899	1798
103	10/15/2015	S. Knight	151	898	D. Ainge	123 Lotus Lane	Phoenix	AZ	50	2	Microwave	449	898
104	10/15/2015	J. Buck	152	789	G. Kite	40 Quatro Road	Mesa	AZ	40	1	Range	789	789
105	11/14/2015	J. Buck	153	3994	F. Roberts	401 Excel Way	Chandler	AZ	10	3	Television	499	1497
105	11/14/2015	J. Buck	153	3994	F. Roberts	401 Excel Way	Chandler	AZ	20	1	Freezer	699	699
105	11/14/2015	J. Buck	153	3994	F. Roberts	401 Excel Way	Chandler	AZ	30	2	Refrigerator	899	1798

Record: 14 11 of 11

TABLE 4-4 Example of Storing S&S Sales Data by Adding Columns for Each Additional Item Sold

Sales : Table

Sales Invoice #	Columns 2-9	Item #	Quantity	Description	Unit Price	Extended Amount	Item #2	Quantity2
101	Same 8	10	2	Television	499	998	50	1
102	columns	10	1	Television	499	499	20	3
103	as in	50	2	Microwave	449	898		
104	Table 4-3	40	1	Range	789	789		
105	above	10	3	Television	499	1497	20	1

Record: 6 of 6

3. The Solution: A Set of Tables. The storage problems in Tables 4-3 and 4-4 are solved using a *relational database*. The set of tables in Table 4-5 represent a well-structured relational database.

Basic Requirements of a Relational Database

We now turn to the guidelines used to develop a properly structured relational database.

1. *Every column in a row must be single valued.* In a relational database, there can only be one value per cell. At S&S, each sale can involve more than one item. On invoice 102, the customer bought a television, a freezer, and a refrigerator. If Item # were an attribute in the Sales table, it would have to take on three values (item numbers 10, 20, and 30). To solve this problem, a Sales-Inventory table was created that lists each item sold on an invoice. The third line in the Sales-Inventory table in Table 4-5 shows invoice 102 and item number 10 (television). The fourth line shows invoice 102 and item 20 (freezer). The fifth line shows invoice 102 and item 30 (refrigerator). This table repeats the invoice number as often as needed to show all the items purchased on a sales invoice.

2. *Primary keys cannot be null.* A primary key cannot uniquely identify a row in a table if it is null (blank). A non-null primary key ensures that every row in a table represents something and that it can be identified. This is referred to as the ***entity integrity rule***. In the Sales-Inventory table in Table 4-5, no single field uniquely identifies each row. However, the first two columns, taken together, do uniquely identify each row and constitute the primary key.

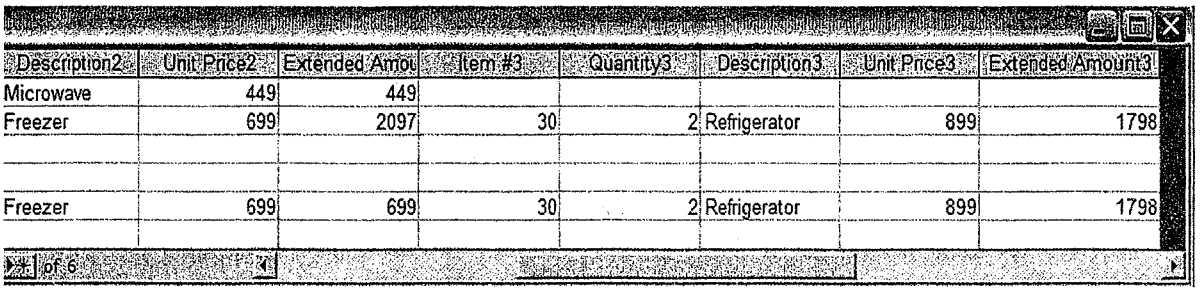
3. *Foreign keys, if not null, must have values that correspond to the value of a primary key in another table.* Foreign keys link rows in one table to rows in another table. In Table 4-5, Customer # can link each sales transaction with the customer who participated in that event only if the Sales table Customer # value corresponds to an actual customer number in the Customer table. This constraint, called the ***referential integrity rule***, ensures database consistency. Foreign keys can contain null values. For example, when customers pay cash, Customer # in the sales table can be blank.

4. *All nonkey attributes in a table must describe a characteristic of the object identified by the primary key.* Most tables contain other attributes in addition to the primary and foreign keys. In the Customer table in Table 4-5, Customer # is the primary key, and customer name, street, city, and state are important facts that describe the customer.

These four constraints produce a well-structured (normalized) database in which data are consistent and redundancy is minimized and controlled. In Table 4-5, having a table for each entity of interest avoids the anomaly problems discussed previously and minimizes redundancy. Redundancy is not eliminated, as certain items, such as Sales Invoice #, appear in more than one table when they are foreign keys. The referential integrity rule ensures that there are no update anomaly problems with the foreign keys.

When data about objects of interest are stored in separate database tables, it is easy to add new data by adding another row to the table. For example, adding a new customer is as simple as adding a new row to the Customer table. Thus, the tables depicted in Table 4-5 are free from insert anomalies.

Relational databases also simplify data deletion. Deleting sales invoice 105, the only sale to customer 153, does not erase all data about that customer, because it is stored in the Customer table. This avoids delete anomalies.



Description2	Unit Price2	Extended Amou	Item #3	Quantity3	Description3	Unit Price3	Extended Amount3
Microwave	449	449					
Freezer	699	2097	30	2	Refrigerator	899	1798
Freezer	699	699	30	2	Refrigerator	899	1798

of 6

Another benefit of the schema shown in Table 4-5 is that space is used efficiently. The Sales-Inventory table contains a row for each item sold on each invoice. There are no blank rows, yet all sales data are recorded. In contrast, the schema in Table 4-4 results in much wasted space.

Two Approaches to Database Design

One way to design a relational database, called ***normalization***, assumes that everything is initially stored in one large table. Rules are followed to decompose that initial table into a set of tables in what is called *third normal form (3NF)*, because they are free of update, insert, and delete anomalies. The details of the normalization process can be found in any database textbook.

In an alternative design approach, called ***semantic data modeling***, the designer uses knowledge of business processes and information needs to create a diagram that shows what to include in the database. This diagram is used to create a set of relational tables that are already in 3NF.

Semantic data modeling has significant advantages. First, using a system designer's knowledge of business processes facilitates the efficient design of transaction processing databases. Second, the graphical model explicitly represents the organization's business processes and policies and, by facilitating communication with system users, helps ensure that the new system meets users' actual needs. Chapter 17 introduces two semantic data modeling tools, entity-relationship diagramming and REA modeling, used to design transaction processing databases.

Creating Relational Database Queries

To retrieve stored data, users query databases. This section of the chapter shows you how to query databases using Microsoft Access. If you want to follow along by creating the queries illustrated in this section, download the S&S In-Chapter Database from the text's Web site. When you open the database and select the Create ribbon, the ribbon in the top half of Table 4-6 appears. There are two ways to query the database: create a query in Design view (the "Query Design" button) or use the wizard (the "Query Wizard" button). These options are highlighted in the top half of Table 4-6. In the example shown in Table 4-6, the Design view is used. Clicking on the "Query Design" button produces the Show Table window shown in Table 4-6. The user selects the tables needed to produce the desired information; if more tables than necessary are selected, the query may not run properly.

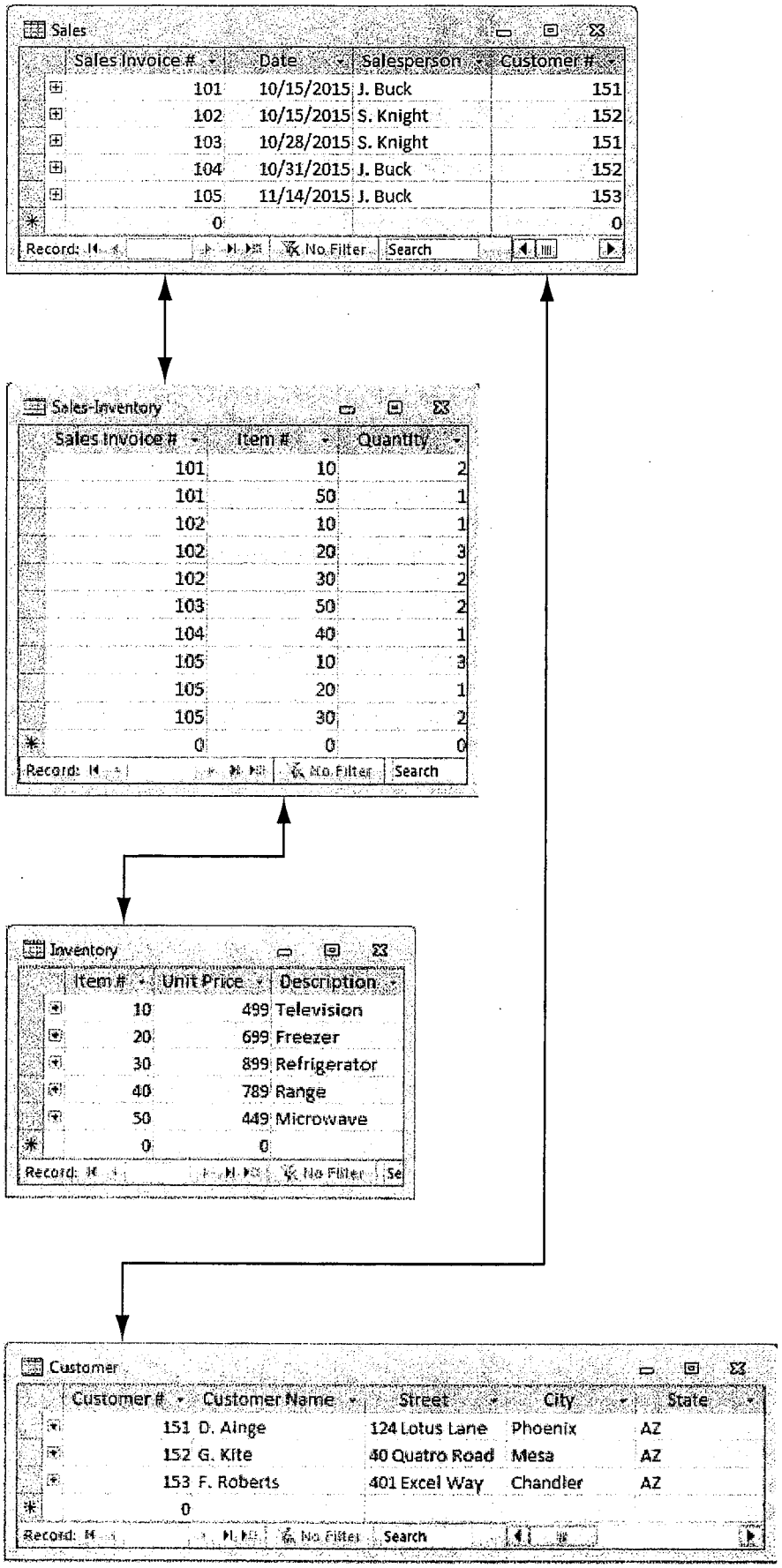
We will use the tables in Table 4-5 to walk through the steps needed to create and run five queries. This will not make you an expert in querying an Access database, but it will show you how to produce useful information.

Query 1

Query 1 answers two questions: What are the invoice numbers of all sales made to D. Ainge, and who was the salesperson for each sale?

The Sales and Customer tables contain the three items needed to answer this query: Sales Invoice #, Salesperson, and Customer Name. Click the "Query Design" button (see Table 4-6), and select the Sales and Customer tables by double-clicking on their names or by single-clicking

TABLE 4-5 Set of Relational Tables for Storing S&S Sales Data



Sales

Sales Invoice #	Date	Salesperson	Customer #
101	10/15/2015	J. Buck	151
102	10/15/2015	S. Knight	152
103	10/28/2015	S. Knight	151
104	10/31/2015	J. Buck	152
105	11/14/2015	J. Buck	153
0			0

Sales-Inventory

Sales Invoice #	Item #	Quantity
101	10	2
101	50	1
102	10	1
102	20	3
102	30	2
103	50	2
104	40	1
105	10	3
105	20	1
105	30	2
0	0	0

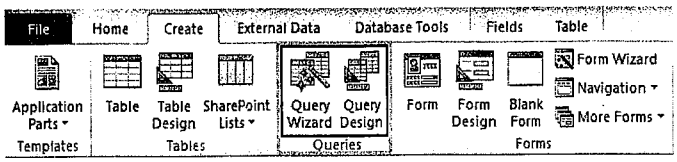
Inventory

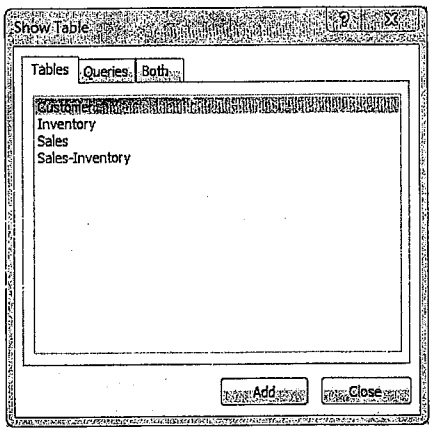
Item #	Unit Price	Description
10	499	Television
20	699	Freezer
30	899	Refrigerator
40	789	Range
50	449	Microwave
0	0	

Customer

Customer #	Customer Name	Street	City	State
151	D. Ainge	124 Lotus Lane	Phoenix	AZ
152	G. Kite	40 Quatro Road	Mesa	AZ
153	F. Roberts	401 Excel Way	Chandler	AZ
0				

TABLE 4-6 Creating Queries in the Microsoft Access Database





on the name and clicking the Add button. The selected tables appear as shown in Table 4-7. A line between the two tables connects the Customer # fields (the Customer table primary key and the Sales table foreign key). Click on Close to make the Show Table window disappears.

To populate the bottom half of the screen shown in Table 4-7, double-click on Sales Invoice #, Salesperson, and Customer Name or drag and drop them into the Field row. Access automatically checks the box in the Show line, so the item will be shown when the query is run.

Since we only want sales to D. Ainge, enter that in the criteria line of the Customer Name column. Run the query by clicking on the red ! (exclamation) mark on the Query Tools Design ribbon. Table 4-8 shows the tables used, the relationship of the primary and foreign keys between tables, and the query answer. The query answer does not automatically have the title "Ainge Sales." To assign the query a name, save it by selecting File from the Access menu, then Save Object As, and then enter "Ainge Sales" in the first line of the Save As window, making sure the Object select box is set to "Query," and then clicking OK. When the query is rerun, the title shown in Table 4-8 will appear.

TABLE 4-7 Completed Query 1

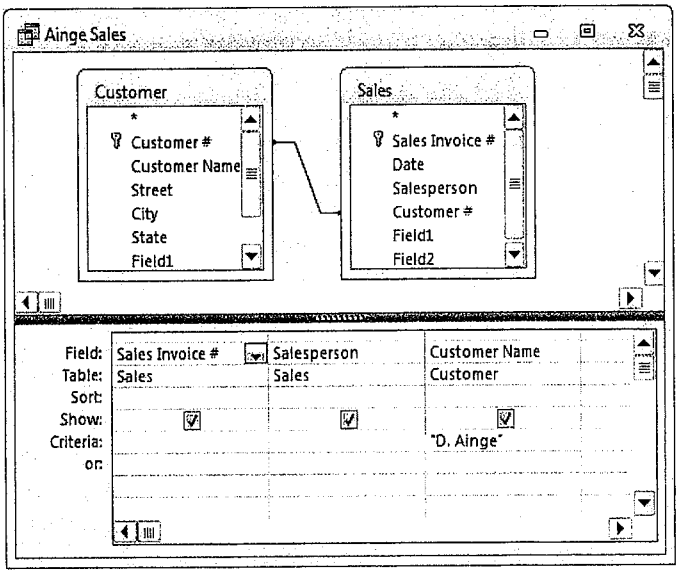
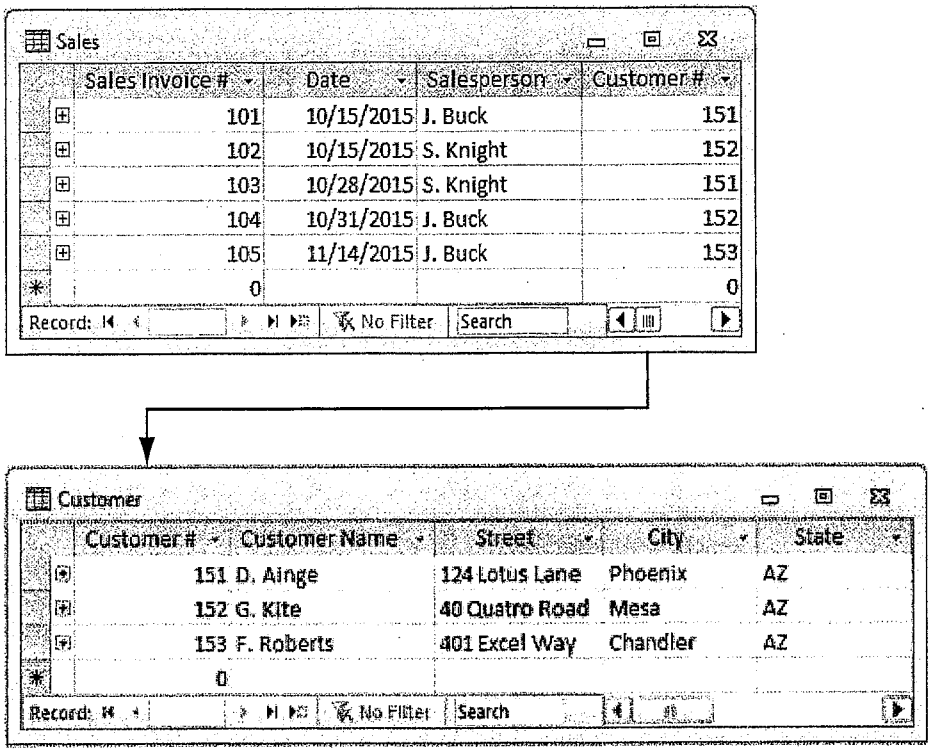
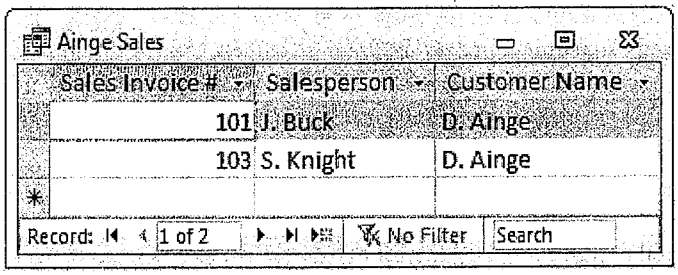


TABLE 4-8 Query 1 Relationships and Query Answer



Query Answer



Query 2

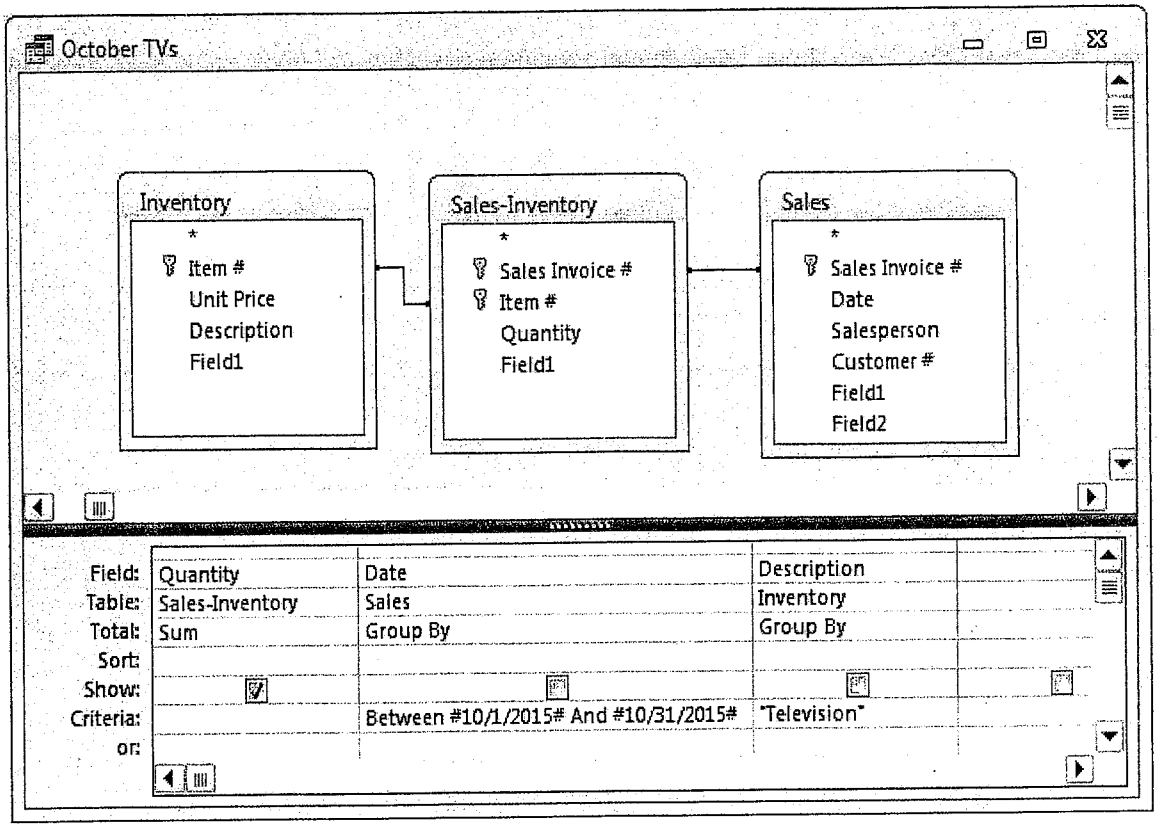
Query 2 answers this question: How many televisions were sold in October?

The Sales, Inventory, and Sales-Inventory tables contain the three items needed to answer this query: Date, Inventory Description, and Quantity. Click on the "Query Design" button in the Create ribbon and select the three tables and the three fields, as shown in Table 4-9. Since we want the quantity of televisions sold in October, we add the criteria "Between #10/1/2015# And #10/31/2015#" to the Date field and "Television" to the Description field.

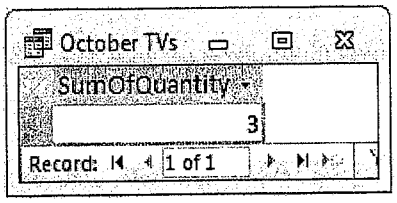
To specify criteria, Access uses operators such as "And" "Or" and "Between." An "And" operator returns the data that meets *all* the criteria linked by "And" operators. The "Between" operator selects all the data in October of 2015; that is, between and including the first and last days of the month. If the "Between" operator was not used and "Or" replaced "And," all televisions sold either on 10/1/2015 or on 10/31/2015 would be selected. The "#" symbol tells Access to look for a date rather than some other type of text.

Since we are only looking for total television sales in October, we uncheck the "Show" box in the Date and Description columns. To generate total sales, click the "Totals" button in the Show/Hide portion of the Query Tools Design ribbon. A new line, called Total, appears (compare Tables 4-7 and 4-9). Click on the Totals line in the Quantity column, then click on the down-arrow symbol, and select Sum from the drop-down menu that appears. The remaining two fields in the Total line will stay as Group By. Running the query in Table 4-9 produces the answer shown.

TABLE 4-9 Completed Query 2 and Answer



Query Answer



Query 3

Query 3 answers this question: What are the names and addresses of customers buying televisions in October?

This query needs these fields: Date (to select October sales), Description (to select televisions), and Customer Name, Street, City, and State (the information requested). All four tables are used because the Sales-Inventory table is used to move between the Sales and Inventory tables. The query uses the same criteria as Query 2. The date and description data do not need to be displayed, so the boxes in the Show line are unchecked. Running the query produces the answer shown in Table 4-10.

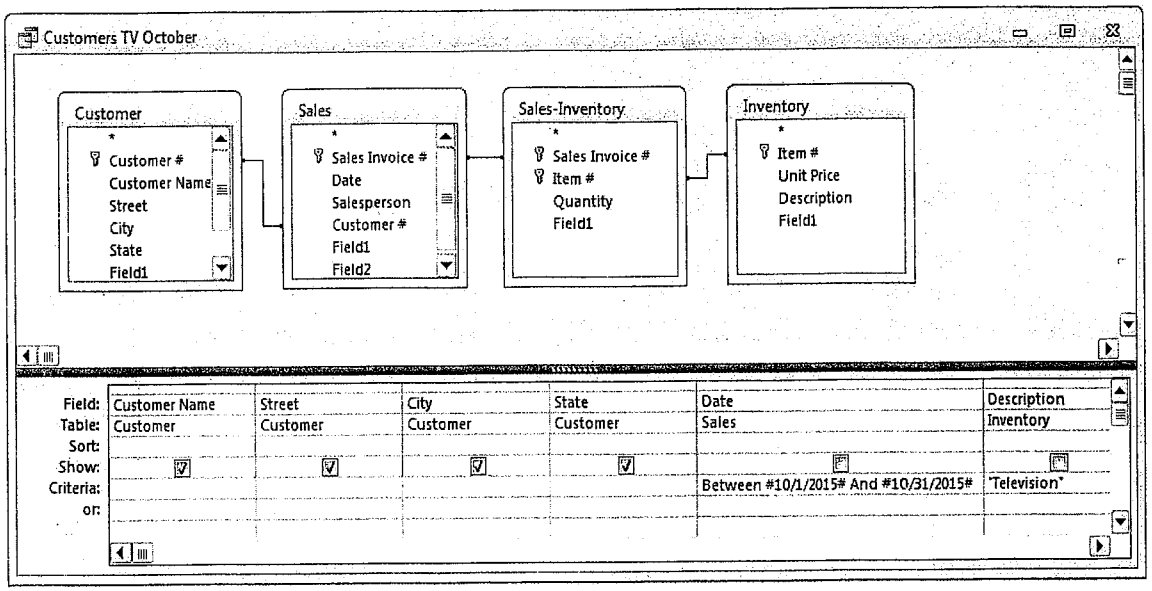
Query 4

Query 4 answers this question: What are the sales invoice numbers, dates, and invoice totals for October sales, arranged in descending order by sale amount?

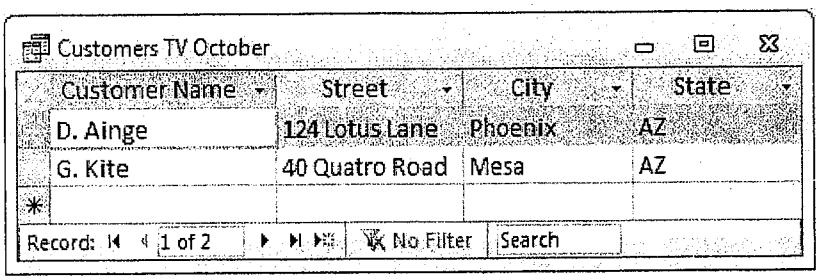
Since the database does not contain an Invoice Total column, it is calculated as follows:

1. For each invoice, calculate the total sales price of each item sold by multiplying the Quantity field in the Sales-Inventory table by the Unit Price field in the Inventory table. The Sales-Inventory table in Table 4-5 shows that three items were sold on Sales Invoice 102. For item 20, we multiply the quantity (3) by the Unit Price (699), producing 2,097. The same calculation is made for items 10 and 30.
2. Sum the three item totals to get an invoice total.

TABLE 4-10 Completed Query 3 and Answer



Query Answer

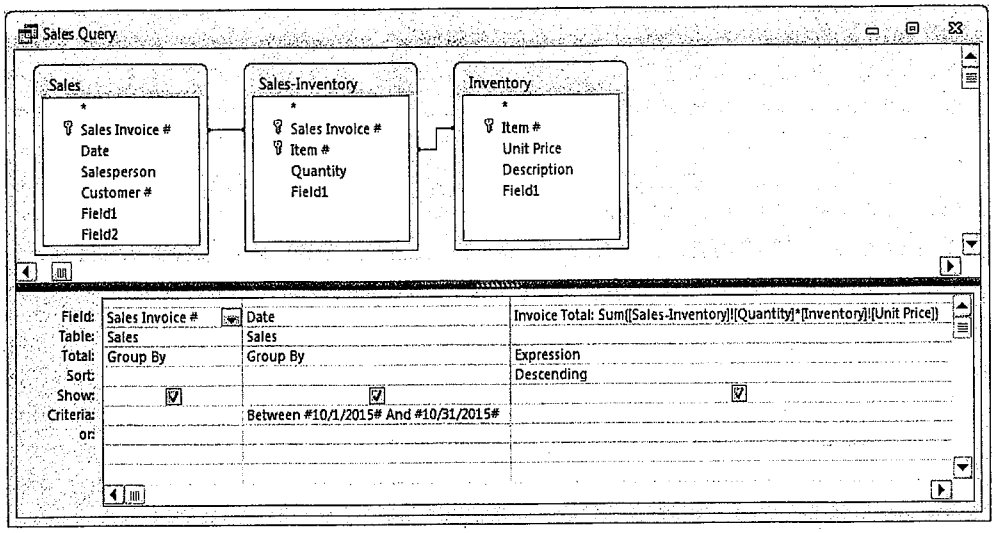


Query 4 requires the Sales table (Date, Sales Invoice #), Sales-Inventory table (Quantity), and the Inventory table (Unit Price). However, some fields will not appear in columns on the Select Query window. As shown in Table 4-11, three columns are displayed: Sales Invoice #, Date, and Invoice Total, which we will calculate. The other fields are used in the Invoice Total calculations.

To calculate Invoice Total, type "Invoice Total:" in the first blank Field cell, right-click in the cell, and select Build from the pop-up menu that appears. An Expression Builder window (see Table 4-12) appears, where the formula to calculate the invoice total is entered by typing "Sum( )". Between the parentheses, click on the + sign in front of the S&S In-Chapter Database folder in the Expressions Elements box. Then clicking on the + sign in the Tables folder causes the four database tables to appear. Click on the Sales-Inventory table, and the fields in the Sales-Inventory table appear. Double-click on Quantity to put this field in the expression. Note in Table 4-12 that the expression shows the table name and the field name, separated by an exclamation point. To multiply Quantity by Unit Price, type * (the multiplication symbol) and select the Inventory table and the Unit Price field. The formula is now complete, and the screen will appear as shown. To enter the expression into the Select Query window, click on OK.

To complete Query 4, click the Totals button in the Query Tools Design ribbon. Click on the down arrow in the Total row of the Invoice Totals column, and select Expression from the pop-up menu. This tells Access to calculate the indicated expression for all items with the same sales invoice number and date. In the same column, click on the down arrow in the Sort row, and select Descending so that the answer is show in descending Invoice Total order. In the criteria section of the Date column, use the "Between" operator to specify the month of October. Running Query 4 produces the answer shown in Table 4-11.

TABLE 4-11 Completed Query 4 and Answer



Query Answer

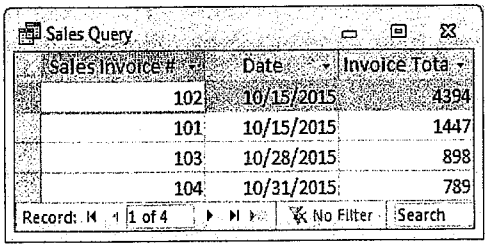
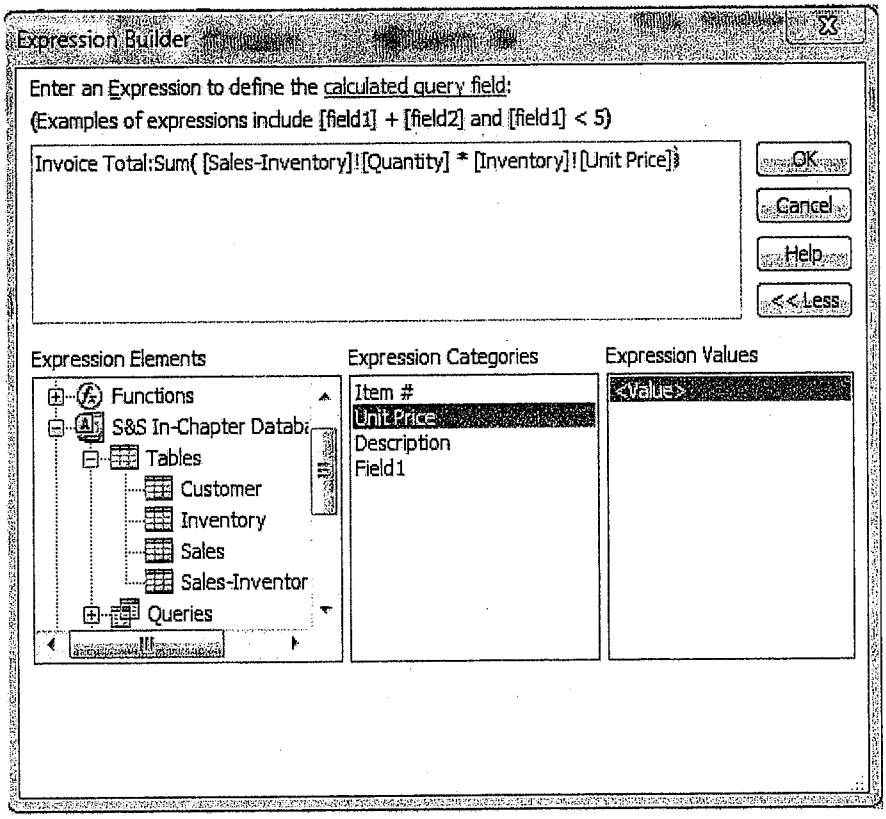


TABLE 4-12 Expression Builder for Query 4



Query 5

Query 5 will answer this question: What are total sales by salesperson?

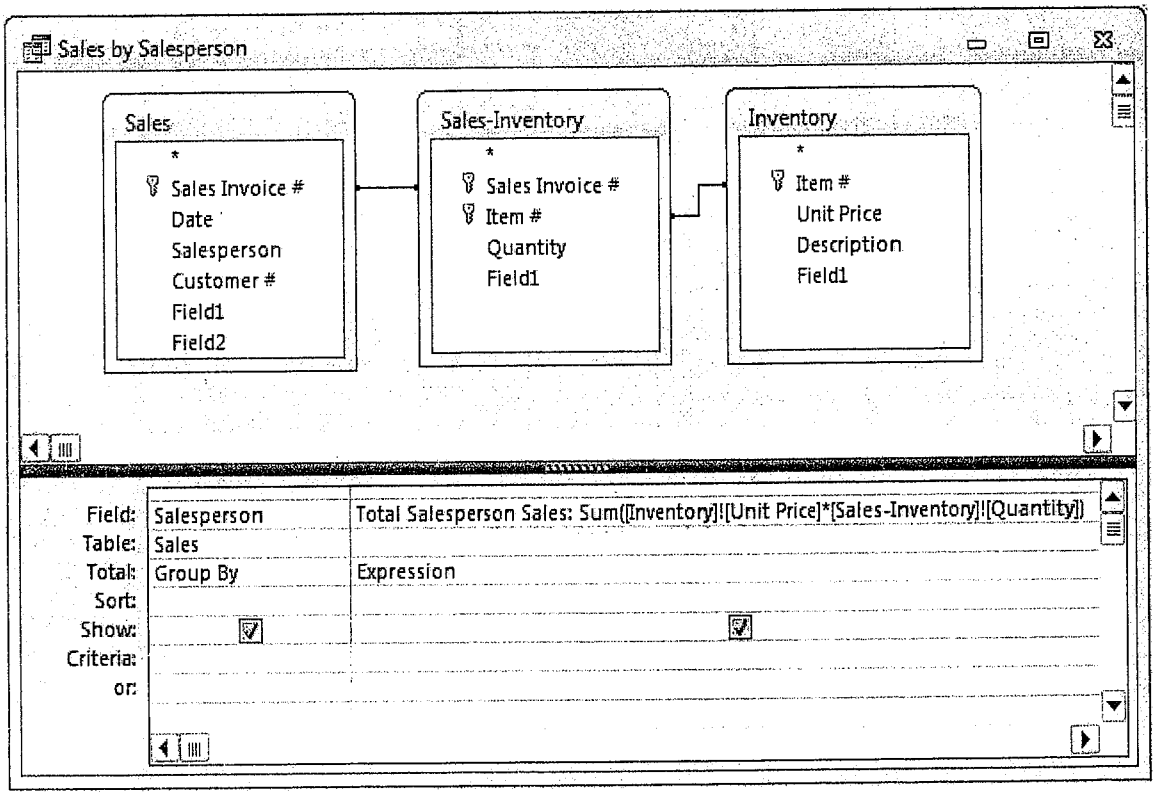
This query is similar to Query 4, except that we total invoices by salesperson rather than by invoice number. We are also not confining our query to the month of October. Try coming up with the query by yourself. The completed query and the answer are shown in Table 4-13.

Database Systems and the Future of Accounting

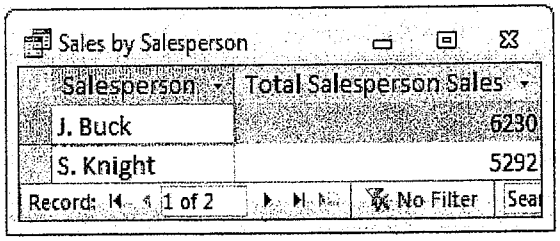
Database systems have the potential to alter external reporting significantly. Considerable time and effort are currently invested in defining how companies should summarize and report accounting information to external users. In the future, companies may make a copy of the company's financial database available to external users in lieu of the traditional financial statements. Users would be free to analyze the raw data however they see fit. Focus 4-1 discusses this possibility in more detail.

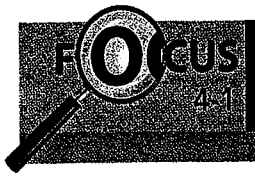
A significant advantage of database systems is the ability to create ad hoc queries to provide the information needed for decision making. No longer is financial information available only in predefined formats and at specified times. Instead, powerful and easy-to-use relational

TABLE 4-13 Query 5



Query Answer





Databases or Financial Statements?

Although information technology has dramatically changed the way business is conducted, it has had less effect on external reporting. Companies still produce highly aggregated, periodic (quarterly and annual) financial reports of past activities based on historical costs. It is estimated that the average financial database of a large company is over 100 gigabytes. Yet annual reports contain only 100 kilobytes of data. Consequently, users see only a small portion of company data presented in a predefined financial statement format.

Why not replace the annual report with a copy of the company's financial database? Many companies already give suppliers and customers limited access to their databases. Suppliers are given access to inventory data to plan production and deliveries. However, they are not given access to payroll data. Companies could similarly exclude data too sensitive to fall into competitors' hands. This database view could be placed on the Internet for investors, creditors, and other external users. The computing power of PCs makes processing such a database feasible, and external users would get a fuller and timelier picture of the organization's performance.

In such a system, the company's primary financial reporting function would be defining data elements and database structure. Users would be free to aggregate and classify that information using whatever decision model they believed to be appropriate.

Source: Robert K. Elliot, "Confronting the Future: Choices for the Attest Function," *Accounting Horizons* (September 1994): 106–124.

database query languages can find and prepare the information management needs, when they want it.

Relational DBMSs can also accommodate multiple views of the same underlying phenomenon. For example, tables storing information about assets can include columns not only for historical costs but also for current replacement costs and market values. Thus, managers will no longer be forced to look at data in ways predefined by accountants.

Finally, relational DBMSs are capable of integrating financial and operational data. For example, customer satisfaction data could be stored in the database, giving managers a richer set of data for decision making.

Relational DBMSs have the potential to increase the use and value of accounting information. Accountants must understand database systems so they can help design and use the AISs of the future. Such participation is important for ensuring that adequate controls are included in those systems to safeguard the data and ensure the reliability of the information produced.

Summary and Case Conclusion

Ashton prepared a report for Scott and Susan summarizing what he knew about databases. He explained that a database management system (DBMS), the software that makes a database system work, is based on a logical data model that shows how users perceive the way the data are stored. Many DBMSs are based on the relational data model that represents data as being stored in tables. Every row in a relational table has only one data value in each column. Neither row nor column position is significant. These properties support the use of simple, yet powerful, query languages for interacting with the database. Users only need to specify the data they want and do not need to be concerned with how the data are retrieved. The DBMS functions as an intermediary between the user and the database, thereby hiding the complex addressing schemes actually used to retrieve and update the information stored in the database.

After reading Ashton's report, Scott and Susan agreed that it was time to upgrade S&S's AIS and to hire a consulting firm to help select and install the new system. They asked Ashton to oversee the design process to ensure that the new system meets their needs.

Key Terms

database 107
database management system (DBMS) 108
database system 108
database administrator (DBA) 108
data warehouse 108
business intelligence 108
online analytical processing (OLAP) 108
data mining 109
record layout 110
logical view 110
physical view 110
schema 110
conceptual-level schema 110
external-level schema 110
subschema 110
internal-level schema 110
data dictionary 112
data definition language (DDL) 112
data manipulation language (DML) 112
data query language (DQL) 112
report writer 112
data model 112
relational data model 112
tuple 112
primary key 112
foreign key 112
update anomaly 114
insert anomaly 114
delete anomaly 114
relational database 116
entity integrity rule 116
referential integrity rule 116
normalization 117
semantic data modeling 117

AIS IN ACTION

Chapter Quiz

1. The relational data model portrays data as being stored in _____.
   a. hierarchies
   b. tables
   c. objects
   d. files

2. How a user conceptually organizes and understands data is referred to as the _____.
   a. physical view
   b. logical view
   c. data model view
   d. data organization view

3. What is each row in a relational database table called?
   a. relation
   b. attribute
   c. anomaly
   d. tuple

4. Which of the following is an individual user's view of the database?
   a. conceptual-level schema
   b. external-level schema
   c. internal-level schema
   d. logical-level schema

5. Which of the following would managers most likely use to retrieve information about sales during the month of October?
   a. DML
   b. DSL
   c. DDL
   d. DQL

6. Which of the following attributes would most likely be a primary key?
   a. supplier name
   b. supplier number
   c. supplier Zip code
   d. supplier account balance

7. Which of the following is a software program that runs a database system?
   a. DQL
   b. DBMS
   c. DML
   d. DDL

8. The constraint that all primary keys must have non-null data values is referred to as which of the following?
   a. referential integrity rule
   b. entity integrity rule
   c. normalization rule
   d. relational data model rule

9. The constraint that all foreign keys must have either null values or the value of a primary key in another table is referred to as which of the following?
   a. referential integrity rule
   b. entity integrity rule
   c. foreign key value rule
   d. null value rule

10. Which of the following attributes in the Cash Receipts table (representing payments received from customers) would most likely be a foreign key?
   a. cash receipt number
   b. customer check number
   c. customer number
   d. cash receipt date

Comprehensive Problem



The Butler Financing Company runs a mortgage brokerage business that matches lenders and borrowers. Table 4-14 lists some of the data that Butler maintains on its borrowers and lenders. The data are stored in a spreadsheet that must be manually updated for each new

TABLE 4-14 Butler Financing Company Spreadsheet

Borrower Number	Last Name	First Name	Current Address	Requested Mortgage Amount	Lender Number	Lender Name	Lender Office Address	Property Appraiser Number	Property Appraiser Name
450	Adams	Jennifer	450 Peachtree Rd.	$245,000	13	Excel Mortgage	6890 Sheridan Dr.	8	Advent Appraisers
451	Adamson	David	500 Loop Highway	$124,688	13	Excel Mortgage	6890 Sheridan Dr.	9	Independent Appraisal Service
452	Bronson	Paul	312 Mountain View Dr.	$345,000	14	CCY	28 Buckhead Way	10	Jones Property Appraisers
453	Brown	Marietta	310 Loop Highway	$ 57,090	15	Advantage Lenders	3345 Lake Shore Dr.	10	Jones Property Appraisers
454	Charles	Kenneth	3 Commons Blvd.	$ 34,000	16	Capital Savings	8890 Coral Blvd.	8	Advent Appraisers
455	Coulter	Tracey	1367 Peachtree Rd.	$216,505	13	Excel Mortgage	6890 Sheridan Dr.	8	Advent Appraisers
456	Foster	Harold	678 Loop Highway	$117,090	12	National Mortgage	750 16 St.	9	Independent Appraisal Service
457	Frank	Vernon	210 Bicayne Blvd.	$ 89,000	12	National Mortgage	750 16 St.	10	Jones Property Appraisers
458	Holmes	Heather	1121 Bicayne Blvd.	$459,010	16	Capital Savings	8890 Coral Blvd.	10	Jones Property Appraisers
459	Johanson	Sandy	817 Mountain View Dr.	$ 67,900	15	Advantage Lenders	3345 Lake Shore Dr.	9	Independent Appraisal Service
460	Johnson	James	985 Loop Highway	$ 12,000	12	National Mortgage	750 16 St.	10	Jones Property Appraisers
461	Jones	Holly	1650 Washington Blvd.	$ 67,890	15	Advantage Lenders	3345 Lake Shore Dr.	9	Independent Appraisal Service

borrower, lender, or mortgage. This updating is error-prone, which has harmed the business. In addition, the spreadsheet has to be sorted in many different ways to retrieve the necessary data.

Create a database from Butler's spreadsheet that does not have any of the data anomalies explained in the chapter. To test the database, prepare a query to show which borrowers (both borrower number and name) took out loans from Excel Mortgage and who the appraiser was for each loan.

Discussion Questions

4.1. Contrast the logical and the physical views of data, and discuss why separate views are necessary in database applications. Describe which perspective is most useful for each of the following employees: a programmer, a manager, and an internal auditor. How will understanding logical data structures assist you when designing and using database systems?

4.2. The relational data model represents data as being stored in tables. Spreadsheets are another tool that accountants use to employ a tabular representation of data. What are some similarities and differences in the way these tools use tables? How might an accountant's familiarity with the tabular representation of spreadsheets facilitate or hinder learning how to use a relational DBMS?

4.3. Some people believe database technology may eliminate the need for double-entry accounting. This creates three possibilities: (1) the double-entry model will be abandoned; (2) the double-entry model will not be used directly, but an external-level schema based on the double-entry model will be defined for accountants' use; or (3) the double-entry model will be retained in database systems. Which alternative do you think is most likely to occur? Why?

4.4. Relational DBMS query languages provide easy access to information about the organization's activities. Does this mean that online, real-time processing should be used for all transactions? Does an organization need real-time financial reports? Why or why not?

4.5. Why is it so important to have good data?

4.6. What is a data dictionary, what does it contain, and how is it used?

4.7. Compare and contrast the file-oriented approach and the database approach. Explain the main advantages of database systems.

Problems



4.1. The following data elements comprise the conceptual-level schema for a database:
billing address
cost
credit limit
customer name
customer number
description
invoice number

item number
price
quantity on hand
quantity sold
shipping address
terms

Required

a. Identify three potential users and design a subschema for each. Justify your design by explaining why each user needs access to the subschema data elements.
b. Use Microsoft Access or some other relational database product to create the schema tables. Specify the primary key(s), foreign key(s), and other data for each table. Test your model by entering sample data in each table.

4.2. Most DBMS packages contain data definition, data manipulation, and data query languages. For each of the following, indicate which language would be used and why.
a. A database administrator defines the logical structure of the database.
b. The controller requests a cost accounting report containing a list of all employees being paid for more than 10 hours of overtime in a given week.
c. A programmer develops a program to update the fixed-assets records stored in the database.
d. The human resources manager requests a report noting all employees who are retiring within five years.
e. The inventory serial number field is extended in the inventory records to allow for recognition of additional inventory items with serial numbers containing more than 10 digits.
f. A user develops a program to print out all purchases made during the past two weeks.
g. An additional field is added to the fixed-asset records to record the estimated salvage value of each asset.

4.3. Ashton wants to store the following data about S&S's purchases of inventory:



item number
date of purchase
vendor number
vendor address
vendor name
purchase price
quantity purchased
employee number
employee name
purchase order number
description
quantity on hand
extended amount
total amount of purchase

Required

a. Design a set of relational tables to store this data. Do all of the data items need to be stored in a table? If not, which ones do not need to be stored, and why do they not need to be stored?
b. Identify the primary key for each table.
c. Identify the foreign keys needed in the tables to implement referential integrity.
d. Implement your tables using any relational database product to which you have access.
e. Test your specification by entering sample data in each table.
f. Create a few queries to retrieve or analyze the data you stored.



4.4. Retrieve the S&S In-Chapter Database (in Microsoft Access format) from the text's Web site (or create the tables in Table 4-5 in a relational DBMS product). Write queries to answer the following questions. *Note*: For some questions, you may have to create two queries—one to calculate an invoice total and the second to answer the question asked.

a. How many different kinds of inventory items does S&S sell?
b. How many sales were made during October?
c. What were total sales in October?
d. What was the average amount of a sales transaction?
e. Which salesperson made the largest sale?
f. How many units of each product were sold?
g. Which product was sold most frequently?



4.5. Enter the tables in Table 4-15 into a relational DBMS package. Write queries to answer the following questions. *Note*: For some questions, you may have to create two queries—one to calculate a total and the second to answer the question asked.

a. Which customers (show their names) made purchases from Martinez?
b. Who has the largest credit limit?
c. How many sales were made in October?
d. What were the item numbers, price, and quantity of each item sold on invoice number 103?
e. How much did each salesperson sell?
f. How many customers live in Arizona?
g. How much credit does each customer still have available?
h. How much of each item was sold? (Include the description of each item in your answer.)
i. Which customers still have more than $1,000 in available credit?
j. For which items are there at least 100 units on hand?

TABLE 4-15

Customer

Customer #	Customer Name	City	State	Credit Limit
1000	Smith	Phoenix	AZ	2500
1001	Jones	St. Louis	MO	1500
1002	Jeffries	Atlanta	GA	4000
1003	Gilkey	Phoenix	AZ	5000
1004	Lankford	Phoenix	AZ	2000
1005	Zelle	Chicago	IL	2000
1006	Pagnozzi	Salt Lake City	UT	3000
1007	Arocha	Chicago	IL	1000
0				

Inventory

Item #	Description	Unit Cost	Unit Price	Quantity on Hand
1010	Blender	$14.00	$29.95	200
1015	Toaster	$12.00	$19.95	300
1020	Mixer	$23.00	$33.95	250
1025	Television	$499.00	$699.95	74
1030	Freezer	$799.00	$999.95	32
1035	Refrigerator	$699.00	$849.95	25
1040	Radio	$45.00	$79.95	100
1045	Clock	$79.00	$99.95	300
0			$0.00	

Sales

Invoice Number	Date	Salesperson	Customer No	Amount
101	10/3/2015	Wilson	1000	$1,549.90
102	10/5/2015	Mahomet	1003	$299.95
103	10/5/2015	Jackson	1002	$1,449.80
104	10/15/2015	Drezen	1000	$799.90
105	10/15/2015	Martinez	1005	$849.95
106	10/16/2015	Martinez	1007	$99.95
107	10/29/2015	Mahomet	1002	$2,209.70
108	11/3/2015	Martinez	1000	$779.90
0			0	

Sales-Inventory

Invoice Numbe	Item Numbe	Quantity	Extension
101	1025	1	$699.95
101	1035	1	$849.95
102	1045	3	$299.85
103	1010	1	$29.95
103	1015	1	$19.95
103	1025	2	$1,399.90
104	1025	1	$699.95
104	1045	1	$99.95
105	1035	1	$849.95
106	1045	1	$99.95
107	1030	1	$999.95
107	1035	1	$849.95
107	1040	2	$159.90
107	1045	2	$199.90
108	1025	1	$699.95
108	1045	1	$99.95
0	0	0	

4.6. The BusyB Company wants to store data about its employee skills. Each employee may possess one or more specific skills, and several employees may have the same skill. Include the following facts in the database:
date hired
date of birth
date skill acquired
employee name
employee number
pay rate
skill name

TABLE 4-16 Database That Needs to Be Extended

Inventory

Item Number	Description	Quantity on Hand	List Price
10573	19" Monitor	13	$495.00
10574	21" Monitor	8	$949.00
10622	Laser Printer	22	$395.00
10623	Color Laser Printer	5	$699.00
10624	Multi-functional Printer	12	$799.00
0			

Record: 14 4 1 of 5 ▶ ▶I ▶* No Filter Search

Inventory Table (Item # is primary key)

Customer

Customer Number	Name	Street	City	State	Zip Code	Credit Limit	Account Balance
11255	G. Hwang	2993 Main	Mesa	AZ	85281	$4,000.00	$875.00
12971	J. Jackson	466 W. Oak	Tempe	AZ	85286	$5,000.00	$2,588.00
13629	P. Szabo	246 E. Palm	Mesa	AZ	85281	$6,000.00	$3,955.00
15637	S. Martinez	2866 Spring	Tempe	AZ	85287	$5,000.00	$250.00
18229	B. Adams	1744 Apache	Tempe	AZ	85287	$3,000.00	$1,675.00
0							

Record: 14 4 1 of 5 ▶ ▶I ▶* No Filter Search

Customer Table (Customer # is primary key)

Sales

Invoice Number	Date	Salesperson #	Customer #	Amount
10001	9/8/2015	25	15637	$399.00
10002	9/10/2015	22	12971	$1,748.00
10003	9/25/2015	24	13629	$1,185.00
10004	10/2/2015	25	11255	$399.00
10005	10/11/2015	22	15637	$1,098.00
10006	10/25/2015	25	18229	$990.00
0			0	

Record: 14 4 1 of 6 ▶ ▶I ▶* No Filter Search

Sales Table (Invoice # is primary key)

Sales-Inventory

Invoice Number	Item Number	Quantity	Actual Unit Price
10001	10573	1	$495.00
10002	10574	1	$949.00
10002	10624	1	$799.00
10003	10622	3	$395.00
10004	10573	1	$495.00
10005	10573	1	$495.00
10005	10623	1	$699.00
10006	10573	2	$495.00
0	0	0	

Record: 14 4 1 of 9 ▶ ▶I ▶* No Filter Search

Sales-Inventory Line Items Table (Combination of Invoice # and Item # forms primary key)

skill number
supervisor

Required

a. Design a set of relational tables to store these data.
b. Identify the primary key for each table, and identify any needed foreign keys.
c. Implement your schema using any relational DBMS. Specify primary and foreign keys, and enforce referential integrity. Demonstrate the soundness of your design by entering sample data in each table.



4.7. You want to extend the schema shown in Table 4-16 to include information about customer payments. Some customers make installment payments on each invoice. Others write a check to pay for several different invoices. You want to store the following information:
amount applied to a specific invoice
cash receipt number
customer name
customer number
date of receipt
employee processing payment
invoice payment applies to
total amount received

Required

a. Modify the set of tables in Table 4-16 to store this additional data.
b. Identify the primary key for each new table you create.
c. Implement your schema using any relational DBMS package. Indicate which attributes are primary and foreign keys, and enter sample data in each table you create.

4.8. Create relational tables that solve the update, insert, and delete anomalies in Table 4-17.

TABLE 4-17 Invoice Table

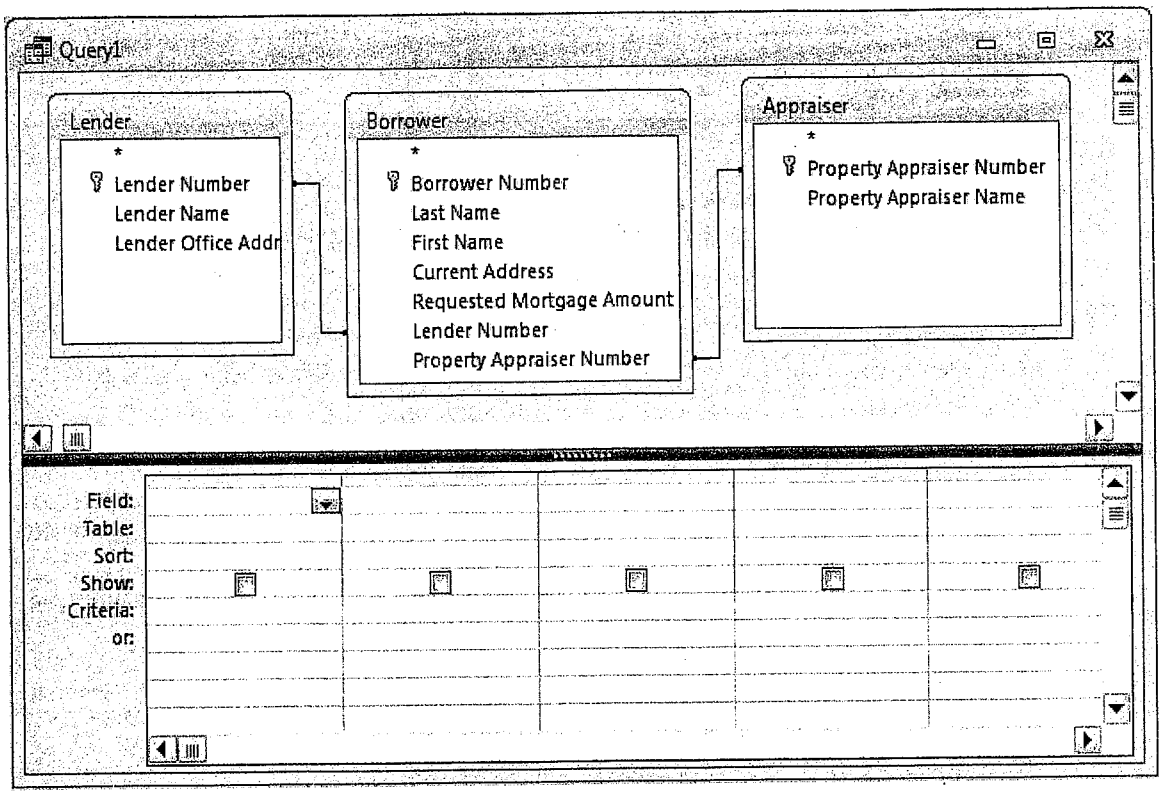
Invoice #	Date	Order Date	Customer ID	Customer Name	Item #	Description	Quantity
52	6-19-2015	5-25-2015	201	Johnson	103	Trek 9000	5
52	6-19-2015	5-25-2015	201	Johnson	122	Nimbus 4000	8
52	6-19-2015	5-25-2015	201	Johnson	10	Izzod 3000	11
52	6-19-2015	5-25-2015	201	Johnson	71	LD Trainer	12
57	6-20-2015	6-01-2015	305	Henry	535	TR Standard	18
57	6-20-2015	6-01-2015	305	Henry	115	NT 2000	15
57	6-20-2015	6-01-2015	305	Henry	122	Nimbus 4000	5

4.9. Create relational tables that solve the update, insert, and delete anomalies in Table 4-18.

TABLE 4-18 Purchase Order (PO) Table

Purchase Order #	Purchase Date	Order Part #	Description	Unit Price	Quantity Ordered	Vendor #	Vendor Name	Vendor Address
2	3/9/2015	334	XYZ	$30	3	504	KL Supply	75 Stevens Dr.
2	3/9/2015	231	PDQ	$50	5	504	KL Supply	75 Stevens Dr.
2	3/9/2015	444	YYM	$80	6	504	KL Supply	75 Stevens Dr.
3	4/5/2015	231	PDQ	$50	2	889	Oscan Inc	55 Cougar Cir.

TABLE 4-19 Selected Query Screen for Chapter Comprehensive Problem



4.10. From the database created in the comprehensive problem, perform queries based on the tables and query grid shown in Table 4-19.



a. Which borrowers use Advent Appraisers?
b. What is the average amount borrowed from National Mortgage?
c. List all of the property appraisers.
d. List all of the lenders.
e. List the lenders that lent more than $100,000.
f. Which borrower requested the largest mortgage?
g. Which borrower requested the smallest mortgage?

Case 4-1 Research Project

As in all areas of information technology, DBMSs are constantly changing and improving. Research how businesses are using DBMSs, and write a report of your findings. Address the following issues:

1. Which popular DBMS products are based on the relational data model?
2. Which DBMS products are based on a logical model other than the relational data model?
3. What are the relative strengths and weaknesses of the different types (relational versus other logical models) of DBMSs?



AIS IN ACTION SOLUTIONS

Quiz Key

1. The relational data model portrays data as being stored in _____.
   a. hierarchies (Incorrect. A hierarchical database portrays data as being stored in hierarchies.)
   ▶ b. tables (Correct. The relational data model portrays data as being stored in a table or relation format.)
   c. objects (Incorrect. An object-oriented database portrays data as being stored as objects.)
   d. files (Incorrect. The file-based data model portrays data as being stored in files.)

2. How a user conceptually organizes and understands data is referred to as the _____.
   a. physical view (Incorrect. The physical view shows how and where data are physically stored.)
   ▶ b. logical view (Correct. The logical view shows how a user conceptually organizes and understands data.)
   c. data model view (Incorrect. This is not a typical database view.)
   d. data organization view (Incorrect. This is not a typical database view.)

3. What is each row in a relational database table called?
   a. relation (Incorrect. A relation is a table in a relational database.)
   b. attribute (Incorrect. Each column in a relational database is an attribute that describes some characteristic of the entity about which data are stored.)
   c. anomaly (Incorrect. An anomaly is a problem in a database, such as an insert anomaly or a delete anomaly.)
   ▶ d. tuple (Correct. A tuple is also called a row in a relational database.)

4. Which of the following is an individual user's view of the database?
   a. conceptual-level schema (Incorrect. A conceptual-level schema is the organizationwide view of the entire database.)
   ▶ b. external-level schema (Correct. The external-level schema represents an individual user's view of the database.)
   c. internal-level schema (Incorrect. The internal-level schema represents how the data are actually stored and accessed.)
   d. logical-level schema (Incorrect. This is not a schema mentioned in the text.)

5. Which of the following would managers most likely use to retrieve information about sales during the month of October?
   a. DML (Incorrect. DML—data manipulation language—is used for data maintenance.)
   b. DSL (Incorrect. DSL is not a DBMS language.)
   c. DDL (Incorrect. DDL—data definition language—is used to build the data dictionary, create a database, describe logical views, and specify any limitations or constraints on security.)
   ▶ d. DQL (Correct. DQL—data query language—is used to retrieve information from a database.)

6. Which of the following attributes would most likely be a primary key?
   a. supplier name (Incorrect. The primary key must be unique. The same name could be used by multiple entities.)
   ▶ b. supplier number (Correct. A unique number can be assigned as a primary key for each entity.)
   c. supplier Zip code (Incorrect. The primary key must be unique. More than one supplier could reside in the same Zip code.)
   d. supplier account balance (Incorrect. The primary key must be unique. The same account balance, such as a $0.00 balance, could be maintained by multiple entities.)

7. Which of the following is a software program that runs a database system?
   a. DQL (Incorrect. DQL—data query language—is used to retrieve information from a database.)
   ▶ b. DBMS (Correct. A DBMS—database management system—is a software program that acts as an interface between a database and various application programs.)
   c. DML (Incorrect. DML—data manipulation language—is used for data maintenance.)
   d. DDL (Incorrect. DDL—data definition language—is used to build the data dictionary, create a database, describe logical views, and specify any limitations or constraints on security.)

8. The constraint that all primary keys must have non-null data values is referred to as which of the following?
   a. referential integrity rule (Incorrect. The referential integrity rule stipulates that foreign keys must have values that correspond to the value of a primary key in another table or be empty.)
   ▶ b. entity integrity rule (Correct. Every primary key in a relational table must have a non-null value.)
   c. normalization rule (Incorrect. The text does not discuss a normalization rule.)
   d. relational data model rule (Incorrect. The text does not discuss a relational data model rule.)

9. The constraint that all foreign keys must have either null values or the value of a primary key in another table is referred to as which of the following?
   ▶ a. referential integrity rule (Correct. The referential integrity rule stipulates that foreign keys must have values that correspond to the value of a primary key in another table or be empty.)
   b. entity integrity rule (Incorrect. This rule states that every primary key in a relational table must have a non-null value.)
   c. foreign key value rule (Incorrect. The text does not discuss a foreign key value rule.)
   d. null value rule (Incorrect. The text does not discuss a null value rule.)

10. Which of the following attributes in the Cash Receipts table (representing payments received from customers) would most likely be a foreign key?
   a. cash receipt number (Incorrect. A cash receipt number is a good candidate for the primary key of the Cash Receipts table.)
   b. customer check number (Incorrect. Because there is no reason to store customer check numbers in a separate table, it is not a good candidate for a foreign key.)
   ▶ c. customer number (Correct. Customer number would be a foreign key in the Cash Receipts table and would link the Cash Receipts table to the Customer Table.)
   d. cash receipt date (Incorrect. Dates usually are not good candidates for foreign keys. The cash receipt date would likely be an attribute in the Cash Receipts table.)

Comprehensive Problem Solution

Since lender and appraiser data are repeated throughout Table 4-14, the spreadsheet contains update, insert, and delete anomalies. To eliminate anomaly problems and reduce redundancy, we break the spreadsheet into three smaller tables: borrowers (Table 4-20), lenders (Table 4-21), and appraisers (Table 4-22).

TABLE 4-20 Borrower Table

Borrower Number (Primary Key)	Last Name	First Name	Current Address	Requested Mortgage Amount	Lender Number (Foreign Key to Lender Table)	Property Appraiser Number (Foreign Key to Appraiser Table)
450	Adams	Jennifer	450 Peachtree Rd.	$245,000	13	8
451	Adamson	David	500 Loop Highway	$124,688	13	9
452	Bronson	Paul	312 Mountain View Dr.	$345,000	14	10
453	Brown	Marietta	310 Loop Highway	$ 57,090	15	10
454	Charles	Kenneth	3 Commons Blvd.	$ 34,000	16	8
455	Coulter	Tracey	1367 Peachtree Rd.	$216,505	13	8
456	Foster	Harold	678 Loop Highway	$117,090	12	9
457	Frank	Vernon	210 Bicayne Blvd.	$ 89,000	12	10
458	Holmes	Heather	1121 Bicayne Blvd.	$459,010	16	10
459	Johanson	Sandy	817 Mountain View Dr.	$ 67,900	15	9
460	Johnson	James	985 Loop Highway	$ 12,000	12	10
461	Jones	Holly	1650 Washington Blvd.	$ 67,890	15	9

TABLE 4-21 Lender Table

Lender Number (Primary Key)	Lender Name	Lender Office Address
12	National Mortgage	750 16 St.
13	Excel Mortgage	6890 Sheridan Dr.
14	CCY	28 Buckhead Way
15	Advantage Lenders	3345 Lake Shore Dr.
16	Capital Savings	8890 Coral Blvd.

TABLE 4-22 Appraiser Table

Property Appraiser Number (Primary Key)	Property Appraiser Name
8	Advent Appraisers
9	Independent Appraisal Service
10	Jones Property Appraisers

Borrower number, lender number, and appraiser number are the primary keys because each uniquely identifies the rows in their respective tables. The primary keys from the Lender and Appraiser tables are added to the Borrower table as foreign keys so that the Lender and Appraiser tables will have a direct link to the Borrower table.

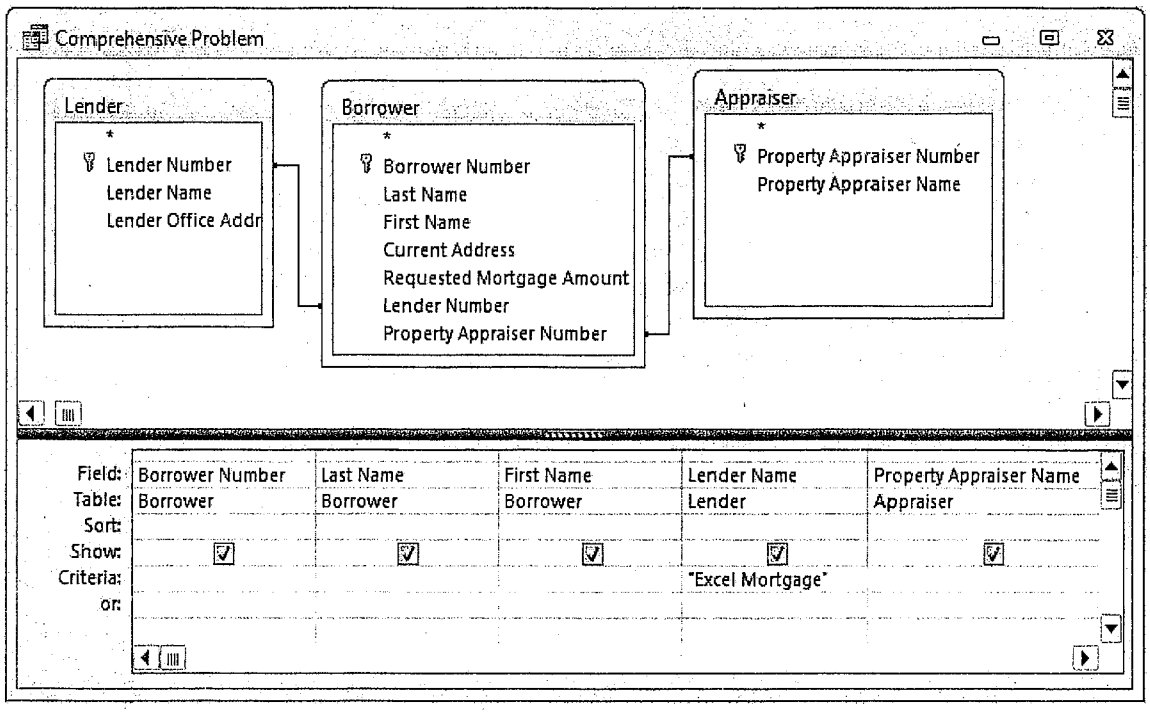
Creating smaller tables with primary and foreign keys solves the three anomaly problems.

- The insert anomaly is solved because a new lender and appraiser can be added without requiring a borrower.
- The delete anomaly is solved because deleting a borrower that decides not to pursue a mortgage does not delete information about the lender and appraiser.
- The update anomaly is solved because there is only one row in one table to update when a lender moves and changes its address, instead of changing all spreadsheet rows that store the lender address.

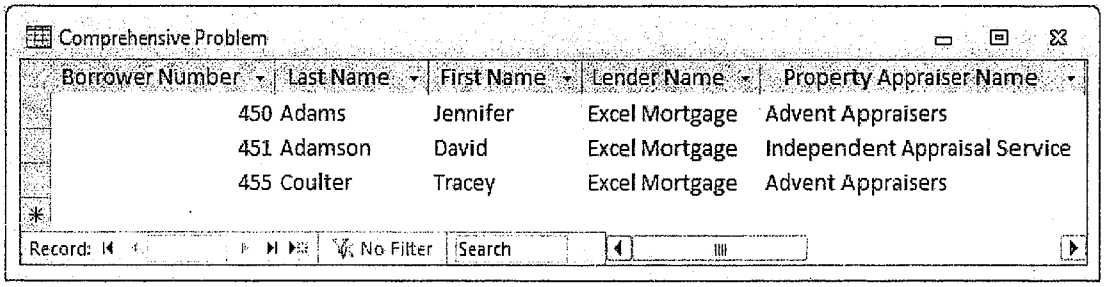
After the data are entered into the Microsoft Access tables, we can query the database. The query in Table 4-23, which finds the borrowers and appraisers associated with loans from Excel Mortgage, is created as follows:

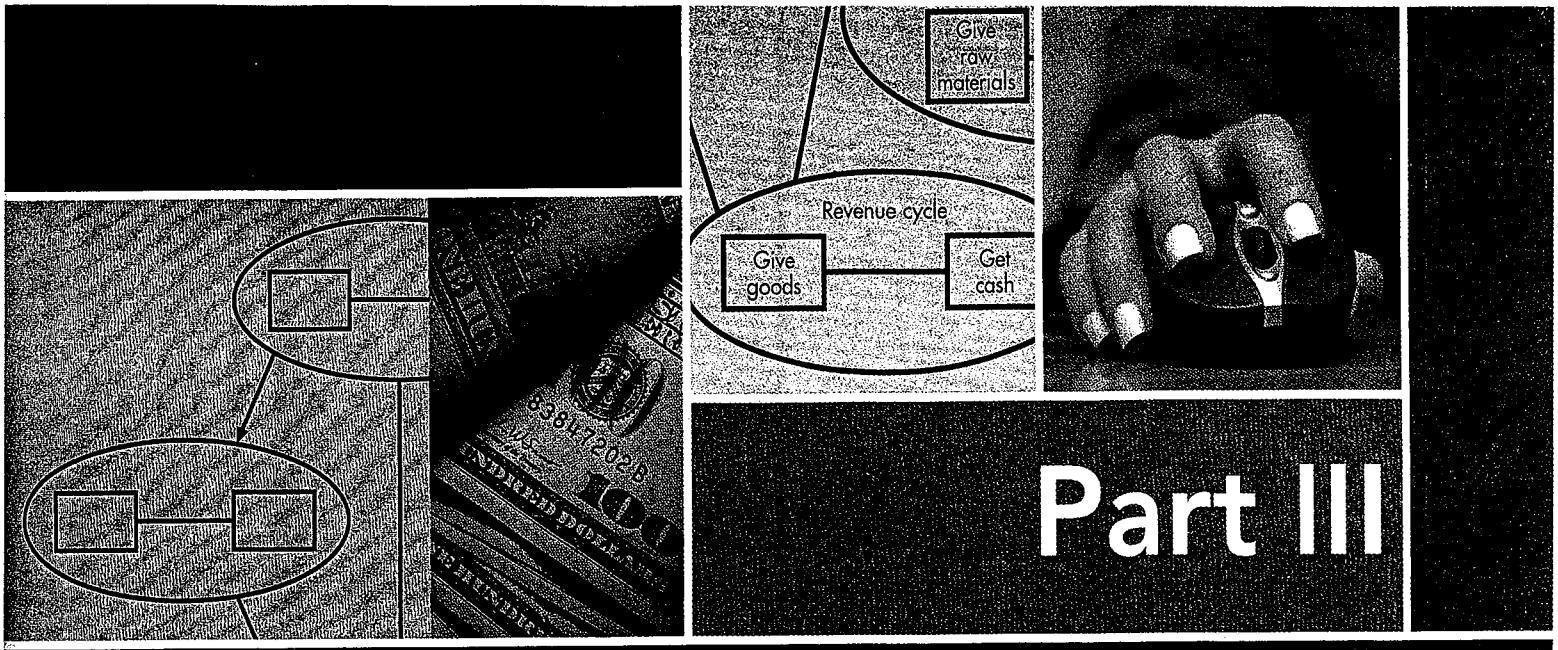
- From the Query menu option, select "Create Query in Design view."
- Add all three tables to your Query Design. Access automatically links the primary and foreign keys.
- Select the following fields: Borrower Number, Last Name, First Name, Lender Name, and Property Appraiser Name.
- Specify "Excel Mortgage" as the criteria in the Lender Name column.
- Run the query.

TABLE 4-23 Borrowers with Loans from Excel Mortgage



Query Answer





Part III

Accounting Information Systems Applications

Chapter 12 The Revenue Cycle: Sales to Cash Collections

Chapter 13 The Expenditure Cycle: Purchasing to Cash Disbursements

Chapter 14 The Production Cycle

Chapter 15 The Human Resources Management and Payroll Cycle

Chapter 16 General Ledger and Reporting System

Chapter 12

The Revenue Cycle: Sales to Cash Collections

Learning Objectives

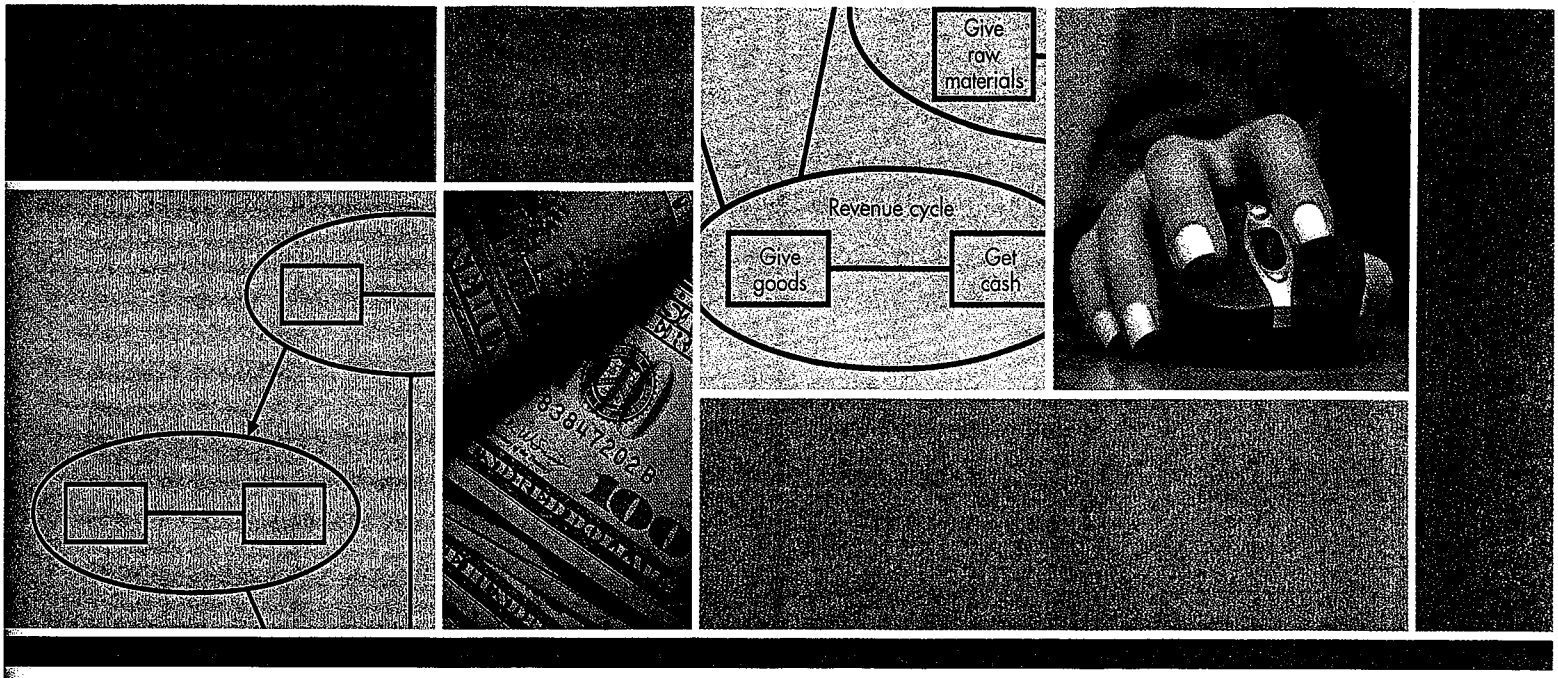
After studying this chapter, you should be able to:

1. Describe the basic business activities and related information processing operations performed in the revenue cycle.
2. Discuss the key decisions that need to be made in the revenue cycle, and identify the information needed to make those decisions.
3. Identify major threats in the revenue cycle, and evaluate the adequacy of various control procedures for dealing with those threats.

INTEGRATIVE CASE ALPHA OMEGA ELECTRONICS

Alpha Omega Electronics (AOE) manufactures a variety of inexpensive consumer electronic products, including calculators, digital clocks, radios, pagers, toys, games, and small kitchen appliances. AOE's primary customers are retail stores, but the company has recently begun selling in bulk to Internet storefronts. Figure 12-1 shows a partial organization chart for AOE.

Linda Spurgeon, president of AOE, called an executive meeting to discuss two pressing issues. First, AOE has been steadily losing market share for the past three years. Second, cash flow problems have necessitated increased short-term borrowing. At the executive meeting, Trevor Whitman, vice president of marketing, explained that one reason for AOE's declining market share is that competitors are apparently providing better customer service. When Linda asked for specifics, however, Trevor admitted that his opinion was based on recent conversations with two major customers. He also admitted that he could not readily identify AOE's 10 most profitable customers. Linda then asked Elizabeth Venko, the controller, about AOE's cash flow problems. The most recent accounts receivable aging schedule indicated a significant increase in the



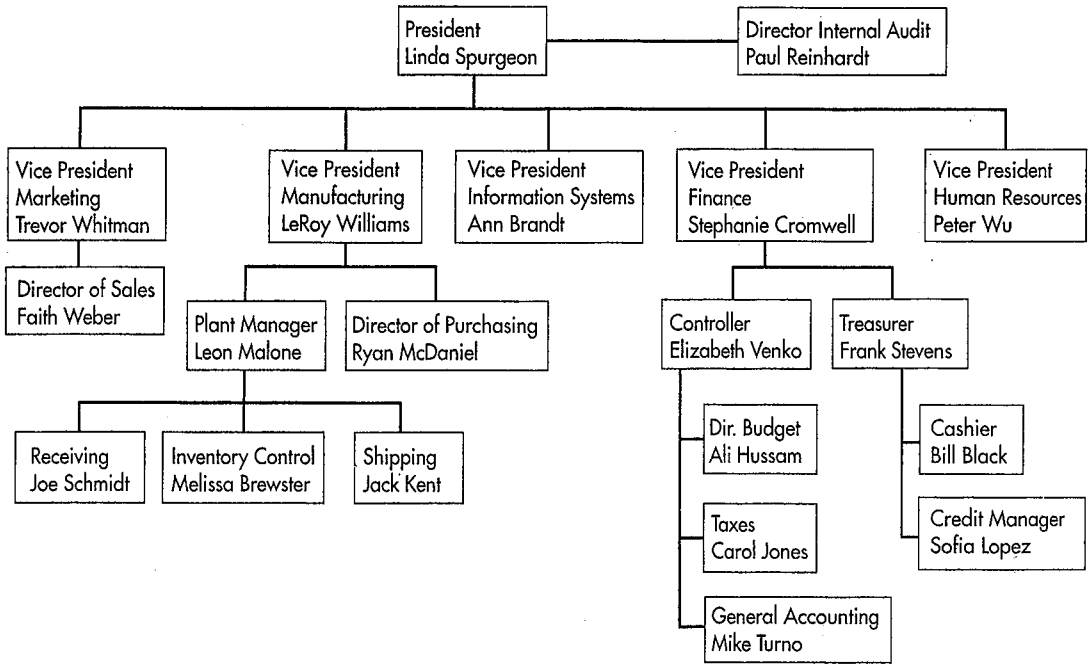


FIGURE 12-1
Partial Organization Chart for Alpha Omega Electronics

number of past-due customer accounts. Consequently, AOE has had to increase its short-term borrowing because of delays in collecting customer payments. In addition, the Best Value Company, a retail chain that has been one of AOE's major customers, recently went bankrupt. Elizabeth admitted that she is unsure whether AOE will be able to collect the large balance due from Best Value.

Linda was frustrated with the lack of detailed information regarding both issues. She ended the meeting by asking Elizabeth and Trevor to work with Ann Brandt, vice president of information systems, to develop improved reporting systems so that AOE could more closely monitor and take steps to improve both customer service and cash flow management. Specifically, Linda asked Elizabeth, Trevor, and Ann to address the following issues:

1. How could AOE improve customer service? What information does marketing need to perform its tasks better?

2. How could AOE identify its most profitable customers and markets?
3. How can AOE improve its monitoring of credit accounts? How would any changes in credit policy affect both sales and uncollectible accounts?
4. How could AOE improve its cash collection procedures?

The AOE case shows how deficiencies in the information system used to support revenue cycle activities can create significant problems for an organization. As you read this chapter, think about how a well-designed information system can improve both the efficiency and effectiveness of an organization's revenue cycle activities.

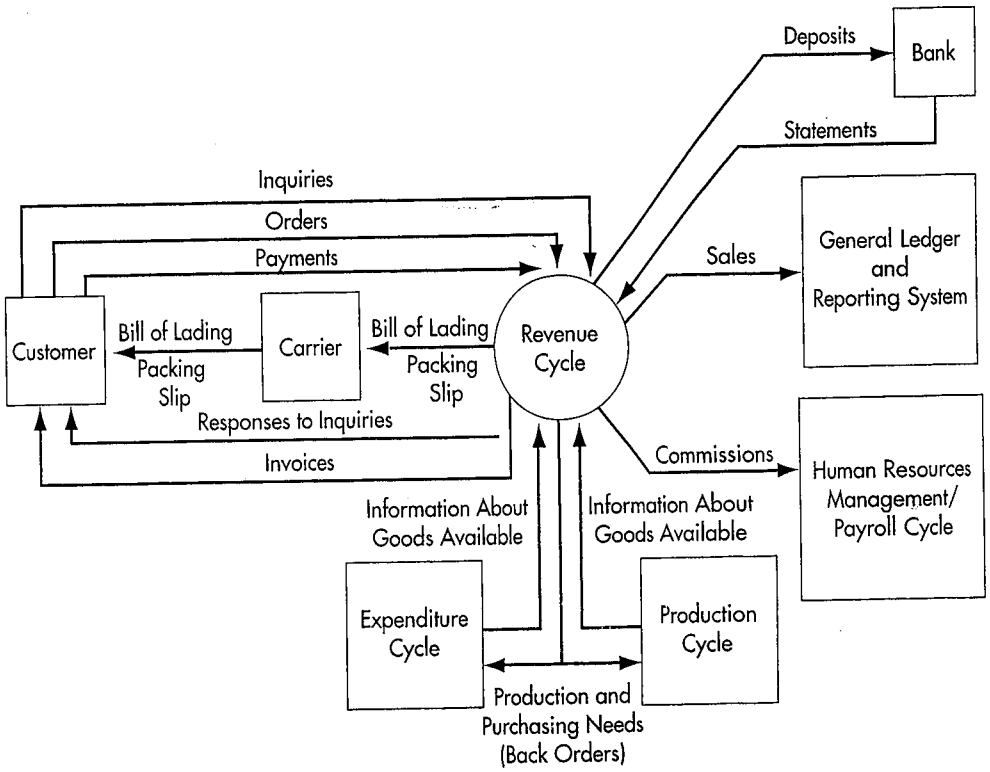
Introduction

The *revenue cycle* is a recurring set of business activities and related information processing operations associated with providing goods and services to customers and collecting cash in payment for those sales (Figure 12-2). The primary external exchange of information is with customers. Information about revenue cycle activities also flows to the other accounting cycles. For example, the expenditure and production cycles use information about sales transactions to initiate the purchase or production of additional inventory to meet demand. The human resources management/payroll cycle uses information about sales to calculate sales commissions and bonuses. The general ledger and reporting function uses information produced by the revenue cycle to prepare financial statements and performance reports.

The revenue cycle's primary objective is to provide the right product in the right place at the right time for the right price. To accomplish that objective, management must make the following key decisions:

- To what extent can and should products be customized to individual customers' needs and desires?
- How much inventory should be carried, and where should that inventory be located?

FIGURE 12-2
The Context Diagram of the Revenue Cycle



- How should merchandise be delivered to customers? Should the company perform the shipping function itself or outsource it to a third party that specializes in logistics?
- What are the optimal prices for each product or service?
- Should credit be extended to customers? If so, what credit terms should be offered? How much credit should be extended to individual customers?
- How can customer payments be processed to maximize cash flow?

The answers to those questions guide how an organization performs the four basic revenue cycle activities depicted in Figure 12-3:

1. Sales order entry
2. Shipping
3. Billing
4. Cash collections

This chapter explains how an organization's information system supports each of those activities. We begin by describing the design of the revenue cycle information system and the basic controls necessary to ensure that it provides management with reliable information. We

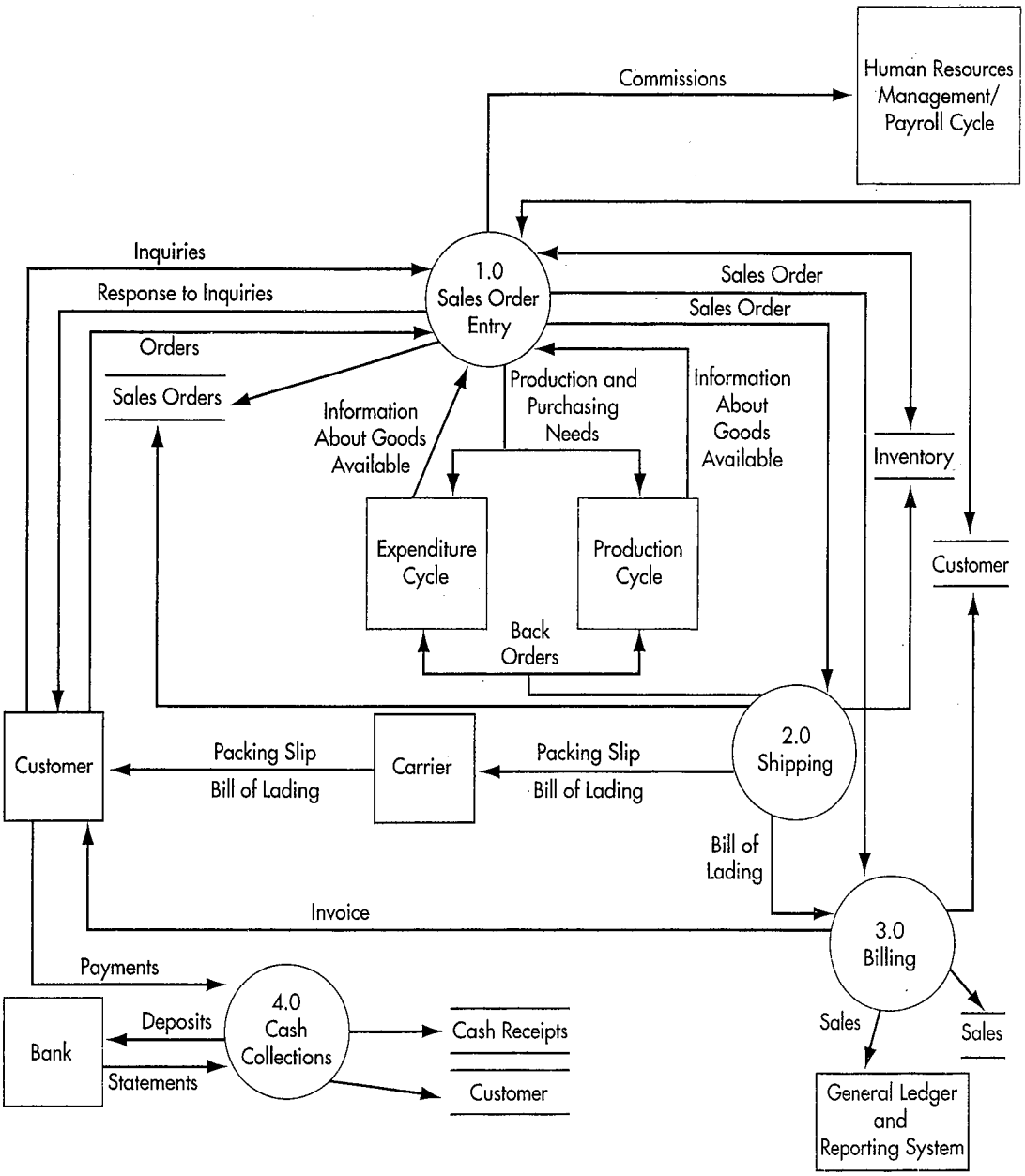


FIGURE 12-3
Level 0 Data Flow Diagram: Revenue Cycle

then discuss in detail each of the four basic revenue cycle activities. For each activity, we, describe how the information needed to perform and manage those activities is collected, processed, and stored. We also explain the controls necessary to ensure not only the reliability of that information but also the safeguarding of the organization's resources.

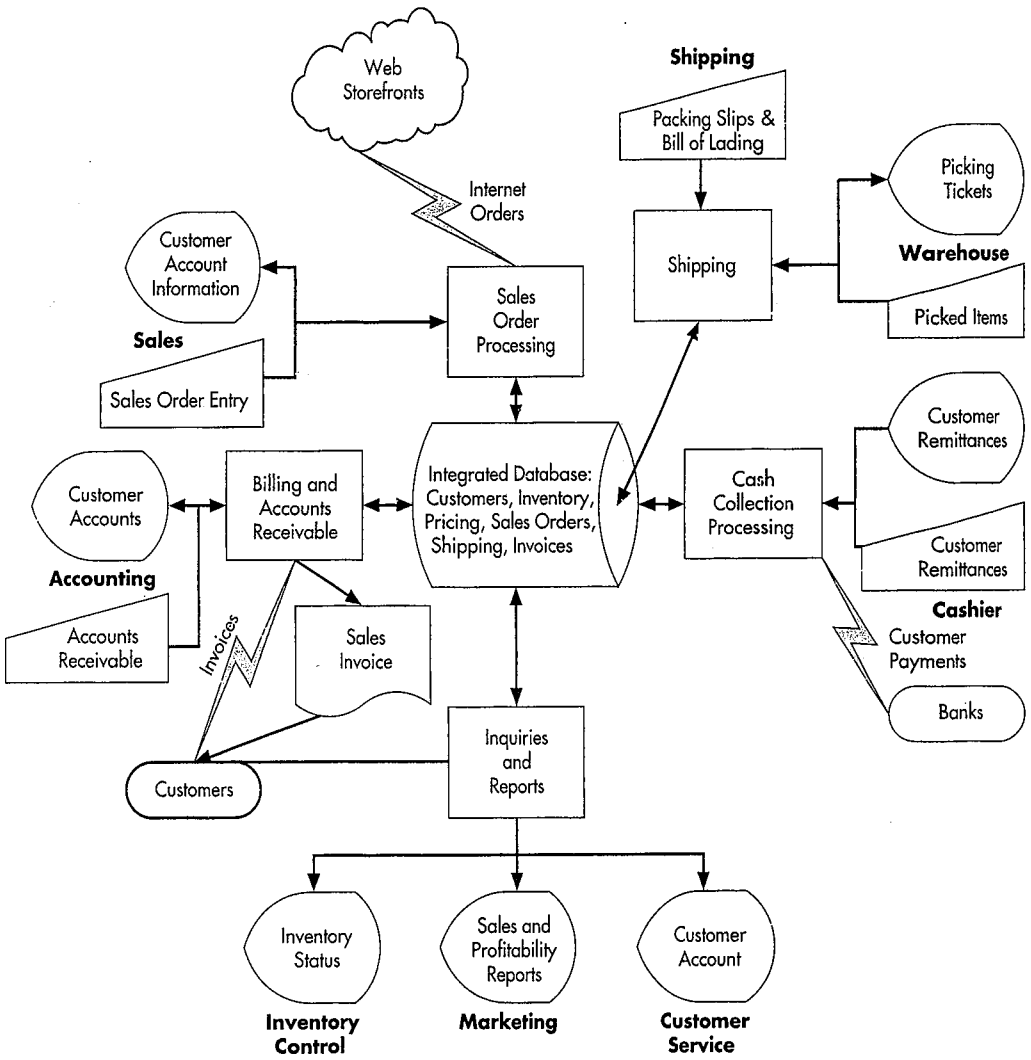
Revenue Cycle Information System

Like most large organizations, AOE uses an enterprise resource planning (ERP) system. Figure 12-4 shows the portion of the ERP system that supports AOE's revenue cycle business activities.

Process

AOE's online sales order processing system receives customer orders via the Internet from various retail Web sites. Using their laptops, salespeople enter orders when calling on customers. The sales department enters customer orders received over the telephone, by fax, or by mail. Regardless of how an order is initially received, the system quickly verifies customer creditworthiness, checks inventory availability, and notifies the warehouse and shipping departments about the approved sale. Warehouse and shipping employees enter data about their activities as soon as they are performed, thereby updating information about inventory status in real time. Nightly, the invoice program runs in batch mode, generating paper or electronic invoices for customers who require invoices. Some of AOE's customers still send checks to one of the regional banks with which AOE has established electronic lockboxes, but an increasing number use their bank's online bill paying service. Each day, the bank sends AOE a file containing remittance

FIGURE 12-4
Overview of ERP System Design to Support the Revenue Cycle



data, which the cashier uses to update the company's cash account balances and the accounts receivable clerk uses to update customer accounts.

Threats and Controls

Figure 12-4 shows that all revenue cycle activities depend on the integrated database that contains information about customers, inventory, and pricing. Therefore, the first general threat listed in Table 12-1 is inaccurate or invalid master data. Errors in customer master data could result in shipping merchandise to the wrong location, delays in collecting payments because of sending invoices to the wrong address, or making sales to customers that exceed their credit limits. Errors in inventory master data can result in failure to timely fulfill customer orders due to unanticipated shortages of inventory, which may lead to loss of future sales. Errors in pricing master data can result in customer dissatisfaction due to overbilling or lost revenues due to underbilling.

As Table 12-1 shows, one way to mitigate the threat of inaccurate or invalid master data is to use the various processing integrity controls discussed in Chapter 10 to minimize the risk of data input errors. It is also important to restrict access to that data and configure the system so that only authorized employees can make changes to master data. This requires changing the default configurations of employee roles in ERP systems to appropriately segregate incompatible duties. For example, sales order entry staff should not be able to change master pricing data or customer credit limits. Similarly, the person who maintains customer account information should not be able to process cash collections from customers or issue credit memos to authorize writing off sales as uncollectible. However, because such preventive controls can never be 100% effective, Table 12-1 also indicates that an important detective control is to regularly produce a report of all changes to master data and review them to verify that the database remains accurate.

A second general threat in the revenue cycle is unauthorized disclosure of sensitive information, such as pricing policies or personal information about customers. Table 12-1 shows that one way to mitigate the risk of this threat is to configure the system to employ strong access controls that limit who can view such information. It is also important to configure the system to limit employees' ability to use the system's built-in query capabilities to access only those specific tables and fields relevant to performing their assigned duties. In addition, sensitive data should be encrypted in storage to prevent IT employees who do not have access to the ERP system from using operating system utilities to view sensitive information. The organization should also design its Web sites to use SSL to encrypt information requested from customers while that information is in transit over the Internet.

A third general threat in the revenue cycle concerns the loss or destruction of master data (see Table 12-1). The best way to mitigate the risk of this threat is to employ the backup and disaster recovery procedures that were discussed in Chapter 10. A best practice is to implement the ERP system as three separate instances. One instance, referred to as production, is used to process daily activity. A second is used for testing and development. A third instance should be maintained as an online backup to production system to provide near real-time recovery.

Accurate master data enables management to better use an ERP system's extensive reporting capabilities to monitor performance (see threat 4 in Table 12-1). Accountants should use their knowledge about the underlying business processes to design innovative measures that provide management with insights beyond those provided by traditional financial statements. For example, companies have always closely monitored sales trends. Additional information is needed, however, to identify the causes of changes in that measure. Metrics such as revenue margin[1] can provide such information. Revenue margin equals gross margin minus all expenses incurred to generate sales, including payroll, salesforce-related travel, customer service and support costs, warranty and repair costs, marketing and advertising expenses, and distribution and delivery expenses. Thus, revenue margin integrates the effects of changes in both productivity and customer behavior. Growth in revenue margin indicates that customers are satisfied (as reflected in repeat sales), productivity is increasing (reflected in reduced costs per sale), or both. Conversely, a declining revenue margin indicates problems with customer retention, productivity, or both. Revenue margin is a metric to evaluate overall performance of revenue cycle activities. As we will see in the following sections, accountants can help managers design detailed reports and metrics that are relevant to evaluating each business activity.

---

[1]The concept of revenue margin was developed by James B. Hangstefer in "Revenue Margin: A Better Way to Measure Company Growth," in *Strategic Finance* (July 2000): pp. 40–45.

TABLE 12-1 Threats and Controls in the Revenue Cycle

Activity	Threat	Controls (first number refers to the corresponding threat)
General issues throughout entire revenue cycle	1. Inaccurate or invalid master data 2. Unauthorized disclosure of sensitive information 3. Loss or destruction of data 4. Poor performance	1.1 Data processing integrity controls 1.2 Restriction of access to master data 1.3 Review of all changes to master data 2.1 Access controls 2.2 Encryption 3.1 Backup and disaster recovery procedures 4.1 Managerial reports
Sales order entry	5. Incomplete/inaccurate orders 6. Invalid orders 7. Uncollectible accounts 8. Stockouts or excess inventory 9. Loss of customers	5.1 Data entry edit controls (see Chapter 10) 5.2 Restriction of access to master data 6.1 Digital signatures or written signatures 7.1 Credit limits 7.2 Specific authorization to approve sales to new customers or sales that exceed a customer's credit limit 7.3 Aging of accounts receivable 8.1 Perpetual inventory control system 8.2 Use of bar-codes or RFID 8.3 Training 8.4 Periodic physical counts of inventory 8.5 Sales forecasts and activity reports 9.1 CRM systems, self-help Web sites, and proper evaluation of customer service ratings
Shipping	10. Picking the wrong items or the wrong quantity 11. Theft of inventory 12. Shipping errors (delay or failure to ship, wrong quantities, wrong items, wrong addresses, duplication)	10.1 Bar-code and RFID technology 10.2 Reconciliation of picking lists to sales order details 11.1 Restriction of physical access to inventory 11.2 Documentation of all inventory transfers 11.3 RFID and bar-code technology 11.4 Periodic physical counts of inventory and reconciliation to recorded quantities 12.1 Reconciliation of shipping documents with sales orders, picking lists, and packing slips 12.2 Use RFID systems to identify delays 12.3 Data entry via bar-code scanners and RFID 12.4 Data entry edit controls (if shipping data entered on terminals) 12.5 Configuration of ERP system to prevent duplicate shipments
Billing	13. Failure to bill 14. Billing errors 15. Posting errors in accounts receivable 16. Inaccurate or invalid credit memos	13.1 Separation of billing and shipping functions 13.2 Periodic reconciliation of invoices with sales orders, picking tickets, and shipping documents 14.1 Configuration of system to automatically enter pricing data 14.2 Restriction of access to pricing master data 14.3 Data entry edit controls 14.4 Reconciliation of shipping documents (picking tickets, bills of lading, and packing list) to sales orders 15.1 Data entry controls 15.2 Reconciliation of batch totals 15.3 Mailing of monthly statements to customers 15.4 Reconciliation of subsidiary accounts to general ledger 16.1 Segregation of duties of credit memo authorization from both sales order entry and customer account maintenance 16.2 Configuration of system to block credit memos unless there is either corresponding documentation of return of damaged goods or specific authorization by management

TABLE 12-1 (Continued)

Activity	Threat	Controls (first number refers to the corresponding threat)
Cash collections	17. Theft of cash 18. Cash flow problems	17.1 Separation of cash handling function from accounts receivable and credit functions 17.2 Regular reconciliation of bank account with recorded amounts by someone independent of cash collections procedures 17.3 Use of EFT, FEDI, and lockboxes to minimize handling of customer payments by employees 17.4 Prompt, restrictive endorsement of all customer checks 17.5 Having two people open all mail likely to contain customer payments 17.6 Use of cash registers 17.7 Daily deposit of all cash receipts 18.1 Lockbox arrangements, EFT, or credit cards 18.2 Discounts for prompt payment by customers 18.3 Cash flow budgets

Sales Order Entry

The revenue cycle begins with the receipt of orders from customers. The sales department, which reports to the vice president of marketing (refer to Figure 12-1), typically performs the sales order entry process, but increasingly customers are themselves entering much of this data through forms on a company's Web site storefront.

Figure 12-5 shows that the sales order entry process entails three steps: taking the customer's order, checking and approving customer credit, and checking inventory availability. Figure 12-5

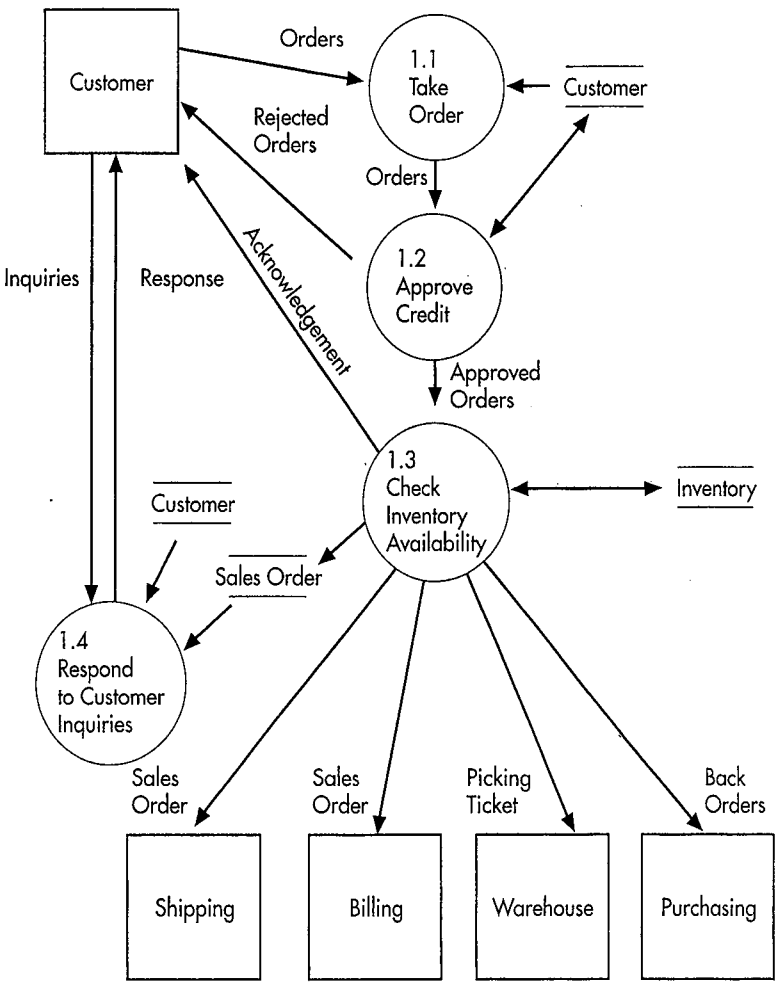


FIGURE 12-5
Level 1 Data Flow Diagram: Sales Order Entry

also includes an important related event that may be handled either by the sales order department or by a separate customer service department (which typically also reports to the vice president of marketing): responding to customer inquiries.

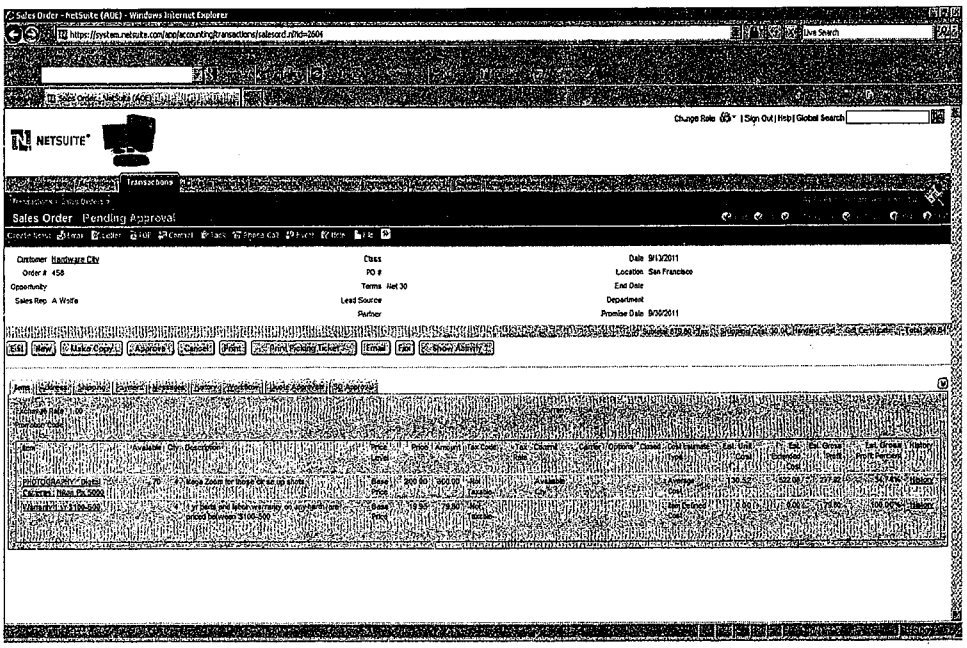
Taking Customer Orders

Customer order data are recorded on a sales order document. In the past, organizations used paper documents; today, as Figure 12-6 shows, the ***sales order*** document is usually an electronic form displayed on a computer monitor screen (interestingly, many ERP systems continue to refer to these data entry screens as documents). Examination of Figure 12-6 reveals that the sales order contains information about item numbers, quantities, prices, and other terms of the sale.

PROCESS In the past, customer orders were entered into the system by employees. Increasingly, organizations seek to leverage IT to have customers do more of the data entry themselves. One way to accomplish this is to have customers complete a form on the company's Web site. Another is for customers to use ***electronic data interchange (EDI)*** to submit the order electronically in a format compatible with the company's sales order processing system. Both techniques improve efficiency and cut costs by eliminating the need for human involvement in the sales order entry process.

Besides cutting costs, Web sites also provide opportunities to increase sales. One technique, used by many Internet retailers, is to use sales history information to create marketing messages tailored to the individual customer. For example, once an Amazon.com customer selects a book, the Web site suggests related books that other customers have purchased when they bought the one the customer has already selected. Amazon.com and other Internet retailers also use sales history data to create customized electronic coupons that they periodically send to customers to encourage additional purchases. Another technique involves the use of interactive sales order entry systems that allow customers to customize products to meet their exact needs. For example, visitors to Dell Computer's Web site can try numerous combinations of components and features until they find a configuration that meets their needs at a price they can afford. Such interactive sales order entry systems not only increase sales, but also help improve cash flow in two ways. First, because many sales are built to order, less capital needs to be tied up in carrying a large inventory of finished goods. Second, the build to order model allows companies to collect all or part of the payment in advance, possibly even before they have to pay for the raw materials.

The effectiveness of a Web site depends largely on its design, however. Therefore, companies should regularly review records of customer interaction on their Web sites to quickly identify



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FIGURE 12-6
Example of a Sales Order Document (Order Entry Screen)

potential problems. A hard-to-use Web site may actually hurt sales by frustrating customers and creating ill will. Conversely, a well-designed Web site can provide useful insights. For example, when managers at National Semiconductor noticed a marked increase in customer interest in the company's new heat sensors, they ramped up production so that the company was able to satisfy increased demand for those products.

Like AOE, many companies continue to employ a sales staff in addition to using a Web site storefront, because of the benefits associated with face-to-face contact with existing and prospective business customers. Information technology provides many opportunities to improve sales force efficiency and effectiveness, a process referred to as sales force automation. Storing promotional information online is cheaper than printing and mailing those materials to sales representatives. E-mail and instant messaging (IM) reduce the costs and time it takes to inform sales staff of pricing changes and sales promotions. Both techniques also can be used to provide sales staff with last-minute reminders about a particular customer's special needs and interests and to enable management to quickly approve special deals. E-mail and IM also reduce the need for salespeople to return to the home office, thereby increasing the proportion of time they can spend with customers. Technology also enhances the quality of sales presentations. Laptop computers enable salespeople to make multimedia presentations, which improves their ability to demonstrate and explain the capabilities and features of complex technical products.

THREATS AND CONTROLS A basic threat during sales order entry is that important data about the order will be either missing or inaccurate (threat 5 in Table 12-1). This not only creates inefficiencies (someone will have to call the customer back and reenter the order in the system), but also may negatively affect customer perceptions and, thereby, adversely affect future sales. ERP systems use a variety of data entry edit controls to mitigate this threat. For example, completeness checks can ensure that all required data, such as both shipping and billing addresses, are entered. Automatic lookup of reference data already stored in the customer master file, such as customer addresses, prevents errors by eliminating data entry. To illustrate, examine the sales order entry screen depicted in Figure 12-6. In the header section (the top portion of the screen), the salesperson need only enter the name of the customer in the sold-to and ship-to fields, and the system pulls the rest of the information from the customer master file. In the detail section (the lower portion of the figure), the salesperson needs to enter only the item number and quantity ordered, and the rest of the information is pulled from the inventory and pricing master files. Note that by looking up the reference data, the ERP system is necessarily performing a validity check of the customer name and inventory item number entered by the salesperson. ERP systems should also be configured to perform reasonableness tests to compare the quantity ordered with item numbers and past sales history.

Of course, all of these built-in controls presuppose that the master data is accurate, which is why Table 12-1 also indicates the need to restrict access to the integrated database (control 5.2) to prevent unauthorized changes that could destroy the integrity of the data. In addition, all of these data entry edit controls need to be incorporated on Web sites to ensure that customers accurately and completely enter all required data and in the EDI system used to accept electronic orders from customers.

A second threat associated with the sales order entry activity concerns the legitimacy of orders (threat 6 in Table 12-1). If a company ships merchandise to a customer and the customer later denies having placed the order, there is a potential loss of assets. For paper-based transactions, the legitimacy of customer orders is established by the customer's signature. As explained in Chapter 9, digital signatures provide similar assurance of legitimacy and the evidence to support nonrepudiation for electronic transactions.

Finally, accountants can help managers to better monitor sales activity by using their knowledge about business processes to design reports that focus on key performance drivers. For example, reports that break down sales by salesperson, region, or product provide a means to evaluate sales order entry efficiency and effectiveness. Reports that show marginal profit contribution by product, distribution channel, region, salesperson, or customer can provide additional insights.

Credit Approval

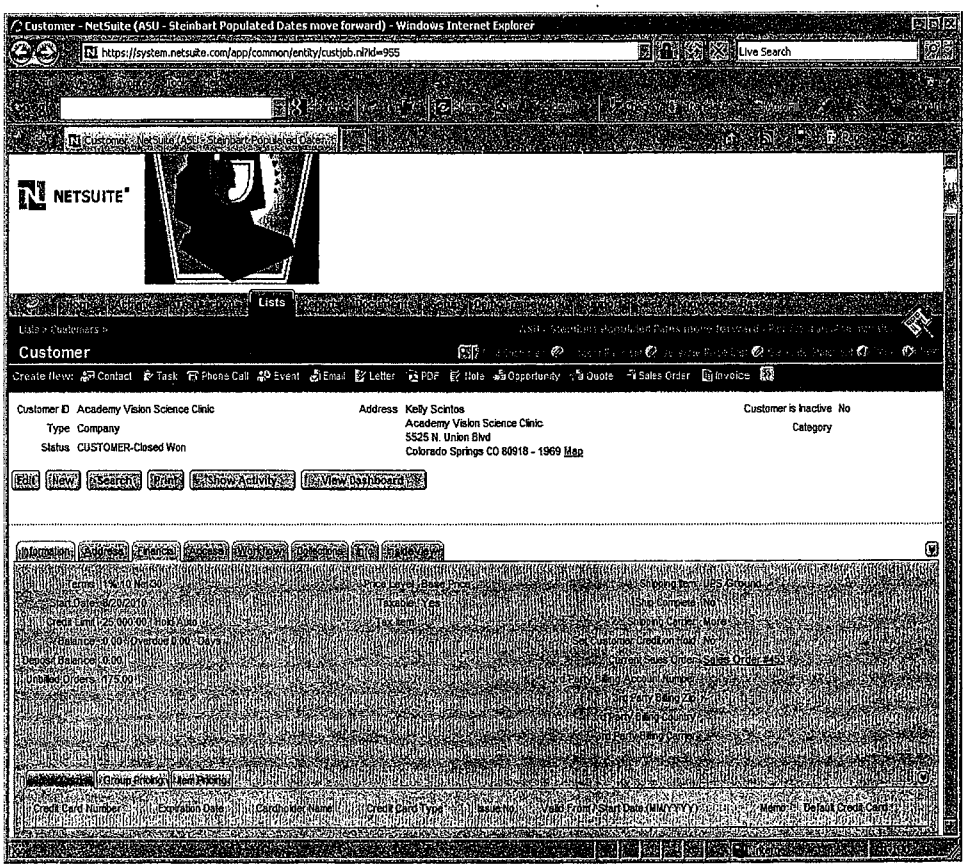
Most business-to-business sales are made on credit. Therefore, another revenue cycle threat listed in Table 12-1 (threat 7) is the possibility of making sales that later turn out to be uncollectible. Requiring proper authorization for each credit sale diminishes this threat.

For existing customers with well-established payment histories, a formal credit check for each sale is usually unnecessary. Instead, management gives sales staff general authorization to approve orders from customers in good standing, meaning those without past-due balances, provided that such sales do not increase the customer's total account balance beyond their credit limit. A ***credit limit*** is the maximum allowable account balance that management wishes to allow for a customer based on that customer's past credit history and ability to pay. Thus, for existing customers, credit approval simply involves checking the customer master file to verify the account exists, identifying the customer's credit limit, and verifying that the amount of the order plus any current account balance does not exceed this limit. This can be done automatically by the system.

The system can also automatically flag orders that require specific authorization because they exceed a customer's preapproved credit limit. For such cases, and for sales to new customers, Table 12-1 shows that someone other than the sales representative should specifically approve extension of credit (control 7.2). This is especially important if the sales staff is paid on commission because their motivation is to make sales, not focus on collectability. The organization chart for AOE (see Figure 12-1) shows how most companies segregate these duties. The credit manager, who sets credit policies and approves the extension of credit to new customers and the raising of credit limits for existing customers, is independent of the marketing function. To enforce this segregation of duties in ERP systems, sales order entry clerks should be granted read-only access to information about individual customer credit limits; the ability to actually change credit limits should be granted only to the credit manager. Figure 12-7 shows some of the information the system makes available to help the credit manager decide whether to adjust a customer's credit limit. The quality of those decisions depends upon maintaining accurate and current information about account balances, sales, and customer remittances.

To be effective, credit approval must occur *before* the goods are released from inventory and shipped to the customer. Nevertheless, problems will occur, and some customers will end up not paying off their accounts. Therefore, careful monitoring of accounts receivable is extremely important. A useful report for doing this is an ***accounts receivable aging report***, which lists customer account balances by length of time outstanding (Figure 12-8). The information provided by such reports is useful for projecting the timing of future cash inflows related to sales, deciding whether to increase the credit limit for specific customers, and for estimating bad debts.

FIGURE 12-7
Sample Inquiry Screen for Checking Customer Credit



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Customer	Amount	Current	1–30 Days Past Due	31–60 Days Past Due	61–90 Days Past Due	Over 90 Days Past Due
Able						
Invoice 221	$ 3,450	$ 3,450				
Invoice 278	2,955	2,955				
Total	$ 6,405	$ 6,405				
Baker						
Invoice 178	$ 4,500			$ 4,500		
Invoice 245	2,560	2,560				
Total	$ 7,060	$ 2,560		$ 4,500		
Other Accounts	$ 185,435	$ 137,935	$ 28,500	$ 5,500	$ 2,500	$ 11,000
Totals	$ 198,900	$ 146,900	$ 28,500	$ 10,000	$ 2,500	$ 11,000

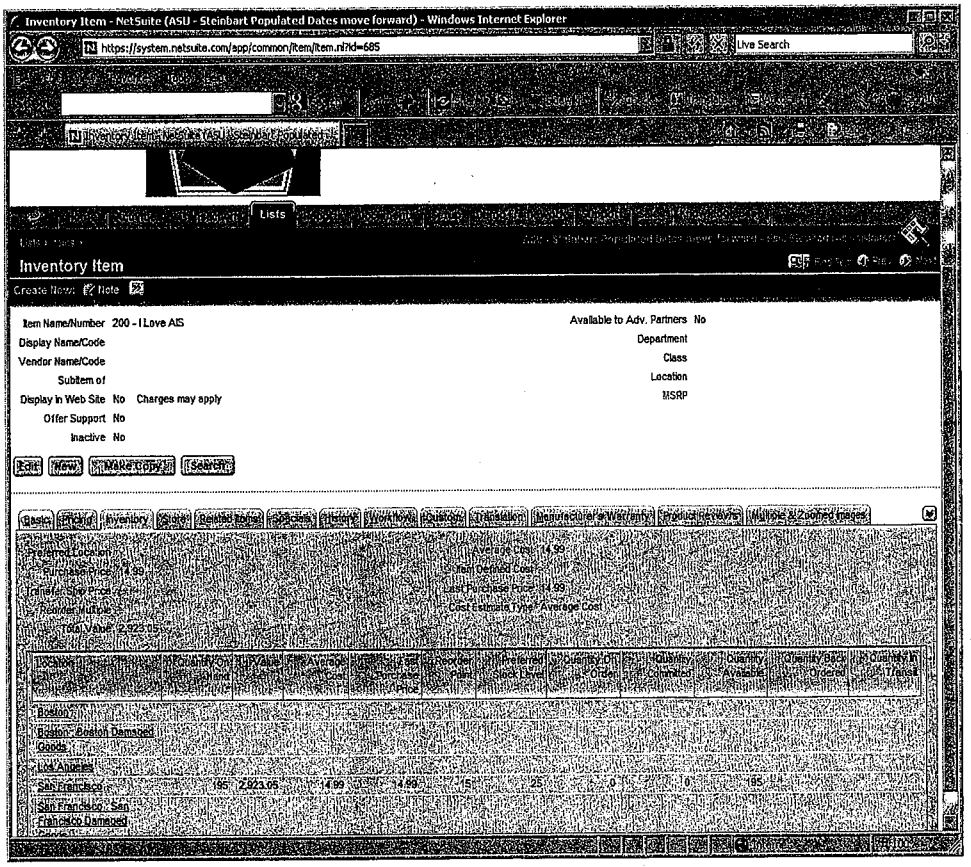
FIGURE 12-8
Example of an Accounts Receivable Aging Report

Management needs to regularly review the accounts receivable aging report because prompt attention to customers who fall behind in their payments can minimize losses. Such a report could have enabled AOE to spot problems with the Best Value Company earlier, so that it could have stopped making additional credit sales. In addition, reports that show trends in bad debt expense can help management decide whether changes are needed in credit policies.

Checking Inventory Availability

In addition to checking a customer's credit, salespeople also need to determine whether sufficient inventory is available to fill the order, so that customers can be informed of the expected delivery date.

PROCESS Figure 12-9 shows an example of the information typically available to the sales order staff: quantity on hand, quantity already committed to other customers, and quantity available. If sufficient inventory is available to fill the order, the sales order is completed, and the



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FIGURE 12-9
Sample Inquiry Screen for Checking Inventory Availability

quantity-available field in the inventory file for each item ordered is reduced by the amount ordered. The shipping, inventory control, and billing departments are then notified of the sale, and an acknowledgment may be sent to the customer. If there is not sufficient inventory on hand to fill the order, a ***back order*** for those items must be created. In manufacturing companies, creating a back order involves notifying the production department to initiate the production of the requested items. In retail companies, the purchasing department would be notified about the need to order the required items.

Once inventory availability has been determined, the system then generates a ***picking ticket*** that lists the items and quantities of each item that the customer ordered. The picking ticket authorizes the inventory control function to release merchandise to the shipping department. Although traditionally a paper document, picking tickets today are often electronic forms that may be displayed on portable handheld devices or on monitors built into forklifts. To improve efficiency, the picking ticket often lists the items by the sequence in which they are stored in the warehouse, rather than in the order listed on the sales order.

THREATS AND CONTROLS Accurate inventory records are important to prevent both stockouts and excess inventory (threat 8 in Table 12-1). Stockouts may result in lost sales if customers are not willing to wait and instead purchase from another source. Conversely, excess inventory increases carrying costs and may even require significant markdowns that reduce profitability. Frequent markdowns can change a company's image to that of a discount retailer, thereby conditioning customers to expect price cuts.

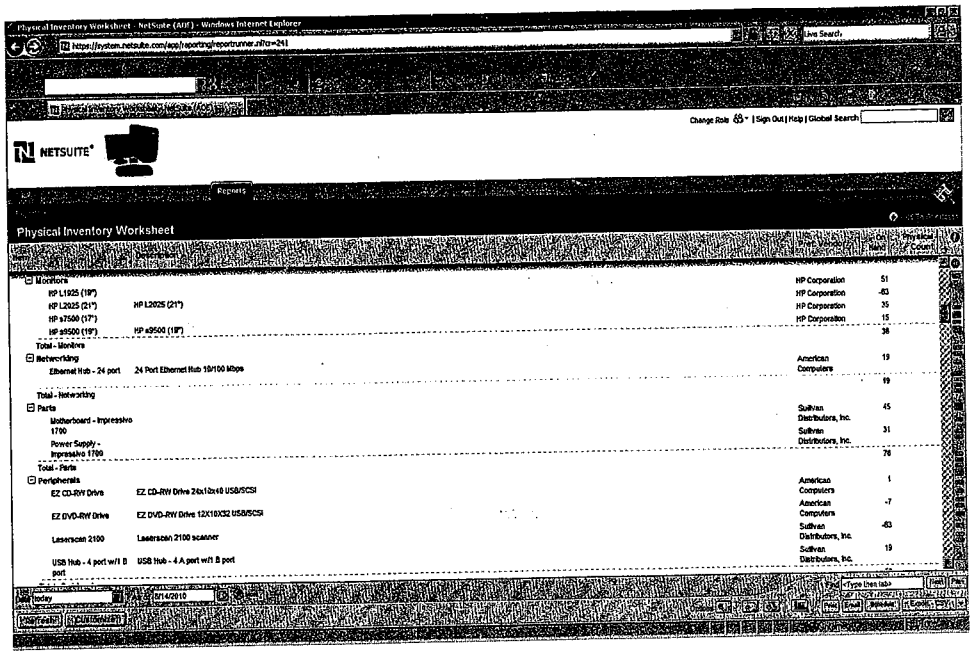
Integrated ERP systems, like the one depicted in Figure 12-4, facilitate the use of the perpetual inventory method, which reduces the risk of unexpected stockouts or excessive inventories. However, the accuracy of the perpetual inventory records requires careful data entry during performance of revenue cycle activities. In particular, shipping and sales clerks must correctly record the quantity of items removed from inventory and delivered to customers. This task is particularly error-prone in retail establishments. For example, when customers purchase multiple items with the same price, such as different flavors of yogurt or soft drinks, the checkout clerks at supermarkets may scan only one item and then enter the total quantity purchased. Although this will generate the correct total sales amount, it will introduce errors into the inventory records. The recorded quantity-on-hand for the one item that was physically scanned will be too low, and the recorded quantity-on-hand for the other flavors of that item will be too high. Proper handling of sales returns is another task that contributes to inaccurate inventory records, particularly in retail establishments. In clothing stores, for example, when a customer returns a wrong-sized item and exchanges it for another, the clerks should enter the exchange into the system. Often, especially during extremely busy sales periods, the clerks simply make the exchange and put the returned item back on the shelf but fail to make the proper entry in the system. Consequently, the system's records for both items are inaccurate.

Replacing bar codes with RFID tags can eliminate many of these problems because the data entry occurs automatically. For situations where use of RFID tags is uneconomical or not practical, training and regular reminders from management can reduce the frequency of the undesired behavior (control 8.3 in Table 12-1). Nevertheless, because the behaviors described above are likely to occur during particularly busy times, periodic physical counts of inventory are necessary to verify the accuracy of recorded amounts. Figure 12-10 shows an example of a physcial inventory worksheet. Notice that it lists each inventory item and the quantity that should be on hand, according to system records. It also includes a column to record the results of the physical count.

Sales forecasts (control 8.5 in Table 12-1) are another tool to help companies better predict inventory needs and thereby reduce the risk of stockouts or carrying excess inventory. Accountants can also prepare reports that enable sales managers to identify the need to adjust those forecasts. For example, reports about the frequency and size of back orders can identify items for which forecasts need to be adjusted to better avoid stockouts. Conversely, reports that break down sales by item can identify slow-moving products in time to prevent excessive stockpiling.

Responding to Customer Inquiries

Besides processing customer orders, as Figure 12-5 shows, the sales order entry process also includes responding to customer inquiries. Sometimes these inquiries precede an order, and often they occur after orders have been placed. In either case, responding to customer inquiries



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FIGURE 12-10
Example of Physical Inventory Worksheet

promptly and accurately is extremely important to a company's long-run success. The objective is to retain customers (threat 9 in Table 12-1). This is important because a general marketing rule of thumb is that it costs at least five times as much to attract and make a sale to a new customer as it does to make a repeat sale to an existing customer. Retention requires more than merely satisfying customers. It requires creating loyalty. Research indicates that if customer satisfaction is rated on a 1-to-5 scale, with 5 representing completely satisfied and 1 representing completely dissatisfied, customers who rated their satisfaction level at 5 were many times more likely to make repeat purchases than were customers who rated their satisfaction level only at 4. Moreover, that same research indicates that the key to generating total satisfaction, and thereby retaining customers, is the quality and nature of the post-sale customer contacts.

Customer service is so important that many companies use special software packages, called ***customer relationship management (CRM) systems***, to support this vital process. CRM systems help organize detailed information about customers to facilitate more efficient and more personalized service. CRM systems also help generate additional sales. For example, after responding to a customer inquiry, a customer service representative can use information about customer preferences and transaction history to suggest other products that may be of interest to the customer. Detailed data about customer requirements and business practices can also be used to proactively contact customers about the need to reorder.

Many customer inquiries are routine, however. Consequently, companies can and should use IT to automate the response to common requests, such as questions about account balances and order status, so that sales order and customer service representatives can concentrate their time and effort on handling the more complex, nonroutine inquiries. For example, Web sites provide a cost-effective alternative to traditional toll-free telephone customer support, automating that process with a list of frequently asked questions (FAQs). Discussion boards can also be provided so that customers can share information and useful tips with one another. Web sites also enable customers to use PINs to directly access their account information and to check on the status of orders. These techniques can significantly reduce customer service costs. Wells Fargo, for example, found that customers with online access to their accounts made 40% fewer calls to the customer service department than did customers without such access. It is impossible, however, to anticipate every question customers may ask. Therefore, Web sites designed to provide customer service should include an instant messaging or chat feature to enable customers to obtain real-time expert assistance and advice for dealing with special issues the FAQ list does not satisfactorily address. Finally, it is important for accountants to design reports that will assist managers in *properly* evaluating the performance of customer service representatives by incorporating both internal and external measures (control 9.1). Failure to include both types of data can result in reports that cause dysfunctional behavior. For example, reports that use only internal data, such as number of inquiries handled per unit of time, may encourage customer service representatives

to try to maximize their efficiency at the expense of satisfying customers. Conversely, relying solely on customer satisfaction ratings removes incentives to be efficient.

Shipping

The second basic activity in the revenue cycle (circle 2.0 in Figure 12-3) is filling customer orders and shipping the desired merchandise. As Figure 12-11 shows, this process consists of two steps: (1) picking and packing the order and (2) shipping the order. The warehouse and shipping departments perform these activities, respectively. Both functions include custody of inventory and, as shown in Figure 12-1, report ultimately to the vice president of manufacturing.

Pick and Pack the Order

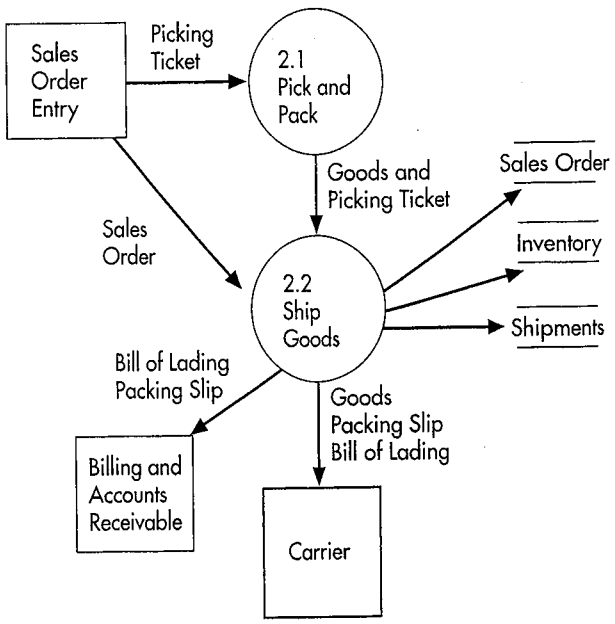
The first step in filling a customer order involves removing the correct items from inventory and packaging them for delivery.

PROCESS The picking ticket generated by the sales order entry process triggers the pick and pack process. Warehouse workers use the picking ticket to identify which products, and the quantity of each product, to remove from inventory. Warehouse workers record the quantities of each item actually picked, either on the picking ticket itself (if a paper document is used) or by entering the data into the system (if electronic forms are used). The inventory is then transferred to the shipping department.

AOE, like many companies, has made significant investments in automated warehouse systems consisting of computers, bar-code scanners, conveyer belts, and communications technology. The goal of such investments is to reduce the time and cost of moving inventory into and out of the warehouse while also improving the accuracy of perpetual inventory systems. Wireless technology, in particular, increases warehouse productivity by eliminating the need for workers to repeatedly return to a centralized dispatch center to receive printed instructions. For example, JCPenney equips its forklifts with radio-frequency data communication (RFDC) terminals to provide drivers with information about which items to pick next and where they are located. At Corporate Express, an office supplies distributor in Broomfield, Colorado, warehouse workers wear headsets and listen to computer-synthesized voice instructions about what to items to pick and package for delivery. The company reports that the oral instructions result in fewer mistakes than occur when drivers try to read a small terminal screen in dim light.

Radio-frequency identification (RFID) tags improve the efficiency and accuracy of tracking inventory movement. With bar codes, the item or box must be positioned properly so that the bar code can be read by the scanner. Switching to an RFID tag eliminates this need to align items

FIGURE 12-11
Level 1 Data Flow Diagram: Shipping



with scanners; instead, the tags can be read as the inventory moves throughout the warehouse. In addition, each RFID tag can store detailed information to facilitate properly storage and routing of the inventory item. For companies that handle large volumes of merchandise, such as Federal Express and UPS, RFID's ability to reduce by even a few seconds the time it takes to process each package can field enormous cost savings.

Automated warehouse systems not only cut costs and improve efficiency in handling inventory but also can allow for more customer-responsive shipments. For example, manufacturers can use bar-code and RFID systems in their warehouses to facilitate packing and shipping related items (e.g., matching shirts and ties) together. The cartons can then be either bar-coded or RFID-tagged so that retailers can quickly check in the merchandise and move it to the selling floor. These services not only save retailers time and money but also help improve turnover, thereby increasing the manufacturer's sales.

THREATS AND CONTROLS One potential problem is the risk of picking the wrong items or in the wrong quantity (threat 10 in Table 12-1). The automated warehousing technologies described earlier can minimize the chance of such errors. Bar-code and RFID scanners, in particular, virtually eliminate errors when they are used by the system to automatically compare the items and quantities picked by warehouse workers with the information on sales orders.

Another threat involves the theft of inventory. Theft losses can be extremely large, and the perpetrators can be either outsiders or employees. In addition to a loss of assets, theft also makes inventory records inaccurate, which can lead to problems in filling customer orders. Table 12-1 lists several control procedures that can reduce the risk of inventory theft. First, inventory should be kept in a secure location to which physical access is restricted (control 11.1). Second, all inventory transfers within the company should be documented. Inventory should be released to shipping employees based only on approved sales orders. Both warehouse and shipping employees should sign the document accompanying the goods (or make the appropriate acknowledgment of the transfer online) at the time the goods are transferred from inventory to shipping. This procedure facilitates tracking the cause of any inventory shortages, and the accountability provided encourages employees to prepare and maintain accurate records. The use of wireless communications technologies and RFID tags can provide real-time tracking of inventory in transit, which may help reduce theft. Finally, recorded amounts of inventory should be periodically reconciled with physical counts of inventory on hand (control 11.4), and the employees responsible for inventory custody should be held accountable for any shortages.

As with the other steps in the revenue cycle, accountants can help managers better monitor performance by designing useful reports. Note that the order-picking process does not involve any direct interaction with customers. Therefore, reports that focus on efficiency, using only internally generated measures such as orders filled per unit of time, are sufficient.

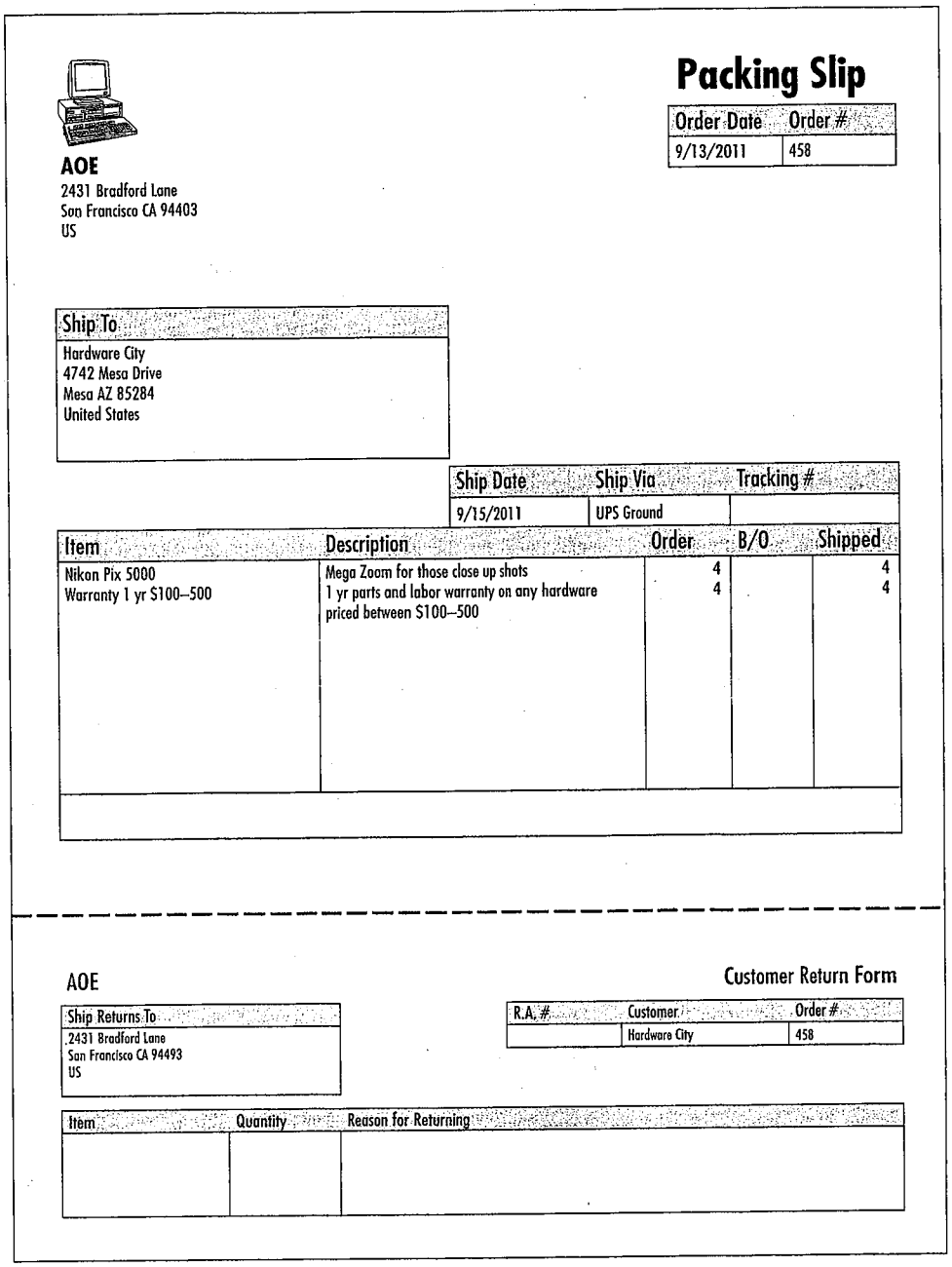
Ship the Order

After the merchandise has been removed from the warehouse, it is shipped to the customer.

PROCESS The shipping department should compare the physical count of inventory with the quantities indicated on the picking ticket and with the quantities indicated on the sales order. Discrepancies can arise either because the items were not stored in the location indicated on the picking ticket or because the perpetual inventory records were inaccurate. In such cases, the shipping department needs to initiate the back ordering of the missing items and enter the correct quantities shipped on the packing slip.

After the shipping clerk counts the goods delivered from the warehouse, the sales order number, item number(s), and quantities are entered using online terminals. This process updates the quantity-on-hand field in the inventory master file. It also produces a packing slip and multiple copies of the bill of lading. The ***packing slip*** (see Figure 12-12) lists the quantity and description of each item included in the shipment. The ***bill of lading*** is a legal contract that defines responsibility for the goods in transit. It identifies the carrier, source, destination, and any special shipping instructions, and it indicates who (customer or vendor) must pay the carrier (see Figure 12-13). A copy of the bill of lading and the packing slip accompany the shipment. If the customer is to pay the shipping charges, this copy of the bill of lading may serve as a *freight bill*, to indicate the amount the customer should pay to the carrier. In other cases, the freight bill is a separate document.

FIGURE 12-12
Example of a Packing Slip



Packing Slip

Order Date	Order #
9/13/2011	458

AOE
2431 Bradford Lane
San Francisco CA 94403
US

Ship To
Hardware City 4742 Mesa Drive Mesa AZ 85284 United States

Ship Date	Ship Via	Tracking #
9/15/2011	UPS Ground	

Item	Description	Order	B/O	Shipped
Nikon Pix 5000	Mega Zoom for those close up shots	4		4
Warranty 1 yr $100–500	1 yr parts and labor warranty on any hardware priced between $100–500	4		4

AOE

Customer Return Form

Ship Returns To
2431 Bradford Lane San Francisco CA 94493 US

R.A. #	Customer	Order #
	Hardware City	458

Item	Quantity	Reason for Returning

One important decision that needs to be made when filling and shipping customer orders concerns the choice of delivery method. Traditionally, many companies have maintained their own truck fleets for deliveries. Large companies such as General Motors have even assigned entire departments to this function. Increasingly, however, manufacturers are outsourcing this function to commercial carriers such as Ryder System, Inc., Schneider Logistics, and YRC. Outsourcing deliveries reduces costs and allows manufacturers to concentrate on their core business activity (the production of goods). Selecting the proper carrier, however, requires collecting and monitoring information about carrier performance (e.g., percentage of on-time deliveries and damage claims).

Another important decision concerns the location of distribution centers. Increasingly, many customers are asking suppliers and manufacturers to deliver products only when needed. Consequently, suppliers and manufacturers must use logistics software tools to identify the optimal locations to store inventory in order to minimize the total amount of inventory carried and to meet each customer's delivery requirements. Logistics software also helps optimize daily activities, such as how to most efficiently use 17 available trucks to make 300 deliveries to various locations in one metropolitan area.

Globalization adds further complexity to outbound logistics. The efficiency and effectiveness of different distribution methods, such as trucking or rail, differ around the world. Taxes and

STRAIGHT BILL OF LADING—SHORT FORM **Not Negotiable.**

Shipper's No.

Carrier **Carrier's No.**

RECEIVED, subject to the classifications and tariffs in effect on the date of the issue of this Bill of Lading.

at _____ **20**____ **from** _____

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in any or all of said property, that every service to be performed hereunder shall be subject to all terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Uniform Freight Classification in effect on the date hereof, if this is a rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Consigned to _____

(Mail or street address of consignee—For purposes of notification only.)

Destination _____ State _____ Zip Code _____ County _____

Delivery Address ★ _____

(★ To be filled in only when shipper desires and governing tariffs provide for delivery thereat.)

Route _____

Delivering Carrier Car or Vehicle Initials No.

No. Packages	Kind of Package, Description of Articles, Special Marks, and Exceptions	*Weight (Sub. to Cor.)	Class or Rate	Check Column

Subject to Section 7 of Conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement.

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

_____

(Signature of Consignor.)

If charges are to be prepaid, write or stamp here, "To Be Prepaid."

_____

Received $ _____ to apply in prepayment of the charges on the property described hereon.

_____

Agent or Cashier

_____

Per _____

amount prepaid

Charges advanced:
$

*If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading shall state whether it is "carrier's or shipper's weight."
NOTE—Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property.
The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding

per

†"The fiber boxes used for this shipment conform to the specifications set forth in the box maker's certificate thereon, and all other requirements of Uniform Freight Classification."
†Shipper's imprint in lieu of stamp; not a part of bill of lading approved by the Interstate Commerce Commission.

_____ Shipper, per _____ Agent, Per _____

Permanent post office address of shipper, _____ _____ _____

FIGURE 12-13
Sample Bill of Lading

regulations in various countries can also affect distribution choices. Therefore, an organization's information system must include logistics software that can maximize the efficiency and effectiveness of its shipping function.

THREATS AND CONTROLS Table 12-1 indicates that shipping errors are a potential problem (threat 11). Regular reconciliation of information about shipments with sales orders (control 11.1) enables timely detection of delay or failure to ship goods to customers. In addition, RFID systems can provide real-time information on shipping status and thus provide additional information about possible delays. If the seller learns that a shipment is going to be late, prompt

notification can help the customer revise its plans accordingly. The cost of providing such notifications is minimal, especially if done via e-mail or IM, but the effort is likely to significantly improve customer satisfaction and loyalty.

Shipping the wrong items or quantities of merchandise and shipping to the wrong location can cause customer dissatisfaction, resulting in the loss of future sales. Shipping errors may also result in the loss of assets if customers do not pay for goods erroneously shipped. To minimize the risk of shipping errors, ERP systems like the one depicted in Figure 12-4 should be configured to compare the quantities and item numbers entered by shipping employees to the information on the sales order and to display a warning about any discrepancies so that the problem can be corrected prior to shipment. Of course, the effectiveness of this control depends upon the accuracy of the information collected about outgoing shipments. To reduce data entry errors by shipping employees, bar codes and RFID tags should be used whenever possible (control 12.3). If shipping data must be entered manually at a terminal, application controls such as field checks, limit or range checks, and completeness tests are necessary.

Duplicate shipments result in increased costs associated with shipping and then processing the return of merchandise. To mitigate this threat, ERP systems should be configured to "block" the line items on sales orders once shipping documents are printed (control 12.5), to prevent using that same sales order to authorize another shipment of the same goods to the same customer. Companies that still use paper documents can reduce the risk of duplicate shipments by sequentially prenumbering all shipping documents, requiring that they be matched with the supporting sales order and picking ticket, and then marking those documents in a manner that prevents their reuse.

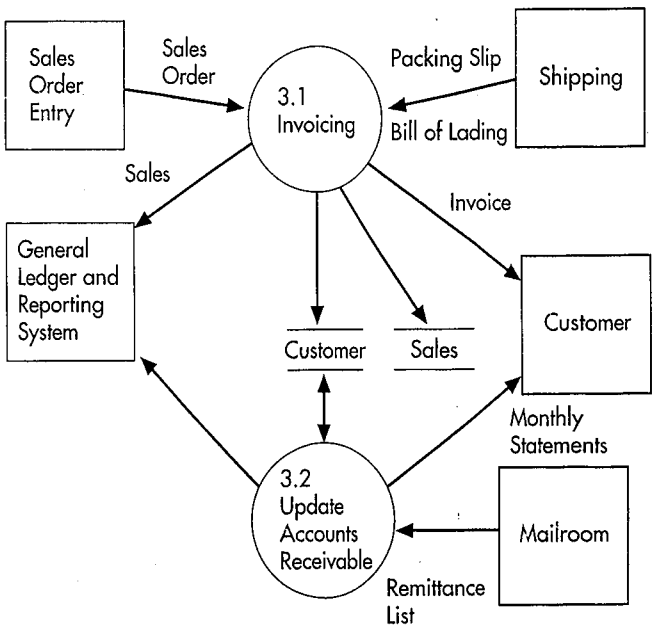
Billing

The third basic activity in the revenue cycle (circle 3.0 in Figure 12-3) involves billing customers. Figure 12-14 shows that this involves two separate, but closely related, tasks: invoicing and updating accounts receivable, which are performed by two separate units within the accounting department.

Invoicing

Accurate and timely billing for shipped merchandise is crucial. The invoicing activity is just an information processing activity that repackages and summarizes information from the sales order entry and shipping activities. It requires information from the shipping department identifying the items and quantities shipped and information about prices and any special sales terms from the sales department.

FIGURE 12-14
Level 1 Data Flow Diagram: Billing Process



PROCESS The basic document created in the billing process is the *sales invoice* (Figure 12-15), which notifies customers of the amount to be paid and where to send payment. Like many companies, AOE still prints paper invoices that it mails to many of its smaller customers. Larger customers, however, receive invoices via EDI. EDI not only eliminates printing and postage costs, but also the labor involved in performing those tasks. For companies that generate hundreds of thousands of sales invoices annually, saving even a few seconds per invoice can yield significant cost reductions. EDI invoices and online bill payment also benefit customers by reducing their time and costs, which should increase both satisfaction and loyalty.

In fact, a well-designed accounting system can entirely eliminate the need to create and store invoices, at least with customers that have sophisticated systems of their own. To understand this concept, reexamine the information included in a typical sales invoice (see Figure 12-13). The invoice indicates the quantity of each item sold and the price charged for that item; but the price is usually set at the time the order is placed, and the actual quantity sold is known at the time the merchandise is shipped to the customer. Thus, the selling company's accounting system already contains all the information needed to calculate the amount of the sale at the time the goods are shipped. Indeed, invoices are often printed in a batch process without any manual data entry. Conversely, the buyer knows the price at the time the order is placed and knows the quantity purchased when the goods are received. Consequently, if both companies have accurate transaction processing systems, it may be possible to establish an agreement in which the buyer will



AOE
2431 Bradford Lane
San Francisco, CA
99403

Invoice

Date	Invoice #
9/16/2011	3091380

Bill To	Ship To
Hardware City 35 Appliance Way Phoenix AZ 85201 United States	Hardware City 4742 Mesa Drive Mesa AZ 85284 United States

Terms	Due Date	PO #	Sales Rep	Ship Via	Tracking Numbers
Net 30	10/16/2011		JKL	UPS Ground	

Item	Qty	Description	Price	Amount
Nikon Pix 5000	4	Mega Zoom for those close up shots	200.00	800.00
Warranty 1 yr $100–500	4	1 yr parts and labor warranty on any hardware priced between $100–500	19.95	79.80

Subtotal	879.80
Shipping Cost (UPS Ground)	30.04
Total	$909.84

FIGURE 12-15
Example of a Sales Invoice

automatically remit payments within a specified number of days after receiving the merchandise. The seller sends an electronic notification, usually via e-mail, when the goods are shipped and the customer sends an electronic acknowledgment when the goods are received. Ford is just one of many companies that have established such relationships with their major suppliers. Note that the seller can still monitor and determine accounts receivable by reconciling shipments to customer remittances because accounts receivable represents all shipments for which the seller has not yet been paid. The attraction of such invoiceless billing is that it saves both the seller and buyer considerable amounts of time and money by eliminating the need to perform a traditional business process (invoicing) that does not provide any new information.

An integrated ERP system also provides the opportunity to merge the billing process with the sales and marketing function by using data about a customer's past purchase history to send information about related products and services. Such customized advertising may generate additional sales with little if any incremental costs.

THREATS AND CONTROLS One threat associated with the invoicing process is a failure to bill customers (threat 13 in Table 12-1), which results in the loss of assets and erroneous data about sales, inventory, and accounts receivable. Segregating the shipping and billing functions is an important control to reduce the risk that this occurs intentionally. Otherwise, an employee performing both functions could ship merchandise to friends without billing them. To reduce the risk of unintentional failure to bill, ERP systems need to be configured to regularly compare sales orders, picking tickets, and shipping documents with sales invoices to produce reports of shipments for which an invoice has not been created. (For invoiceless systems, this control involves matching sales orders to shipping documents). Management needs to regularly review such reports and take corrective action. In paper-based systems, prenumbering all documents and periodically accounting for them identifies shipments that have not been invoiced.

Billing errors, such as pricing mistakes and billing customers for items not shipped or on back order, represent another potential threat. Overbilling can result in customer dissatisfaction, and underbilling results in the loss of assets. Pricing mistakes can be avoided by having the system retrieve the appropriate data from the pricing master file and by restricting the ability of employees to make changes to that data. If employees must enter billing data manually, the use of the data entry edit controls discussed in chapter 10 can minimize errors. Mistakes involving quantities shipped can be caught by reconciling the quantities listed on the packing slips with those on the sales order.

Maintain Accounts Receivable

The accounts receivable function, which reports to the controller, performs two basic tasks: It uses the information on the sales invoice to debit customer accounts and subsequently credits those accounts when payments are received.

PROCESS The two basic ways to maintain accounts receivable are the open-invoice and the balance-forward methods. The two methods differ in terms of when customers remit payments, how those payments are applied to update the accounts receivable master file, and the format of the monthly statement sent to customers. Under the ***open-invoice method,*** customers typically pay according to each invoice. Usually, two copies of the invoice are mailed to the customer, who is requested to return one copy with the payment. This copy is a turnaround document called a ***remittance advice.*** Customer payments are then applied against specific invoices. In contrast, under the ***balance-forward method,*** customers typically pay according to the amount shown on a monthly statement, rather than by individual invoices. The ***monthly statement*** lists all transactions, including both sales and payments, that occurred during the past month and informs customers of their current account balances (Figure 12-16). The monthly statement often has a tear-off portion containing preprinted information, including the customer's name, account number, and balance. Customers are asked to return this stub, which serves as a remittance advice, with payment. Remittances are applied against the total account balance, rather than against specific invoices.

One advantage of the open-invoice method is that it is conducive to offering discounts for prompt payment, as invoices are individually tracked and aged. It also results in a more uniform flow of cash collections throughout the month. A disadvantage of the open-invoice method is the added complexity required to maintain information about the status of each individual invoice

MONTHLY STATEMENT March 2011

Alpha Omega Electronics
2431 Bradford Lane
San Francisco, CA 99403

Hardware City
35 Appliance Way
Phoenix, AZ 85201

Invoice Number	Date	Current	Past Due 1–30	Past Due 31–60	Past Due 61–90	Past Due Over 90
34567	3/20/2011	4292.50				
34591	3/27/2011	2346.50				
Totals		6639.00				
Total Amount Due					6639.00	

Please detach here and return with remittance

Bill date 03/31/2011
Account number 73256
Payment due 04/10/2011
Total amount due 6639.00
Amount enclosed

Pay To: AOE
PO Box 7341
San Francisco, CA 99403-7341

FIGURE 12-16
Example of a Monthly Statement

for each customer. Consequently, the open-invoice method is typically used by business whose customers are primarily other businesses, because the number of individual transactions is relatively small and the dollar value of those transactions is high. Companies with large numbers of customers who make many small purchases each month, such as utility companies, credit card issuers (e.g., Citibank), or national retail chains (e.g., Sears and JCPenney) typically use the balance-forward method. For them, this method is more efficient and reduces costs by avoiding the need to process cash collections for each individual sale. It is also more convenient for the customer to make one monthly remittance.

Many companies that use the balance-forward method use a process called cycle billing to prepare and mail monthly statements to their customers. Under ***cycle billing***, monthly statements are prepared for subsets of customers at different times. For example, the customer master file might be divided into four parts, and each week monthly statements would be prepared for one-fourth of the customers. Cycle billing produces a more uniform flow of cash collections throughout the month and reduces the time that the computer system is dedicated to printing monthly statements. Cycle billing can significantly affect processing requirements. Consider the case of a utility company serving several million customers in a large metropolitan area. If it prepared monthly statements for all its customers at the same time, and it took 10 seconds to print out each one, its printers would be tied up for several days.

Image processing technology can further improve the efficiency and effectiveness of managing customer accounts. The digital images of customer remittances and invoices can be stored electronically and then be easily retrieved, manipulated, and integrated with other images and data to produce various types of output. Doing so provides employees fast access to all documents relating to a customer and eliminates the time wasted searching through file cabinets for lost paperwork. If a customer needs a duplicate copy of a monthly statement or an invoice to replace a lost original, it can be retrieved, printed, and faxed while the employee is talking to the customer on the phone. Image processing also can facilitate resolving customer complaints, because the same image can be viewed simultaneously by more than one person. Thus, a customer account representative and a credit manager could both review an image of a document in

question while discussing the problem with the customer on the telephone. Image processing also reduces the space and cost associated with storing paper documents. The savings in this area can be substantial: One optical disk can store up to 20,000 documents, in a fraction of the space.

Adjustments to a customer's account are sometimes necessary. For example, customer accounts may be credited to reflect either the return of items or allowances granted for damaged goods. To credit a customer's account for returned goods, the credit manager must obtain information from the receiving dock that the goods were actually returned and placed back in inventory. Upon notification from the receiving department that the goods have been returned, the credit manager issues a *credit memo* (Figure 12-17), which authorizes the crediting of the customer's account. If the damage to the goods is minimal, the customer may agree to keep them for a price reduction. In such cases, the credit manager issues a credit memo to reflect the amount that should be credited to the customer's account. A copy of the credit memo is sent to accounts receivable to authorize an adjustment to the customer's account balance; another copy is sent to the customer.

After repeated attempts to collect payment have failed, it may be necessary to write off a customer's account. In such cases, the credit manager issues a credit memo to authorize the write-off. Unlike the cases involving damaged or returned goods, however, a copy of the credit memo used to authorize the write-off of an account is not sent to the customer.

THREATS AND CONTROLS Errors in maintaining customer accounts (threat 15 in Table 12-1) can lead to the loss of future sales and also may indicate possible theft of cash. The data entry edit checks discussed in Chapter 10 can minimize the risk of errors in maintaining customer accounts. For example, validity checks and closed-loop verification can ensure that the correct customer account is being updated, and field checks can ensure that only numeric data is entered for sales and payments. Customer payments are often processed in batches, so batch totals can provide an additional means to detect posting errors. Specifically, the sum of all customer

FIGURE 12-17
Example of a Credit Memo

11121

CREDIT MEMORANDUM

Alpha Omega Electronics
2431 Bradford Lane
San Francisco, CA 99403

Credit To: Hardware City
35 Appliance Way
Phoenix, AZ 85201

Date April 7, 2011

Salesperson FRM

Apply To Invoice Number	Date	Customer's Order No.
34603	April 1, 2011	7413

Quantity	Item Number	Description	Unit Price	Amount
3	4120	PCS	85.00	255 00

Reason Credit Issued: Units damaged during shipment.
Returned on April 6, 2011

Received By: ALZ

Authorized By: PJS

We Credit Your Account For This Amount 255 00

payments processed should equal the change to the total of all customer account balances. To ensure that all remittances were processed, the number of customer accounts updated should be compared with the number of checks received. These reconciliations should be performed by someone other than the individual involved in processing the original transactions because (1) it is easier to catch someone else's mistakes than one's own, and (2) it provides a means to identify possible cases of fraud. Mailing monthly account statements to every customer (control 15.3) provides an additional independent review of posting accuracy because customers will complain if their accounts have not been properly credited for payments they remitted. Traditionally, another important control to verify the accuracy of updates to accounts receivable involved reconciling the subsidiary accounts receivable records with the general ledger. After customer payments are processed, the sum of all individual customer account balances (the accounts receivable subsidiary file) should equal the total balance of the accounts receivable control account in the general ledger. If the two are not equal, an error in posting has probably occurred, and all transactions just entered should be reexamined. ERP systems, however, typically are configured so that postings to general ledger control accounts can occur only through the subsidiary ledger and are only made by the system itself. Although this eliminates the possibility of discrepancies between the subsidiary and general ledger arising from data entry errors, configuration errors are still possible.

Another threat listed in Table 12-1 is that an employee may issue credit memos to write-off account balances for friends or to cover up the theft of cash or inventory. Proper segregation of duties (control 16.1) can reduce the risk of this threat. To prevent employees making sales to friends that are then written off, the ERP system should be configured so that the person who can issue credit memos does not also have rights to enter sales orders or to maintain customer accounts. The system should also be configured to match all credit memos to sales invoices. In addition, the system should be configured to block credit memos for which there does not exist validated documentation that the goods have been returned by the customer (control 16.2). Blocking forces specific managerial review and approval of cases where the company agrees to let the customer both keep the merchandise and receive credit.

Cash Collections

The final step in the revenue cycle is collecting and processing payments from customers (circle 4.0 in Figure 12-3).

Process

Because cash and customer checks can be stolen so easily, it is important to take appropriate measures to reduce the risk of theft. As discussed more fully in the section on controls, this means that the accounts receivable function, which is responsible for recording customer remittances, should not have physical access to cash or checks. Instead, the cashier, who reports to the treasurer (see Figure 12-1), handles customer remittances and deposits them in the bank.

How then, does the accounts receivable function identify the source of any remittances and the applicable invoices that should be credited? One method involves mailing the customer two copies of the invoice and requesting that one be returned with the payment. This remittance advice is then routed to accounts receivable, and the actual customer payment is sent to the cashier. An alternative solution is to have mailroom personnel prepare a ***remittance list***, which is a document identifying the names and amounts of all customer remittances, and send it to accounts receivable. Yet another alternative is to photocopy all customer remittances and send the copies to accounts receivable while forwarding the actual remittances to the cashier for deposit.

Managing cash flow is important to overall profitability, as the AOE case showed. Therefore, companies are continually seeking ways to speed up the receipt of payments from customers. Focus 12-1 describes how imaging technology can improve cash flow in situations where customers send payments directly to the company.

FOCUS 12-1 Using Image Processing Technology to Speed Cash Collections

Image-scanning software offers an opportunity to improve the efficiency of the internal processing of customer payments and reduce the time it takes to access those funds. Scanners can detect the presence of any metal objects, such as coins or staples, in envelopes containing payments from customers. Envelopes without such items can be opened mechanically and their contents (customer checks) run through a high-speed imaging device that automatically applies remittances to the corresponding customer account. Only envelopes containing staples or coins need to be processed manually.

By using Remote Deposit Capture software, businesses can more quickly get access to funds remitted by customers. The software creates an encrypted file of customer checks that have been scanned. Then, instead of physically depositing the customer checks with its bank, the company electronically transmits the encrypted file of check images. The bank decrypts the file and notifies the company electronically when the checks have cleared. This process shaves at least one day off the clearing process and also saves the company the time and expense associated with physically depositing the checks.

Another way to speed up the processing of customer payments involves the use of a lockbox arrangement with a bank. A ***lockbox*** is a postal address to which customers send their remittances. The participating bank picks up the checks from the Post Office box and deposits them in the company's account. The bank then sends the remittance advices, an electronic list of all remittances, and photocopies of all checks to the company. Having customers send payments to a lockbox eliminates the delay associated with processing customer remittances before depositing them. Cash flow can be further improved by selecting several banks around the country to maintain lockboxes, with the locations chosen to minimize the time customer checks are in the mail. Similarly, establishing lockbox arrangements with foreign banks reduces the time it takes to collect payments from sales to international customers.

Information technology can provide additional efficiencies in the use of lockboxes. In an ***electronic lockbox*** arrangement, the bank electronically sends the company information about the customer account number and the amount remitted as soon as it receives and scans those checks. This method enables the company to begin applying remittances to customer accounts before the photocopies of the checks arrive.

Lockbox arrangements, however, eliminate only those delays that are associated with internal processing of remittances mailed directly to the company. With ***electronic funds transfer (EFT)***, customers send their remittances electronically to the company's bank and thus eliminate the delay associated with the time the payment is in the mail system. EFT also reduces the time lag before the bank makes the deposited funds available to the company. EFT is usually accomplished through the banking system's Automated Clearing House (ACH) network.

EFT, however, involves only the transfer of funds. To properly credit customer accounts, companies also need additional data about each remittance, such as invoice numbers and discounts taken. Although every bank can do EFT through the ACH system, not every bank possesses the EDI capabilities necessary to process the related remittance data. Consequently, many companies have had to separate the EFT and EDI components of processing customer payments, as shown in the top panel of Figure 12-18. This complicates the seller's task of properly crediting customer accounts for payments because information about the total amount of funds received arrives separately from information about the invoices that payment should be applied against. Similarly, the customer's task is complicated by the need to send information about the payment to two different parties.

Financial electronic data interchange (FEDI) solves these problems by integrating the exchange of funds (EFT) with the exchange of the remittance data (EDI). As shown in the lower panel of Figure 12-18, the customer sends both remittance data and funds transfer instructions together. Similarly, the seller receives both pieces of information simultaneously. Thus, FEDI completes the automation of both the billing and cash collections processes. To fully reap the

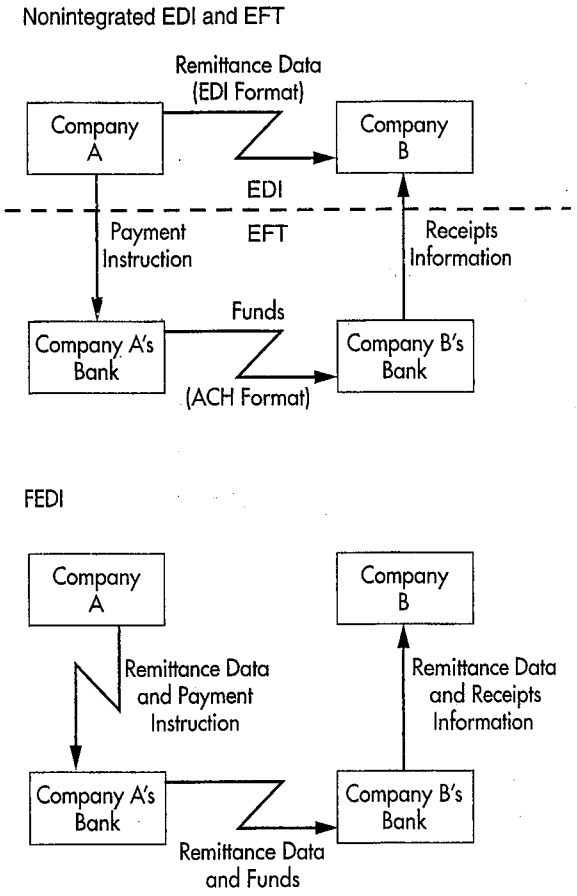


FIGURE 12-18
EFT and FEDI

benefits of FEDI, however, requires that both the selling company and its customers use banks that are capable of providing EDI services.

Companies can also speed the collection process by accepting credit cards or procurement cards (a special type of credit card that will be discussed in Chapter 13). The benefit is that the card issuer usually transfers the funds within two days of the sale. This benefit must be weighed against the costs of accepting such cards, which typically range from 2% to 4% of the gross sales price.

Threats and Controls

The primary objective of the cash collections function is to safeguard customer remittances. Special control procedures must be utilized because cash is so easy to steal (threat 17 in Table 12-1). Segregation of duties is the most effective control procedure for reducing the risk of such theft. Employees who have physical access to cash should not have responsibility for recording or authorizing any transactions involving its receipt. Specifically, the following pairs of duties should be segregated:

1. *Handling cash or checks and posting remittances to customer accounts.* A person performing both of these duties could commit the special type of embezzlement called *lapping* that was discussed in Chapter 5. Therefore, only the remittance data should be sent to the accounts receivable department, with customer payments being sent to the cashier. Such an arrangement establishes two mutually independent control checks. First, the total credits to accounts receivable recorded by the accounting department should equal the total debit to cash representing the amount deposited by the cashier. Second, the copy of the remittance list that is sent to the internal audit department can be compared with the validated deposit slips and bank statements to verify that all checks the organization received were deposited. Finally, the monthly statements mailed to customers provide another layer of control, because customers would notice the failure to properly credit their accounts for payments remitted.

2. *Handling cash or checks and authorizing credit memos.* A person performing both of these duties could conceal theft of cash by creating a credit memo equal to the amount stolen.
3. *Handling cash or checks and reconciling the bank statement.* An important detective control is reconciliation of the bank account statement with the balance of cash recorded in the company's information system. Having this reconciliation performed by someone who does not have access to cash or customer remittances provides an independent check on the cashier and prevents manipulation of the bank statement to conceal the theft of cash.

In ERP systems, employee roles must be properly configured to segregate these combinations of incompatible duties. In addition, the system should be configured to require specific approval by an appropriate manager of high-risk transactions, such as issuing credit memos without requiring the customer to return the merchandise.

In general, the handling of money and checks within the organization should be minimized. The optimal methods are a bank lockbox arrangement or the use of EFT, FEDI, or credit cards for customer payments (control 17.3), which totally eliminates employee access to customer payments. The costs of these arrangements must be weighed against the benefits of reduced internal processing costs and faster access to customer payments. If customer payments must be processed internally, prompt documentation of remittances is crucial, because the risk of loss is greatest at the time of first receipt. Therefore, a list of all checks received should be prepared *immediately* after opening the mail. The checks should also be restrictively endorsed at that time. To further minimize the risk of misappropriating any cash or checks received, two people should open all incoming mail (control 17.5).

Retail stores and organizations that receive cash directly from customers should use cash registers that automatically produce a written record of all cash received. In these situations, customers also can play a role in controlling cash collections. For example, many stores use signs to inform customers that their purchase is free if they fail to get a receipt or that receipts marked with a red star entitle them to a discount. Such policies encourage customers to watch that employees actually ring up the cash sale and do so correctly.

All customer remittances should be deposited, intact, in the bank each day (control 17.7). Daily deposits reduce the amount of cash and checks at risk of theft. Depositing all remittances intact, and not using any of them for miscellaneous expenditures, facilitates reconciliation of the bank statement with the records of sales, accounts receivable, and cash collections. ERP systems should be configured to require that all cash collections transactions be processed through an approved list of bank accounts.

Finally, as the AOE case illustrated, cash flow problems are a serious concern (threat 18 in Table 12-1). The use of lockbox arrangements, EFT, credit cards, and offering discounts for early payment can speed up cash collections. However, the best control procedure to reduce the risk of unanticipated cash shortfalls is to use a ***cash flow budget*** (Figure 12-19), which provides estimates of cash inflows (projected collections from sales) and outflows (outstanding payables). A cash flow budget can alert an organization to a pending short-term cash shortage, thereby enabling it to plan ahead to secure short-term loans at the best possible rates. Conversely, an organization that knows a surplus of cash is pending can take steps to invest those excess funds

FIGURE 12-19
Sample Cash Flow Budget

	January	February	March	April
Beginning Balance	10,000	11,000	8,000	8,000
Projected Cash Receipts:				
Cash Sales	7,000	8,500	8,000	9,000
Collections on Account	26,000	29,000	28,000	30,000
Total Cash Available (A)	43,000	48,500	44,000	47,000
Projected Cash Disbursements (B)	(32,000)	(41,000)	(39,000)	(36,000)
Projected Ending Cash Balance (C = A − B)	11,000	7,500	5,000	11,000
Desired Minimum Balance (D)	8,000	8,000	8,000	8,000
Amount Needed to Borrow	0	500	3,000	0
Ending Balance	11,000	8,000	8,000	11,000

to earn the best possible returns. Regular monitoring of a cash flow budget would have helped AOE avoid the need for short-term borrowing at unfavorable rates.

Summary and Case Conclusion

An organization's accounting system should be designed to maximize the efficiency and effectiveness with which the four basic revenue cycle activities (sales order entry, shipping, billing, and cash collections) are performed. It must also incorporate adequate internal control procedures to mitigate such threats as uncollectible sales, billing errors, and lost or misappropriated inventory and cash. Control procedures also are needed to ensure that the information provided for decision making is both accurate and complete. Finally, to facilitate strategic decision making, the accounting system should be designed to accommodate the integration of internally generated data with data from external sources.

At the next executive meeting, Elizabeth summarized the proposals that she, Trevor, and Ann developed to provide the information needed to better manage customer relationships and cash flows. Among the recommendations were the following:

1. Equip the sales force with wireless-enabled pen-based laptop computers. Trevor Whitman, vice president of marketing, believes that AOE will still need its sales staff to visit existing customers to identify which additional products can be profitably carried. Sales staff also will continue to make cold calls on prospective customers to try to convince them to carry AOE's products. As they walk down store aisles, sales representatives can check off the items that need to be restocked and then write in the appropriate quantities. When the order is complete, they can transmit the order back to headquarters. The system can check the customer's credit status and inventory availability and confirm orders within minutes, including an estimated delivery date. After the customer approves the order, the system will immediately update all affected files so that current information about inventory status is available to other sales representatives.
2. Improve warehouse and shipping efficiency by replacing bar codes with RFID tags.
3. Improve billing process efficiency by increasing the number of customers who agree to participate in invoiceless sales relationships and, when possible, by using EDI to transmit invoices to those customers who still require them.
4. In an effort to improve customer service, periodically survey customers about their satisfaction with AOE's products and performance.
5. Improve the efficiency of cash collections by encouraging all customers to use EFT. In addition, encourage EDI-capable customers to move to FEDI so that AOE receives both the funds and remittance data together.

Linda Spurgeon approved these proposals. She then asked Elizabeth and Ann to turn their attention to solving several problems related to AOE's expenditure cycle business activities.

Key Terms

revenue cycle 352
sales order 354
electronic data interchange (EDI) 358
credit limit 360
accounts receivable aging report 360
back order 362
picking ticket 362
customer relationship management (CRM) systems 363
packing slip 365
bill of lading 365
sales invoice 369
open-invoice method 370
remittance advice 370
balance-forward method 370
monthly statement 370
cycle billing 371
credit memo 372
remittance list 373
lockbox 374
electronic lockbox 374
electronic funds transfer (EFT) 374
financial electronic data interchange (FEDI) 374
cash flow budget 376

AIS IN ACTION

Chapter Quiz

1. Which activity is part of the sales order entry process?
   a. setting customer credit limits
   b. preparing a bill of lading
   c. checking customer credit
   d. approving sales returns

2. Which document often accompanies merchandise shipped to a customer?
   a. picking ticket
   b. packing slip
   c. credit memo
   d. sales order

3. Which method is most likely used when a company offers customers discounts for prompt payment?
   a. open-invoice method
   b. balance-forward method
   c. accounts receivable aging method
   d. cycle billing method

4. Which of the following techniques is the most efficient way to process customer payments and update accounts receivable?
   a. EFT
   b. CRM
   c. FEDI
   d. ACH

5. Which of the following revenue cycle activities can potentially be eliminated by technology?
   a. sales order entry
   b. shipping
   c. billing
   d. cash collections

6. The integrated database underlying an ERP system results in which of the following general threats to the revenue cycle?
   a. inaccurate or invalid master data
   b. unauthorized disclosure of sensitive information
   c. loss or destruction of data
   d. all of the above

7. Which document is used to authorize the release of merchandise from inventory control (warehouse) to shipping?
   a. picking ticket
   b. packing slip
   c. shipping order
   d. sales invoice

8. Which of the following provides a means both to improve the efficiency of processing customer payments and also to enhance control over those payments?
   a. CRM
   b. lockboxes
   c. aging accounts receivable
   d. EDI

9. For good internal control, who should approve credit memos?
   a. credit manager
   b. sales manager
   c. billing manager
   d. controller

10. For good internal control over customer remittances, the mailroom clerk should separate the checks from the remittance advices and send the customer payments to which department?
    a. billing
    b. accounts receivable
    c. cashier
    d. sales

Discussion Questions

12.1. Customer relationship management systems hold great promise, but their usefulness is determined by the amount of personal data customers are willing to divulge. To what extent do you think concerns about privacy-related issues affect the use of CRM systems?

12.2. Some products, such as music and software, can be digitized. How does this affect each of the four main activities in the revenue cycle?

12.3. Many companies use accounts receivable aging schedules to project future cash inflows and bad-debt expense. Review the information typically presented in such a report (see Figure 12-8). Which specific metrics can be calculated from those data that might be especially useful in providing early warning about looming cash flow or bad-debt problems?

12.4. Table 12-1 suggests that restricting physical access to inventory is one way to reduce the threat of theft. How can information technology help accomplish that objective?

12.5. Invoiceless pricing has been adopted by some large businesses for business-to-business transactions. What are the barriers, if any, to its use in sales to consumers?

12.6. The use of some form of electronic "cash" that would provide the same kind of anonymity for e-commerce that cash provides for traditional physical business transactions has been discussed for a long time. What are the advantages and disadvantages of electronic cash to customers? To businesses? What are some of the accounting implications of using electronic cash?

Problems

12.1. Match the term in the left column with its definition in the right column.

___ **1.** CRM system	a. Document used to authorize reducing the balance in a customer account
___ **2.** Open-invoice method	b. Process of dividing customer account master file into subsets and preparing invoices for one subset at a time
___ **3.** Credit memo	c. System that integrates EFT and EDI information
___ **4.** Credit limit	d. System that contains customer-related data organized in a manner to facilitate customer service, sales, and retention
___ **5.** Cycle billing	e. Electronic transfer of funds
___ **6.** FEDI	f. Method of maintaining accounts receivable that generates one payment for all sales made the previous month
___ **7.** Remittance advice	g. Method of maintaining customer accounts that generates payments for each individual sales transaction
___ **8.** Lockbox	h. Maximum possible account balance for a customer
___ **9.** Back order	i. Electronic invoicing
___ **10.** Picking ticket	j. Post Office box to which customers send payments
___ **11.** Bill of lading	k. Document used to indicate stockouts exist
	l. Document used to establish responsibility for shipping goods via a third party
	m. Document that authorizes removal of merchandise from inventory
	n. Turnaround document returned by customers with payments

12.2. What internal control procedure(s) would provide protection against the following threats?

a. Workers on the shipping dock steal goods, claiming that the inventory shortages reflect errors in the inventory records.
b. An employee posts the sales amount to the wrong customer account because he incorrectly keys the customer account number into the system.
c. An employee makes a credit sale to a customer who is already four months behind in making payments on his account.
d. An employee authorizes a credit memo for a sales return when the goods were never actually returned.
e. An employee writes off a customer's accounts receivable balance as uncollectible to conceal the theft of subsequent cash payments from that customer.
f. Customers are billed for the quantity ordered, but the quantity shipped is actually less because some items have been back ordered.
g. The mailroom clerk steals checks and then endorses them for deposit into the clerk's personal bank account.
h. The cashier steals funds by cashing several checks from customers.
i. A waiter steals cash by destroying the customer sales ticket for customers who paid cash.
j. Goods are shipped to a customer, but that customer is not billed.
k. A business loses sales because of stockouts of several products for which the computer records indicated there was adequate quantity on hand.
l. A business experiences unauthorized disclosure of the buying habits of several well-known customers.
m. A business loses all information about amounts owed by customers in New York City because the master database for that office was destroyed in a fire.
n. The company's Web site is unavailable for seven hours because of a power outage.
o. Customers' credit card numbers are intercepted and stolen while being sent to the company's Web site.
p. A sales clerk sells a $7,000 wide-screen TV to a friend and alters the price to $700.
q. A shipping clerk who is quitting to start a competing business copies the names of the company's 500 largest customers and offers them lower prices and better terms if they purchase the same product from the clerk's new company.
r. A fire in the office next door damages the company's servers and all optical and magnetic media in the server room. The company immediately implements its disaster recovery procedures and shifts to a backup center several miles away. The company has made full daily backups of all files and has stored a copy at the backup center. However, none of the backup copies are readable.

12.3. For good internal control, which of the following duties can be performed by the same individual?

1. Approving changes to customer credit limits
2. Sales order entry
3. Shipping merchandise
4. Billing customers
5. Depositing customer payments
6. Maintaining accounts receivable
7. Issuing credit memos
8. Reconciling the organization's bank accounts
9. Checking inventory availability



12.4. Excel Project. (*Hint:* For help on steps b and c, see the article "Dial a Forecast," by James A. Weisel, in the December 2006 issue of the *Journal of Accountancy*. The *Journal of Accountancy* is available in print or online at the AICPA's Web site: www.aicpa.org.

Required

a. Create a 12-month cash flow budget in Excel using the following assumptions:
   - Initial sales of $5 million, with forecasted monthly growth of 1%
   - 40% of each month's sales for cash; 30% collected the following month; 20% collected 2 months later; 8% collected 3 months later; and 2% never collected
   - Initial cash balance of $350,000

b. Add a "spinner" to your spreadsheet that will enable you to easily change forecasted monthly sales growth to range from 0.5% to 1.5% in increments of 0.1%.

c. Add a scroll bar to your spreadsheet that will let you modify the amount of initial sales to vary from $4 million to $6 million in increments of $100,000.

d. Design appropriate data entry and processing controls to ensure spreadsheet accuracy.

12.5. For each of the following activities, identify the data that must be entered by the employee performing that activity, and list the appropriate data entry controls:

a. A sales order entry clerk takes a customer order.

b. A shipping clerk completes a bill of lading for shipment of an order to a customer.

12.6. Create a questionnaire checklist that can be used to evaluate controls for each of the four basic activities in the revenue cycle (sales order entry, shipping, billing, and cash collections).

Required

a. For each control issue, write a Yes/No question such that a "No" answer represents a control weakness. For example, one question might be, "Are customer credit limits set and modified by a credit manager with no sales responsibility?"

b. For each Yes/No question, write a brief explanation of why a "No" answer represents a control weakness.

12.7. O'Brien Corporation is a midsized, privately owned industrial instrument manufacturer supplying precision equipment to manufacturers in the Midwest. The corporation is ten years old and uses an integrated ERP system. The administrative offices are located in a downtown building, and the production, shipping, and receiving departments are housed in a renovated warehouse a few blocks away.

Customers place orders on the company's Web site, by fax, or by telephone. All sales are on credit, FOB destination. During the past year, sales have increased dramatically, but 15% of credit sales have had to written off as uncollectible, including several large online orders to first-time customers who denied ordering or receiving the merchandise.

Customer orders are picked and sent to the warehouse, where they are placed near the loading dock in alphabetical sequence by customer name. The loading dock is used both for outgoing shipments to customers and for receipt of incoming deliveries. There are 10 to 20 incoming deliveries every day, from a variety of sources.

The increased volume of sales has resulted in a number of errors in which customers were sent the wrong items. There have also been some delays in shipping because items that supposedly were in stock could not be found in the warehouse. Although a perpetual inventory is maintained, there has been no physical count of inventory for two years. When an item is missing, the warehouse staff writes the information down in a log book. Once a week, the warehouse staff uses the log book to update the inventory records.

The system is configured to prepare the sales invoice only after shipping employees enter the actual quantities sent to a customer, thereby ensuring that customers are billed only for items actually sent and not for anything on back order.

Required

Identify at least three weaknesses in O'Brien Corporation's revenue cycle activities. Describe the problem resulting from each weakness. Recommend control procedures that should be added to the system to correct the weakness. *(CMA Examination, adapted)*

12.8. Parktown Medical Center, Inc., is a small health care provider owned by a publicly held corporation. It employs seven salaried physicians, ten nurses, three support staff, and three clerical workers. The clerical workers perform such tasks as reception, correspondence, cash receipts, billing, and appointment scheduling. All are adequately bonded.

Most patients pay for services rendered by cash or check on the day of their visit. Sometimes, however, the physician who is to perform the respective services approves credit based on an interview. When credit is approved, the physician files a memo with one of the clerks to set up the receivable using data the physician generates.

The servicing physician prepares a charge slip that is given to one of the clerks for pricing and preparation of the patient's bill. At the end of the day, one of the clerks uses the bills to prepare a revenue summary and, in cases of credit sales, to update the accounts receivable subsidiary ledger.

The front office clerks receive cash and checks directly from patients and give each patient a prenumbered receipt. The clerks take turns opening the mail. The clerk who opens that day's mail immediately stamps all checks "for deposit only." Each day, just before lunch, one of the clerks prepares a list of all cash and checks to be deposited in Parktown's bank account. The office is closed from 12 noon until 2:00 P.M. for lunch. During that time, the office manager takes the daily deposit to the bank. During the lunch break the clerk who opened the mail that day uses the list of cash receipts and checks to update patient accounts.

The clerks take turns preparing and mailing monthly statements to patients with unpaid balances. One of the clerks writes off uncollectible accounts only after the physician who performed the respective services believes the account will not pay and communicates that belief to the office manager. The office manager then issues a credit memo to write off the account, which the clerk processes.

The office manager supervises the clerks, issues write-off memos, schedules appointments for the doctors, makes bank deposits, reconciles bank statements, and performs general correspondence duties.

Additional services are performed monthly by a local accountant who posts summaries prepared by the clerks to the general ledger, prepares income statements, and files the appropriate payroll forms and tax returns.

Required

Identify at least three control weaknesses at Parktown. Describe the potential threat and exposure associated with each weakness, and recommend how to best correct them. *(CPA Examination, adapted)*

12.9. Figure 12-20 on pages 384 and 385 depicts the activities performed in the revenue cycle by the Newton Hardware Company.

Required

a. Identify at least seven weaknesses in Newton Hardware's revenue cycle. Explain the resulting threat, and suggest methods to correct the weakness.
b. Identify ways to use IT to streamline Newton's revenue cycle activities. Describe the control procedures required in the new system.
(CPA Examination, adapted)

12.10. The Family Support Center is a small charitable organization. It has only four full-time employees: two staff, an accountant, and an office manager. The majority of its funding comes from two campaign drives, one in the spring and one in the fall. Donors make pledges over the telephone. Some donors pay their pledge by credit card during the telephone campaign, but many prefer to pay in monthly installments by check. In such cases, the donor pledges are recorded during the telephone campaign, and the donors are then mailed pledge cards. Donors mail their contributions directly to the charity. Most donors send a check, but occasionally some send cash. Most donors return their pledge card with their check or cash donation, but occasionally the Family Support Center receives anonymous cash donations. The procedures used to process donations are as follows:

Sarah, a staff member who has worked for the Family Support Center for 12 years, opens all mail. She sorts the donations from the other mail and prepares a list of all donations, indicating the name of the donor (or anonymous), amount of the donation, and the pledge number (if the donor returned the pledge card). Sarah then sends the list, cash, and checks to the accountant.

The accountant enters the information from the list into the computer to update the Family Support Center's files. The accountant then prepares a deposit slip (in duplicate) and deposits all cash and checks into the charity's bank account at the end of each day. No funds are left on the premises overnight. The validated deposit slip is then filed by date. The accountant also mails an acknowledgment letter thanking each donor. Monthly, the accountant retrieves all deposit slips and uses them to reconcile the Family Support Center's bank statement. At this time, the accountant also reviews the pledge files and sends a follow-up letter to those people who have not yet fulfilled their pledges.

Each employee has a computer workstation that is connected to the internal network. Employees are permitted to surf the Web during lunch hours. Each employee has full access to the charity's accounting system, so that anyone can fill in for someone else who is out sick or on vacation. Each Friday, the accountant makes a backup copy of all computer files. The backup copy is stored in the office manager's office.

Required

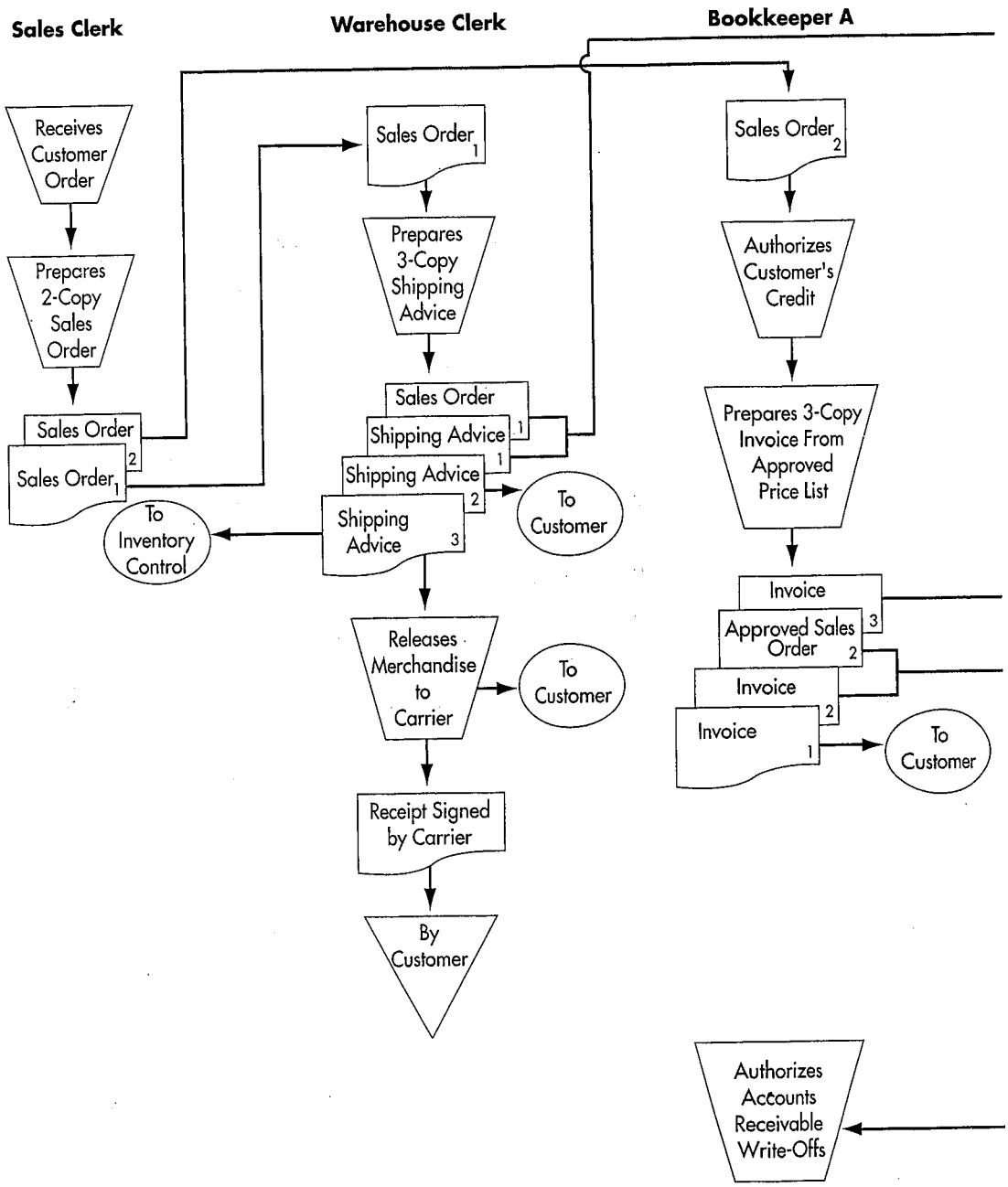
a. Identify two major control weaknesses in the Family Support Center's cash receipts procedures. For each weakness you identify, suggest a method to correct that weakness. Your solution must be specific—*identify which specific employees should do what. Assume that no new employees can be hired.*

b. Describe the IT control procedures that should exist in order to protect the Family Support Center from loss, alteration, or unauthorized disclosure of data.

12.11. Match the threats in the first column to the appropriate control procedures in the second column (more than one control may address the same threat).

Threat	Applicable Control Procedures
___ **1.** Uncollectible sales	a. Restricted access to master data
___ **2.** Mistakes in shipping orders to customers	b. Encryption of customer information while in storage
___ **3.** Crediting customer payments to the wrong account	c. Backup and disaster recovery procedures
___ **4.** Theft of customer payments	d. Digital signatures
___ **5.** Theft of inventory by employees	e. Physical access controls on inventory
___ **6.** Excess inventory	f. Segregation of duties of handling cash and maintaining accounts receivable
___ **7.** Reduced prices for sales to friends	g. Reconciliation of packing lists with sales orders
___ **8.** Orders later repudiated by customers who deny placing them	h. Reconciliation of invoices with packing lists and sales orders
___ **9.** Failure to bill customers	i. Use of bar codes or RFID tags
___**10.** Errors in customer invoices	j. Periodic physical counts of inventory
___**11.** Cash flow problems	k. Perpetual inventory system
___**12.** Loss of accounts receivable data	l. Use of either EOQ, MRP, or JIT inventory control system
___**13.** Unauthorized disclosure of customer personal information	m. Lockboxes or electronic lockboxes
___**14.** Failure to ship orders to customers	n. Cash flow budget
	o. Mailing of monthly statements to customers
	p. Credit approval by someone not involved in sales
	q. Segregation of duties of shipping and billing
	r. Periodic reconciliation of prenumbered sales orders with prenumbered shipping documents

FIGURE 12-20
Newton Hardware Company Revenue Cycle Procedures



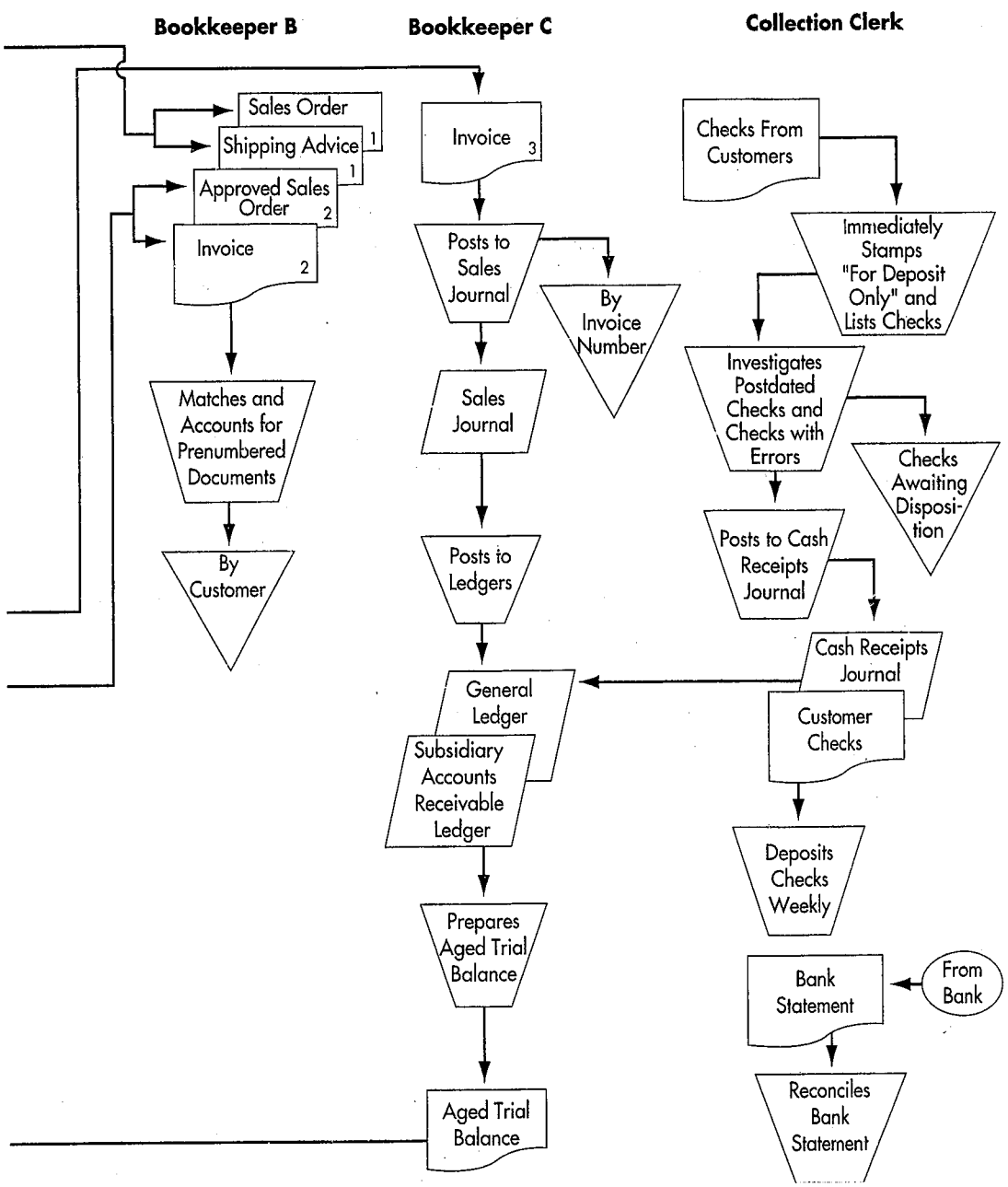

Bookkeeper B
Bookkeeper C
Collection Clerk
Sales Order
Shipping Advice 1
Approved Sales Order 2
Invoice 2
Matches and Accounts for Prenumbered Documents
By Customer
Invoice 3
Posts to Sales Journal
By Invoice Number
Sales Journal
Posts to Ledgers
General Ledger
Subsidiary Accounts Receivable Ledger
Prepares Aged Trial Balance
Aged Trial Balance
Checks From Customers
Immediately Stamps "For Deposit Only" and Lists Checks
Investigates Postdated Checks and Checks with Errors
Checks Awaiting Disposition
Posts to Cash Receipts Journal
Cash Receipts Journal
Customer Checks
Deposits Checks Weekly
Bank Statement
From Bank
Reconciles Bank Statement

FIGURE 12-20



12.12. Excel Problem

Required

Use Excel's regression tools to analyze and forecast future sales.

(*Hint:* The article "Forecasting with Excel," by James A. Weisel in the February 2009 issue of the *Journal of Accountancy* (available at www.aicpa.org) explains how to perform the following tasks using either Excel 2003 or Excel 2007.)

a. Create a spreadsheet with the following data about targeted e-mails, click ads, and unit sales:

E-mails	Clicks	Unit Sales	E-mails	Clicks	Unit Sales
150000	100	12000	130000	125	13000
155000	105	12500	100000	85	12000
125000	75	10000	110000	100	9000
130000	150	14000	120000	135	10000
135000	125	12500	130000	140	13500
120000	100	10000	140000	125	13400
125000	125	10900	130000	115	12750
130000	135	11500	120000	105	12750
130000	110	12500	100000	95	10000
120000	95	10500	130000	145	9000
100000	75	10750	150000	150	15000
110000	100	10000	140000	120	12000
100000	80	9500	125000	100	13500
140000	130	13500	110000	95	11000
120000	110	11500	130000	140	13500

b. Create a scattergraph to illustrate the relationship between targeted e-mails and unit sales. Display the regression equation and the R^2 between the two variables on the chart.

c. Create a scattergraph to illustrate the relationship between click ads and unit sales. Display the regression equation and the R^2 between the two variables on the chart.

d. Which variable (targeted e-mails or click ads) has the greater influence on unit sales? How do you know?

e. Use the "=Forecast" function to display the forecasted sales for 200,000 targeted e-mails and for 200 click ads.

12.13. Give two specific examples of nonroutine transactions that may occur in processing cash receipts and updating accounts receivable. Also, specify the control procedures that should be in place to ensure the accuracy, completeness, and validity of those transactions.

Case 12-1 Research Project: Impact of IT on Revenue Cycle Activities, Threats, and Controls

Search popular business and technology magazines (*Business Week, Forbes, Fortune, CIO,* etc.) to find an article about an innovative use of IT to improve one or more activities in the revenue cycle. Write a report that:

a. Explains how IT can be used to change revenue cycle activities.

b. Discusses the control implications. Refer to Table 12-1, and explain how the new procedure changes the threats and appropriate control procedures for mitigating those threats.



AIS IN ACTION SOLUTIONS

Quiz Key

1. Which activity is part of the sales order entry process?
   a. setting customer credit limits (Incorrect. The credit department, not the sales department, sets credit limits.)
   b. preparing a bill of lading (Incorrect. This occurs as part of the shipping process.)
   ▶ c. checking customer credit (Correct. Checking customer credit and inventory availability are two key parts of the sales order entry process.)
   d. approving sales returns (Incorrect. Someone outside the sales department should approve all returns.)

2. Which document often accompanies merchandise shipped to a customer?
   a. picking ticket (Incorrect. The picking ticket is used by warehouse workers to fill the order. If a copy of the picking ticket is used as a packing slip, it is referred to as a packing slip.)
   ▶ b. packing slip (Correct. This document specifies what is being shipped.)
   c. credit memo (Incorrect. A credit memo is used to adjust a customer's account balance for sales returns, allowances, or write-offs.)
   d. sales order (Incorrect. This is a source document created during sales order entry.)

3. Which method is most likely used when a company offers customers discounts for prompt payment?
   ▶ a. open-invoice method (Correct. The open-invoice method provides a means to offer discounts because it facilitates aging each invoice to verify whether a discount should be granted.)
   b. balance-forward method (Incorrect. The balance-forward method does not facilitate tracking the age of individual invoices and thus is difficult to use to offer discounts for early payment of individual invoices.)
   c. accounts receivable aging method (Incorrect. Aging of accounts receivable is a control measure designed to timely detect potential uncollectible accounts.)
   d. cycle billing method (Incorrect. Cycle billing is a method of smoothing the timing of cash receipts by billing different subsets of the customer file each week.)

4. Which of the following techniques is the most efficient way to process customer payments and update accounts receivable?
   a. EFT (Incorrect. EFT deals only with the transfer of funds. It does not include remittance information necessary to update accounts receivable.)
   b. CRM (Incorrect. CRM stands for "customer relationship management.")
   ▶ c. FEDI (Correct. FEDI integrates EFT, for processing customer payments, with EDI, for processing related remittance data to update accounts receivable.)
   d. ACH (Incorrect. ACH stands for "Automated Clearing House," the private communications network used by financial institutions to transfer funds.)

5. Which of the following revenue cycle activities can potentially be eliminated by technology?
   a. sales order entry (Incorrect. IT may change how sales orders are entered, but the sales process must always begin with taking the customer's order.)
   b. shipping (Incorrect. The product must always be shipped to the customer. The manner may change, particularly for products that can be digitized, but there is still a shipping process.)
   ▶ c. billing (Correct. The use of integrated ERP systems makes printing invoices superfluous, because both the seller and customer already know all the information included in the invoice. Some large manufacturers have already moved to invoiceless systems with their major suppliers.)
   d. cash collections (Incorrect. IT may change how the funds are received, but sellers will always need to collect payments from customers.)

6. The integrated database underlying an ERP system results in which of the following general threats to the revenue cycle?
   a. inaccurate or invalid master data (Incorrect. Table 12-1 shows that this is not the only general threat to the revenue cycle.)
   b. unauthorized disclosure of sensitive information (Incorrect. Table 12-1 shows that this is not the only general threat to the revenue cycle.)
   c. loss or destruction of data (Incorrect. Table 12-1 shows that this is not the only general threat to the revenue cycle.)
   ▶ d. all of the above (Correct.)

7. Which document is used to authorize the release of merchandise from the inventory control (warehouse) to shipping?
   ▶ a. picking ticket (Correct. A picking ticket is generated by sales order entry to authorize removal of inventory to be shipped to the customer.)
   b. packing slip (Incorrect. The packing slip accompanies the shipment and lists the contents of the shipment.)
   c. shipping order (Incorrect. A shipping order is an internal document used to record what was shipped when the shipping function is performed in-house; a bill of lading serves the same purpose when a third-party common carrier is used to deliver merchandise.)
   d. sales invoice (Incorrect. A sales invoice documents the terms of the sale and requests payment.)

8. Which of the following provides a means to both improve the efficiency of processing customer payments and also enhance control over those payments?
   a. CRM (Incorrect. CRM stands for "customer relationship management" and is a process used to improve customer satisfaction and retention.)
   ▶ b. lockboxes (Correct. The use of lockboxes eliminates the delays involved in processing customer payments and then depositing them. It also improves control because customer payments are not directly handled by any employees.)
   c. aging accounts receivable (Incorrect. Aging accounts receivable is an important control for managing customer accounts, but not for processing payments.)
   d. EDI (Incorrect. EDI stands for "electronic data interchange." It is used to exchange documents, but not to process customer payments.)

9. For good internal control, who should approve credit memos?
   ▶ a. credit manager (Correct. This is the credit manager's function.)
   b. sales manager (Incorrect. The same person who authorizes sales should not also authorize credit memos to adjust customer accounts for those sales.)
   c. billing manager (Incorrect. The billing manager is in charge of invoicing customers and should not have authority to reduce accounts receivable by issuing credit memos.)
   d. controller (Incorrect. The controller is responsible for the recording function and should not also be able to authorize changes to accounts via credit memos.)

10. For good internal control over customer remittances, the mailroom clerk should separate the checks from the remittance advices and send the customer payments to which department?
    a. billing (Incorrect. Billing creates invoices but should not be involved in processing payments from customers.)
    b. accounts receivable (Incorrect. Accounts receivable performs the recording function and should not also have physical custody of assets.)
    ▶ c. cashier (Correct. This is the cashier's job. The cashier function has custody of cash accounts.)
    d. sales (Incorrect. The sales department authorizes release of merchandise and should not also have custody of assets.)

Chapter 13

The Expenditure Cycle: Purchasing to Cash Disbursements

Learning Objectives

After studying this chapter, you should be able to:

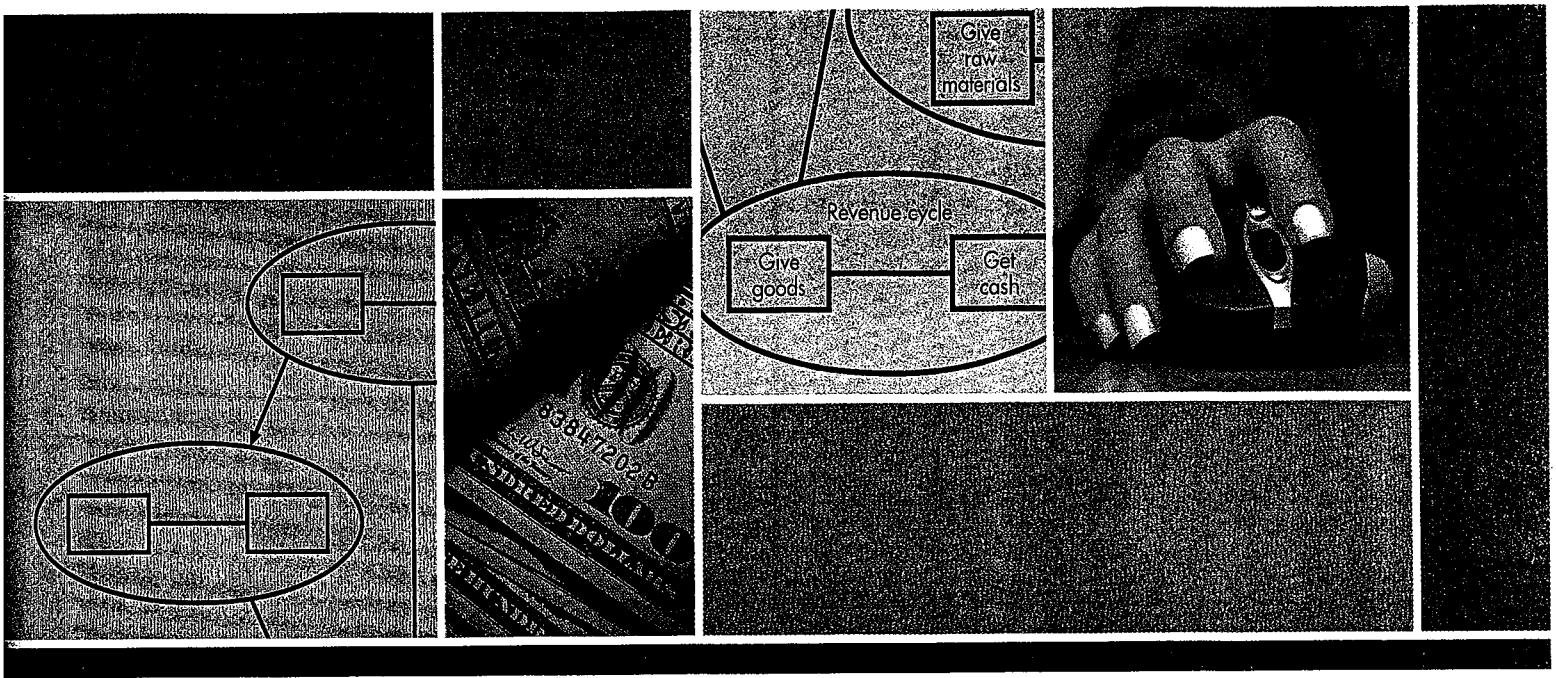
1. Explain the basic business activities and related information processing operations performed in the expenditure cycle.
2. Discuss the key decisions to be made in the expenditure cycle and identify the information needed to make those decisions.
3. Identify major threats in the expenditure cycle, and evaluate the adequacy of various control procedures for dealing with those threats.

INTEGRATIVE CASE ALPHA OMEGA ELECTRONICS

Although the new enterprise resource planning (ERP) system at Alpha Omega Electronics (AOE) has enabled the company to slash its costs associated with purchasing and accounts payable, Linda Spurgeon, AOE's president, is convinced that additional improvements are needed. She is particularly concerned about issues recently raised by LeRoy Williams, vice president of manufacturing for AOE. LeRoy is upset because several production runs were delayed at the Wichita plant because components that AOE's inventory records indicated as being in stock actually were not on hand. There were also delays at the Dayton plant because suppliers either did not deliver components on time or delivered substandard products.

Linda asked Elizabeth Venko, the controller, and Ann Brandt, AOE's vice president of information systems, for some recommendations on how AOE's new ERP system could help solve these problems. Specifically, she asked Elizabeth and Ann to address the following issues:

1. What must be done to ensure that AOE's inventory records are current and accurate to avoid unexpected components shortages like those experienced at the Wichita plant?



2. How could the problems at the Dayton plant be avoided in the future? What can be done to ensure timely delivery of quality components?
3. Is it possible to reduce AOE's investment in materials inventories?
4. How could the information system provide better information to guide planning and production?
5. How could IT be used to further reengineer expenditure cycle activities?

As this case reveals, deficiencies in the information system used to support expenditure cycle activities can create significant financial problems for an organization. Current and accurate information about inventories, suppliers, and the status of outstanding purchase orders is crucial for managing the expenditure cycle effectively. As you read this chapter, think about how to solve AOE's problems with its expenditure cycle activities.

Introduction

The *expenditure cycle* is a recurring set of business activities and related information processing operations associated with the purchase of and payment for goods and services (Figure 13-1). This chapter focuses on the acquisition of raw materials, finished goods, supplies, and services.

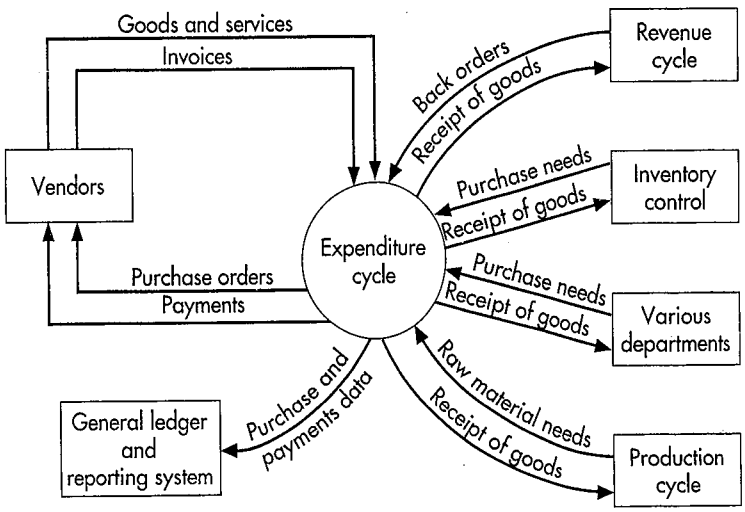


FIGURE 13-1
Context Diagram of the Expenditure Cycle

Chapters 13 and 14 address two other special types of expenditures: the acquisition of fixed assets and labor services, respectively.

In the expenditure cycle, the primary external exchange of information is with suppliers (vendors). Within the organization, information about the need to purchase goods and materials flows to the expenditure cycle from the revenue and production cycles, inventory control, and various departments. Once the goods and materials arrive, notification of their receipt flows back to those sources from the expenditure cycle. Expense data also flow from the expenditure cycle to the general ledger and reporting function for inclusion in financial statements and various management reports.

The primary objective in the expenditure cycle is to minimize the total cost of acquiring and maintaining inventories, supplies, and the various services the organization needs to function. To accomplish this objective, management must make the following key decisions:

- What is the optimal level of inventory and supplies to carry?
- Which suppliers provide the best quality and service at the best prices?
- How can the organization consolidate purchases across units to obtain optimal prices?
- How can information technology (IT) be used to improve both the efficiency and accuracy of the inbound logistics function?
- How can the organization maintain sufficient cash to take advantage of any discounts suppliers offer?
- How can payments to vendors be managed to maximize cash flow?

The answers to those questions guide how an organization performs the four basic expenditure cycle activities depicted in Figure 13-2:

1. Ordering materials, supplies, and services
2. Receiving materials, supplies, and services
3. Approving supplier invoices
4. Cash disbursements

This chapter explains how an organization's information system supports each of those activities. We begin by describing the design of the expenditure cycle information system and the basic controls necessary to ensure that it provides management with reliable information to assess operational efficiency and effectiveness. We then discuss in detail each of the four basic expenditure cycle activities. For each activity, we describe how the information needed to perform and manage those activities is collected, processed, and stored. We also explain the controls necessary to ensure not only the reliability of that information but also the safeguarding of the organization's resources.

Expenditure Cycle Information System

As Table 13-1 shows, the activities in the expenditure cycle are mirror images of the basic activities performed in the revenue cycle.

These close linkages between the buyer's expenditure cycle activities and the seller's revenue cycle activities have important implications for the design of both parties' accounting information systems. Specifically, by applying new IT developments to reengineer expenditure cycle activities, companies create opportunities for suppliers to reengineer their revenue cycle activities. Conversely, using IT to redesign a company's revenue cycle can create opportunities for customers to modify their own expenditure cycles. In fact, the changes in one company's operations may *necessitate* corresponding changes in the operations of other companies with which it does business. For example, the major automobile manufacturers and many large retailers, such as Walmart, require their suppliers to transmit invoices via electronic data interchange (EDI), or they will not do business with them. Consequently, those suppliers must modify their accounting information systems to incorporate the use of EDI.

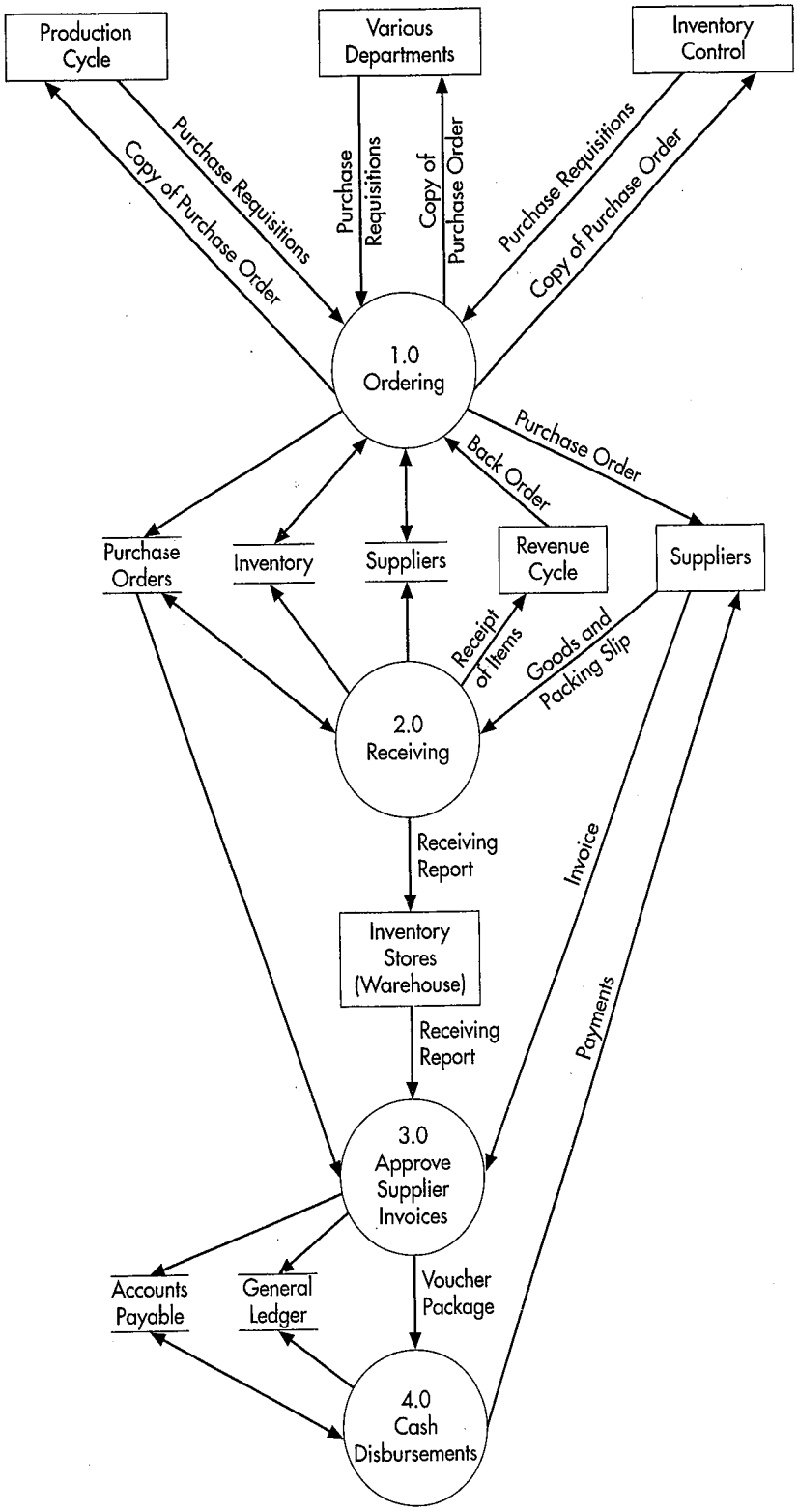


FIGURE 13-2
Level 0 Data Flow Diagram for the Expenditure Cycle

TABLE 13-1 Comparison of Revenue and Expenditure Cycle Activities

Revenue Cycle Activity	Expenditure Cycle Activity
Sales order entry—process orders from customers	Ordering of materials, supplies, and services—send orders to suppliers
Shipping—deliver merchandise or services to customers (outbound logistics)	Receiving—receive merchandise or services from suppliers (inbound logistics)
Billing—send invoices to customers	Processing invoices—review and approve invoices from suppliers
Cash collections—process payments from customers	Cash disbursements—process payments to suppliers

Process

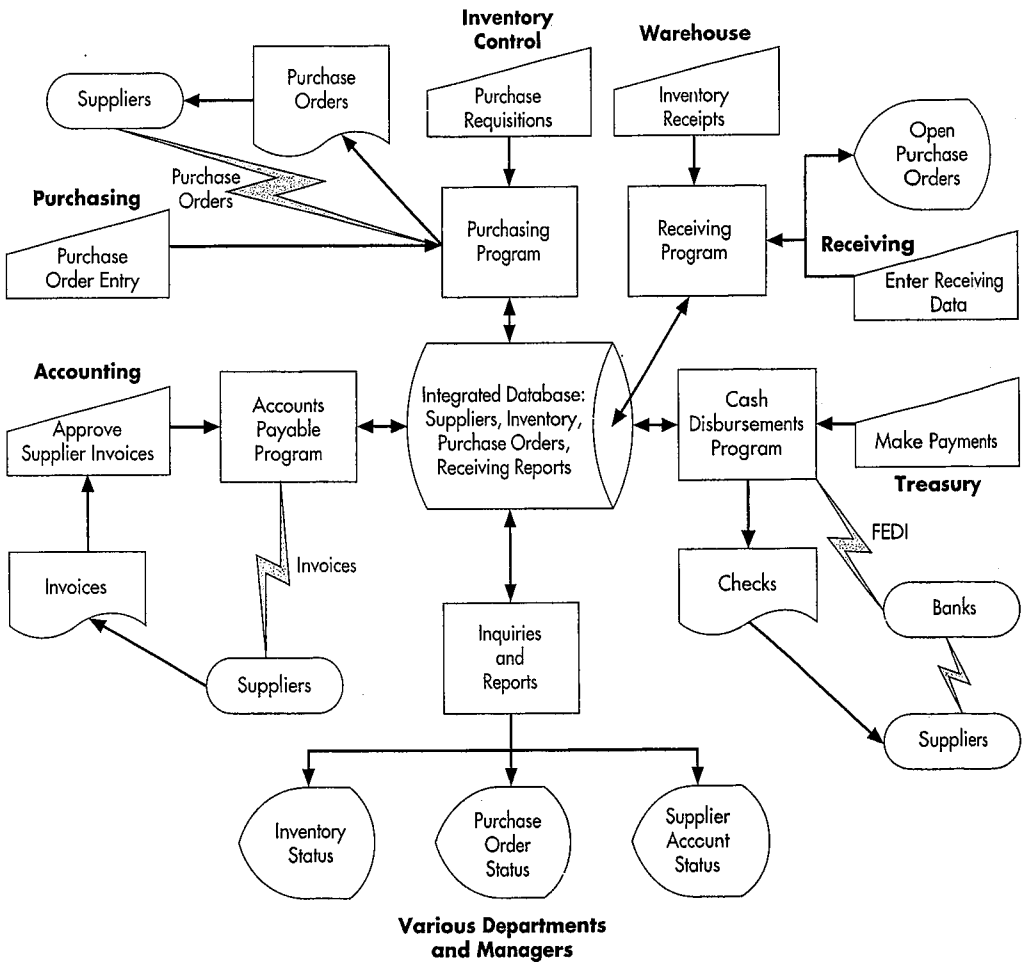
Like most large organizations, AOE uses an enterprise resource planning (ERP) system. Figure 13-3 shows the portion of the ERP system that supports AOE's expenditure cycle business activities.

Although Figure 13-3 shows that AOE's inventory control department has primary responsibility for ensuring an adequate quantity of materials and supplies, any department can submit a request to purchase items. Once a purchase request has been approved, the system searches the inventory master file to identify the preferred supplier for that item. The system then creates a purchase order that is sent to the supplier via EDI. (If necessary, paper copies are printed and mailed.) The receiving department has access to the open purchase order file so that it can plan for and verify the validity of deliveries. Accounts payable is notified of orders so that it can plan for pending financial commitments. The department that generated the purchase requisition is also notified that its request has been approved.

Major suppliers send electronic notification of coming deliveries, which enables AOE to plan to have adequate staffing to process incoming shipments at its warehouses. When a shipment arrives, the receiving dock workers use the inquiry processing system to verify that an order is expected from that supplier. Most suppliers bar-code or RFID tag their products to facilitate the counting of the goods. Receiving dock workers inspect the goods and use an online terminal to enter information about the quantity and condition of items received. The exact time of the delivery also is recorded to help evaluate vendor performance. The system checks that data against the open purchase order, and any discrepancies are immediately displayed on the screen so that they can be resolved.

Upon transfer of the goods to the warehouse, the inventory stores clerk verifies the count of the items and enters that data in the system. For suppliers who do not send invoices, the system automatically schedules a payment according to the terms agreed upon when the order was placed. Accounts payable clerks enter information from suppliers who send EDI, and sometimes paper, invoices. The system then compares the supplier invoice with the information contained in the purchase order and receiving report to ensure accuracy and validity. For purchases

FIGURE 13-3
Overview of ERP System Design to Support the Expenditure Cycle



of supplies or services that do not usually involve purchase orders and receiving reports, the invoice is sent to the appropriate supervisor for approval. The supplier invoice itself is also checked for mathematical accuracy. The system automatically schedules invoices for payment by due date.

AOE, like most companies, uses batch processing to pay its suppliers. Each day, the treasurer uses the inquiry processing system to review the invoices that are due and approves them for payment. AOE makes payments to some of its larger suppliers using FEDI but still prints paper checks for many of its smaller suppliers. When an EFT payment is authorized or a check is printed, the system updates the accounts payable, open-invoice, and general ledger files. For each supplier, the totals of all vouchers are summed, and that amount is subtracted from the balance field in that supplier's master file record. The relevant purchase orders and receiving reports are flagged to mark that those transactions have been paid. The invoices that are paid are then deleted from the open-invoice file. A remittance advice is prepared for each supplier, which lists each invoice being paid and the amounts of any discounts or allowances taken. For payments made by EFT, the remittance data accompany the EFT payment as part of the FEDI package. For payments made by check, the printed remittance advice accompanies the signed check. After all disbursement transactions have been processed, the system generates a summary journal entry, debiting accounts payable and crediting cash, and posts that entry to the general ledger.

The cashier reviews checks against the supporting documents and then signs them. Checks above a specified amount also require a second signature by the treasurer or another authorized manager. The cashier then mails the signed checks and remittance advices to the suppliers. EFT transactions are also performed by the cashier and reviewed by the treasurer.

The easy access to up-to-date, accurate information enables managers to closely monitor performance. However, the quality of decisions depends upon the accuracy of the information in the database. We now discuss the general threats associated with the expenditure cycle activities and explain the controls that can mitigate them.

Threats and Controls

Figure 13-3 shows that all expenditure cycle activities depend on the integrated database that contains information about suppliers, inventory, and purchasing activities. Therefore, the first general threat listed in Table 13-2 is inaccurate or invalid master data. Errors in the supplier master data could result in ordering from unapproved suppliers, purchasing materials of inferior quality, untimely deliveries, sending payments to the wrong address, and fraudulent disbursements to fictitious suppliers. Errors in the inventory master data can result in production delays due to unanticipated shortages of key materials or unnecessary purchases and excess inventory. Errors in the purchasing master data can result in unauthorized purchases and failure to take advantage of negotiated discounts.

Table 13-2 shows that one way to mitigate the threat of inaccurate or invalid master data is to employ the data processing integrity controls described in Chapter 10. It is also important to restrict access to expenditure cycle master data and configure the system so that only authorized employees can make changes to master data. This requires changing the default configurations of employee roles in ERP systems to appropriately segregate incompatible duties. For example, consider the situation where an accounts payable clerk enters the name of a supplier who is not currently on the list of approved suppliers. The default configuration of many ERP systems would result in a prompt query as to whether the clerk wants to create a new supplier record. This violates proper segregation of duties by permitting the person responsible for recording payments to suppliers to also authorize the creation of new accounts. Similarly, the default configurations of many ERP systems permit accounts payable staff not only to read the prices of various products and the current balances owed to suppliers but also to change the values of those data items. These examples are just some of the many configuration settings that need to be reviewed to ensure proper segregation of duties. However, because such preventive controls can never be 100% effective, Table 13-2 also indicates that an important detective control is to regularly produce a report of all changes to master data and review them to verify that the database remains accurate (control 1.3).

A second general threat in the expenditure cycle is unauthorized disclosure of sensitive information, such as banking information about suppliers and special pricing discounts offered

TABLE 13-2 Threats and Controls in the Expenditure Cycle

Activity	Threat	Controls (first number refers to the corresponding threat)
General issues throughout entire expenditure cycle	1. Inaccurate or invalid master data 2. Unauthorized disclosure of sensitive information 3. Loss or destruction of data 4. Poor performance	1.1 Data processing integrity controls 1.2 Restriction of access to master data 1.3 Review of all changes to master data 2.1 Access controls 2.2 Encryption 3.1 Backup and disaster recovery procedures 4.1 Managerial reports
Ordering	5. Inaccurate inventory records 6. Purchasing items not needed 7. Purchasing at inflated prices 8. Purchasing goods of inferior quality 9. Unreliable suppliers 10. Purchasing from unauthorized suppliers 11. Kickbacks	5.1 Perpetual inventory system 5.2 Bar coding or RFID tags 5.3 Periodic physical counts of inventory 6.1 Perpetual inventory system 6.2 Review and approval of purchase requisitions 6.3 Centralized purchasing function 7.1 Price lists 7.2 Competitive bidding 7.3 Review of purchase orders 7.4 Budgets 8.1 Purchasing only from approved suppliers 8.2 Review and approval of purchases from new suppliers 8.3 Holding purchasing managers responsible for rework and scrap costs 8.4 Tracking and monitoring product quality by supplier 9.1 Requiring suppliers to possess quality certification (e.g., ISO 9000) 9.2 Collecting and monitoring supplier delivery performance data 10.1 Maintaining a list of approved suppliers and configuring the system to permit purchase orders only to approved suppliers 10.2 Review and approval of purchases from new suppliers 10.3 EDI-specific controls (access, review of orders, encryption, policy) 11.1 Requiring purchasing agents to disclose financial and personal interests in suppliers 11.2 Training employees in how to respond to offers of gifts from suppliers 11.3 Job rotation and mandatory vacations 11.4 Supplier audits
Receiving	12. Accepting unordered items 13. Mistakes in counting 14. Verifying receipt of services 15. Theft of inventory	12.1 Requiring existence of approved purchase order prior to accepting any delivery 13.1 Do not inform receiving employees about quantity ordered 13.2 Require receiving employees to sign receiving report 13.3 Incentives 13.4 Document transfer of goods to inventory 13.5 Use of bar-codes and RFID tags 13.6 Configuration of the ERP system to flag discrepancies between received and ordered quantities that exceed tolerance threshold for investigation 14.1 Budgetary controls 14.2 Audits 15.1 Restriction of physical access to inventory 15.2 Documentation of all transfers of inventory between receiving and inventory employees 15.3 Periodic physical counts of inventory and reconciliation to recorded quantities 15.4 Segregation of duties: custody of inventory versus receiving
Approving supplier invoices	16. Errors in supplier invoices 17. Mistakes in posting to accounts payable	16.1 Verification of invoice accuracy 16.2 Requiring detailed receipts for procurement card purchases 16.3 ERS 16.4 Restriction of access to supplier master data 16.5 Verification of freight bill and use of approved delivery channels 17.1 Data entry edit controls 17.2 Reconciliation of detailed accounts payable records with the general ledger control account

TABLE 13-2 Continued

Activity	Threat	Controls (first number refers to the corresponding threat)
Cash disbursements	18. Failure to take advantage of discounts for prompt payment	18.1 Filing of invoices by due date for discounts
		18.2 Cash flow budgets
	19. Paying for items not received	19.1 Requiring that all supplier invoices be matched to supporting documents that are acknowledged by both receiving and inventory control
	20. Duplicate payments	
	21. Theft of cash	19.2 Budgets (for services)
	22. Check alteration	19.3 Requiring receipts for travel expenses
	23. Cash flow problems	19.4 Use of corporate credit cards for travel expenses
		20.1 Requiring a complete voucher package for all payments
		20.2 Policy to pay only from original copies of supplier invoices
		20.3 Cancelling all supporting documents when payment is made
		21.1 Physical security of blank checks and check-signing machine
		21.2 Periodic accounting of all sequentially numbered checks by cashier
		21.3 Access controls to EFT terminals
		21.4 Use of dedicated computer and browser for online banking
		21.5 ACH blocks on accounts not used for payments
		21.6 Separation of check-writing function from accounts payable
		21.7 Requiring dual signatures on checks greater than a specific amount
		21.8 Regular reconciliation of bank account with recorded amounts by someone independent of cash disbursements procedures
		21.9 Restriction of access to supplier master file
		21.10 Limiting the number of employees with ability to create one-time suppliers and to process invoices from one-time suppliers
		21.11 Running petty cash as an imprest fund
		21.12 Surprise audits of petty cash fund
		22.1 Check protection machines
		22.2 Use of special inks and papers
		22.3 "Positive Pay" arrangements with banks
		23.1 Cash flow budget

by preferred suppliers. Table 13-2 shows that one way to mitigate the risk of this threat is to configure the system to employ strong access controls that limit who can view such information. It is also important to configure the system to limit employees' ability to use the system's built-in query capabilities to specific tables and fields. In addition, sensitive data should be encrypted in storage to prevent IT employees who do not have access to the ERP system from using operating system utilities to view sensitive information. Information exchanged with suppliers over the Internet should also be encrypted during transmission.

As Table 13-2 shows, a third general threat in the expenditure cycle concerns the loss or destruction of master data. The best way to mitigate the risk of this threat is to employ the backup and disaster recovery procedures that were discussed in Chapter 10. A best practice is to implement the ERP system as three separate instances. One instance, referred to as *production*, is used to process daily activity. A second is used for testing and development. A third instance should be maintained as an online backup to the production system to provide near real-time recovery.

Accurate master data enable management to better use an ERP system's extensive reporting capabilities to monitor performance. Because inventory represents a sizable investment of working capital, reports that help manage inventory are especially valuable. A key measure to evaluate inventory management is inventory turnover, which is the ratio of cost of goods sold divided by inventory on hand. Consider the following example: annual sales are $500 million, and annual cost of goods sold total $360 million. An inventory turnover ratio of 1 means that the company is effectively carrying a year's supply of inventory, tying up $360 million. Improving the inventory turnover ratio to 3 would reduce that unprofitable investment to $120 million, thereby freeing up $240 million that could be used for other purposes.

Accountants need to understand how business activities are performed in order to design other reports that can help management better manage inventory. For example, it is useful to monitor the percentage of requisitions that are filled from inventory on hand. For critical items, this should be close to 100% to avoid stockouts and delays in filling customer orders. For most

items, however, such a high fill rate is undesirable because it requires carrying too much inventory. Other reports can help management identify the relative importance of various inventory items. For example, it may be useful to classify items along several dimensions, such as frequency of purchase, frequency of use or resale, and contribution to profitability. Items that are frequently purchased and used and that make a significant contribution to profitability are of high importance and should be managed so as to maintain high fill rates. In contrast, management may wish to consider eliminating items that are seldom purchased, infrequently used, and that do not contribute much to profitability. As we will see in the following sections, accountants can help managers by designing a variety of detailed reports and metrics that are relevant to evaluating each business activity in the expenditure cycle.

Ordering Materials, Supplies and Services

The first major business activity in the expenditure cycle (circle 1.0 in Figure 13-2) is ordering inventory, supplies, or services. This involves first identifying what, when, and how much to purchase, and then choosing from which supplier to purchase.

Identifying What, When, and How Much to Purchase

As the introductory case showed, inaccurate inventory records can create significant problems for organizations. Therefore, accountants and systems professionals need to understand best practices for managing inventory.

PROCESS The traditional approach to managing inventory is to maintain sufficient stock so that production can continue without interruption even if inventory use is greater than expected or if suppliers are late in making deliveries. This traditional approach is often called the ***economic order quantity (EOQ)*** approach because it is based on calculating an optimal order size to minimize the sum of ordering, carrying, and stockout costs. *Ordering costs* include all expenses associated with processing purchase transactions. *Carrying costs* are those associated with holding inventory. *Stockout costs* are those that result from inventory shortages, such as lost sales or production delays.

Actual application of the EOQ approach varies depending on the type of item. For high-cost or high-use items, such as the computer chips and displays AOE uses, all three types of costs are included in the formula. For low-cost or low-usage items, such as the screws and springs AOE uses to assemble its products, ordering and carrying costs are usually ignored, and the sole objective is to maintain sufficient inventory levels. The EOQ formula is used to calculate *how much* to order. The ***reorder point*** specifies *when* to order. Companies typically set the reorder point based on delivery time and desired levels of safety stock to handle unexpected fluctuations in demand.

The traditional EOQ approach to inventory control often results in carrying significant amounts of inventory. The money invested in carrying inventory earns nothing. Consequently, in recent years many large U.S. manufacturing companies, including Xerox, Ford, Motorola, NCR, Intel, McDonnell Douglas, and Delco Electronics, have minimized or even eliminated the amount of inventory on hand by adopting either materials requirements planning or just-in-time inventory management systems.

Materials requirements planning (MRP) seeks to reduce required inventory levels by improving the accuracy of forecasting techniques to better schedule purchases to satisfy production needs. For example, the production planning department of a company using MRP would prepare a detailed schedule specifying the quantities of each finished product to manufacture in a specified time period, such as the next three months, based on sales forecast data. This schedule and the engineering specifications for each product identify the quantities of raw materials, parts, and supplies needed in production and the point in time when they will be needed. Thus, MRP systems reduce uncertainties about when raw materials are needed and therefore enable companies to carry less inventory.

A ***just-in-time (JIT) inventory system*** attempts to minimize, if not totally eliminate, finished goods inventory by purchasing and producing goods only in response to actual, rather than forecasted, sales. Consequently, JIT systems are characterized by frequent deliveries of

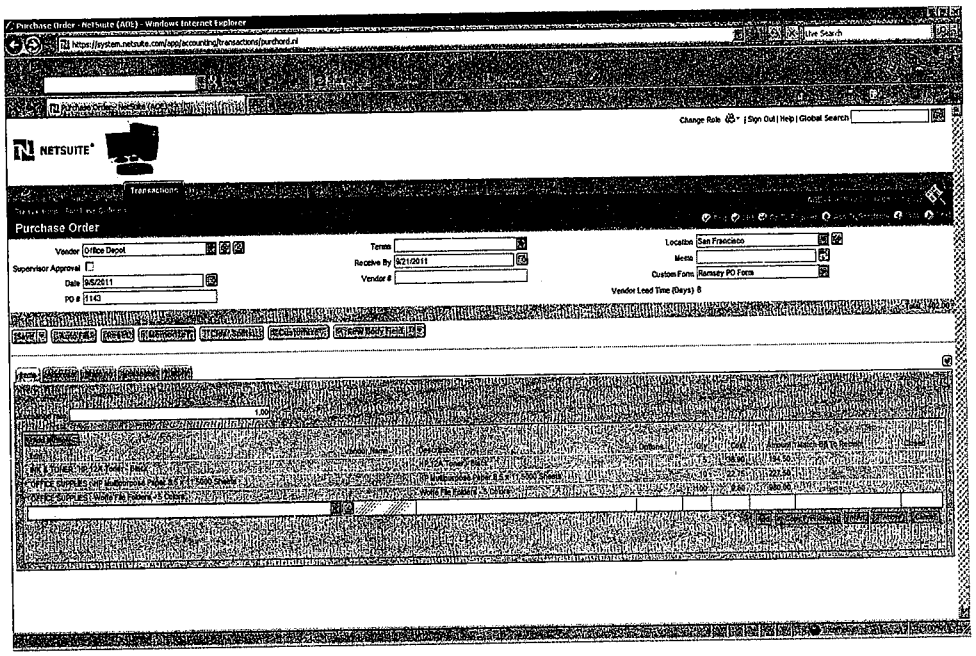
small amounts of materials, parts, and supplies directly to the specific locations that require them when they are needed, rather than by infrequent bulk deliveries to a central receiving and storage facility. Therefore, a factory using a JIT system will have multiple receiving docks, each assigned to accept deliveries of items needed at nearby work centers.

A major difference between MRP and JIT systems is production scheduling. MRP systems schedule production to meet forecasted sales, thereby creating an "optimal" quantity of finished goods inventory. JIT systems schedule production in response to customer demands, thereby virtually eliminating finished goods inventory, but they require carrying sufficient quantities of raw materials in order to quickly adjust production in response to consumer demand. Both MRP and JIT systems can reduce costs and improve efficiency. Choosing between them depends, in part, on the types of products a company sells. MRP systems are more effectively used with products that have predictable patterns of demand, such as consumer staples. For such items, companies can plan purchases to minimize stockouts (with the resultant lost sales) while simultaneously minimizing the risk of overstocking and the subsequent costs of marking down or scrapping the excess inventory. In contrast, JIT inventory systems are especially useful for products that have relatively short life cycles and for which demand cannot be accurately predicted, such as toys associated with specific movies. In such cases, it is important that the business be able to quickly speed up production to meet unanticipated demand as well as to quickly stop production to avoid accumulating large inventories that must be marked down for clearance because the product is no longer in demand.

A request to purchase goods or supplies is triggered either by the inventory control function or when employees notice a shortage of materials. The advanced inventory control systems used in large manufacturing companies, such as IBM and Ford, automatically generate purchase requests when the quantity of an item on hand falls below its reorder point. In small companies, however, the employees who use the items note when stock is running low and request that it be reordered. Moreover, even in large companies, office supplies, such as copier paper and pencils, are often ordered by the employees who use those items when they notice that stock is running low.

Regardless of its source, the need to purchase goods or supplies often results in the creation of a ***purchase requisition*** that identifies the requisitioner; specifies the delivery location and date needed; identifies the item numbers, descriptions, quantity, and price of each item requested; and may suggest a supplier. The person approving the purchase requisition indicates the department number and account number to which the purchase should be charged.

Figure 13-4 shows a typical purchase requisition data entry screen used in ERP systems. Minimizing the amount of data that must be manually entered improves both efficiency and accuracy. Thus, in Figure 13-4, the employee initiating the purchase request needs to complete



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FIGURE 13-4
Purchase Requisition Data Entry Screen

only the supplier (vendor), date required, and location (where to ship the merchandise) fields in the header section (the top of the screen) and the item number and quantity requested in the details section. The system then pulls up all the other relevant information from the related master files. You probably noticed the similarity in design to the sales order entry data entry screen (see Figure 12-6). This is intentional; it makes it easier for employees to learn how to perform new job duties arising from promotions or transfers.

THREATS AND CONTROLS One threat is that inaccurate inventory records can result in stockouts that lead to lost sales or to carrying excess inventory that increases costs. To reduce the risk of these problems, the perpetual inventory method should be used to ensure that information about inventory stocks is always current. However, data entry errors can result in inaccurate perpetual inventory records because even expert typists do make mistakes. Therefore, using information technology to eliminate the need for manual data entry can improve the accuracy of perpetual inventory records.

Bar-coding is one option, but it is not a panacea. Errors can still occur if employees attempt to save time by scanning one item and then manually entering the quantity. For example, a grocery store orders 12 varieties of a private-brand soda, the receiving clerk may scan only one can and then manually enter the number purchased. Since the flavors are all priced the same, the amount of the purchase is correctly calculated. The perpetual inventory records will be incorrect, however, because the exact count of the flavors purchased is not correctly recorded.

Affixing RFID tags to individual products eliminates the problems just discussed because the reader automatically records each item. RFID technology is also more efficient than bar codes because there is no need for a human to align the bar code on the product with the reader. However, RFID technology is more expensive than bar-coding and cannot be used for every type of product (e.g., liquids).

It is also important to periodically count inventory on hand and investigate any discrepancies between those counts and the perpetual inventory records (control 5.3 in Table 13-2). One annual physical inventory count will generally not be sufficient to maintain accurate inventory records, especially for MRP and JIT systems. Instead, an *ABC cost analysis* should be used to classify items according to their importance: The most critical items (A items) should be counted most frequently, and the least critical items (C items) can be counted less often. If such interim counts reveal significant discrepancies with inventory records, a comprehensive count of all inventory should be immediately undertaken. This approach might have alerted management at AOE's Wichita plant in the chapter introductory case about shortages of key components early enough to avoid production delays.

Another threat is purchasing items that are not currently needed. Accurate perpetual inventory records (control 6.1) ensure the validity of purchase requisitions that the inventory control system automatically generates. Supervisors need to review and approve purchase requisitions that individual employees initiate. A related problem is multiple purchases of the same item by different subunits of the organization. As a result, the organization may be carrying a larger inventory than desired and may fail to take advantage of volume discounts that might be available. A centralized purchasing function mitigates this threat.

Choosing Suppliers

Once the need to purchase has been identified, the next step is to select a supplier. Purchasing agents (sometimes called buyers) usually perform this task. In manufacturing companies such as AOE, the purchasing function is closely related to the production cycle. Thus, as Figure 12-1 shows, Ryan McDaniel, the head of the purchasing department at AOE, reports directly to LeRoy Williams, the vice president of manufacturing.

PROCESS The crucial operating decision in the purchasing activity is selecting suppliers for inventory items. Several factors should be considered in making this decision:

- Price
- Quality of materials
- Dependability in making deliveries

Note that properly evaluating suppliers requires more than just maintaining data about purchase prices. Companies also incur costs, such as rework and scrap, related to the quality of the products purchased. There are also costs associated with supplier delivery performance (such as the problems described in the introductory case at AOE's Dayton plant). Supplier dependability is especially important for companies that use JIT systems because late deliveries can bring the entire system to a halt.

Once a supplier has been selected for a product, the supplier's identity should become part of the product inventory master record to avoid repeating the supplier selection process for every subsequent order. (In some cases, however, such as for the purchase of high-cost and low-usage items, management may explicitly want to reevaluate all potential suppliers each time that product is ordered.) A list of potential alternative suppliers for each item should also be maintained, in case the primary supplier is out of stock of a needed item.

A ***purchase order*** (Figure 13-5) is a document or electronic form that formally requests a supplier to sell and deliver specified products at designated prices. It is also a promise to pay and becomes a contract once the supplier accepts it. The purchase order includes the names of the supplier and purchasing agent, the order and requested delivery dates, the delivery location and shipping method, and information about the items ordered. Frequently, several purchase orders are generated to fill one purchase requisition, because different vendors may be the preferred suppliers for the various items requested. The quantity ordered may also differ from that requested, to allow the purchaser to take advantage of quantity discounts.

Many companies maintain special purchasing arrangements with important suppliers. A ***blanket purchase order*** is a commitment to purchase specified items at designated prices from a particular supplier for a set time period, often one year. Blanket purchase orders reduce the buyer's uncertainty about reliable sources of raw materials and help the supplier plan its capacity and operations more effectively.

The major cost driver in the purchasing function is the number of purchase orders processed. Thus, finding ways to reduce the number of orders processed and to streamline the steps involved can yield significant savings. Using EDI is one way to improve the purchasing process. EDI reduces costs by eliminating the clerical work associated with printing and mailing paper documents.

Alpha Omega Electronics **No. 2463**

Billing Address: **2431 Bradford Lane**
San Francisco, CA 94403
(314) 467-2341

Reference the above number on all invoices and shipping documents

PURCHASE ORDER

To: Best Office Supply
4567 Olive Blvd.
Dayton, OH 33422-1234

Ship To: AOE, Inc.
1735 Sandy Dr.
Dayton, OH 33421–2243

Vendor Number:	Order Date:	Requisition Number:	Buyer:	Terms:
121	07/03/2011	89010	Fred Mozart	1/10, n/30

F.O.B.	Ship Via:	Delivery Date:	Remarks:
Destination	Your choice	07/15/2011	

Item	Item Number	Quantity	Description	Unit Price
1	32047	15 boxes	Xerox 4200 paper, 20 wt., 10 ream box	$33.99
2	80170	5 boxes	Moore 2600 continuous form, 20 lb.	$31.99
3	81756	20 boxes	CD cases, box of 10	$ 6.49
4	10407	100	700 MB CDs, 1 box	$19.99

Approved by: *Susan Beethoven*

FIGURE 13-5
Example of a Purchase Order (items in bold are pre-printed)

The time between recognizing the need to reorder an item and subsequently receiving it also is reduced. Consequently, the risk of running out of stock is diminished, which can significantly increase profitability. In the past, EDI was expensive because it required the use of proprietary third-party networks and software. However, the development of standards for EDI over the Internet (EDINT) has drastically cut the costs of EDI. An example is AS2, which is a protocol that governs the secure electronic exchange of documents such as purchase orders.

Vendor-managed inventory programs provide another means of reducing purchase and inventory costs. A ***vendor-managed inventory*** program essentially outsources much of the inventory control and purchasing function: Suppliers are given access to sales and inventory data and are authorized to automatically replenish inventory when stocks fall to predetermined reorder points. This arrangement cuts carrying costs by reducing the amount of inventory on hand and lowers processing costs by eliminating the need to generate and exchange formal purchase orders.

Reverse auctions provide yet another technique to reduce purchasing-related expenses. In reverse auctions, suppliers compete with one another to meet demand at the lowest price. Although reverse auctions can yield significant cost savings, because the primary focus is on price, they are probably best suited to the purchase of commodity items rather than critical components for which quality, vendor reliability, and delivery performance are important.

One other way to reduce purchasing-related costs is to conduct a pre-award audit. Pre-award audits are typically used for large purchases that involve formal bids by suppliers. The internal auditor visits each potential supplier who has made the final cut in the contracting process to verify the accuracy of its bid. Pre-award audits often identify simple mathematical errors in complex pricing formulas and other discrepancies that, when corrected, can provide considerable savings.

EDI, vendor-managed inventory, reverse auctions, and pre-award audits are techniques for reducing the purchasing-related costs of raw materials and finished goods inventory. New IT developments can also change how companies account for their inventory. Traditionally, most companies have used the LIFO, FIFO, or weighted-average approaches to allocate costs to inventory and cost of goods sold. RFID, however, provides the capability to track individual inventory items. Thus, RFID makes it possible for companies to more accurately account for actual inventory-related costs by switching to the specific identification method for accounting for inventories.

THREATS AND CONTROLS Table 13-2 lists five threats to placing orders with suppliers. One (threat 7) involves purchasing items at inflated prices. The cost of purchased components represents a substantial portion of the total cost of many manufactured products. Therefore, companies strive to secure the best prices for the items they purchase. Several procedures can help ensure that companies do not pay too much for specific products. Price lists for frequently purchased items should be stored in the computer and consulted when orders are made. The prices of many low-cost items can be readily determined from catalogs. Competitive, written bids should be solicited for high-cost and specialized products (control 7.2). Purchase orders should be reviewed to ensure that these policies have been followed.

Budgets (control 7.4) are also helpful in controlling purchasing expenses. Purchases should be charged to an account that is the responsibility of the person or department approving the requisition. Actual costs should be compared periodically with budget allowances. To facilitate control, these reports should highlight any significant deviations from budgeted amounts for further investigation (the principle of management by exception).

In attempting to obtain the lowest possible prices, another threat is purchasing inferior-quality products. Substandard products can result in costly production delays. Moreover, the costs of scrap and rework often result in higher total production costs than if higher-quality, more expensive materials had been initially purchased. Through experience, buyers often learn which suppliers provide the best-quality goods at competitive prices. Such informal knowledge should be incorporated into formal control procedures so that it is not lost when a particular employee leaves the company. One best practice is to establish lists of approved suppliers known to provide goods of acceptable quality (control 8.1). Purchase orders should be reviewed to ensure that only these approved suppliers are being used. In addition, the accounting information system should collect detailed product quality data. For example, AOE can measure the quality of a supplier's products by tracking how often its items fail to pass inspection in the receiving department and

the amount of production that has to be reworked or scrapped because of substandard materials. The purchasing manager should regularly review that data to maintain and revise the list of approved suppliers. Finally, purchasing managers should be held responsible for the total cost of purchases, which includes not only the purchase price but also the quality-related costs of rework and scrap. Doing this requires designing the system to track the latter costs so that they can be allocated back to the purchasing department.

As the introductory case demonstrated, another potential problem is unreliable performance by suppliers (threat 9 in Table 13-2). One way to reduce the risk of problems with supplier dependability is to require that suppliers be certified as meeting international quality standards such as ISO 9000. However, the accounting information system should also be designed to capture and track information about supplier performance (control 9.2). For example, AOE can track actual delivery dates versus those promised. Indeed, the ERP system can be configured to automatically generate reports of purchase orders that have been not been delivered within the promised time period.

Purchasing from unauthorized suppliers (threat 10) can result in numerous problems. Items may be of inferior quality or overpriced. The purchase may even cause legal problems. Various government agencies, such as the Office of Foreign Assets Control and the Bureau of Industry and Security in the Department of Commerce, maintain lists of individuals and companies with whom it is illegal to transact business. Payments to entities on such lists can result in substantial fines and, sometimes, imprisonment. Consequently, all purchase orders should be reviewed to ensure that only approved suppliers are used. It is especially important to restrict access to the approved supplier list and to periodically review the list for any unauthorized changes. ERP systems should be configured to prevent issuing purchase orders to suppliers not in the approved master file.

Using EDI for purchase orders requires additional control procedures. Access to the EDI system should be controlled and limited to authorized personnel through the use of passwords, user IDs, access control matrices, and physical access controls. Procedures to verify and authenticate EDI transactions also are needed. Most EDI systems are programmed to send an acknowledgment for each transaction, which provides a rudimentary accuracy check. Further protection against transmission problems, which can result in the loss of orders, is provided by time-stamping and numbering all EDI transactions. Companies should maintain and periodically review a log of all EDI transactions to ensure that all have been processed and that established policies are being followed. Encryption can ensure the privacy of EDI transactions, which is especially important for competitive bids. Digital signatures should be used to ensure the authenticity of transactions.

Numerous policy-related threats also arise with EDI, each of which must be covered in the trading agreement. Examples of these types of issues include the following:

- At what point in the process can the order be canceled?
- Which party is responsible for the cost of return freight if contract terms are not followed?
- Which party is responsible for errors in bar codes, RFID tags, and labels?
- What happens if errors in the purchasing company's sales system cause additional errors in the amount of goods that suppliers provide?
- Can suppliers ship more inventory than ordered if doing so reduces total freight costs because it results in a full, rather than partial, truckload?

Table 13-2 shows that ***kickbacks***, which are gifts from suppliers to purchasing agents for the purpose of influencing their choice of suppliers, are another threat. For the kickback to make economic sense, the supplier must find some way to recover the money spent on the bribe. This usually is accomplished by inflating the price of subsequent purchases or by substituting goods of inferior quality. Even if neither of these problems occurs, kickbacks impair the buyer's objectivity.

To prevent kickbacks, companies should prohibit purchasing agents from accepting any gifts from potential or existing suppliers. (Trinkets that are clearly of inconsequential value may be allowed.) These policies should apply not only to gifts of tangible goods, but also to services. For example, meeting planners should be informed that it is against company policy to accept frequent-traveler points from hotels for booking the company's meetings there. Training employees how to respond to unsolicited "gifts" from suppliers (control 11.2) is also important, because many kickback schemes are initiated when unethical vendors send such "tokens of appreciation,"

FOCUS 13-1 Supplier Audits: A Means to Control Purchasing

Supplier audits may be one of the best tools for assessing the effectiveness of expenditure cycle controls. It entails having an internal auditor visit a supplier's office to check its records. The objective is to identify suppliers likely to be associated with problems such as kickbacks. Red flags that indicate potential problems include:

1. A large percentage of the supplier's gross sales was to the company conducting the supplier audit.
2. The supplier's pricing methods differ from standard industry practice.
3. The supplier does not own the equipment it rents, but is itself renting that equipment from a third party.
4. Entertainment expenses are high in terms of a percentage of the supplier's gross sales.
5. The supplier submits altered or fictitious third-party invoices.
6. The supplier's address on its invoices is fictitious.

Supplier audits can yield substantial returns. One company recovered more than $250,000 for such problems as duplicate billings. Supplier audits also often uncover violations of the company's conflict of interest policy. Interestingly, many suppliers support the idea of supplier audits, because the process gives them a "good excuse" for not offering purchasing agents gifts or entertainment.

usually in the form of cash, to unwary employees. Once the employee accepts the gift, the supplier threatens to disclose the payment to a supervisor unless the employee makes additional purchases from that vendor.

Job rotation is another important control to reduce the risk of kickbacks: Purchasing agents should not deal with the same suppliers indefinitely, because doing so increases the risk that they may succumb to the constant temptations offered by an unethical vendor. If the organization is too small to rotate job duties across different purchasing agents, it should periodically conduct a detailed audit of the purchasing agent's activities. Purchasing agents should also be required to take their allotted vacation time each year, because many frauds are discovered when the perpetrator is absent and unable to continue covering up the illicit activity. Finally, purchasing agents should be required to sign annual conflict of interest statements, disclosing any financial interests they may have in current or potential suppliers.

Kickbacks are difficult to prevent, so detective controls are also necessary. Focus 13-1 discusses one particularly effective detection control: the supplier audit.

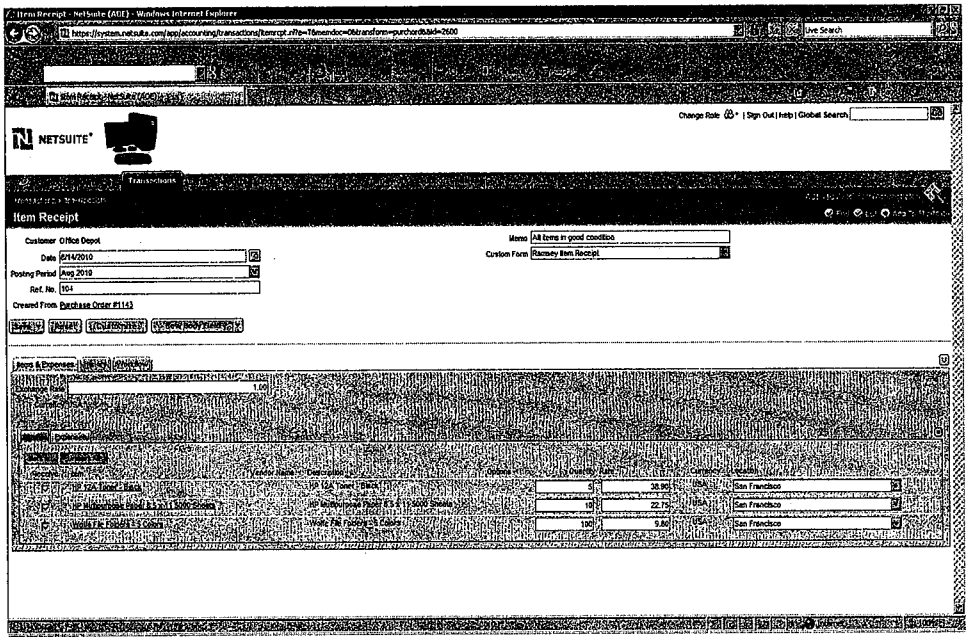
Receiving

The second major business activity in the expenditure cycle (circle 2.0 in Figure 13-2) is the receipt and storage of ordered items. The receiving department is responsible for accepting deliveries from suppliers. It usually reports to the warehouse manager, who in turn reports to the vice president of manufacturing. The inventory stores department, which also reports to the warehouse manager, is responsible for storage of the goods. Information about the receipt of ordered merchandise must be communicated to the inventory control function to update the inventory records.

Process

When a delivery arrives, a receiving clerk compares the purchase order number referenced on the supplier's packing slip with the open purchase order file to verify that the goods were ordered. The receiving clerk then counts the quantity of goods delivered. Before routing the inventory to the warehouse or factory, the receiving clerk also should examine each delivery for signs of obvious damage.

The *receiving report* documents details about each delivery, including the date received, shipper, supplier, and purchase order number (Figure 13-6). For each item received, it shows the item number, description, unit of measure, and quantity. The receiving report also contains space to identify the persons who received and inspected the goods as well as for remarks concerning the



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FIGURE 13-6
Example of a Receiving Report Data Entry Screen

quality of the items received. A receiving report is typically not used to document the receipt of services, such as advertising and cleaning. Instead, receipt of such services is usually documented by supervisory approval of the supplier's invoice.

The three possible exceptions to this process are (1) receiving a quantity of goods different from the amount ordered, (2) receiving damaged goods, or (3) receiving goods of inferior quality that fail inspection. In all three cases, the purchasing department must resolve the situation with the supplier. Usually the supplier will give the buyer permission to correct the invoice for any discrepancies in quantity. In the case of damaged or poor-quality goods, a document called a debit memo is prepared after the supplier agrees to take back the goods or to grant a price reduction. The ***debit memo*** records the adjustment being requested. One copy of the debit memo is sent to the supplier, who subsequently creates and returns a credit memo in acknowledgment. The accounts payable department is notified and adjusts the account balance owed to that supplier. A copy of the debit memo accompanies the goods to the shipping department to authorize their return to the supplier.

Counting and recording inventory deliveries is a labor-intensive task. One way for companies such as AOE to improve the efficiency of this process is to require suppliers to bar-code or affix RFID tags to their products. Either approach streamlines the counting of items received but does not eliminate the need to inspect the quality.

EDI and satellite technology provide another way to improve the efficiency of inbound logistics. EDI advance shipping notices inform companies when products have been shipped. By using shipping companies whose trucks are equipped with data terminals linked to satellites, a business can track the exact location of all incoming shipments and ensure that adequate staff will be there to unload the trucks. Truck drivers also can be directed to pull up to specific loading docks closest to the place where the goods will be used.

Finally, audits may identify opportunities to cut freight costs. For example, many companies have negotiated significant savings with specific carriers. The success of such arrangements depends on suppliers using the designated carriers. Periodic audits can verify this. Internal auditors should also verify the accuracy of freight bills and invoices to ensure that suppliers are not billing for transportation costs that they are supposed to pay.

Threats and Controls

Accepting delivery of unordered goods (threat 12) results in costs associated with unloading, storing, and later returning those items. The best control procedure to mitigate this threat is to instruct the receiving department to accept only deliveries for which there is an approved purchase order. Therefore, the receiving department needs access to the open purchase orders file.

Another threat is making mistakes in counting items received. Correctly counting the quantity received is crucial for maintaining accurate perpetual inventory records. It also ensures that

the company pays only for goods actually received. To encourage the receiving clerk to accurately count what was delivered, many companies design the inquiry processing system so that receiving-dock workers do not see the quantity ordered (control 13.1). (If paper documents are still used, the quantity-ordered field is blacked out on the receiving department's copy of the purchase order.) Nevertheless, the receiving clerk still knows the expected quantity of goods because suppliers usually include a packing slip with each order. Consequently, there is a temptation to do just a quick visual comparison of quantities received with those indicated on the packing slip, to quickly route the goods to where they are needed. Therefore, companies must clearly communicate to receiving clerks the importance of carefully and accurately counting all deliveries. An effective means of communication is to require receiving clerks not only to record the quantity received but also to sign the receiving report (or enter their employee ID numbers in the system). Such procedures indicate an assumption of responsibility, which usually results in more diligent work. Some companies also offer bonuses to receiving clerks for catching discrepancies between the packing slip and actual quantity received before the delivery person leaves. An additional control is to require the inventory control function, or the appropriate user department, to count the items transferred from receiving and then hold that department responsible for any subsequent shortages. Wherever feasible, use of bar codes and RFID tags can significantly reduce accidental mistakes in counting. Finally, the ERP system should be configured to automatically flag discrepancies between receiving counts and order quantities that exceed a predetermined tolerance level so that they can be promptly investigated.

Thus far, the discussion has centered on the purchase of inventory items. Different procedures are needed to control the purchase of services, such as painting or maintenance work. The major challenge in this area is establishing that the services were actually performed (threat 14), which may be difficult. For example, visual inspection can indicate whether a room has been painted; it does not reveal, however, whether the walls were appropriately primed, unless the inspection was done during the painting process, which may not always be feasible.

One way to control the purchase of services is to hold the appropriate supervisor responsible for all such costs incurred by that department. The supervisor is required to acknowledge receipt of the services, and the related expenses are then charged to accounts for which he or she is responsible. Actual versus budgeted expenses should be routinely compared and any discrepancies investigated.

It is difficult to prevent fraudulent billing for services. Therefore, detective controls are also needed. One of the most effective techniques is for the internal audit function to periodically conduct detailed reviews of contracts for services, including audits of supplier records, as discussed in Focus 13-1.

Theft of inventory is another threat. Several control procedures can be used to safeguard inventory against loss. First, inventories should be stored in secure locations with restricted access. Second, all transfers of inventory within the company should be documented. For example, both the receiving department and the inventory stores department should acknowledge the transfer of goods from the receiving dock into inventory. Similarly, both the inventory stores and the production departments should acknowledge the release of inventory into production. This documentation provides the necessary information for establishing responsibility for any shortages, thereby encouraging employees to take special care to record all inventory movements accurately. Third, it is important to periodically count the inventory on hand and to reconcile those counts with the inventory records.

Finally, proper segregation of duties (control 15.4) can further help minimize the risk of inventory theft. Employees who are responsible for controlling physical access to inventory should not be able to adjust inventory records without review and approval. Neither the employees responsible for custody of inventory nor those authorized to adjust inventory records should be responsible for the receiving or shipping functions.

Approving Supplier Invoices

The third main activity in the expenditure cycle is approving supplier invoices for payment (circle 3.0 in Figure 13-2).

Process

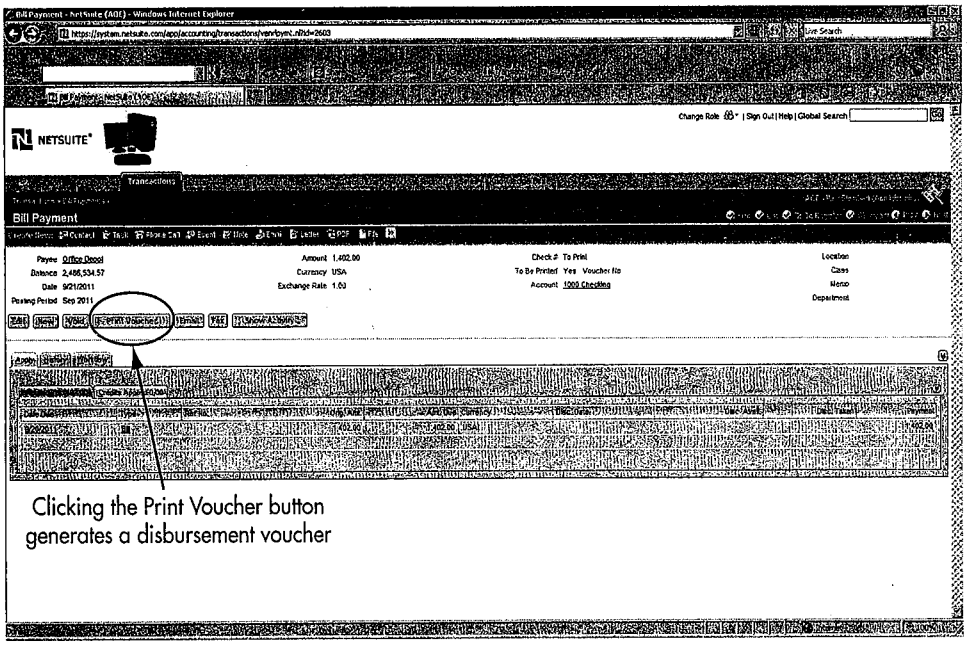
The accounts payable department approves supplier invoices for payment. A legal obligation to pay suppliers arises at the time goods are received. For practical reasons, however, most companies record accounts payable only after receipt and approval of the supplier's invoice. This timing difference is usually not important for daily decision making, but it does require making appropriate adjusting entries to prepare accurate financial statements at the end of a fiscal period.

When a supplier's invoice is received, the accounts payable department is responsible for matching it with a corresponding purchase order and receiving report. This combination of the supplier invoice and associated supporting documentation creates what is called a ***voucher package***. Figure 13-7 shows an example of a data entry screen for approving a supplier invoice. Once the approver has verified that the company received what it had ordered, the invoice is approved for payment.

There are two ways to process supplier invoices, referred to as nonvoucher or voucher systems. In a ***nonvoucher system***, each approved invoice (along with the supporting documentation) is posted to individual supplier records in the accounts payable file and is then stored in an open-invoice file. When a check is written to pay for an invoice, the voucher package is removed from the open-invoice file, the invoice is marked paid, and then the voucher package is stored in the paid-invoice file. In a ***voucher system***, an additional document called a disbursement voucher is also created when a supplier invoice is approved for payment. The ***disbursement voucher*** identifies the supplier, lists the outstanding invoices, and indicates the net amount to be paid after deducting any applicable discounts and allowances.

Voucher systems offer three advantages over nonvoucher systems. First, they reduce the number of checks that need to be written, because several invoices may be included on one disbursement voucher. Second, because the disbursement voucher is an internally generated document, it can be prenumbered to simplify tracking all payables. Third, because the voucher provides an explicit record that a vendor invoice has been approved for payment, it facilitates separating the time of invoice approval from the time of invoice payment. This makes it easier to schedule both activities to maximize efficiency.

The accounts payable process, which matches vendor invoices to purchase orders and receiving reports, is a prime candidate for automation. Large global companies can process over a million vendor invoices each year. Processing efficiency can be improved by requiring suppliers to submit invoices electronically, by EDI, and having the system automatically match those invoices to the appropriate purchase orders and receiving reports. Only those vendor invoices that fail this matching process need be processed manually.



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FIGURE 13-7
Example of Supplier Invoice Approval Screen

Another option is to eliminate vendor invoices. After all, for most recurring purchases, companies know the prices of goods and services at the time they are ordered. Thus, as soon as receipt of the goods or services is verified, all the information required to pay the supplier is already known. This "invoiceless" approach is called ***evaluated receipt settlement (ERS)***. ERS replaces the traditional three-way matching process (vendor invoice, receiving report, and purchase order) with a two-way match of the purchase order and receiving report (Figure 13-8). ERS saves time and money by reducing the number of documents that need to be matched and, hence, the number of potential mismatches. In fact, ERS systems are often configured to automate the two-way matching process and automatically generate payments; manual review is necessary only when there are discrepancies between the receiving report and purchase order. ERS also saves suppliers the time and expense of generating and tracking invoices. This is an example

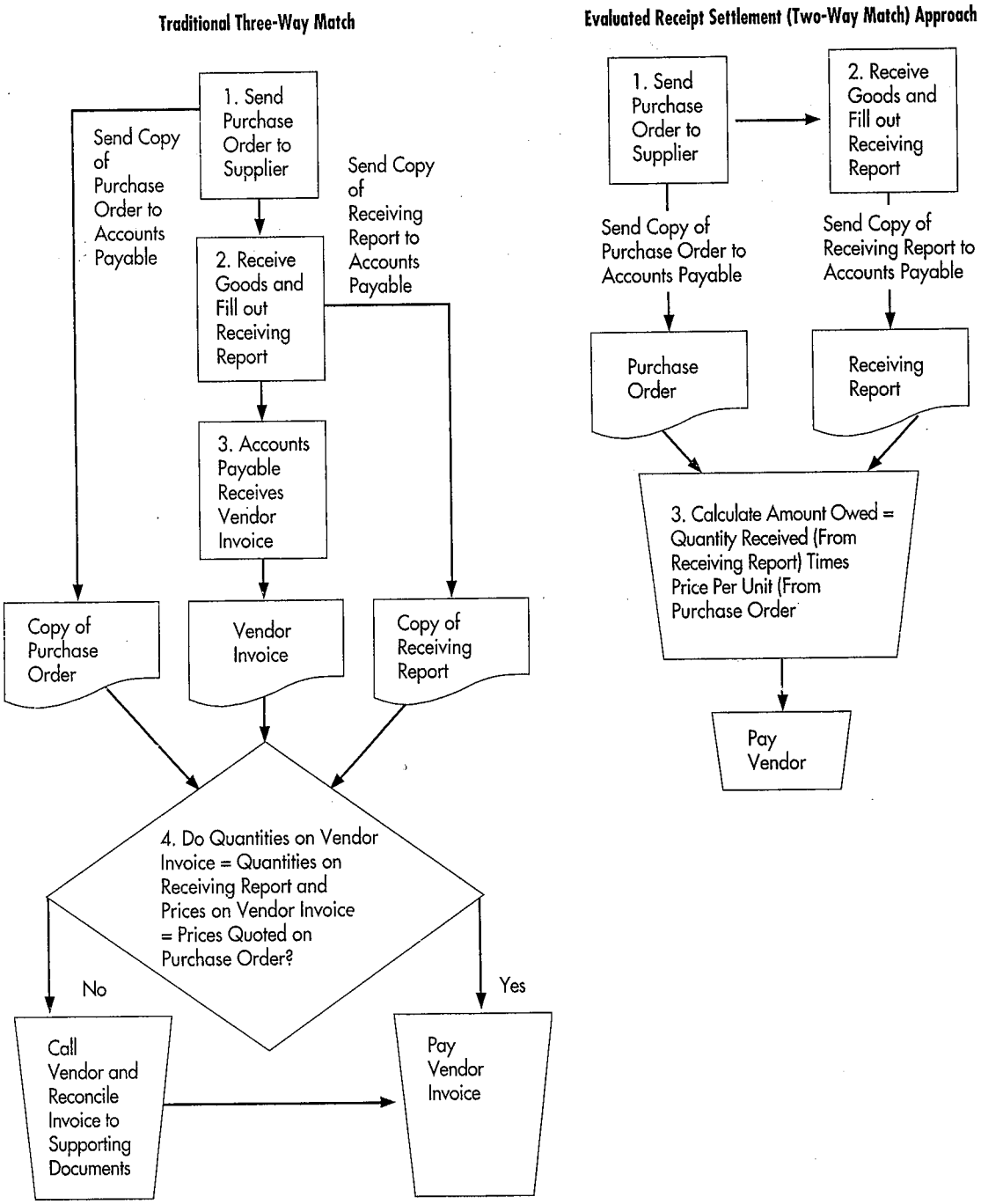


FIGURE 13-8

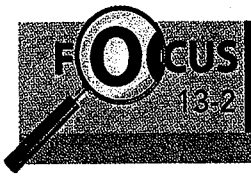
Comparison of Traditional Three-Way Match for Accounts Payable with the Two-Way Match used by Evaluated Receipt Settlement (ERS) Systems

of how improvements in one company's expenditure cycle processes provide benefits to another company's revenue cycle processes.

Noninventory purchases for supplies provide perhaps the biggest opportunity to improve the efficiency of accounts payable and cash disbursements. Noninventory purchases typically account for a large proportion of accounts payable transactions but represent a small percentage of the total dollar value of all purchases. For example, an AICPA-sponsored survey found that over 60% of all invoices processed by accounts payable departments were for amounts under $2,000. Procurement cards provide one way to eliminate the need for accounts payable to process many such small invoices. A ***procurement card*** is a corporate credit card that employees can use only at designated suppliers to purchase specific kinds of items. Spending limits can be set for each card. In addition, the account numbers on each procurement card can be mapped to specific general ledger accounts, such as office supplies. Procurement cards simplify accounts payable because the company receives one monthly statement that summarizes noninventory purchases by account category. Procurement cards also improve the efficiency of the cash disbursement process because the company only has to make one payment for all noninventory purchases during a given time period, instead of making separate payments to various suppliers. Finally, dramatic improvements can often result from reengineering the accounts payable process itself.

Threats and Controls

Table 13-2 indicates that one threat is errors on supplier invoices, such as discrepancies between quoted and actual prices charged or miscalculations of the total amount due. Consequently, the mathematical accuracy of vendor invoices must be verified and the prices and quantities listed therein compared with those indicated on the purchase order and receiving report. For procurement



Using Business Process Analysis to Identify Threats and Controls in the Expenditure Cycle

A leading manufacturer of heavy trucks, buses, and coaches has three production sites in Europe. One of the core capabilities of the organization is continuous improvement. The use of improvement groups has spread in the organization, giving even greater importance to the philosophy of developing the organization and its employees.

Recently a central improvement group has been assigned to improve the effectiveness, efficiency, integrity, and compliance of the expenditure cycle for the three European production sites. The expenditure cycle is initiated by the purchase requisitions that are (automatically) sent from the ERP systems of the production sites or entered manually into SAP SRM. Purchases such as engine parts, custom-made steel plates, tires, and windshields are automatically ordered and directly paid for. The central purchase department closes annual purchase contracts with suppliers. The warehouse keeper of the sites registers the received goods in SAP SRM, after which the stock is updated.

The improvement team uses an approach called business process analysis. This approach combines business process redesign and business balanced scorecard techniques. In summary, the team divides the process into subprocesses and activities and identifies, for each activity, the input and output, threats, risk assessment, requirements, implemented controls, and residual risk. The risk assessment and residual risk are based on the critical success factors and critical performance indicators of the process.

For example, the input and output for the ordering subprocess are a purchase requisition and a purchase order. Relevant threats are incorrect quantities, incorrect material, and unauthorized order requisitions. The risk is assessed as "high" and it is required that all requisitions be on time, complete, accurate, and authorized. To mitigate the risk, a number of controls are defined. For instance, requisitions can be made only on an existing vendor/information record.

There are many advantages to using business process analysis. It is structured, it includes both manual and automated activities, it addresses multiple dimensions of quality, and it is accessible for both management and auditors.

In this specific case, the improvement team achieved some remarkable results, including the following:

- Stockouts were reduced almost to zero, cutting back the average delivery time by 20%.
- Labor-intensive manual controls were replaced with automated processing controls, resulting in a cost saving of 5 FTE (full-time equivalents).
- Compliance with the payment terms was optimized, resulting in a better cash flow and liquidity. Credit facilities and interest payments were reduced by more than 40%.

card purchases, users should be required to keep receipts and verify the accuracy of the monthly statement. Adopting the ERS approach eliminates the potential for errors in vendor invoices because companies pay by matching counts of what they receive with prices quoted when the goods were ordered. However, the use of ERS makes it important to control access to the supplier master file and monitor all changes made to it because the supplier master file now contains information about the prices of the various items being purchased. Upon entry of data about the quantity of goods received, the system uses those prices to establish the amount to be paid to suppliers. Thus, unauthorized changes to those prices can result in overpayments to suppliers.

Even with ERS, freight expenses require special consideration because their complexity creates numerous opportunities for mistakes to occur. The best way to reduce freight-related threats is to provide the purchasing and accounts payable staffs with adequate training on transportation practices and terminology. For example, if the purchase contract says "full freight allowed," then the supplier is responsible for the freight costs. When the purchasing organization is responsible for freight expenses, using a designated carrier for all incoming shipments can reduce costs. The discounts will only be realized, however, if suppliers comply with requests to use that carrier. Therefore, an important detective control is to capture data on all incoming carriers, so that reports identifying suppliers who fail to comply with shipping instructions can be prepared.

Mistakes in recording and posting payments to suppliers (threat 17) result in additional errors in financial and performance reports that, in turn, can contribute to poor decision making. The data entry and processing controls to ensure processing integrity that were discussed in Chapter 10 are necessary to prevent these types of problems. One such control is to compare the difference in supplier account balances with the total amount of invoices processed—before and after processing checks. The total of all supplier account balances (or unpaid vouchers) also should be reconciled periodically with the amount of the accounts payable control account in the general ledger.

Cash Disbursements

The final activity in the expenditure cycle is paying suppliers (circle 4.0 in Figure 13-2).

Process

The cashier, who reports to the treasurer, is responsible for paying suppliers. This segregates the custody function, performed by the cashier, from the authorization and recording functions, performed by the purchasing and accounts payable departments, respectively. Payments are made when accounts payable sends the cashier a voucher package. Although many payments continue to be made by check, the use of EFT and FEDI is increasing.

Threats and Controls

Failing to take advantage of purchase discounts for prompt payment (threat 18) can be costly. For example, a 1% discount for paying within 10 days instead of 30 days represents a savings of 18% annually. Proper filing can significantly reduce the risk of this threat. Approved invoices should be filed by due date, and the system should be designed to track invoice due dates and print a periodic list of all outstanding invoices. A cash flow budget that indicates expected cash inflows and outstanding commitments also can help companies plan to utilize available purchase discounts. The information in this budget comes from a number of sources. Accounts receivable provides projections of future cash collections. The accounts payable and open purchase order files indicate the amount of current and pending commitments to suppliers, and the human resources function provides information about payroll needs.

Another threat is paying for goods not received. The best control to prevent this threat is to compare the quantities indicated on the vendor invoice with the quantities entered by the inventory control person, who accepts the transfer of those goods from the receiving department. Many companies require the inventory control department to verify the quantities on the receiving report before it can be used to support payment of a supplier invoice. Verification that services (e.g., cleaning or painting) were performed in the manner billed is more difficult. Therefore,

most companies rely on budgetary controls and careful review of departmental expenses to indicate potential problems that need investigation.

Reimbursement of employees' travel and entertainment expenses warrants special attention because this is an area in which fraud often occurs and technological trends have made it easier for employees to submit fraudulent claims. For example, most airlines now encourage travelers to print their boarding passes at home. This saves the traveler time at check-in, but it also reduces the value of a boarding pass as supporting documentation for a claimed expense because the document can be altered by the traveler or printed but never used. Consequently, many organizations require employees to submit additional evidence to prove that they actually took a trip, such as a conference agenda that identifies attendees. Another potential threat is for an employee to book multiple flights or hotels, cancel all but the cheapest ones, but submit a reimbursement claim for the most expensive option. The best way to prevent this problem is to require all employees to use corporate credit cards for travel, as this ensures that the organization will receive a complete audit trail of all charges *and* credits to the account.

Duplicate payments (threat 20) can happen for a variety of reasons. It may be a duplicate invoice that was sent after the company's check was already in the mail, or it may have become separated from the other documents in the voucher package. Although the supplier usually detects a duplicate payment and credits the company's account, it can affect a company's cash flow needs. In addition, the financial records will be incorrect, at least until the duplicate payment is detected.

Several related control procedures can mitigate this threat. First, invoices should be approved for payment only when accompanied by a complete voucher package (purchase order and receiving report). Second, only the original copy of an invoice should be paid. Most duplicate invoices that suppliers send clearly indicate that they are not originals. Payment should never be authorized for a photocopy of an invoice. Third, when the check to pay for an invoice is signed, the invoice and the voucher package should be canceled (marked "paid") in a manner that would prevent their resubmission. Although ERS eliminates vendor invoices entirely, it is still important to mark all receiving reports as paid to avoid duplicate payments.

Probably the most serious threat associated with the cash disbursements function is theft or misappropriation of funds (threat 21). Because cash is the easiest asset to steal, access to cash, blank checks, and the check-signing machine should be restricted. Checks should be sequentially numbered and periodically accounted for by the cashier.

Electronic funds transfer (EFT), either by itself or as part of FEDI, requires additional control procedures. Strict access controls over all outgoing EFT transactions are important. Passwords and user IDs should be used to specifically identify and monitor each employee authorized to initiate EFT transactions. The location of the originating terminal should also be recorded. EFT transactions above a certain threshold should require real-time supervisory approval. There should also be limits on the total dollar amount of transactions allowed per day per individual. All EFT transmissions should be encrypted to prevent alteration. In addition, all EFT transactions should be time-stamped and numbered to facilitate subsequent reconciliation. Special programs, called *embedded audit modules*, can be designed into the system to monitor all transactions and identify any that possess specific characteristics. A report of those flagged transactions then can be given to management and internal audit for review and, if necessary, more detailed investigation.

Online banking transactions require constant monitoring. Timely detection of suspicious transactions and prompt notification of the bank are necessary for recovering any funds that are fraudulently disbursed. A serious threat is that keystroke-logging software could infect the computer used for online banking and provide criminals with the organization's banking credentials. The best way to mitigate this threat is to designate a specific computer to be used for online banking, to restrict access to that computer to the treasurer or whoever is responsible for authorizing payments, and to use that computer only for online banking and no other activity. Companies should also consider placing Automated Clearing House (ACH) blocks, which instruct banks to not allow ACH debits (outflows) from specific accounts. For example, if a company makes all payments to its suppliers only from its main operating checking account, it may wish to instruct the bank to block all ACH debits from any of its other bank accounts.

Fraudulent disbursements, particularly the issuance of checks to fictitious suppliers, are a common type of fraud. Proper segregation of duties (control 21.6) can significantly reduce the

risk of this threat. The accounts payable function should authorize payment, including the assembling of a voucher package; however, only the treasurer or cashier should sign checks. To ensure that checks are sent to the intended recipients, the cashier should mail the signed checks rather than return them to accounts payable. The cashier also should cancel all documents in the voucher package to prevent their being resubmitted to support another disbursement. Checks in excess of a certain amount, such as $5,000 to $10,000, should require two signatures, thereby providing yet another independent review of the expenditure. Finally, someone who did not participate in processing either cash collections or disbursements should reconcile all bank accounts. This control provides an independent check on accuracy and prevents someone from misappropriating cash and then concealing the theft by adjusting the bank statement.

Access to the approved supplier list should be restricted, and any changes to that list should be carefully reviewed and approved. It is especially important to restrict the ability to create one-time suppliers and process invoices so that the same employee cannot both create a new supplier and issue a check to that supplier.

When possible, expenditures should be made by check or EFT. Nevertheless, it is often more convenient to pay for minor purchases, such as coffee or pencils, in cash. A petty cash fund, managed by an employee who has no other cash-handling or accounting responsibilities, should be established to handle such expenditures. The petty cash fund should be set up as an imprest fund. An ***imprest fund*** has two characteristics: it is set at a fixed amount, such as $100, and it requires vouchers for every disbursement. At all times, the sum of cash plus vouchers should equal the preset fund balance. When the fund balance gets low, the vouchers are presented to accounts payable for replenishment. After accounts payable authorizes this transaction, the cashier then writes a check to restore the petty cash fund to its designated level. As with the supporting documents used for regular purchases, the vouchers used to support replenishment of the petty cash fund should be canceled at the time the fund is restored to its preset level.

The operation of an imprest petty cash fund technically violates the principle of segregation of duties, because the same person who has custody of the cash also authorizes disbursements from the fund and maintains a record of the fund balance. The threat of misappropriation is more than offset, however, by the convenience of not having to process small miscellaneous purchases through the normal expenditure cycle. Moreover, the risk of misappropriation can be mitigated by having the internal auditor make periodic unannounced counts of the fund balance and vouchers and by holding the person in charge of the petty cash fund responsible for any shortages discovered during those surprise audits.

Theft can also occur through check alteration (threat 22). Check-protection machines can reduce the risk of this threat by imprinting the amount in distinctive colors, typically a combination of red and blue ink. Using special inks that change colors if altered and printing checks on special papers that contain watermarks can further reduce the probability of alteration. Many banks also provide special services to help protect companies against fraudulent checks. One such service, called Positive Pay, involves sending a daily list of all legitimate checks to the bank, which will then clear only checks appearing on that list. Finally, bank reconciliations are an important detective control for identifying check fraud. If done in a timely manner, they facilitate recovery from banks. Indeed, many banks will cover bad-check losses only if a company notifies them promptly of any such checks it discovers.

Finally, it is important to plan and monitor expenditures in order to avoid cash flow problems (threat 23). A cash flow budget (see Chapter 12) is the best control to mitigate this threat.

Summary and Case Conclusion

The basic business activities performed in the expenditure cycle include ordering materials, supplies, and services; receiving materials, supplies, and services; approving supplier invoices for payment; and paying for goods and services.

The efficiency and effectiveness of these activities can significantly affect a company's overall performance. For example, deficiencies in requesting and ordering necessary inventory and supplies can create production bottlenecks and result in lost sales due to stockouts of popular

items. Problems in the procedures related to receiving and storing inventory can result in a company's paying for items it never received, accepting delivery and incurring storage costs for unordered items, and experiencing a theft of inventory. Problems in approving supplier invoices for payment can result in overpaying suppliers or failing to take available discounts for prompt payment. Weaknesses in the cash disbursement process can result in the misappropriation of cash.

IT can help improve the efficiency and effectiveness with which expenditure cycle activities are performed. In particular, EDI, bar-coding, RFID, and EFT can significantly reduce the time and costs associated with ordering, receiving, and paying for goods. Proper control procedures, especially segregation of duties, are needed to mitigate various threats such as errors in performing expenditure cycle activities and the theft of inventory or cash.

At the next executive meeting, Ann Brandt and Elizabeth Venko presented to Linda Spurgeon their recommendations for improving AOE's expenditure cycle business activities. Ann indicates that LeRoy Williams's plan to conduct more frequent physical counts of key raw materials components will increase the accuracy of the database and reduce the likelihood of future stockouts at the Wichita plant. She also designed a query to produce a daily supplier performance report that will highlight any negative trends before they become the types of problems that disrupted production at the Dayton plant. Ann also indicated that it would be possible to link AOE's inventory and production planning systems with major suppliers to better manage AOE's inventory levels.

Elizabeth Venko stated that she was working to increase the number of suppliers who either bar-code or RFID tag their shipments. This would improve both the efficiency and accuracy of the receiving process and also the accuracy of AOE's inventory records, thereby providing possible additional reductions in inventory carrying costs. In addition, Elizabeth wants to encourage more suppliers to either send invoices via EDI or agree to ERS, which should improve the efficiency and accuracy of processing invoices and reduce the costs associated with handling and storing paper invoices. Concurrently, Elizabeth plans to increase EFT as much as possible to further streamline the cash disbursements process and reduce the costs associated with processing payments by check.

As the meeting draws to a close, LeRoy Williams asks if Elizabeth and Ann can meet with him to explore additional ways to improve how AOE's new system tracks manufacturing activities.

Key Terms

expenditure cycle 391
economic order quantity (EOQ) 398
reorder point 398
materials requirements planning (MRP) 398
just-in-time (JIT) inventory system 398
purchase requisition 399
purchase order 401
blanket purchase order 401
vendor-managed inventory 402
kickbacks 403
receiving report 404
debit memo 405
voucher package 407
nonvoucher system 407
voucher system 407
disbursement voucher 407
evaluated receipts settlement (ERS) 408
procurement card 409
imprest fund 412

AIS IN ACTION

Chapter Quiz

1. Which of the following inventory control methods is most likely to be used for a product such as lumber (1 × 2's, 2 × 4's, etc.) for which sales can be reliably forecast?
   a. JIT
   b. EOQ
   c. MRP
   d. ABC

2. Which of the following matches is performed in evaluated receipt settlement (ERS)?
   a. the vendor invoice with the receiving report
   b. the purchase order with the receiving report
   c. the vendor invoice with the purchase order
   d. the vendor invoice, the receiving report, and the purchase order

3. Which of the following is true?
   a. ERS systems involve a three-way match of purchase orders, receiving reports, and supplier invoices.
   b. Setting up petty cash as an imprest fund violates segregation of duties.
   c. The EOQ formula is used to identify when to reorder inventory.
   d. A voucher package usually includes a debit memo.

4. Which document is used to establish a contract for the purchase of goods or services from a supplier?
   a. vendor invoice
   b. purchase requisition
   c. purchase order
   d. disbursement voucher

5. Which method would provide the greatest efficiency improvements for the purchase of noninventory items such as miscellaneous office supplies?
   a. bar-coding
   b. EDI
   c. procurement cards
   d. EFT

6. Which of the following expenditure cycle activities can be eliminated through the use of IT or reengineering?
   a. ordering goods
   b. approving vendor invoices
   c. receiving goods
   d. cash disbursements

7. What is the best control procedure to prevent paying the same invoice twice?
   a. Segregate check-preparation and check-signing functions.
   b. Prepare checks only for invoices that have been matched to receiving reports and purchase orders.
   c. Require two signatures on all checks above a certain limit.
   d. Cancel all supporting documents when the check is signed.

8. For good internal control, who should sign checks?
   a. cashier
   b. accounts payable
   c. purchasing agent
   d. controller

9. Which of the following procedures is designed to prevent the purchasing agent from receiving kickbacks?
   a. maintaining a list of approved suppliers and requiring all purchases to be made from suppliers on that list
   b. requiring purchasing agents to disclose any financial investments in potential suppliers
   c. requiring approval of all purchase orders
   d. prenumbering and periodically accounting for all purchase orders

10. Which document is used to record adjustments to accounts payable based on the return of unacceptable inventory to the supplier?
    a. receiving report
    b. credit memo
    c. debit memo
    d. purchase order

Discussion Questions

13.1. In this chapter and in Chapter 12, the controller of AOE played a major role in evaluating and recommending ways to use IT to improve efficiency and effectiveness. Should the company's chief information officer make these decisions instead?

Should the controller be involved in making these types of decisions? Why or why not?

13.2. Companies such as Walmart have moved beyond JIT to vendor-managed inventory (VMI) systems. Discuss the potential advantages and disadvantages of this arrangement. What special controls, if any, should be developed to monitor VMI systems?

13.3. Procurement cards are designed to improve the efficiency of small noninventory purchases. What controls should be placed on their use? Why?

13.4. In what ways can you apply the control procedures discussed in this chapter to paying personal debts (e.g., credit card bills)?

13.5. Should every company switch from the traditional three-way matching process (purchase orders, receiving reports, and supplier invoices) to the two-way match (purchase orders and receiving reports) used in evaluated receipt settlement (ERS)? Why or why not?

13.6. Should companies allow purchasing agents to start their own businesses that produce goods the company frequently purchases? Why? Would you change your answer if the purchasing agent's company were rated by an independent service, such as *Consumer Reports*, as providing the best value for price? Why?

Problems

13.1. Which internal control procedure would be most cost-effective in dealing with the following expenditure cycle threats?

a. A purchasing agent orders materials from a supplier that he partially owns.
b. Receiving-dock personnel steal inventory and then claim the inventory was sent to the warehouse.
c. An unordered supply of laser printer paper delivered to the office is accepted and paid for because the "price is right." After all of the laser printers are jammed, however, it becomes obvious that the "bargain" paper is of inferior quality.
d. The company fails to take advantage of a 1% discount for promptly paying a vendor invoice.
e. A company is late in paying a particular invoice. Consequently, a second invoice is sent, which crosses the first invoice's payment in the mail. The second invoice is submitted for processing and also paid.
f. Inventory records show that an adequate supply of copy paper should be in stock, but none is available on the supply shelf.
g. The inventory records are incorrectly updated when a receiving-dock employee enters the wrong product number at the terminal.
h. A clerical employee obtains a blank check and writes a large amount payable to a fictitious company. The employee then cashes the check.
i. A fictitious invoice is received and a check is issued to pay for goods that were never ordered or delivered.
j. The petty cash custodian confesses to having "borrowed" $12,000 over the last five years.
k. A purchasing agent adds a new record to the supplier master file. The company does not exist. Subsequently, the purchasing agent submits invoices from the fake company for various cleaning services. The invoices are paid.
l. A clerk affixes a price tag intended for a low-end flat-panel TV to a top-of-the-line model. The clerk's friend then purchases that item, which the clerk scans at the checkout counter.

13.2. Match the terms in the left column with their appropriate definition in the right column.

Terms	Definitions
___ 1. Economic order quantity	a. A document that creates a legal obligation to buy and pay for goods or services
___ 2. Materials requirements planning (MRP)	b. The method used to maintain the cash balance in petty cash account
___ 3. Just-in-time (JIT) inventory system	c. The time to reorder inventory triggered when the quantity on hand falls to a predetermined level
___ 4. Purchase requisition	d. A document used to authorize a reduction in accounts payable because merchandise has been returned to a supplier
___ 5. Imprest fund	e. An inventory control system that triggers production based upon actual sales
___ 6. Purchase order	f. An inventory control system that triggers production based on forecasted sales
___ 7. Kickbacks	g. A document used only internally to initiate the purchase of materials, supplies, or services
___ 8. Procurement card	h. A process for approving supplier invoices based on a two-way match of the receiving report and purchase order
___ 9. Blanket purchase order	i. A process for approving supplier invoices based on a three-way match of the purchase order, receiving report, and supplier invoice
___ 10. Evaluated receipts settlement (ERS)	j. A method of maintaining accounts payable in which each supplier invoice is tracked and paid for separately
___ 11. Disbursement voucher	k. A method of maintaining accounts payable that generates one check to pay for a set of invoices from the same supplier
___ 12. Receiving report	l. Combination of a purchase order, receiving report, and supplier invoice that all relate to the same transaction
___ 13. Debit memo	m. A document used to list each invoice being paid by a check
___ 14. Vendor-managed inventory	n. An inventory control system that seeks to minimize the sum of ordering, carrying, and stockout costs
___ 15. Voucher package	o. A system whereby suppliers are granted access to point-of-sale (POS) and inventory data in order to automatically replenish inventory levels
___ 16. Nonvoucher system	p. An agreement to purchase set quantities at specified intervals from a specific supplier
___ 17. Voucher system	q. A document used to record the quantities and condition of items delivered by a supplier
	r. A special-purpose credit card used to purchase supplies
	s. A fraud in which a supplier pays a buyer or purchasing agent in order to sell its products or services



13.3. Excel Project: Using Benford's Law to Detect Potential Disbursements Fraud.

Required

a. Read the article "Using Spreadsheets and Benford's Law to Test Accounting Data," by Mark G. Simkin in the *ISACA Journal*, Vol. 1, 2010, available at www.isaca.org.

b. Follow the steps in the article to analyze the following set of supplier invoices:

Invoice Number	Amount	Invoice Number	Amount
2345	$7,845	2360	$8,256
2346	$2,977	2361	$1,863
2347	$1,395	2362	$3,375
2348	$3,455	2363	$6,221
2349	$7,733	2364	$1,799
2350	$1,455	2365	$1,450
2351	$6,239	2366	$7,925
2352	$2,573	2367	$2,839
2353	$1,862	2368	$1,588
2354	$1,933	2369	$2,267
2355	$7,531	2370	$7,890
2356	$4,400	2371	$7,945
2357	$5,822	2372	$1,724
2358	$7,925	2373	$9,311
2359	$2,100	2374	$4,719

Hint: You may need to use the VALUE function to transform the results of using the LEFT function to parse the lead digit in each invoice amount.

13.4. Match the threats in the left column to appropriate control procedures in the right column. More than one control may be applicable.

Threat

___ 1. Failing to take available purchase discounts for prompt payment

___ 2. Recording and posting errors in accounts payable

___ 3. Paying for items not received

___ 4. Kickbacks

___ 5. Theft of inventory

___ 6. Paying the same invoice twice

___ 7. Stockouts

___ 8. Purchasing items at inflated prices

___ 9. Misappropriation of cash

___ 10. Purchasing goods of inferior quality

___ 11. Wasted time and cost of returning unordered merchandise to suppliers

___ 12. Accidental loss of purchasing data

Control Procedure

a. Accept only deliveries for which an approved purchase order exists.

b. Document all transfers of inventory.

c. Restrict physical access to inventory.

d. File invoices by due date.

e. Maintain a cash budget.

f. Conduct an automated comparison of total change in cash to total changes in accounts payable.

g. Adopt a perpetual inventory system.

h. Require purchasing agents to disclose financial or personal interests in suppliers.

i. Require purchases to be made only from approved suppliers.

j. Restrict access to the supplier master data.

k. Restrict access to blank checks.

l. Issue checks only for complete voucher packages (receiving report, supplier invoice, and purchase order).

Threat	Control Procedure
___ 13. Disclosure of sensitive supplier information (e.g., banking data)	m. Cancel or mark "Paid" supporting documents in voucher package when check is issued. n. Carry out a regular backup of expenditure cycle database. o. Train employees in how to properly respond to gifts or incentives offered by suppliers. p. Hold purchasing managers responsible for costs of scrap and rework. q. Ensure that someone other than the cashier reconciles bank accounts.

13.5. Use Table 13-2 to create a questionnaire checklist that can be used to evaluate controls for each of the basic activities in the expenditure cycle (ordering goods, receiving, approving supplier invoices, and cash disbursements).

Required

a. For each control issue, write a Yes/No question such that a "No" answer represents a control weakness. For example, one question might be "Are supporting documents, such as purchase orders and receiving reports, marked 'paid' when a check is issued to the vendor?"
b. For each Yes/No question, write a brief explanation of why a "No" answer represents a control weakness.



13.6. Excel Project
a. Expand the cash flow budget you created in Problem 12.4 to include a row for expected cash outflows equal to 77% of the current month's sales.
b. Also add a row to calculate the amount of cash that needs to be borrowed in order to maintain a minimum cash balance of $50,000 at the end of each month.
c. Add another row to show the cash inflow from borrowing.
d. Add another row to show the cumulative amount borrowed.
e. Add another row to show the amount of the loan that can be repaid, being sure to maintain a minimum ending balance of $50,000 each month.
f. Add appropriate data validation controls to ensure spreadsheet accuracy.

13.7. For each of the following activities, identify the data that must be entered by the employee performing that activity, and list the appropriate data entry controls:
a. Purchasing agent generating a purchase order
b. Receiving clerk completing a receiving report

13.8. The following list identifies several important control features. For each control, (1) describe its purpose, and (2) explain how it could be best implemented in an integrated ERP system.
a. Cancellation of the voucher package by the cashier after signing the check
b. Separation of duties of approving invoices for payment and signing checks
c. Prenumbering and periodically accounting for all purchase orders
d. Periodic physical count of inventory
e. Requiring two signatures on checks for large amounts
f. Requiring that a copy of the receiving report be routed through the inventory stores department prior to going to accounts payable
g. Requiring a regular reconciliation of the bank account by someone other than the person responsible for writing checks
h. Maintaining an approved supplier list and checking that all purchase orders are issued only to suppliers on that list

13.9. For good internal control, which of the following duties can be performed by the same individual?

1. Approve purchase orders
2. Negotiate terms with suppliers
3. Reconcile the organization's bank account
4. Approve supplier invoices for payment
5. Cancel supporting documents in the voucher package
6. Sign checks
7. Mail checks
8. Request inventory to be purchased
9. Inspect quantity and quality of inventory received

13.10. Last year the Diamond Manufacturing Company purchased over $10 million worth of office equipment under its "special ordering" system, with individual orders ranging from $5,000 to $30,000. Special orders are for low-volume items that have been included in a department manager's budget. The budget, which limits the types and dollar amounts of office equipment a department head can requisition, is approved at the beginning of the year by the board of directors. The special ordering system functions as follows.

Purchasing A purchase requisition form is prepared and sent to the purchasing department. Upon receiving a purchase requisition, one of the five purchasing agents (buyers) verifies that the requester is indeed a department head. The buyer next selects the appropriate supplier by searching the various catalogs on file. The buyer then phones the supplier, requests a price quote, and places a verbal order. A prenumbered purchase order is processed, with the original sent to the supplier and copies to the department head, receiving, and accounts payable. One copy is also filed in the open requisition file. When the receiving department verbally informs the buyer that the item has been received, the purchase order is transferred from the open to the filled file. Once a month, the buyer reviews the unfilled file to follow up on open orders.

Receiving The receiving department gets a copy of each purchase order. When equipment is received, that copy of the purchase order is stamped with the date, and, if applicable, any differences between the quantity ordered and the quantity received are noted in red ink. The receiving clerk then forwards the stamped purchase order and equipment to the requisitioning department head and verbally notifies the purchasing department that the goods were received.

Accounts Payable Upon receipt of a purchase order, the accounts payable clerk files it in the open purchase order file. When a vendor invoice is received, it is matched with the applicable purchase order, and a payable is created by debiting the requisitioning department's equipment account. Unpaid invoices are filed by due date. On the due date, a check is prepared and forwarded to the treasurer for signature. The invoice and purchase order are then filed by purchase order number in the paid invoice file.

Treasurer Checks received daily from the accounts payable department are sorted into two groups: those over and those under $10,000. Checks for less than $10,000 are machine signed. The cashier maintains the check signature machine's key and signature plate and monitors its use. Both the cashier and the treasurer sign all checks over $10,000.

Required

a. Describe the weaknesses relating to purchases and payments of "special orders" by the Diamond Manufacturing Company.

b. Recommend control procedures that must be added to overcome weaknesses identified in part a.
c. Describe how the control procedures you recommended in part b should be modified if Diamond reengineered its expenditure cycle activities to make maximum use of current IT (e.g., EDI, EFT, bar-code scanning, and electronic forms in place of paper documents). *(CPA Examination, adapted)*

13.11. The ABC Company performs its expenditure cycle activities using its integrated ERP system as follows:

- Employees in any department can enter purchase requests for items they note as either out of stock or in small quantity.
- The company maintains a perpetual inventory system.
- Each day, employees in the purchasing department process all purchase requests from the prior day. To the extent possible, requests for items available from the same supplier are combined into one larger purchase order to obtain volume discounts. Purchasing agents use the Internet to compare prices in order to select suppliers. If an Internet search discovers a potential new supplier, the purchasing agent enters the relevant information in the system, thereby adding the supplier to the approved supplier list. Purchase orders above $10,000 must be approved by the purchasing department manager. EDI is used to transmit purchase orders to most suppliers, but paper purchase orders are printed and mailed to suppliers who are not EDI capable.
- Receiving department employees have read-only access to outstanding purchase orders. Usually, they check the system to verify existence of a purchase order prior to accepting delivery, but sometimes during rush periods they unload trucks and place the items in a corner of the warehouse where they sit until there is time to use the system to retrieve the relevant purchase order. In such cases, if no purchase order is found, the receiving employee contacts the supplier to arrange for the goods to be returned.
- Receiving department employees compare the quantity delivered to the quantity indicated on the purchase order. Whenever a discrepancy is greater than 5%, the receiving employee sends an e-mail to the purchasing department manager. The receiving employee uses an online terminal to enter the quantity received before moving the material to the inventory stores department.
- Inventory is stored in a locked room. During normal business hours, an inventory employee allows any employee wearing an identification badge to enter the storeroom and remove needed items. The inventory storeroom employee counts the quantity removed and enters that information in an online terminal located in the storeroom.
- Occasionally, special items are ordered that are not regularly kept as part of inventory, from a specialty supplier who will not be used for any regular purchases. In these cases, an accounts payable clerk creates a one-time supplier record.
- All supplier invoices (both regular and one-time) are routed to accounts payable for review and approval. The system is configured to perform an automatic three-way match of the supplier invoice with the corresponding purchase order and receiving report.
- Each Friday, approved supplier invoices that are due within the next week are routed to the treasurer's department for payment. The cashier and treasurer are the only employees authorized to disburse funds, either by EFT or by printing a check. Checks are printed on dedicated printer located in the treasurer's department, using special stock paper that is stored in a locked cabinet accessible only to the treasurer and cashier. The paper checks are sent to accounts payable to be mailed to suppliers.
- Monthly, the treasurer reconciles the bank statements and investigates any discrepancies with recorded cash balances.

Required

Identify weaknesses in ABC's expenditure cycle procedures, explain the resulting problems, and suggest how to correct those problems.

13.12. Alden, Inc., has hired you to review its internal controls for the purchase, receipt, storage, and issuance of raw materials. You observed the following:

- Raw materials, which consist mainly of high-cost electronic components, are kept in a locked storeroom. Storeroom personnel include a supervisor and four clerks. All are well trained, competent, and adequately bonded. Raw materials are removed from the storeroom only upon written or oral authorization by a production supervisor.
- No perpetual inventory records are kept; hence, the storeroom clerks do not keep records for goods received or issued. To compensate, the storeroom clerks perform a physical inventory count each month.
- After the physical count, the storeroom supervisor matches the quantities on hand against a predetermined reorder level. If the count is below the reorder level, the supervisor enters the part number on a materials requisition list that is sent to the accounts payable clerk. The accounts payable clerk prepares a purchase order for each item on the list and mails it to the supplier from whom the part was last purchased.
- The storeroom clerks receive the ordered materials upon their arrival. The clerks count all items and verify that the counts agree with the quantities on the bill of lading. The bill of lading is then initialed, dated, and filed in the storeroom to serve as a receiving report.

Required

a. Describe the weaknesses that exist in Alden's expenditure cycle.
b. Suggest control procedures to overcome the weaknesses noted in part a.
c. Discuss how those control procedures would be best implemented in an integrated ERP system using the latest developments in IT.
(CPA Examination, adapted)

Case13-1 Research Project: Impact of Information Technology on Expenditure Cycle Activities, Threats, and Controls

Search popular business and technology magazines (*Business Week, Forbes, Fortune, CIO,* etc.) to find an article about an innovative use of IT that can be used to improve one or more activities in the expenditure cycle. Write a report that:

a. Explains how IT can be used to change expenditure cycle activities.
b. Discusses the control implications. Refer to Table 13-2, and explain how the new procedure changes the threats and appropriate control procedures for mitigating those threats.

AIS IN ACTION SOLUTIONS

Quiz Key

1. Which of the following inventory control methods is most likely to be used for a product such as lumber (1 × 2's, 2 × 4's, etc.) for which sales can be reliably forecast?
   a. JIT (Incorrect. JIT seeks to minimize inventory by making purchases only after sales. It is used to primarily for products for which it is hard to forecast demand. Lumber is an example of a product for which demand can be forecast rather accurately.)
   b. EOQ (Incorrect. EOQ represents the optimal amount of inventory to purchase to minimize the sum of ordering, carrying, and stockout costs.)
   ▶ c. MRP (Correct. MRP forecasts sales and uses that information to purchase inventory to meet anticipated needs. Demand for lumber can be forecast rather accurately, including

seasonal fluctuations (increased demand due to construction during spring, summer, and fall and reduced demand during winter).

d. ABC (Incorrect. ABC is a method for stratifying inventory according to importance and scheduling more frequent inventory counts for the more important items.)

2. Which of the following matches is performed in evaluated receipt settlement (ERS)?
   a. the vendor invoice with the receiving report (Incorrect. ERS eliminates the vendor invoice.)
   ▶ b. the purchase order with the receiving report (Correct. ERS eliminates the vendor invoice and schedules payments based on matching the purchase order and receiving report.)
   c. the vendor invoice with the purchase order (Incorrect. ERS eliminates the vendor invoice.)
   d. the vendor invoice, the receiving report, and the purchase order (Incorrect. ERS eliminates the vendor invoice.)

3. Which of the following is true?
   a. ERS systems involve a three-way match of purchase orders, receiving reports, and supplier invoices. (Incorrect. ERS systems eliminate supplier invoices and rely upon a two-way match of purchase orders and receiving reports.)
   ▶ b. Setting up petty cash as an imprest fund violates segregation of duties. (Correct. Technically, setting up petty cash as an imprest fund violates segregation of duties because the same person has custody of the asset—cash—authorizes its disbursement, and maintains records.)
   c. The EOQ formula is used to identify when to reorder inventory. (Incorrect. The EOQ formula is used to determine how much to order. The reorder point identifies when to reorder inventory.)
   d. A voucher package usually includes a debit memo. (Incorrect. Voucher packages consist of the purchase order, receiving report, and vendor invoice, if one is received; debit memos are used to record adjustments of accounts payable.)

4. Which document is used to establish a contract for the purchase of goods or services from a supplier?
   a. vendor invoice (Incorrect. The vendor invoice is a bill.)
   b. purchase requisition (Incorrect. A purchase requisition is an internal document.)
   ▶ c. purchase order (Correct. A purchase order is an offer to buy goods.)
   d. disbursement voucher (Incorrect. A disbursement voucher is used to specify which accounts to debit when paying vendor invoices.)

5. Which method would provide the greatest efficiency improvements for the purchase of noninventory items such as miscellaneous office supplies?
   a. bar-coding (Incorrect. Bar-coding improves accuracy of counting inventory items. The biggest efficiency-realted problem with non-inventory purchases is the time and effort required to generate a purchase order, create a voucher package, and make payments for a large number of small-dollar amount purchases.)
   b. EDI (Incorrect. EDI is seldom used for miscellaneous purchases.)
   ▶ c. procurement cards (Correct. Procurement cards were designed specifically for purchase of noninventory items.)
   d. EFT (Incorrect. EFT improves the efficiency of payments, but does not improve the efficiency of ordering and approving supplier invoices.)

6. Which of the following expenditure cycle activities can be eliminated through the use of IT or reengineering?
   a. ordering goods (Incorrect. Even with vendor-managed inventory, the vendor's system must initiate the ordering process.)
   ▶ b. approving vendor invoices (Correct. ERS systems eliminate vendor invoices.)
   c. receiving goods (Incorrect. Ordered goods must always be received and moved to the appropriate location.)

d. cash disbursements (Incorrect. IT can change the method used to make cash disbursements, such as by EFT instead of by check, but the function must still be performed.)

7. What is the best control procedure to prevent paying the same invoice twice?
   a. Segregate check-preparation and check-signing functions. (Incorrect. This is a good control procedure, but its purpose is to ensure that payments are valid.)
   b. Prepare checks only for invoices that have been matched to receiving reports and purchase orders. (Incorrect. This is a good control procedure, but its purpose is to ensure that organizations pay only for goods ordered and received.)
   c. Require two signatures on all checks above a certain limit. (Incorrect. This is a good control procedure, but its purpose is to better control large outflows of cash.)
   ▶ d. Cancel all supporting documents when the check is signed. (Correct. This ensures that the supporting documents cannot be resubmitted to pay the same invoice again.)

8. For good internal control, who should sign checks?
   ▶ a. cashier (Correct. The cashier is responsible for managing cash and reports to the treasurer.)
   b. accounts payable (Incorrect. Accounts payable maintains vendor records.)
   c. purchasing agent (Incorrect. The purchasing agent authorizes acquisition of goods.)
   d. controller (Incorrect. The controller is in charge of accounting, the record-keeping function.)

9. Which of the following procedures is designed to prevent the purchasing agent from receiving kickbacks?
   a. maintaining a list of approved suppliers and requiring all purchases to be made from suppliers on that list (Incorrect. The purpose of this control is to minimize the risk of purchasing inferior goods at inflated prices or violating regulations.)
   ▶ b. requiring purchasing agents to disclose any financial investments in potential suppliers (Correct. The purpose of such disclosure is to minimize the risk of conflicts of interest that could result in kickbacks.)
   c. requiring approval of all purchase orders (Incorrect. This control is designed to ensure that only goods that are really needed are ordered and that they are ordered from approved vendors.)
   d. prenumbering and periodically accounting for all purchase orders (Incorrect. This control procedure is designed to ensure that all valid purchase orders are recorded.)

10. Which document is used to record adjustments to accounts payable based on the return of unacceptable inventory to the supplier?
   a. receiving report (Incorrect. This document records quantities of goods received.)
   b. credit memo (Incorrect. This document is used in the revenue cycle to adjust a customer's account.)
   ▶ c. debit memo (Correct. This document is used to adjust accounts payable.)
   d. purchase order (Incorrect. This document establishes a legal obligation to purchase goods.)

Chapter 14

The Production Cycle

Learning Objectives

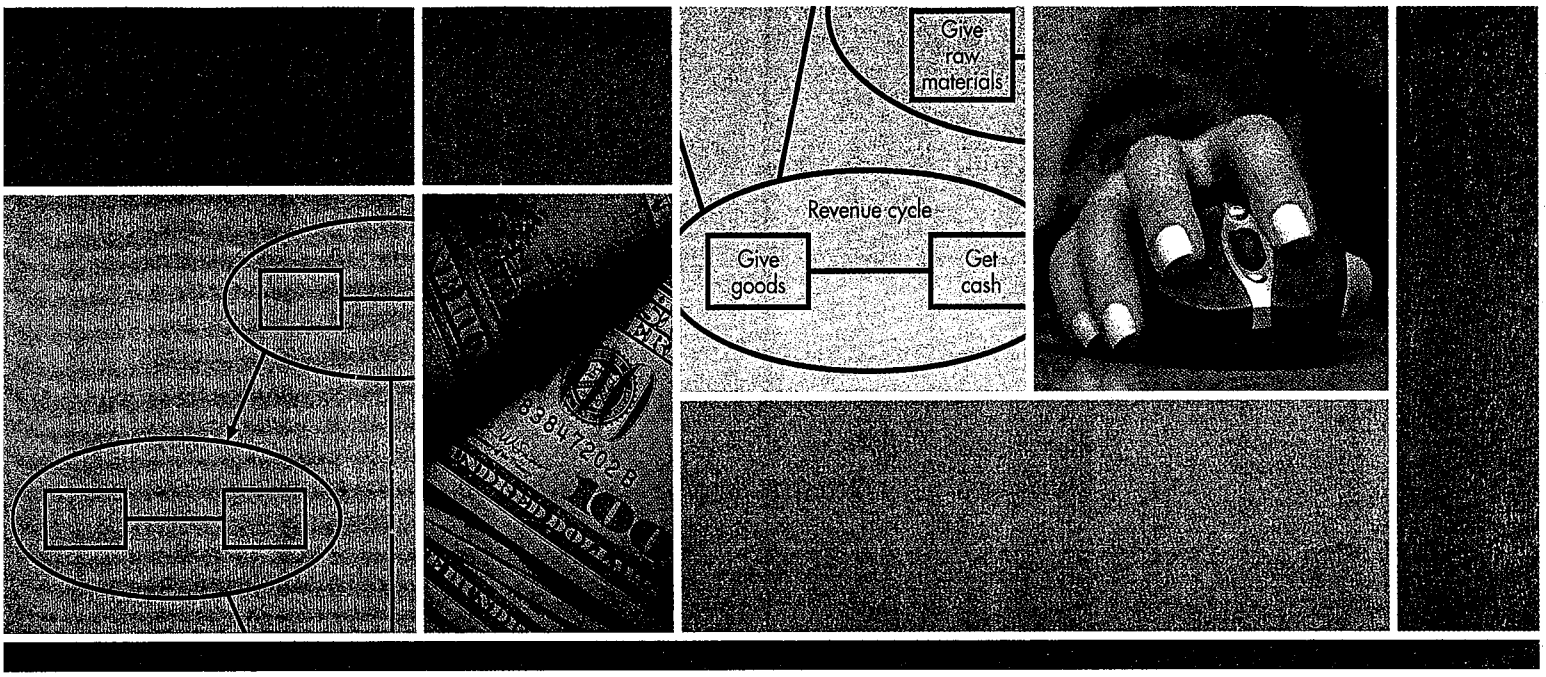
After studying this chapter, you should be able to:

1. Describe the major business activities and related information processing operations performed in the production cycle.
2. Identify major threats in the production cycle and evaluate the adequacy of various control procedures for dealing with those threats.
3. Explain how a company's cost accounting system can help it achieve its manufacturing goals.
4. Discuss the key decisions that must be made in the production cycle and identify the information required to make those decisions.

INTEGRATIVE CASE ALPHA OMEGA ELECTRONICS

LeRoy Williams, vice president for manufacturing at Alpha Omega Electronics (AOE), is concerned about problems associated with the company's change in strategic mission. Two years ago, AOE's top management decided to shift the company from its traditional position as a low-cost producer of consumer electronic products to a product differentiation strategy. Since then, AOE has increased the variety of sizes, styles, and features within each of its product lines.

To support this shift in strategic focus, AOE has invested heavily in factory automation. Top management also endorsed LeRoy's decision to adopt lean manufacturing techniques, with the goal of dramatically reducing inventory levels of finished goods. AOE's cost accounting system has not been changed, however. For example, manufacturing overhead is still allocated based on direct labor hours, even though automation has drastically reduced the amount of direct labor used to manufacture a product. Consequently, investments in new equipment and machinery have resulted in



dramatic increases in manufacturing overhead rates. This situation has created the following problems:

1. Production supervisors complain that the accounting system makes no sense and that they are being penalized for making investments that improve overall efficiency. Indeed, according to the system, some products now cost more to produce using state-of-the-art equipment than they did before the new equipment was purchased. Yet the new equipment has increased production capacity while simultaneously reducing defects.
2. The marketing and product design executives have all but dismissed the system's product cost figures as useless for setting prices or determining the potential profitability of new products. Indeed, some competitors have begun to price their products below what AOE's cost accounting system says it costs to produce that item.
3. Although a number of steps have been taken to improve quality, the cost accounting system does not provide adequate measures to evaluate the effect of those steps and to indicate areas that need further improvement. Indeed, LeRoy is frustrated by his inability to quantify the effects of the quality improvements that have occurred.
4. Performance reports continue to focus primarily on financial measures. Line managers in the factory, however, complain that they need more accurate and timely information on physical activities, such as units produced, defect rates, and production time.
5. LeRoy is frustrated because the move to lean manufacturing was successful in markedly reducing inventory levels this past year, but the traditional GAAP-based financial reports show that this has significantly lowered profitability.

LeRoy has expressed these concerns to Linda Spurgeon, AOE's president, who agrees that the problems are serious. Linda then called a meeting with LeRoy; Ann Brandt, AOE's vice president of information systems; and Elizabeth Venko, AOE's controller. At the meeting, Elizabeth and Ann agreed to study how to modify the cost

accounting system to more accurately reflect AOE's new production processes. To begin this project, LeRoy agreed to take Elizabeth and Ann on a factory tour so that they could see and understand how the new technology has affected production cycle activities.

As this case suggests, deficiencies in the information system used to support production cycle activities can create significant problems for an organization. As you read this chapter, think about how the introduction of new technology in the production cycle may require corresponding changes in a company's cost accounting system.

Introduction

The **production cycle** is a recurring set of business activities and related information processing operations associated with the manufacture of products. Figure 14-1 shows how the production cycle is linked to the other subsystems in a company's information system. The revenue cycle information system (see Chapter 12) provides the information (customer orders and sales forecasts) used to plan production and inventory levels. In return, the production cycle information system sends the revenue cycle information about finished goods that have been produced and are available for sale. Information about raw materials needs is sent to the expenditure cycle information system (see Chapter 13) in the form of purchase requisitions. In exchange, the expenditure cycle system provides information about raw material acquisitions and also about other expenditures included in manufacturing overhead. Information about labor needs is sent to the human resources cycle (see Chapter 15), which in return provides data about labor costs and availability. Finally, information about the cost of goods manufactured is sent to the general ledger and reporting information system (see Chapter 16).

Figure 14-2 depicts the four basic activities in the production cycle: product design, planning and scheduling, production operations, and cost accounting. Although accountants are involved primarily in the fourth step, cost accounting, they also must understand the other three processes to be able to design reports that provide management with the information needed to manage the production cycle activities of a modern manufacturing company. For example, one popular approach to improving manufacturing performance, called Six Sigma, begins with careful measurement and analysis of current processes in order to find ways to improve them. Accountants should participate in such efforts by helping to design accurate measures; their ability to do so, however, requires that they understand the production activities being measured.

This chapter explains how an organization's information system supports each of the production cycle activities. We begin by describing the design of the information system and the basic controls necessary to ensure that it provides management with reliable information to assess the efficiency and effectiveness of production cycle activities. We then discuss in detail

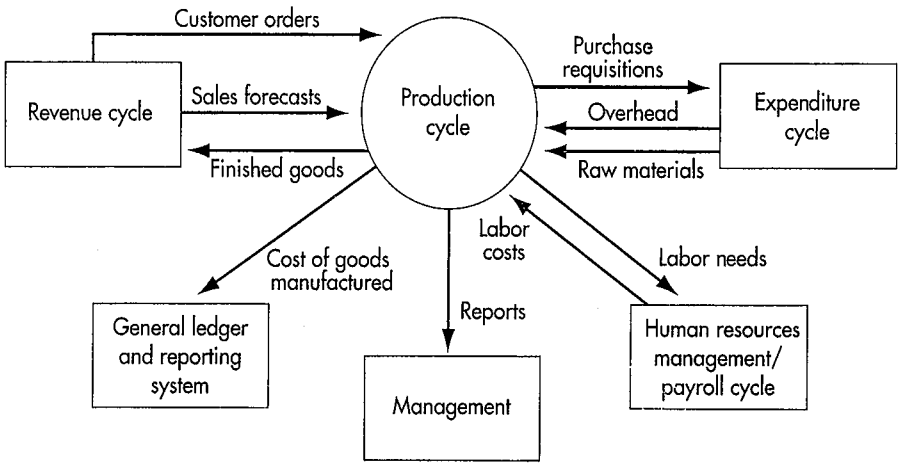


FIGURE 14-1
Context Diagram of the Production Cycle

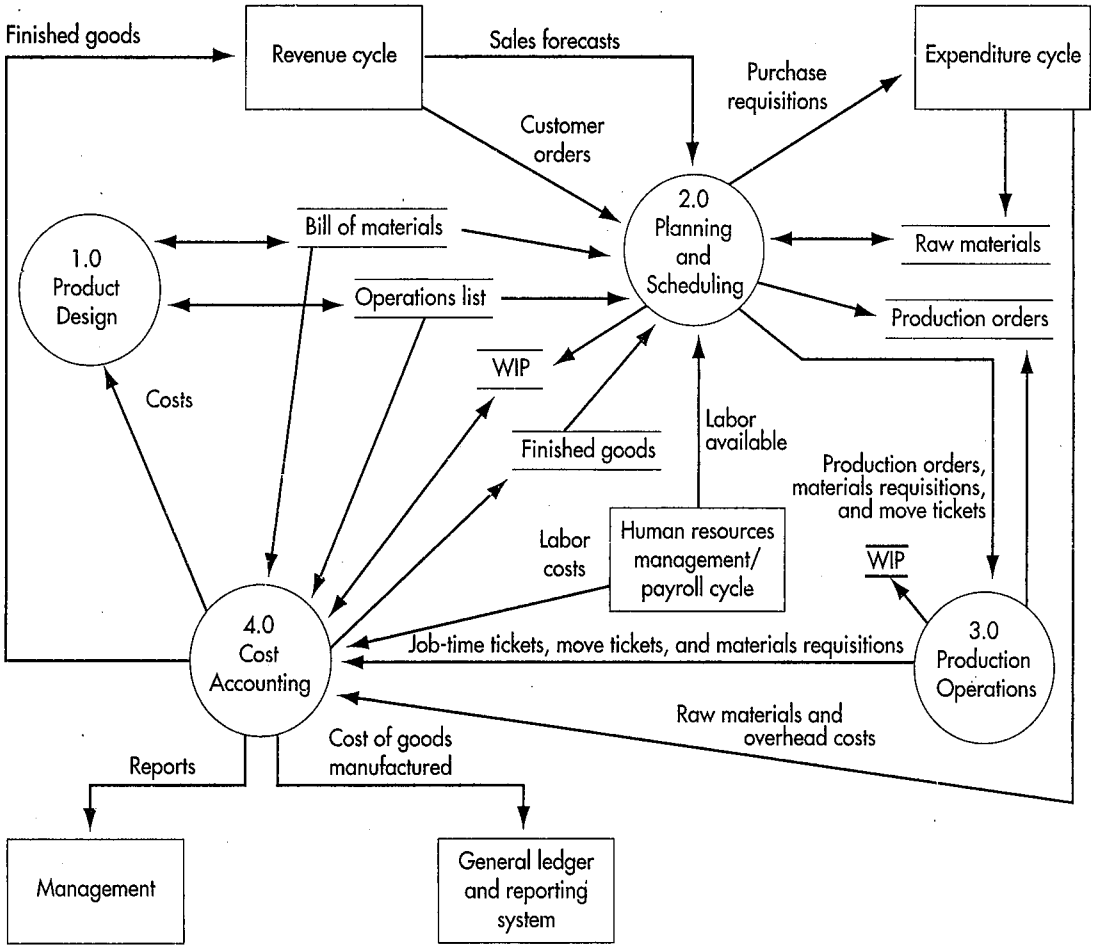


FIGURE 14-2
Level 0 Data Flow Diagram of the Production Cycle

each of the four basic production cycle activities. For each activity, we describe how the information needed to perform and manage those activities is collected, processed, and stored. We also explain the controls necessary to ensure not only the reliability of that information but also the safeguarding of the organization's resources.

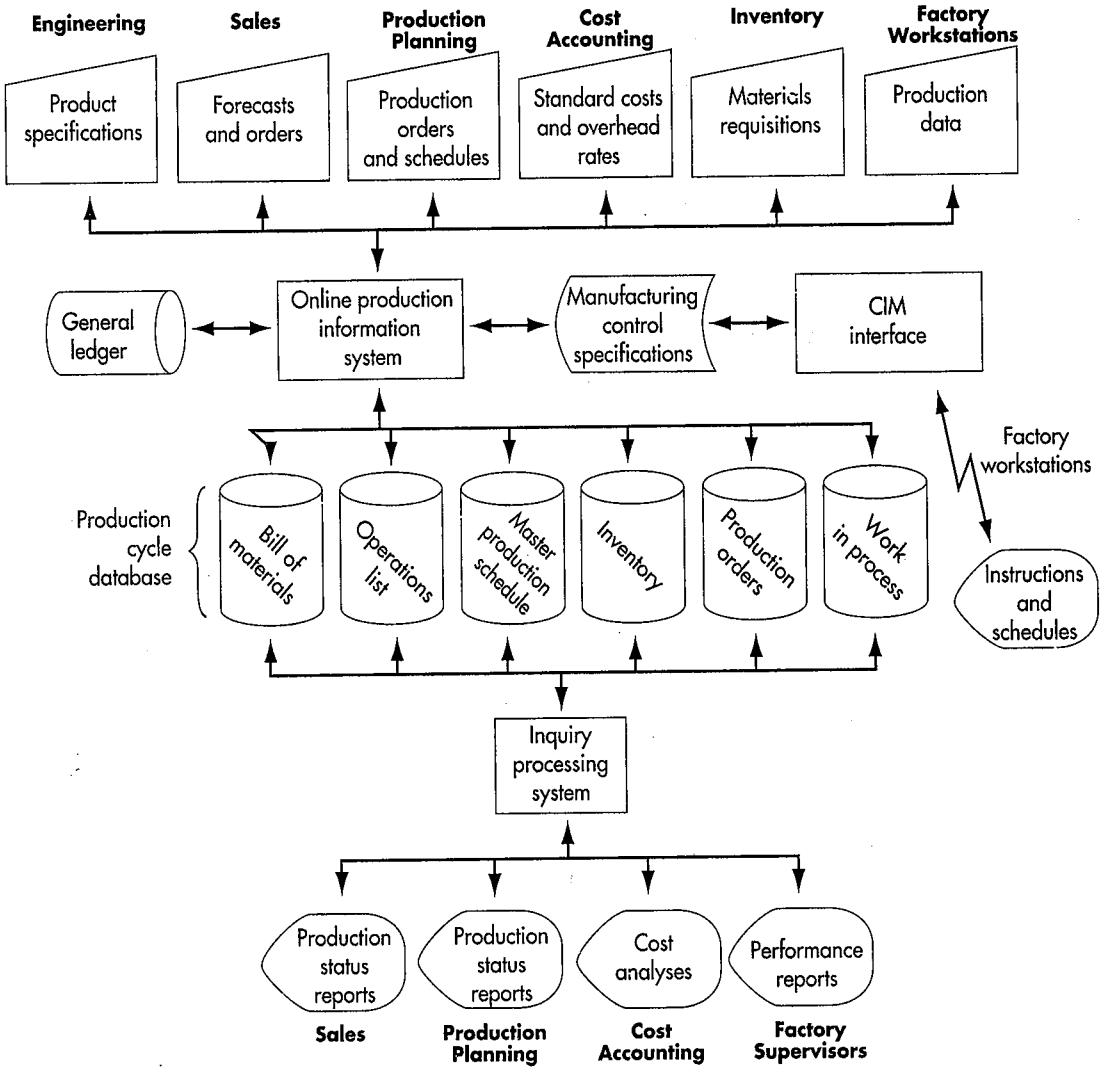
Production Cycle Information System

Figure 14-3 presents the portion of the enterprise resource planning (ERP) that supports an organization's production cycle.

Process

Notice how the production cycle information system integrates both operational and financial data from many sources. The engineering department is responsible for developing product specifications. The bill of materials file stores information about product components, and the operations list file contains information about how to manufacture each product. To develop those specifications, engineering accesses both files to examine the design of similar products. It also accesses the general ledger and inventory files for information about the costs of alternative product designs. The sales department enters information about sales forecasts and customer orders. The production planning department uses that information, plus data about current inventory levels, to develop the master production schedule and create new records in the production order file to authorize the production of specific goods. At the same time, new records are added to the work-in-process file to accumulate cost data. Materials requisitions are sent to the inventory stores department to authorize the release of raw materials. The computer-integrated manufacturing (CIM) interface sends detailed instructions to factory workstations. The CIM interface also collects cost and operational data that is used to update the work-in-process and production order files, respectively.

FIGURE 14-3
Overview of ERP System Design to Support the Production Cycle



Threats and Controls

As Figure 14-3 shows, the production cycle activities depend on and update the integrated database that contains master data about product specifications and inventory (both finished goods and raw materials). Therefore, the first threat listed in Table 14-1 is the risk of inaccurate or invalid master data. Inaccurate data about factory operations can result in incorrect costing of products and valuation of inventory. Inaccurate inventory records can result in either failure to timely manufacture finished goods or unnecessary production. Errors in product specifications (bills of materials and operations lists) can result in poorly designed products. The various processing integrity controls discussed in Chapter 10 can reduce the risk of inaccurate data entry. It is also important to restrict access to production cycle master data. Enforcing proper access controls and segregation of duties requires that the controller or CFO review and suggest appropriate configuration of user rights in integrated ERP systems. The default installation of such systems typically provides every employee with far too much power. Therefore, it is important to modify user permissions to ensure that employees are assigned only those privileges necessary to perform their specified job duties. In addition to multifactor authentication of employees, location-based access controls on devices should also be used. For example, the system should be programmed to reject any attempts to alter inventory records from a terminal located in the engineering department. Finally, logs of all activities, especially any actions involving managerial approval, such as requests for additional raw materials or overtime, should be recorded and maintained for later review as part of the audit trail.

Another threat is the unauthorized disclosure of production information, such as trade secrets and process improvements that provide a company with a competitive advantage. The various access controls discussed earlier provide one way to mitigate this threat. In addition, sensitive data, such as the precise procedures to follow in manufacturing a given product, should be

TABLE 14-1 Threats and Controls in the Production Cycle

Activity	Threat	Controls (first number refers to the corresponding threat)
General issues throughout entire production cycle	1. Inaccurate or invalid master data 2. Unauthorized disclosure of sensitive information 3. Loss or destruction of data	1.1 Data processing integrity controls 1.2 Restriction of access to master data 1.3 Review of all changes to master data 2.1 Access controls 2.2 Encryption 3.1 Backup and disaster recovery procedures
Product design	4. Poor product design resulting in excess costs	4.1 Accounting analysis of costs arising from product design choices 4.2 Analysis of warranty and repair costs
Planning and scheduling	5. Over- and underproduction	5.1 Production planning systems 5.2 Review and approval of production schedules and orders 5.3 Restriction of access to production orders and production schedules
Production operations	6. Theft of inventory 7. Theft of fixed asset 8. Poor performance 9. Suboptimal investment in fixed assets 10. Loss of inventory or fixed assets due to fire or other disasters 11. Disruption of operations	6.1 Physical access control 6.2 Documention of all inventory movement 6.3 Segregation of duties—custody of assets from recording and authorization of removal 6.4 Restriction of access to inventory master data 6.5 Periodic physical counts of inventory and reconciliation of those counts to recorded quantities 7.1 Physical inventory of all fixed assets 7.2 Restriction of physical access to fixed assets 7.3 Maintaining detailed records of fixed assets, including disposal 8.1 Training 8.2 Performance reports 9.1 Proper approval of fixed asset acquisitions, including use of requests for proposals to solicit multiple competitive bids 10.1 Physical safeguards (e.g., fire sprinklers) 10.2 Insurance 11.1 Backup and disaster recovery plans
Cost accounting	12. Inaccurate cost data 13. Inappropriate allocation of overhead costs 14. Misleading reports	12.1 Source data automation 12.2 Data processing integrity controls 13.1 Time-driven activity-based costing 14.1 Innovative performance metrics (e.g., throughput)

encrypted both while in storage and during transmission over the Internet to manufacturing plants and business partners.

The third general threat listed in Table 14-1 is the loss or alteration of production data. The production cycle database must be protected from either intentional or accidental loss or damage. As discussed in Chapter 10, regular backing up of all data files is imperative. Additional copies of key master files, such as open production orders and raw materials inventory, should be stored off-site. To reduce the possibility of accidental erasure of important files, all disks and tapes should have both external and internal file labels.

Now that we have provided an overview of the production cycle information system, let us examine each of the basic activities depicted in Figure 14-2 in more detail.

Product Design

The first step in the production cycle is product design (circle 1.0 in Figure 14-2). The objective is to create a product that meets customer requirements in terms of quality, durability, and functionality while simultaneously minimizing production costs. These criteria often conflict with one another, making product design a challenging task.

Process

The product design activity creates two outputs. The first, a **bill of materials** (Figure 14-4), specifies the part number, description, and quantity of each component used in a finished product. The second is an ***operations list*** (Figure 14-5), which specifies the sequence of steps to follow in making the product, which equipment to use, and how long each step should take.

Tools such as product life-cycle management (PLM) software can help improve the efficiency and effectiveness of the product design process. PLM software consists of three key components: computer-aided design (CAD) software to design new products, digital manufacturing software that simulates how those products will be manufactured, and product data management software that stores all the data associated with products. CAD software enables manufacturers to design and test virtual 3-D models of products, thereby eliminating the costs associated with creating and destroying physical prototypes. CAD software facilitates collaboration by design teams dispersed around the globe and eliminates the costs associated with exchanging static copies of product designs. Digital manufacturing software allows companies to determine labor, machine, and process requirements to optimally produce items in different facilities across the globe in order to minimize costs. Product data management software provides easy access to detailed engineering specifications and other product data to facilitate product redesign, modification, and post-sale maintenance. Although PLM can dramatically improve both the efficiency and effectiveness of product design, Focus 14-1 shows that reaping its full benefits requires careful supervision by senior management.

Threats and Controls

Poor product design (threat 4 in Table 14-1) drives up costs in several ways. Using too many unique components when producing similar products increases the costs associated with purchasing and maintaining raw materials inventories. It also often results in inefficient production processes because of excessive complexity in changing from the production of one product to another. Poorly designed products are also more likely to incur high warranty and repair costs.

To mitigate this threat, accountants should participate in the product design activity because 65% to 80% of product costs are determined at this stage of the production process. Accountants can analyze how the use of alternative components and changes to the production process affect costs. In addition, accountants can use information from the revenue cycle about repair and warranty costs associated with existing products to identify the primary causes of product failure and suggest opportunities to redesign products to improve quality.

FIGURE 14-4
Example of a Bill of Materials

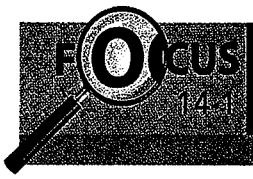
Finished Product: DVD Player

Part Number	Description	Quantity
105	Control Unit	1
125	Back Panel	1
148	Side Panel	2
155	Top/Bottom Panel	2
173	Timer	1
195	Front Panel	1
199	Screw	6

FIGURE 14-5
Example of an Operations List

Operations List for: Create Side Panel

Operation Number	Description	Machine Number	Standard Time (minutes:seconds)
105	Cut to shape	ML15-12	2:00
106	Corner cut	ML15-9	3:15
124	Turn and shape	S28-17	4:00
142	Finish	F54-5	7:10
155	Paint	P89-1	9:30



FOCUS 14-1 Using PLM Software to Improve Product Design: The Need for Management Involvement

The potential benefits of PLM software are enormous. For example, General Motors estimates that it costs approximately $500,000 to run crash tests with real cars and hopes that CAD software can reduce the number of such tests by 85%. As Airbus learned, however, PLM software also has pitfalls. In 2006 it announced that production of the A380 superjumbo airliner would be delayed by up to two years, costing Airbus approximately $6 billion in lost profits. The problem? Use of different versions of the same CAD software by design teams in Germany and France resulted in incompatibilities between the front and rear fuselages. Each A380 contains over 300 miles of wires and more than 40,000 connectors to power everything in both the customer cabin and the cockpit. When workers tried to assemble the front and rear fuselages, they discovered that the wiring could not be properly connected.

How could using two editions of the same software create such problems? The answer is that each version treated drawings in different ways, resulting in different models. Engineers using the older version at the German plant had to manually tinker with the drawings to indicate where conduits should be placed, whereas the newer version of the software used at the French plant did this automatically. In addition, many technical notes containing key information about product specifications and units of measurement were lost when drawings were converted between the two versions of the software.

The experience of Airbus is not unique. A survey found that almost 50% of companies using CAD software had to redesign products because of incompatibilities between CAD software used by different design teams. Airbus executives did not force engineers at different plants to use the same versions of CAD software. This decision initially saved money by avoiding the need to purchase new software and the associated time and costs of retraining engineers. But those short-term savings were more than offset by the subsequent loss of profits due to production delays. This underscores the importance of management involvement and support whenever companies implement complex software such as PLM.

Planning and Scheduling

The second step in the production cycle is planning and scheduling (circle 2.0 in Figure 14-2). The objective is to develop a production plan efficient enough to meet existing orders and anticipated short-term demand while minimizing inventories of both raw materials and finished goods.

Production Planning Methods

Two common methods of production planning are manufacturing resource planning and lean manufacturing. **Manufacturing resource planning (MRP-II)** is an extension of materials resource planning (discussed in Chapter 13) that seeks to balance existing production capacity and raw materials needs to meet forecasted sales demands. MRP-II systems are often referred to as *push manufacturing*, because goods are produced in expectation of customer demand.

Just as MRP-II is an extension of MRP inventory control systems, ***lean manufacturing*** extends the principles of just-in-time inventory systems (discussed in Chapter 13) to the entire production process. The goal of lean manufacturing is to minimize or eliminate inventories of raw materials, work in process, and finished goods. Lean manufacturing is often referred to as *pull manufacturing*, because goods are produced in response to customer demand. Theoretically, lean manufacturing systems produce only in response to customer orders. In practice, however, most lean manufacturing systems develop short-run production plans. For example, Toyota develops monthly production plans so that it can provide a stable schedule to its suppliers. This strategy enables the suppliers to plan their production schedules so that they can deliver their products to Toyota at the exact time they are needed.

Thus, both MRP-II and lean manufacturing systems plan production in advance. They differ, however, in the length of the planning horizon. MRP-II systems may develop production plans for up to 12 months in advance, whereas lean manufacturing systems use much shorter planning horizons. If demand for a company's product is predictable and the product has a long life cycle, then an MRP-II approach may be justified. In contrast, a lean manufacturing approach may be

more appropriate if a company's products are characterized by short life cycles, unpredictable demand, and frequent markdowns of excess inventory.

Key Documents and Forms

Information about customer orders, sales forecasts, and inventory levels of finished goods is used to determine production levels. The result is a ***master production schedule (MPS)***, which specifies how much of each product is to be produced during the planning period and when that production should occur (Figure 14-6). Although the long-range part of the MPS may be modified in response to changes in market conditions, production plans for many products must be frozen a few weeks in advance to provide sufficient time to procure the necessary raw materials, supplies, and labor resources.

The complexity of scheduling increases dramatically as the number of factories grows. For example, large manufacturing companies such as Intel and General Motors must coordinate production at many different plants in different countries. Some of those plants produce basic components, and others assemble the final products. The production information system must coordinate these activities to minimize bottlenecks and the buildup of partially completed inventories.

The MPS is used to develop a detailed timetable that specifies daily production and to determine whether raw materials need to be purchased. To do this, it is necessary to "explode" the bill of materials to determine the immediate raw materials requirements for meeting the production goals listed in the MPS (Table 14-2). These requirements are compared with current inventory levels, and if additional materials are needed, purchase requisitions are generated and sent to the purchasing department to initiate the acquisition process.

Figure 14-2 shows that the planning and scheduling activity produces three other documents: production orders, materials requisitions, and move tickets. A **production order** authorizes the manufacture of a specified quantity of a particular product. It lists the operations that need to be performed, the quantity to be produced, and the location where the finished product should be delivered. It also collects data about each of those activities (Figure 14-7). A ***materials requisition*** authorizes the removal of the necessary quantity of raw materials from the storeroom to the factory location where they will be used. This document contains the production order number, date of issue, and, based on the bill of materials, the part numbers and quantities of all necessary raw materials (Figure 14-8). Subsequent transfers of raw materials throughout the factory are documented on ***move tickets***, which identify the parts being transferred, the location to which they are transferred, and the time of transfer (Figure 14-9 shows an example of an inventory transfer data entry screen).

FIGURE 14-6
Sample of a Master Production Schedule (MPS)

MASTER PRODUCTION SCHEDULE

Product Number	120			**Description:**	DVD Player			
Lead time:[a]	**Week Number**							
1 week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Quantity on hand	500	350[b]	350	300	350	300	450	300
Scheduled production	150[c]	300	250	300	250	400	250	300
Forecasted sales	300	300	300	250	300	250	400	250
Net available	350[d]	350	300	350	300	450	300	350

[a] *Time to manufacture product (1 week for DVD player).*
[b] *Ending quantity on hand (net available) from prior week.*
[c] *Calculated by subtracting quantity on hand from sum of this week's and next week's forecasted sales, plus a 50-unit buffer stock. For example, begin week 1 with 500 units. Projected sales for weeks 1 and 2 total 600 units. Adding 50-unit desired buffer inventory yields 650 units needed by end of week 1. Subtracting beginning inventory of 500 units results in planned production of 150 units during week 1.*
[d] *Beginning quantity on hand plus scheduled production less forecasted sales.*

TABLE 14-2 Example of "Exploding" a Bill of Materials

Step 1: Multiply the component requirements for ONE product by the number of products to be produced next period (from the MPS).

COMPONENTS IN EACH DVD PLAYER

Part No.	Description	Quantity	Number of DVD Players	Total Requirements
105	Control Unit	1	2,000	2,000
125	Back Panel	1	2,000	2,000
148	Side Panel	4	2,000	8,000
173	Timer	1	2,000	2,000
195	Front Panel	1	2,000	2,000
199	Screw	6	2,000	12,000
135	Top Panel	1	2,000	2,000
136	Bottom Panel	1	2,000	2,000

COMPONENTS IN EACH CD PLAYER

Part No.	Description	Quantity	Number of CD Players	Total Requirements
103	Control Unit	1	3,000	3,000
120	Front Panel	1	3,000	3,000
121	Back Panel	1	3,000	3,000
173	Timer	1	3,000	3,000
190	Side Panel	4	3,000	12,000
199	Screw	4	3,000	12,000
135	Top Panel	1	3,000	3,000
136	Bottom Panel	1	3,000	3,000

Step 2: Calculate total component requirements by summing products.

Part No.	DVD Player	CD Player	Total
103	0	3,000	3,000
105	2,000	0	2,000
120	0	3,000	3,000
121	0	3,000	3,000
125	2,000	0	2,000
148	8,000	0	8,000
173	2,000	3,000	5,000
190	0	12,000	12,000
195	2,000	0	2,000
199	12,000	12,000	24,000
135	2,000	3,000	5,000
136	2,000	3,000	5,000

Step 3: Repeat steps 1 and 2 for each week during planning horizon.

Part No.	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
103	3,000	2,000	2,500	3,000	2,500	3,000
105	2,000	2,000	2,500	2,500	2,000	3,000
120	3,000	2,000	2,500	3,000	2,500	3,000
121	3,000	2,000	2,500	3,000	2,500	3,000
125	2,000	2,000	2,500	2,500	2,000	3,000
148	8,000	8,000	10,000	10,000	8,000	12,000
173	5,000	4,000	5,000	5,500	4,500	6,000
190	12,000	12,000	10,000	12,000	10,000	12,000
195	2,000	2,000	2,500	2,500	2,000	3,000
199	24,000	20,000	25,000	27,000	22,000	30,000
135	5,000	5,000	5,000	5,000	5,000	5,000
136	5,000	5,000	5,000	5,000	5,000	5,000

FIGURE 14-7
Sample Production Order for Alpha Omega Electronics

4587

Alpha Omega Engineering

PRODUCTION ORDER

Order No. 2289	**Product No.** 4430	**Description:** Cabinet Side Panel		**Production Quantity** 1000
Approved by: PJS	**Release Date:** 02/24/2011	**Issue Date:** 02/25/2011	**Completion Date:** 03/09/2011	**Deliver to:** Assembly Department

Work Station No.	**Product Operation No.**	**Quantity**	**Operation Description**	**Start Date & Time**		**Finish Date & Time**	
MH25	100	1,003	Transfer from stock	02/28	0700	02/28	0800
ML15-12	105	1,003	Cut to shape	02/28	0800	02/28	1000
ML15-9	106	1,002	Corner cut	02/28	1030	02/28	1200
S28-17	124	1,002	Turn & shape	02/28	1300	02/28	1700
F54-5	142	1,001	Finish	03/01	0800	03/01	1100
P89-1	155	1,001	Paint	03/01	1300	03/02	1300
QC94	194	1,001	Inspect	03/02	1400	03/02	1600
MH25	101	1,000	Transfer to assembly	03/02	1600	03/02	1700

Explanation of numbers in Quantity column:

1. *Total of 1,003 sheets of raw material used to produce 1,000 good panels and 3 rejected panels.*
2. *One panel not cut to proper shape, thus only 1,002 units had operations 106 and 124 performed on them.*
3. *One panel not properly turned and shaped; hence only 1,001 panels finished, painted, and received final inspection.*
4. *One panel rejected during final inspection; thus only 1,000 good panels transferred to assembly department.*

Notice that many of the documents used in the production cycle track the movement and usage of raw materials. The use of bar-coding and RFID tags provides opportunities to improve the efficiency and accuracy of these materials handling activities by eliminating the need for manual entry of data. RFID also facilitates locating specific inventory because the scanning devices are not limited to reading only those items that are directly in line-of-sight. This can be especially useful in large warehouse and storage facilities, where items may get moved around to make room for new shipments.

Finally, accurate production plannning requires integrating information about customer orders (from the revenue cycle) with information about purchases from suppliers (from the expenditure cycle), along with information about labor availability (from the HR/payroll cycle). Figure 14-10 illustrates how an ERP system provides this integration. The system first checks inventory on hand to determine how much needs to be produced to fill the new order. It then

FIGURE 14-8
Sample Materials Requisition for Alpha Omega Electronics

No. 2345

MATERIALS REQUISITION

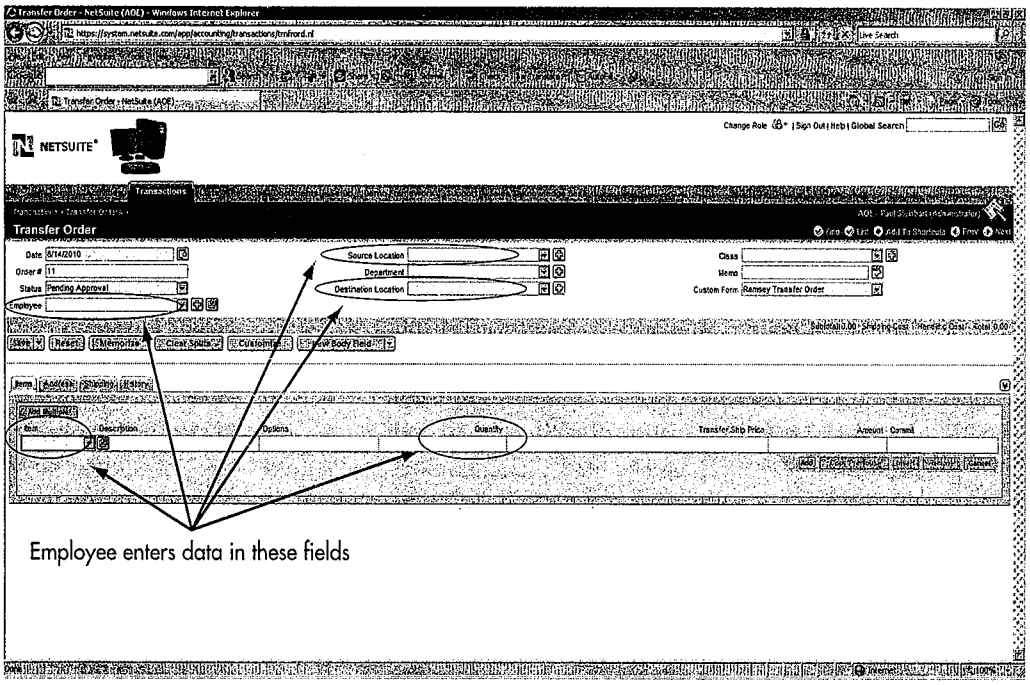
Issued To: Assembly	**Issue Date:** 08/15/2011	**Production Order Number:** 62913

Part Number	**Description**	**Quantity**	**Unit Cost $**	**Total Cost $**
115	Calculator Unit	2,000	2.95	5,900.00
135	Lower Casing	2,000	.45	900.00
198	Screw	16,000	.02	320.00
178	Battery	2,000	.75	1,500.00
136	Upper Casing	2,000	.80	1,600.00
199	Screw	12,000	.02	240.00
				10,460.00

Issued by: AKL

Received by: GWS Costed by: ZBD

Note: Cost information is entered when the materials requisition is turned in to the cost accounting department. Other information, except for signatures, is printed by the system when the document is prepared.



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FIGURE 14-9
Example of Inventory Transfer Screen

calculates labor needs and determines whether there is a need to schedule overtime or hire temporary help in order to meet the promised fill date. At the same time, information in the bill of materials is used to determine what components, if any, need to be ordered. Any necessary purchase orders are sent to suppliers via electronic data interchange (EDI). The master production schedule is then adjusted to include the new order. Notice how this sharing of information across the revenue, production, and expenditure cycles in the manner just described enables companies to efficiently manage inventories by timing their purchases to meet actual customer demand.

Threats and Controls

Table 14-1 shows that the primary threat in the planning and scheduling activity is over- or underproduction. Overproduction can result in a supply of goods in excess of short-run demands, thereby creating potential cash flow problems because resources are tied up in

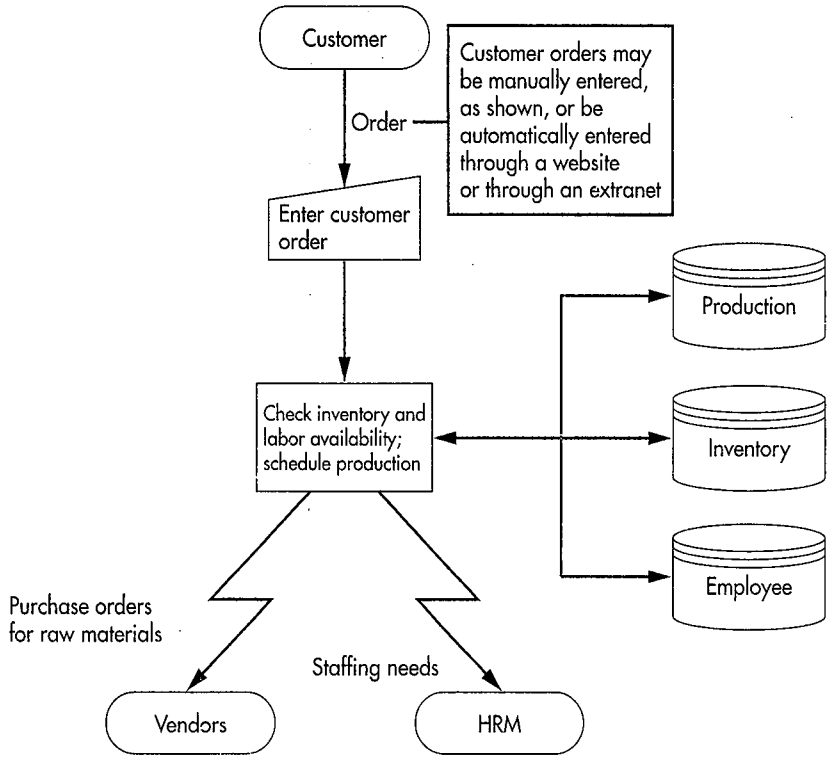


FIGURE 14-10
Illustration of How ERP Systems Integrate Production Cycle Information with Data from Other Cycles

inventory. Overproduction also increases the risk of carrying inventory that becomes obsolete. Conversely, underproduction can result in lost sales and customer dissatisfaction because of lack of availability of desired items. These threats are especially important for companies that produce new, innovative products, such as current fashion clothing, because the demand for such products is much more volatile than the demand for staples and commodities, such as food or office supplies.

Production planning systems can reduce the risk of over- and underproduction. Improvement requires accurate and current sales forecasts and data about inventory stocks, information that the revenue and expenditure cycle systems can provide. In addition to improved forecasts, information about production performance, particularly concerning trends in total time to manufacture each product, should be regularly collected. These data sources should be used periodically to review and adjust the master production schedule.

Proper approval and authorization of production orders is another control to prevent over- or underproduction of specific items. The risk of unauthorized production orders can be reduced by restricting access to the production scheduling program. Careful review and approval also ensures that the correct production orders are released.

Production Operations

The third step in the production cycle is the actual manufacture of products (circle 3.0 in Figure 14-2). The manner in which this activity is accomplished varies greatly across companies, differing according to the type of product being manufactured and the degree of automation used in the production process.

Using various forms of information technology (IT) in the production process, such as robots and computer-controlled machinery, is referred to as **computer-integrated manufacturing (CIM)**. CIM can significantly reduce production costs. For example, Northrop Grumman Corporation once used 16,000 sheets of paper to record shop-floor work instructions related to the manufacture of plane fuselages. Installation of online terminals at each assembly station eliminated that paper flow and improved efficiency, reducing costs by 30%.

Accountants need not be experts on every facet of CIM, but they must understand how it affects both operations and cost accounting. One operational effect of CIM is a shift from mass production to custom-order manufacturing. For example, every Northrop Grumman product is assembled to order. Each product, however, can use any of about 256,000 separate components. Thus, CIM requires redesign of inventory management systems and work flows to facilitate quick changes in production. As we will discuss in the final section of this chapter, such flexibility in manufacturing operations also has implications for the design of cost accounting systems.

Threats and Controls

Theft of inventories (threat 6) and fixed assets (threat 7) are major concerns (see Table 14-1). In addition to the loss of assets, thefts also result in overstated asset balances, which can lead to erroneous analyses of financial performance and underproduction.

To reduce the risk of inventory loss, physical access to inventories should be restricted, and all internal movements of inventory should be documented. Thus, materials requisitions should be used to authorize the release of raw materials to production. Both the inventory control clerk and the production employee receiving the raw materials should sign the requisition to acknowledge release of the goods to production. Requests for additional materials in excess of the amounts specified in the bill of materials should be documented and authorized by supervisory personnel. Move tickets should be used to document subsequent movement of inventory through various stages of the production process. The return of any materials not used in production also should be documented. Wherever feasible, RFID tags or bar codes should be used to automate the tracking of inventories.

Proper segregation of duties is important to safeguard inventory. Maintaining physical custody of the raw materials and finished goods inventories is the responsibility of the inventory stores department. Department or factory supervisors have primary responsibility for work-in-process

inventories. The authorization function, represented by the preparation of production orders, materials requisitions, and move tickets, is the responsibility of the production planners or, increasingly, of the production information system itself. RFID equipment, bar-code scanners, and online terminals can be used to record movement of inventory, thereby maintaining accurate perpetual inventory records. Consequently, proper access controls and compatibility tests are important to ensure that only authorized personnel have access to those records (control 6.4). Finally, an employee without any custodial responsibility should periodically count inventory on hand. Any discrepancies between these physical counts and recorded amounts should be investigated.

Similar controls are needed to safeguard fixed assets. First, all fixed assets must be identified and recorded (control 7.1) so that managers can be assigned responsibility and accountability for fixed assets under their control. RFID tags provide a cost-effective way to monitor the location of fixed assets. As with inventory, security measures should be in place to control physical access to fixed assets. Because manufacturing machinery and equipment are often replaced before they are completely worn out, it is important to formally approve and accurately record their sale or disposal. A report of all fixed-asset transactions should be printed periodically and sent to the controller, who should verify that each transaction was properly authorized and executed. The cost accounting system also needs to maintain accurate records of acquisition cost, any improvements, and depreciation in order to properly calculate the gain or loss arising from such transactions.

Poor performance is another threat to production operations. Training is one way to mitigate this threat. Indeed, surveys of manufacturing companies report a direct relationship between time spent on training and overall productivity. It is also important to regularly prepare and review reports on performance in order to identify when additional training is needed.

Another threat associated with production cycle activities is suboptimal investment in fixed assets. Overinvesting in fixed assets can create excess costs; underinvestment can impair productivity. Both problems reduce profitability. Thus, proper authorization of fixed-asset transactions is important.

Acquisitions of fixed assets represent a special type of expenditure and follow the same basic processes (order the fixed asset, receive it, and pay for it) and control procedures discussed in Chapter 13. Nonetheless, the size of most fixed-asset transactions necessitates some modifications of the processes used to acquire inventory and miscellaneous supplies. A supervisor or manager, who provides details about expected cash flows and other costs and benefits of the proposed expenditure, should first recommend large capital expenditures. All such recommendations should be reviewed by a senior executive or by an executive committee and the various projects ranked by priority. Smaller capital expenditures (e.g., those costing $10,000 or less) usually can be purchased directly out of departmental budgets, which avoids a formal approval process. Holding managers accountable for their department's return on the fixed assets provides additional incentive to control such expenditures.

Another difference is that orders for machinery and equipment almost always involve a formal request for competitive bids by potential suppliers. A document called a ***request for proposal (RFP)***, which specifies the desired properties of the asset, is sent to each prospective supplier. The capital investments committee should review the responses and select the best bid. Once a supplier has been selected, the acquisition of the asset may be handled through the regular expenditure cycle process, as described in Chapter 13. Specifically, a formal purchase order is prepared, receipt of the asset is formally documented using a receiving report, and a disbursement voucher is used to authorize payment to the supplier. The same set of processing controls and edit checks employed for other purchases also should be used for fixed-asset acquisitions (for details, refer back to the discussion in Chapter 13).

Another threat noted in Table 14-1 is that both inventories and fixed assets are subject to loss due to fire or other disasters. Physical safeguards, such as fire suppression systems, are designed to prevent such disasters. However, because preventive controls are never 100% effective, organizations also need to purchase adequate insurance to cover such losses and provide for replacement of those assets.

A related concern is disruption of production activities (threat 11). The high level of automation in production cycle activities means that disasters, such as the power outages experienced in California in recent years, not only interrupt the functioning of information systems but can also disrupt manufacturing activities. Backup power sources, such as generators, and uninterruptible

power supply devices should be acquired to ensure that critical equipment and machinery is not damaged by sudden unexpected loss of power and that important production processes can continue on schedule. Companies also need to investigate the disaster preparedness of key suppliers and identify alternative sources for critical components. This is especially important for companies that practice lean manufacturing; they maintain low inventories of both raw materials and finished goods, so any disruptions to either their manufacturing activities or those of their suppliers can quickly result in lost sales.

Cost Accounting

The final step in the production cycle is cost accounting (circle 4.0 in Figure 14-2). The three principal objectives of the cost accounting system are (1) to provide information for planning, controlling, and evaluating the performance of production operations; (2) to provide accurate cost data about products for use in pricing and product mix decisions; and (3) to collect and process the information used to calculate the inventory and cost of goods sold values that appear in the company's financial statements.

Process

To successfully accomplish the first objective, the cost accounting system must be designed to collect real-time data about the performance of production activities so that management can make timely decisions. To accomplish the other two objectives, the cost accounting system must classify costs by various categories and then assign those costs to specific products and organizational units. This requires careful coding of cost data during collection, because often the same costs may be allocated in multiple ways, for several different purposes. For example, factory supervisory costs may be assigned to departments for performance evaluation purposes but to specific products for pricing and product mix decisions.

Most companies use either job-order or process costing to assign production costs. **Job-order costing** assigns costs to specific production batches, or jobs, and is used when the product or service being sold consists of discretely identifiable items. For example, construction companies use job-order costing for each house being built. Similarly, public accounting and law firms use job-order costing to account for the costs of individual audits or cases, respectively. AOE currently uses job-order costing.

In contrast, **process costing** assigns costs to each process, or work center, in the production cycle, and then calculates the average cost for all units produced. Process costing is used when similar goods or services are produced in mass quantities and discrete units cannot be readily identified. For example, breweries accumulate the costs associated with the various processes (e.g., mashing, primary fermentation, filtering, and bottling) in producing a batch of a particular kind of beer and then compute the average total unit cost for that product. Similarly, mutual funds accumulate the costs associated with handling customer deposits and withdrawals and then compute the per-unit costs of those transactions.

The choice of job-order or process costing affects only the method used to *assign* costs to products, not the methods used to collect that data. Let us now examine how data about raw materials used, labor hours expended, machine operations performed, and manufacturing overhead are collected.

RAW MATERIALS USAGE DATA When production is initiated, the issuance of a materials requisition triggers a debit to work in process for the raw materials sent to production. If additional materials are needed, another debit is made to work in process. Conversely, work in process is credited for any materials not used and returned to inventory. Many raw materials are bar-coded so that usage data can be collected by scanning the products when released from, or returned to, inventory. Increasingly, manufacturers are using RFID tags to further improve the efficiency of tracking materials usage. In fact, if RFID tags are applied to individual products, companies may, if they desire, adopt the specific identification method for tracking inventory. It is difficult, however, to use bar codes or RFID tags for some items, such as liquids. Inventory clerks and factory workers must use online terminals to enter usage data for such items.

DIRECT LABOR COSTS In the past, AOE and other manufacturers used a paper document called a ***job-time ticket*** to collect data about labor activity. This document recorded the amount of time a worker spent on each specific job task. Now, as shown in Figure 14-3, workers enter this data using online terminals at each factory workstation. To further improve the efficiency of this process, AOE is considering switching to coded identification cards, which workers would run through a badge reader or bar-code scanner when they start and finish any task. The time savings associated with using bar-coding to automate data collection can be significant. For example, Consolidated Diesel Company found that using bar-code scanners to capture data about materials usage and labor operations saved about 12 seconds per workstation, per activity. Although this may not seem like much, when multiplied by the hundreds of workstations and multiple activities performed daily by hundreds of employees, the change resulted in a permanent 15% increase in productivity.

MACHINERY AND EQUIPMENT USAGE As companies implement CIM to automate the production process, an ever larger proportion of product costs relate to the machinery and equipment used to make that product. Data about machinery and equipment usage are collected at each step in the production process, often in conjunction with data about labor costs. For example, when workers record their activities at a particular workstation, the system can also record information identifying the machinery and equipment used and the duration of such use. Until recently, this data was collected by wiring the factory so that each piece of equipment was linked to the computer system. This limited the ability to quickly and easily redesign the layout of the shop floor to improve production efficiency. Consequently, many manufacturing companies are replacing such wired connections with wireless technology. Doing so enables them to use new 3-D simulation software to evaluate the effects of modifying shop-floor layout and workflow and to easily and quickly implement beneficial changes.

MANUFACTURING OVERHEAD COSTS Manufacturing costs that are not economically feasible to trace directly to specific jobs or processes are considered **manufacturing overhead.** Examples include the costs of water, power, and other utilities; miscellaneous supplies; rent, insurance, and property taxes for the factory plant; and the salaries of factory supervisors. Most of these costs are collected by the expenditure cycle information system (see Chapter 13), with the exception of supervisory salaries, which are processed by the human resources cycle information system (see Chapter 15).

Accountants can play a key role in controlling overhead costs by carefully assessing how changes in product mix affect total manufacturing overhead. They should go beyond merely collecting such data, however, and identify the underlying factors that drive the changes in total costs. This information then can be used to adjust production plans and factory layout to maximize efficiency and profitability. As the AOE case illustrates, to do this effectively requires that the cost accounting system be redesigned to collect and report costs in a manner consistent with the production planning techniques of the company. For example, lean manufacturing emphasizes working in teams and seeks to maximize the efficiency and synergy of all teams involved in making a particular product. Consequently, Elizabeth Venko realizes that collecting and reporting labor variances at the individual or team level may create dysfunctional incentives to maximize local performance at the expense of plantwide performance. Therefore, she plans to redesign AOE's cost accounting system so that it collects and reports costs in a manner that highlights the *joint* contributions of all teams that make a particular product.

Threats and Controls

As the AOE case illustrated, inaccurate cost data (threat 12 in Table 14-1) can diminish the effectiveness of production scheduling and undermine management's ability to monitor and control manufacturing operations. For example, inaccurate cost data can result in inappropriate decisions about which products to make and how to set current selling prices. Errors in inventory records can lead to either over- or underproduction of goods. Overstated fixed assets increase expenses through extra depreciation and higher property taxes. Understated fixed assets also can cause problems; for example, inaccurate counts of the number of personal computers in use can cause a company to unknowingly violate software license requirements. Inaccuracies in financial statements and managerial reports can distort analyses of past performance and the desirability of future investments or changes in operations.

The best control procedure to ensure that data entry is accurate is to automate data collection using RFID technology, bar-code scanners, badge readers, and other devices. When this is not feasible, online terminals should be used for data entry and should employ the various data entry edit controls discussed in chapter 10. For example, check digits and closed-loop verification should be used to ensure that information about the raw materials used, operations performed, and employee number is entered correctly. Validity checks, such as comparing part numbers of raw materials to those listed in the bill of materials file, provide further assurance of accuracy. Finally, to verify the accuracy of database records, periodic physical counts of inventories and fixed assets should be made and compared with recorded quantities.

Accurate cost data are not sufficient, however. As the AOE case showed, poorly designed cost accounting systems misallocate costs to products (threat 13) and produce misleading reports about production cycle activities (threat 14), both of which can lead to erroneous decisions and frustration. The following two subsections explain how activity-based costing systems and innovative performance metrics can mitigate these problems.

IMPROVED CONTROL WITH ACTIVITY-BASED COSTING SYSTEMS Traditional cost systems use volume-driven bases, such as direct labor or machine hours, to apply overhead to products. Many overhead costs, however, do not vary directly with production volume. Purchasing costs, for example, vary with the number of purchase orders processed. Similarly, receiving costs vary with the number of shipments from suppliers. Setup and materials handling costs vary with the number of different batches that are run, not with the total number of units produced. Thus, allocating these types of overhead costs to products based on output volume overstates the costs of products manufactured in large quantities. It also understates the costs of products manufactured in small batches.

In addition, allocating overhead based on direct labor input can distort costs across products. As investments in factory automation increase, the amount of direct labor used in production decreases. Consequently, the amount of overhead charged per unit of labor increases dramatically. As a result, small differences in the amount of labor used to produce two products can result in significant differences in product costs.

Activity-based costing[1] can refine and improve cost allocations under both job-order and process cost systems. It attempts to trace costs to the activities that create them, such as grinding or polishing, and only subsequently allocates those costs to products or departments. An underlying objective of activity-based costing is to link costs to corporate strategy. Corporate strategy results in decisions about what goods and services to produce. Activities must be performed to produce these goods and services, which in turn incur costs. Thus, corporate strategy determines costs. Consequently, by measuring the costs of basic activities, such as materials handling or processing purchase orders, activity-based costing provides information to management for evaluating the consequences of strategic decisions.

Activity-based costing systems differ from conventional cost accounting systems in three important ways:

1. Activity-based cost systems attempt to directly trace a larger proportion of overhead costs to products. Advances in IT make this feasible. For example, RFID technology and bar-coding facilitate tracking the exact quantities of miscellaneous parts used in each product or process stage. When implementing activity-based costing systems, accountants observe production operations and interview factory workers and supervisors to obtain a better understanding of how manufacturing activities affect costs.
2. Activity-based cost systems use a greater number of cost pools to accumulate indirect costs (manufacturing overhead). Whereas most traditional cost systems lump all overhead costs together, activity-based costing systems distinguish three separate categories of overhead:
   - **Batch-related overhead.** Examples include setup costs, inspections, and materials handling. Activity-based cost systems accumulate these costs for a batch and then allocate them to the units produced in that batch. Thus, products produced in large quantities have lower batch-related overhead costs per unit than products produced in small quantities.

[1] In this section, we provide an overview of activity-based costing, its effects on the cost accounting system, and its benefits. For additional details on the mechanics of activity-based costing, see any cost accounting textbook.

- **Product-related overhead.** These costs are related to the diversity of the company's product line. Examples include research and development, expediting, shipping and receiving, environmental regulations, and purchasing. Activity-based cost systems try to link these costs to specific products when possible. For example, if a company produces three product lines, one of which generates hazardous waste, an activity-based cost system would charge only that one set of products for all the costs of complying with environmental regulations. Other costs, such as purchasing raw materials, might be allocated across products based on the relative number of purchase orders required to make each product.
- **Companywide overhead.** This category includes such costs as rent or property taxes. These costs apply to all products. Thus, activity-based cost systems typically allocate them using departmental or plant rates.

3. Activity-based cost systems attempt to rationalize the allocation of overhead to products by identifying cost drivers. A **cost driver** is anything that has a cause-and-effect relationship on costs. For example, the number of purchase orders processed is one cost driver of purchasing department costs; that is, the total costs of processing purchase orders (e.g., purchasing department salaries, postage) vary directly with the number of purchase orders that are processed. As in this example, cost drivers in activity-based cost systems are often nonfinancial variables. In contrast, traditional costing systems often use financial variables, such as dollar volume of purchases, as the bases for allocating manufacturing overhead.

ERP systems make it easier to implement activity-based costing because they provide detailed information about the steps required to process a transaction. For example, the time (and therefore the cost) of requisitioning the raw materials needed to manufacture a product depends upon the number of components in the finished product. Accountants and engineers can observe and calculate the average time it takes to retrieve one component from inventory. That time measure can then be multiplied by the number of line items in a production order (automatically recorded by the ERP system) to calculate the materials requisition costs for each different finished product.

Proponents of activity-based costing argue that it provides two important benefits: More accurate cost data result in better product mix and pricing decisions, and more detailed cost data improve management's ability to control and manage total costs.

Better Decisions Traditional cost systems tend to apply too much overhead to some products and too little to others, because too few cost pools are used. This leads to two types of problems, both of which AOE experienced. First, companies may accept sales contracts for some products at prices below their true cost of production. Consequently, although sales increase, profits decline. Second, companies may overprice other products, thereby inviting new competitors to enter the market. Ironically, if more accurate cost data were available, companies would find that they could cut prices to keep competitors out of the market and still make a profit on each sale. Activity-based cost systems avoid these problems because overhead is divided into three categories and applied using cost drivers that are causally related to production. Therefore, product cost data are more accurate.

Activity-based costing also makes better use of production data to improve product design. For example, the costs associated with processing purchase orders can be used to calculate the purchasing-related overhead associated with each component used in a finished product. Engineering can use this information, along with data on relative usage of components across products, to identify unique components that could be replaced by lower-cost, more commonly used parts.

Finally, activity-based cost data improve managerial decision making by providing information about the costs associated with specific activities, instead of classifying those costs by financial statement category. Table 14-3 shows an example of how this rearrangement of data can improve managerial analysis by focusing attention on key processes. Notice how the traditional cost report draws attention to the fact that travel and software costs are above budget. The activity-based cost report, in contrast, shows which *activities* (training, testing, maintenance and systems analysis) are running over budget, and which are not.

Improved Cost Management Proponents argue that another advantage of activity-based costing is that it clearly measures the results of managerial actions on overall profitability. Whereas

TABLE 14-3 Comparison of Reports Based on Activity-Based and Traditional Cost Systems

TRADITIONAL COST REPORTS, BASED ON GENERAL LEDGER ACCOUNT CATEGORIES

	Budget	Actual	Variance
Salaries	$386,000	$375,000	$11,000
Computer software	845,000	855,000	(10,000)
Travel	124,000	150,000	(26,000)
Supplies	25,000	20,000	5,000
Total	$1,380,000	$1,400,000	($20,000)

ACTIVITY-BASED COSTING ANALYSIS

	Budget	Actual	Variance
Systems analysis	$200,000	$210,000	($10,000)
Coding	440,000	400,000	40,000
Testing	235,000	250,000	(15,000)
Maintenance	250,000	275,000	(25,000)
User support	90,000	50,000	40,000
Reports	87,000	75,000	12,000
Training	78,000	140,000	(62,000)
Total	$1,380,000	$1,400,000	($20,000)

traditional cost systems only measure spending to acquire resources, activity-based cost systems measure both the amount spent to acquire resources and the consumption of those resources. This distinction is reflected in the following formula:

Cost of activity capability = Cost of activity used + Cost of unused capacity

To illustrate, consider the receiving function at a manufacturing firm such as AOE. The total monthly employee cost in the receiving department, including salaries and benefits, represents the cost of providing this function—receiving shipments from suppliers. Assume that the salary expense of the receiving department is $100,000, and assume that the number of employees is sufficient to handle 500 shipments. The cost per shipment would be $200. Finally, assume that 400 shipments are actually received. The activity-based cost system would report that the cost of the receiving activity used is $80,000 ($200 × 400 shipments) and that the remaining $20,000 in salary expense represents the cost of unused capacity.

In this way, performance reports that activity-based cost systems generate help direct managerial attention to how policy decisions made in one area affect costs in another area. For example, a purchasing department manager may decide to increase the minimum size of orders to obtain larger discounts for bulk purchases. This would reduce the number of incoming shipments that the receiving department must handle, thereby increasing its unused capacity. Similarly, actions taken to improve the efficiency of operations, such as requiring vendors to send products in bar-coded containers, increase practical capacity and create additional unused capacity. In either case, activity-based cost performance reports highlight this excess capacity for managerial attention. Management can then try to improve profitability by applying that unused capacity to other revenue-generating activities.

IMPROVED CONTROL WITH INNOVATIVE PERFORMANCE METRICS Modern approaches to production, such as lean manufacturing, differ significantly from traditional mass production. One major difference is a marked reduction in inventory levels of finished goods, because production is scheduled in response to customer demand instead of projections based on prior years. Although this is beneficial in the long run, it often creates a short-term decline in reported

profitability. The reason: Traditional financial accounting treats inventory as an asset. Thus, the costs of producing inventory are not recognized until the products are sold. When a company switches from mass production to lean manufacturing, it reduces existing inventory levels, with the result that costs incurred in prior periods to create that inventory are now expensed. In addition, because lean manufacturing seeks to minimize the creation of additional inventories, almost all labor and overhead costs are expensed in the current period, instead of being allocated to inventory and thereby treated as an asset and deferred to future periods. The combined effect of these changes often results in a marked increase in expenses in the year of transitioning to lean accounting. Although this effect is only temporary, it can create significant concern among managers, particularly if their performance evaluations are based primarily on the company's reported financial statements.

To address these problems, CPAs who work for and with companies that have adopted lean manufacturing techniques advocate supplementing traditional financial reports based on GAAP with additional reports based on lean accounting[2] principles. One suggested change involves assigning costs to product lines instead of departments. For example, all the costs incurred to design, produce, sell, deliver, process customer payments, and provide postsales support are grouped by product. Another change involves reporting overhead costs as a separate item, rather than including them in the calculation of the cost of goods sold. Lean-accounting reports also identify the change in inventory as a separate expense item, to more clearly reveal the effect of inventory levels on reported profits.

In addition to changing the structure of performance reports, accountants should also develop and refine new measures designed to focus on issues important to production cycle managers. Two particularly important issues are the level of usable output produced per unit of time and measures of quality control.

Throughput: A Measure of Production Effectiveness Throughput represents the number of good units produced in a given period of time. It consists of three factors, each of which can be separately controlled, as shown in the following formula[3]:

$$\text{Throughput} = (\text{Total units produced/Processing time}) \times (\text{Processing time/Total time}) \times (\text{Good units/Total units})$$

Productive capacity, the first term in the formula, shows the maximum number of units that can be produced using current technology. Productive capacity can be increased by improving labor or machine efficiency, by rearranging the factory-floor layout to expedite the movement of materials, or by simplifying product design specifications. *Productive processing time*, the second term in the formula, indicates the percentage of total production time used to manufacture the product. Productive processing time can be improved by improving maintenance to reduce machine downtime or by more efficient scheduling of material and supply deliveries to reduce wait time. *Yield*, the third term in the formula, represents the percentage of good (nondefective) units produced. Using better-quality raw materials or improving worker skills can improve yield.

Quality Control Measures Information about quality costs can help companies determine the effects of actions taken to improve yield and identify areas for further improvement. Quality control costs can be divided into four areas:

1. *Prevention costs* are associated with changes to production processes designed to reduce the product defect rate.
2. *Inspection costs* are associated with testing to ensure that products meet quality standards.
3. *Internal failure costs* are associated with reworking, or scrapping, products identified as being defective prior to sale.
4. *External failure costs* result when defective products are sold to customers. They include such costs as product liability claims, warranty and repair expenses, loss of customer satisfaction, and damage to the company's reputation.

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[2]The introductory material in this section is based on an article by Karen M. Kroll, "The Lowdown on Lean Accounting," *Journal of Accountancy* (July 2004): 69–76.

[3]This formula was developed by Carole Cheatham in "Measuring and Improving Throughput," *Journal of Accountancy* (March 1990): 89–91.

The ultimate objective of quality control is to "get it right the first time" by manufacturing products that meet customer specifications. This often requires trade-offs among the four quality cost categories. For example, increasing prevention costs can lower inspection costs as well as internal and external failure costs. Many companies have found, however, that increased spending to prevent defects reduces total manufacturing costs. In addition, improved quality control can also help companies become "greener." For example, when the Subaru plant in Indiana redesigned its manufacturing process, it reduced the amount of electricity required to produce a car by 14% and totally eliminated waste sent to landfills.

Summary and Case Conclusion

The production cycle consists of four basic activities: product design, production planning and scheduling, production operations, and cost accounting. Companies are continually investing in IT to improve the efficiency of the first three activities. However, for a business to reap the full benefit of these changes, corresponding modifications must also be made to the cost accounting system. In addition, accountants need to modify financial reports and develop new measures that more accurately reflect and measure manufacturing performance.

After completing her tour of the factory, Elizabeth Venko was convinced that some major changes were required in AOE's cost accounting system. For example, although AOE's production operations were highly automated, manufacturing overhead was still being allocated based on direct labor hours. This resulted in distorted product costs due to small differences in the amount of direct labor used to assemble each item. Elizabeth decided that the solution was to do more than merely change the allocation base. Instead, AOE would implement activity-based costing. A number of different pools would be used to accumulate overhead costs, and the appropriate cost drivers would be identified for use in assigning those costs to specific products. Based on her research, including conversations with a controller at another company that had recently implemented an activity-based costing system, Elizabeth believed that these changes would solve AOE's problems with product pricing and mix decisions and more accurately reflect the effects of investments in factory automation.

Elizabeth also decided that three other major changes were needed in the reports the production cycle information system produced. First, data about all the costs associated with quality control, not just those involving rework and scrap, should be collected and reported. Second, performance reports should include nonfinancial measures, such as throughput, in addition to financial measures. Third, lean accounting principles, rather than GAAP, could be used to create financial reports intended for internal use. She discussed with LeRoy the likely behavioral effects of these changes. They agreed that identifying the different components of quality control costs should encourage continued investments that would be likely to improve the overall yield rate. Further, separately showing the effect of changes in inventory levels on profits would make it easier to reward efforts to reduce inventory levels. They also agreed on the need to closely monitor the effects of any new performance reports and make appropriate modifications to them.

Ann Brandt realized that Elizabeth's proposed changes would necessitate a redesign of AOE's production cycle database. In addition, the desire for more timely and accurate information would require additional investments in RFID technology to replace the use of bar codes wherever feasible.

Elizabeth and Ann presented their plans at the next executive meeting. LeRoy Williams was satisfied that the changes would indeed address his complaints about AOE's current production cycle information system. Linda Spurgeon supported the proposal and agreed to fund the necessary changes. She then told Elizabeth and Ann that their next task was to look at ways to improve AOE's HR and payroll process.

Key Terms

production cycle 426
bill of materials 430
operations list 430
manufacturing resource planning (MRP-II) 431
lean manufacturing 431
master production schedule (MPS) 432
production order 432
materials requisition 432
move ticket 432
computer-integrated manufacturing (CIM) 436
request for proposal (RFP) 437
job-order costing 438
process costing 438
job-time ticket 439
manufacturing overhead 439
activity-based costing 440
cost driver 441
throughput 443

AIS IN ACTION

Chapter Quiz

1. Most costs are locked in at which stage in the production cycle?
   a. product design
   b. production planning
   c. production operations
   d. cost accounting

2. Which of the following is an advantage of bar-coding over RFID?
   a. speed
   b. accuracy
   c. cost
   d. safety

3. Which document lists the components needed to manufacture a specific product?
   a. operations list
   b. master production schedule
   c. bill of materials
   d. production order

4. Which document captures information about labor used in production?
   a. move ticket
   b. job-time ticket
   c. operations list
   d. bill of materials

5. An increase in which component of quality costs is most likely to result in a decrease in the other three components?
   a. prevention costs
   b. inspection costs
   c. internal failure costs
   d. external failure costs

6. Activity-based costing can be used to refine which of the following?
   a. job-order costing
   b. process costing
   c. both job-order and process costing
   d. neither job-order nor process costing

7. Which system is most likely to be used by a company that mass-produces large batches of standard items in anticipation of customer demand?
   a. MRP-II
   b. lean manufacturing
   c. activity-based costing
   d. throughput

8. The development of an MPS would be most effective in preventing which of the following threats?
   a. recording and posting errors
   b. loss of inventory
   c. production of poor-quality goods
   d. excess production

9. Which control procedure is probably *least* effective in reducing the threat of inventory loss?
   a. limiting physical access to inventory
   b. documenting all transfers of inventory within the company

c. regular materials usage reports that highlight variances from standards
d. periodically counting inventory and investigating any discrepancies between those counts and recorded amounts

10. What is the number of good units produced in a given period of time called?
a. productive capacity
b. productive processing time
c. yield
d. throughput

Discussion Questions

14.1. When activity-based cost reports indicate that excess capacity exists, management should either find alternative revenue-enhancing uses for that capacity or eliminate it through downsizing. What factors influence management's decision? What are the likely behavioral side effects of each choice? What implications do those side effects have for the long-run usefulness of activity-based cost systems?

14.2. Why should accountants participate in product design? What insights about costs can accountants contribute that differ from the perspectives of purchasing managers and engineers?

14.3. Some companies have eliminated the collection and reporting of detailed analyses on direct labor costs broken down by various activities. Instead, first-line supervisors are responsible for controlling the total costs of direct labor. The justification for this argument is that labor costs represent only a small fraction of the total costs of producing a product and are not worth the time and effort to trace to individual activities. Do you agree or disagree with this argument? Why?

14.4. Typically, McDonald's produces menu items in advance of customer orders based on anticipated demand. In contrast, Burger King produces menu items only in response to customer orders. Which system (MRP-II or lean manufacturing) does each company use? What are the relative advantages and disadvantages of each system?

14.5. Some companies have switched from a "management by exception" philosophy to a "continuous improvement" viewpoint. The change is subtle, but significant. Continuous improvement focuses on comparing actual performance to the ideal (i.e., perfection). Consequently, all variances are negative (how can you do better than perfect?). The largest variances indicate the areas with the greatest amount of "waste," and, correspondingly, the greatest opportunity for improving the bottom line. What are the advantages and disadvantages of this practice?

Problems

14.1. Match the terms in the left column with their definitions from the right column:

___ 1. Bill of materials	a. A factor that causes costs to change
___ 2. Operations list	b. A measure of the number of good units produced in a period of time
___ 3. Master production schedule	c. A list of the raw materials used to create a finished product
___ 4. Lean manufacturing	d. A document used to authorize removal of raw materials from inventory
___ 5. Production order	e. A cost accounting method that assigns costs to products based on specific processes performed
___ 6. Materials requisition	f. A cost accounting method that assigns costs to specific batches or production runs and is used when the product or service consists of uniquely identifiable items

____ 7. Move ticket	g. A cost accounting method that assigns costs to each step or work center and then calculates the average cost for all products that passed through that step or work center
____ 8. Job-time ticket	h. A document that records labor costs associated with manufacturing a product
____ 9. Job-order costing	i. A document that tracks transfer of inventory from one work center to another
____10. Cost driver	j. A document that authorizes manufacture of a finished good
____11. Throughput	k. A document that lists the steps required to manufacture a finished good
____12. Computer-integrated manufacturing	l. A document that specifies how much of a finished good is to be produced during a specific time period
	m. A production planning technique that is an extension of the just-in-time inventory control method
	n. A production planning technique that is an extension of the materials requirement planning inventory control method
	o. A term used to refer to the use of robots and other IT techniques as part of the production process

14.2. What internal control procedure(s) would best prevent or detect the following problems?

a. A production order was initiated for a product that was already overstocked in the company's warehouse.
b. A production employee stole items of work-in-process inventory.
c. The "rush-order" tag on a partially completed production job became detached from the materials and lost, resulting in a costly delay.
d. A production employee entered a materials requisition form into the system in order to steal $300 worth of parts from the raw materials storeroom.
e. A production worker entering job-time data on an online terminal mistakenly entered 3,000 instead of 300 in the "quantity-completed" field.
f. A production worker entering job-time data on an online terminal mistakenly posted the completion of operation 562 to production order 7569 instead of production order 7596.
g. A parts storeroom clerk issued parts in quantities 10% lower than those indicated on several materials requisitions and stole the excess quantities.
h. A production manager stole several expensive machines and covered up the loss by submitting a form to the accounting department indicating that the missing machines were obsolete and should be written off as worthless.
i. The quantity-on-hand balance for a key component shows a negative balance.
j. A factory supervisor accessed the operations list file and inflated the standards for work completed in his department. Consequently, future performance reports show favorable budget variances for that department.
k. A factory supervisor wrote off a robotic assembly machine as being sold for salvage but actually sold the machine and pocketed the proceeds.
l. Overproduction of a slow-moving product resulted in excessive inventory that had to eventually be marked down and sold at a loss.

14.3. Use Table 14-1 to create a questionnaire checklist that can be used to evaluate controls for each of the basic activities in the production cycle (product design, planning and scheduling, production operations, and cost accounting).

Required

a. For each control issue, write a Yes/No question such that a "No" answer represents a control weakness.
b. For each Yes/No question, write a brief explanation of why a "No" answer represents a control weakness.

14.4. You have recently been hired as the controller for a small manufacturing firm that makes high-definition televisions. One of your first tasks is to develop a report measuring throughput.

Required

Describe the data required to measure throughput and the most efficient and accurate method of collecting that data.

14.5. The Joseph Brant Manufacturing Company makes athletic footwear. Processing of production orders is as follows: At the end of each week, the production planning department prepares a master production schedule (MPS) that lists which shoe styles and quantities are to be produced during the next week. A production order preparation program accesses the MPS and the operations list (stored on a permanent disk file) to prepare a production order for each shoe style that is to be manufactured. Each new production order is added to the open production order master file stored on disk.

Each day, parts department clerks review the open production orders and the MPS to determine which materials need to be released to production. All materials are bar-coded. Factory workers work individually at specially designed U-shaped work areas equipped with several machines to assist them in completely making a pair of shoes. Factory workers scan the bar codes as they use materials. To operate a machine, the factory workers swipe their ID badge through a reader. This results in the system automatically collecting data identifying who produced each pair of shoes and how much time it took to make them.

Once a pair of shoes is finished, it is placed in a box. The last machine in each work cell prints a bar-code label that the worker affixes to the box. The completed shoes are then sent to the warehouse.

Required

a. Prepare a data flow diagram of all operations described.
b. What control procedures should be included in the system?

14.6. The XYZ Company's current production processes have a scrap rate of 15% and a return rate of 3%. Scrap costs (wasted materials) are $12 per unit; warranty/repair costs average $60 per unit returned. The company is considering the following alternatives to improve its production processes:

- Option A: Invest $400,000 in new equipment. The new process will also require an additional $1.50 of raw materials per unit produced. This option is predicted to reduce both scrap return rates by 40% from current levels.
- Option B: Invest $50,000 in new equipment, but spend an additional $3.20 on higher-quality raw materials per unit produced. This option is predicted to reduce both scrap and return rates by 90% from current levels.
- Option C: Invest $2 million in new equipment. The new process will require no change in raw materials. This option is predicted to reduce both scrap and return rates by 50% from current levels.

Required

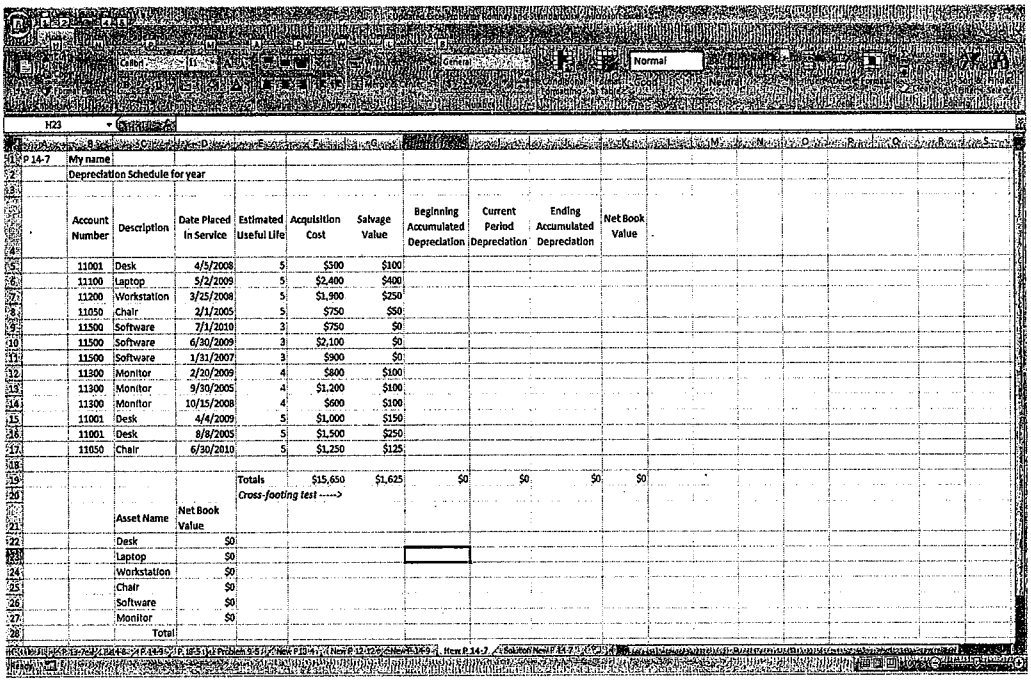
a. Assume that current production levels of 1 million units will continue. Which option do you recommend? Why?
b. Assume that all of the proposed changes will increase product quality such that production will jump to 1.5 million units. Which option do you recommend? Why?



14.7. Excel Problem

Required

a. Create the following spreadsheet (next page):



P 14-7	My name										
	Depreciation Schedule for year										
	Account Number	Description	Date Placed in Service	Estimated Useful Life	Acquisition Cost	Salvage Value	Beginning Accumulated Depreciation	Current Period Depreciation	Ending Accumulated Depreciation	Net Book Value	
	11001	Desk	4/5/2008	5	$500	$100					
	11100	Laptop	5/2/2009	5	$2,400	$400					
	11200	Workstation	3/25/2008	5	$1,900	$250					
	11050	Chair	2/1/2005	5	$750	$50					
	11500	Software	7/1/2010	3	$750	$0					
	11500	Software	6/30/2009	3	$2,100	$0					
	11500	Software	1/31/2007	3	$900	$0					
	11300	Monitor	2/20/2009	4	$800	$100					
	11300	Monitor	9/30/2005	4	$1,200	$100					
	11300	Monitor	10/15/2008	4	$600	$100					
	11001	Desk	4/4/2009	5	$1,000	$150					
	11001	Desk	8/8/2005	5	$1,500	$250					
	11050	Chair	6/30/2010	5	$1,250	$125					
				Totals	$15,650	$1,625	$0	$0	$0	$0	
				Cross-footing test ----->							
		Asset Name	Net Book Value								
		Desk	$0								
		Laptop	$0								
		Workstation	$0								
		Chair	$0								
		Software	$0								
		Monitor	$0								
		Total									

b. Create formulas to calculate the following:
   - Accumulated depreciation (all assets use the straight-line method; all assets acquired any time during the year get a full year's initial depreciation)
   - Current year's depreciation (straight-line method, full amount for initial year in which asset acquired)
   - Ending accumulated depreciation
   - Net book value at end of period
   - Current year in the cell to the right of the phrase "Depreciation schedule for year"
   - Column totals for acquisition cost, beginning depreciation, current depreciation, ending accumulated depreciation, net book value
   - In the cell to the right of the arrow following the text "Cross-footing test," create a formula that checks whether the sum of the net book value column equals the sum of acquisition costs minus the sum of ending accumulated depreciation. If the two values match, the formula should display the text "Okay"; otherwise, it should display the text "Error."

c. Create a table at the bottom of your worksheet that consists of two columns: (1) asset name (values should be chair, desk, laptop, monitor, software, and workstation); and (2) net book value (create a formula to calculate this number), assuming that the current date is 06/30/2011. Then:
   - Create a formula that sums the total net book values for all classes of assets.
   - In the cell to the right of the total net book values for all asset classes, create a formula that compares the total net book values for all classes of assets to the sum of all net book values in the top portion of the spreadsheet. The formula should return "Okay" if the two totals match or "Error: Sum of net book values by asset class does not equal sum of all net book values" if the two totals do not equal one another.

d. Enter your name in row 1 in the cell to the right of the text "Name."

14.8. Excel Problem



Task: Use Excel and the Solver add-in to explore the effect of various resource constraints on the optimal product mix.

a. Read the article "Boost Profits With Excel," by James A. Weisel in the December 2003 issue of the *Journal of Accountancy* (available online at the AICPA's Web site, www.aicpa.org).
b. Download the sample spreadsheet discussed in the article, and print out the screenshots showing that you used the Solver tool as discussed in the article.
c. Rerun the Solver program to determine the effect of the following actions on income (print out the results of each option):
   - Double market share limitations for all three products
   - Double market share limitations for all three products plus the following constraint: sauce case sales cannot exceed 50% of the sum of soup and casserole case sales

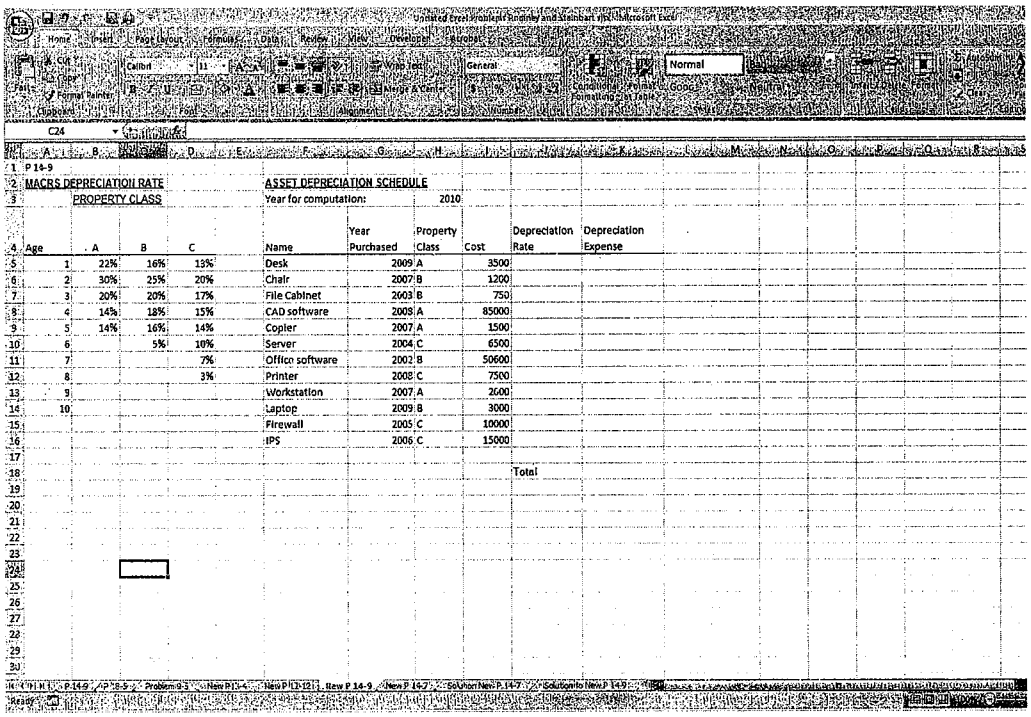


14.9. Excel Problem

Required

Create the spreadsheet shown in Figure 14-11. Write formulas to calculate the total depreciation expense and to display the correct values in the following three columns: Age, Depreciation Rate, and Depreciation Expense. (*Hint*: You will need to use the VLOOKUP and MATCH functions to do this. You may also want to read the article "Double-Teaming In Excel," by Judith K. Welch, Lois S. Mahoney, and Daniel R. Brickner, in the November 2005 issue of the *Journal of Accountancy*, from which this problem was adapted.)

FIGURE 14-11
Spreadsheet for Problem 14-9



P 14-9

MACRS DEPRECIATION RATE

Age	A	B	C
1	22%	16%	13%
2	30%	25%	20%
3	20%	20%	17%
4	14%	18%	15%
5	14%	16%	14%
6		5%	10%
7			7%
8			3%
9			
10			

PROPERTY CLASS

ASSET DEPRECIATION SCHEDULE

Year for computation: 2010

Name	Year Purchased	Property Class	Cost	Depreciation Rate	Depreciation Expense
Desk	2009	A	3500		
Chair	2007	B	1200		
File Cabinet	2003	B	750		
CAD software	2008	A	85000		
Copier	2007	A	1500		
Server	2004	C	6500		
Office software	2002	B	50600		
Printer	2008	C	7500		
Workstation	2007	A	2600		
Laptop	2009	B	3000		
Firewall	2005	C	10000		
IPS	2006	C	15000		
				Total	

Case 14-1 The Accountant and CIM

Examine issues of the *Journal of Accountancy*, *Strategic Finance*, and other business magazines for the past three years to find stories about current developments in factory automation. Write a brief report that discusses the accounting implications of one development: how it affects the efficiency and accuracy of data collection and any new opportunities for improving the quality of performance reports. Also discuss how the development affects the risks of various production cycle threats and the control procedures used to mitigate those risks.

AIS IN ACTION SOLUTIONS

Quiz Key

1. Most costs are locked in at which stage in the production cycle?
   ▶ a. product design (Correct. Decisions made during product design determine the majority of costs.)
   b. production planning (Incorrect. Decisions made during product design determine the majority of costs.)
   c. production operations (Incorrect. Decisions made during product design determine the majority of costs.)
   d. cost accounting (Incorrect. Decisions made during product design determine the majority of costs.)

2. Which of the following is an advantage of bar-coding over RFID?
   a. speed (Incorrect. RFID technology can read information from multiple items at the same time, whereas bar-code scanners can read only one item at a time. In addition, employees spend time aligning the bar codes on each item with the reader.)
   b. accuracy (Incorrect. In certain applications, RFID is more accurate than bar-coding. For example, in retail stores, when checking out items that are similar but not identical—for example, different flavors of soda—clerks frequently enter the bar code for one item and then enter a quantity of, say, 7, rather than scanning the bar codes of each item; an RFID reader, in contrast, would identify which seven specific products were sold.)
   ▶ c. cost (Correct. Bar-coding is currently less expensive than RFID.)
   d. safety (Incorrect. There is no difference in the safety of bar-coding and RFID.)

3. Which document lists the components needed to manufacture a specific product?
   a. operations list (Incorrect. This document lists the sequence of steps to manufacture the product.)
   b. master production schedule (Incorrect. This document is used to plan production activities.)
   ▶ c. bill of materials (Correct. The bill of materials lists the components of a finished product.)
   d. production order (Incorrect. This document authorizes production activities.)

4. Which document captures information about labor used in production?
   a. move ticket (Incorrect. The move ticket documents movement of materials.)
   ▶ b. job-time ticket (Correct. The job-time ticket records time spent on each activity.)
   c. operations list (Incorrect. The operations list specifies the sequence of steps to manufacture a product.)
   d. bill of materials (Incorrect. The bill of materials identifies the components used to manufacture a product.)

5. An increase in which component of quality costs is most likely to result in a decrease in the other three components?
   ▶ a. prevention costs (Correct. Increases in prevention costs often reduce the time and cost of inspecting products, as well as the proportion of defective products.)
   b. inspection costs (Incorrect. Increases in inspection costs do not necessarily reduce the other three quality control costs.)
   c. internal failure costs (Incorrect. Increases in internal failure costs do not have any effect on prevention or inspection costs.)
   d. external failure costs (Incorrect. Increases in external failure costs do not reduce other components of quality costs.)

6. Activity-based costing can be used to refine which of the following?
   a. job-order costing (Incorrect. Activity-based costing can be used with either job-order or process costing.)
   b. process costing (Incorrect. Activity-based costing can be used with either job-order or process costing.)
   ▶ c. both job-order and process costing (Correct. Activity-based costing can be used with either job-order or process costing.)
   d. neither job-order nor process costing (Incorrect. Activity-based costing can be used with either job-order or process costing.)

7. Which system is most likely to be used by a company that mass-produces large batches of standard items in anticipation of customer demand?
   ▶ a. MRP-II (Correct. MRP-II is a push form of manufacturing that is appropriate for mass production of standardized items for which demand is predictable.)
   b. lean manufacturing (Incorrect. Lean manufacturing seeks to minimize inventories by producing only in response to customer orders.)
   c. activity-based costing (Incorrect. Activity-based costing is a cost allocation system, not a production planning technique.)
   d. throughput (Incorrect. Throughput is a measure of efficiency.)

8. The development of an MPS would be most effective in preventing which of the following threats?
   a. recording and posting errors (Incorrect. Data validation and processing controls would best minimize recording and posting errors.)
   b. loss of inventory (Incorrect. Access controls and frequent physical counts of inventory would best reduce the risk of inventory theft.)
   c. production of poor-quality goods (Incorrect. Product design addresses this issue.)
   ▶ d. excess production (Correct. An MPS schedules production to satisfy demand and, therefore, reduces the chance of overproduction.)

9. Which control procedure is probably *least* effective in reducing the threat of inventory loss?
   a. limiting physical access to inventory (Incorrect. Physical access controls are an important method for reducing the risk of inventory theft.)
   b. documenting all transfers of inventory within the company (Incorrect. Adequate documentation is an important control to reduce the risk of inventory theft.)
   ▶ c. regular materials usage reports that highlight variances from standards (Correct. Although variances could indicate theft, they are more likely to reflect changes in efficiency.)
   d. periodically counting inventory and investigating any discrepancies between those counts and recorded amounts (Incorrect. Periodic counts of inventory are an important control for reducing the risk of inventory theft.)

10. What is the number of good units produced in a given period of time called?
    a. productive capacity (Incorrect. Productive capacity is a component of throughput that represents the total number of units, both good and bad, produced per unit of time.)
    b. productive processing time (Incorrect. Productive processing time is the component of throughput that measures the proportion of time actually spent producing output.)
    c. yield (Incorrect. Yield is the component of throughput that measures the proportion of good units produced per batch.)
    ▶ d. throughput (Correct. Throughput is the measure of the number of good units produced per unit of time.)

Chapter 15

The Human Resources Management and Payroll Cycle

Learning Objectives

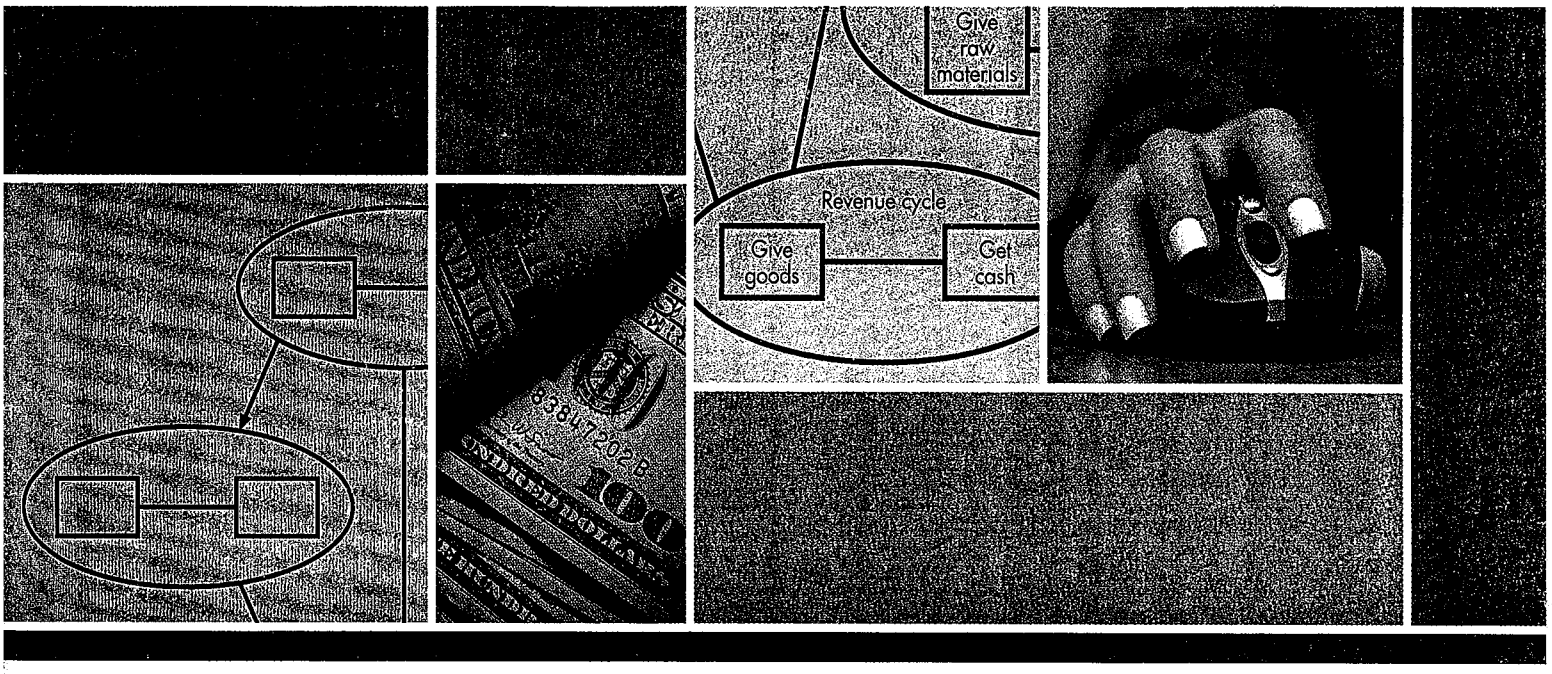
After studying this chapter, you should be able to:

1. Describe the major business activities and related information processing operations performed in the human resources management (HRM)/payroll cycle.
2. Discuss the key decisions to be made in the HRM/payroll cycle and identify the information needed to make those decisions.
3. Identify the major threats in the HRM/payroll cycle and evaluate the adequacy of various internal control procedures for dealing with them.

INTEGRATIVE CASE ALPHA OMEGA ELECTRONICS

Like many companies, AOE did not fully implement all modules of its new enterprise resource planning (ERP) system at the same time. It focused first on integrating the revenue and expenditure cycles with the production cycle while continuing to use its existing payroll and HRM systems. Thus, like many companies, AOE currently has separate HRM and payroll systems. The payroll system, which is under the accounting department's control, produces employee paychecks and maintains the related records as required by government regulations. The payroll system uses batch processing: Hourly employees are paid biweekly; salaried employees and those on commission are paid monthly. The HRM system, which the human resources department runs, maintains files on employee job history, skills, and benefits; these files are updated weekly. Each system maintains its own separate files, sometimes storing the same data, such as pay rates, in different formats. This practice makes it difficult for accounting personnel to prepare reports that combine HRM and payroll data.

Peter Wu, the new vice president for human resources at AOE, wants to address several problems with AOE's payroll and HRM activities. Payroll processing costs have



risen, and employees are unhappy with the lengthy delays required to obtain information about their benefits and retirement plans. In addition, the current HRM system makes it difficult to accurately track employee skill development, which impedes evaluating the effectiveness of AOE's investment in training and continuing education. Consequently, employees find it difficult and time-consuming to obtain approval to attend professional training classes. In addition, managers have tended to hire externally to meet new staffing needs, rather than promoting or transferring existing employees. These practices have hurt employee morale. Peter thinks that implementing the payroll and HRM modules of the ERP system will solve these problems.

Peter meets with Elizabeth Venko and Ann Brandt to discuss the process of migrating from AOE's current stand-alone payroll and HRM systems to integration of those functions in the new ERP system. Elizabeth and Ann agree that such a conversion would improve both the efficiency of payroll processing and the effectiveness of HR management. They begin developing a detailed timetable for the system conversions. As you read this chapter, think about the relationships between HRM and payroll activities and how an integrated database can make both functions more efficient and effective.

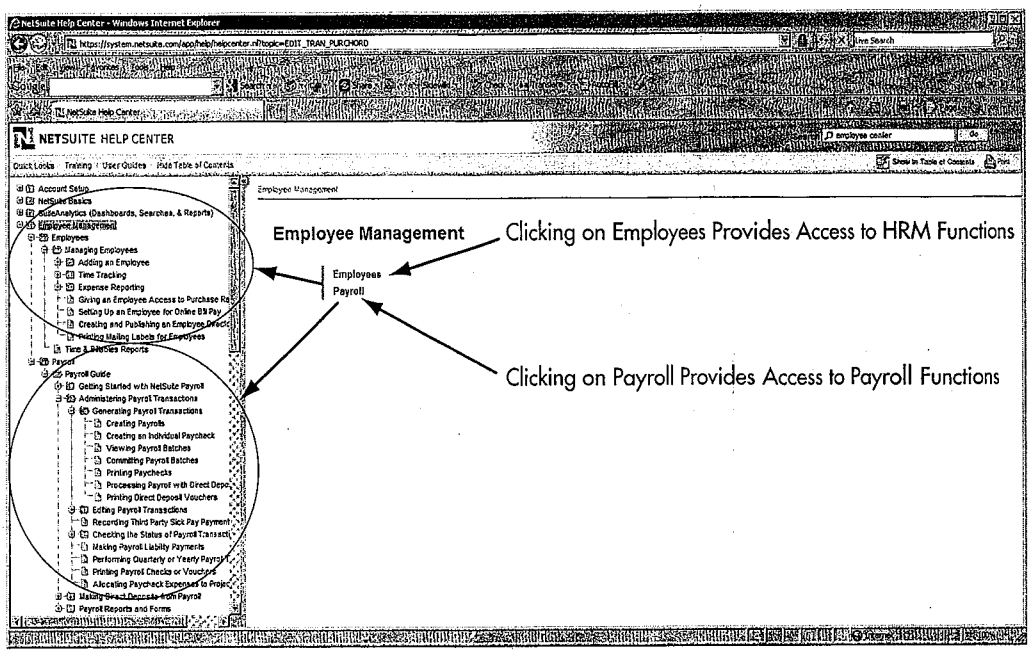
Introduction

The *human resources management (HRM)/payroll cycle* is a recurring set of business activities and related data processing operations associated with effectively managing the employee workforce. The more important tasks include the following:

1. Recruiting and hiring new employees
2. Training
3. Job assignment
4. Compensation (payroll)
5. Performance evaluation
6. Discharge of employees due to voluntary or involuntary termination

Tasks 1 and 6 are performed only once for each employee, whereas tasks 2 through 5 are performed repeatedly for as long as an employee works for the company. In most companies, these six activities are split between two separate systems. Task 4, compensating employees, is the

FIGURE 15-1
Integration of HRM and Payroll Functions in Typical ERP System



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payroll system's primary function. (In addition, as discussed in Chapter 14, the payroll system also allocates labor costs to products and departments for use in product pricing and mix decisions.) The HRM system performs the other five tasks. In many companies, these two systems are organizationally separate: The HRM system is usually the responsibility of the director of human resources, whereas the controller manages the payroll system. However, as Figure 15-1 shows, ERP systems integrate the two sets of activities.

This chapter focuses primarily on the payroll system, because accountants have traditionally been responsible for this function. We begin by describing the design of the integrated HRM/payroll system and discuss the basic controls necessary to ensure that it provides management with reliable information and complies with government regulations. We then describe in detail each of the basic payroll cycle activities. We conclude with a discussion of options for outsourcing both payroll and HRM functions.

HRM/Payroll Cycle Information System

Figure 15-2 depicts the portion of an ERP system that supports the HRM/payroll cycle. The HRM-related activities (information about hiring, firing, transfers, training, etc.) and the collection of information about the use of employee time occur daily. The actual processing of payroll, however, occurs only periodically because in most organizations employees are paid on a weekly, biweekly, or monthly basis rather than every day. Thus, payroll is one application that continues to be processed in batch mode.

Overview of HRM Process and Information Needs

Organizational success depends on skilled and motivated employees because their knowledge and skills affect the quality of the goods and services provided to customers. Indeed, in professional service organizations, such as accounting and law firms, employees' knowledge and skills *are* the principal component of the company's product, and labor costs represent the major expense incurred in generating revenues. Even in manufacturing firms, where direct labor costs represent only a fraction of total direct costs, employees are a key cost driver in that the quality of their work affects both overall productivity and product defect rates. Thus, it is not surprising to find that some stock analysts believe that employee skills and knowledge may be worth several times the value of a company's tangible assets such as inventory, property, and equipment.

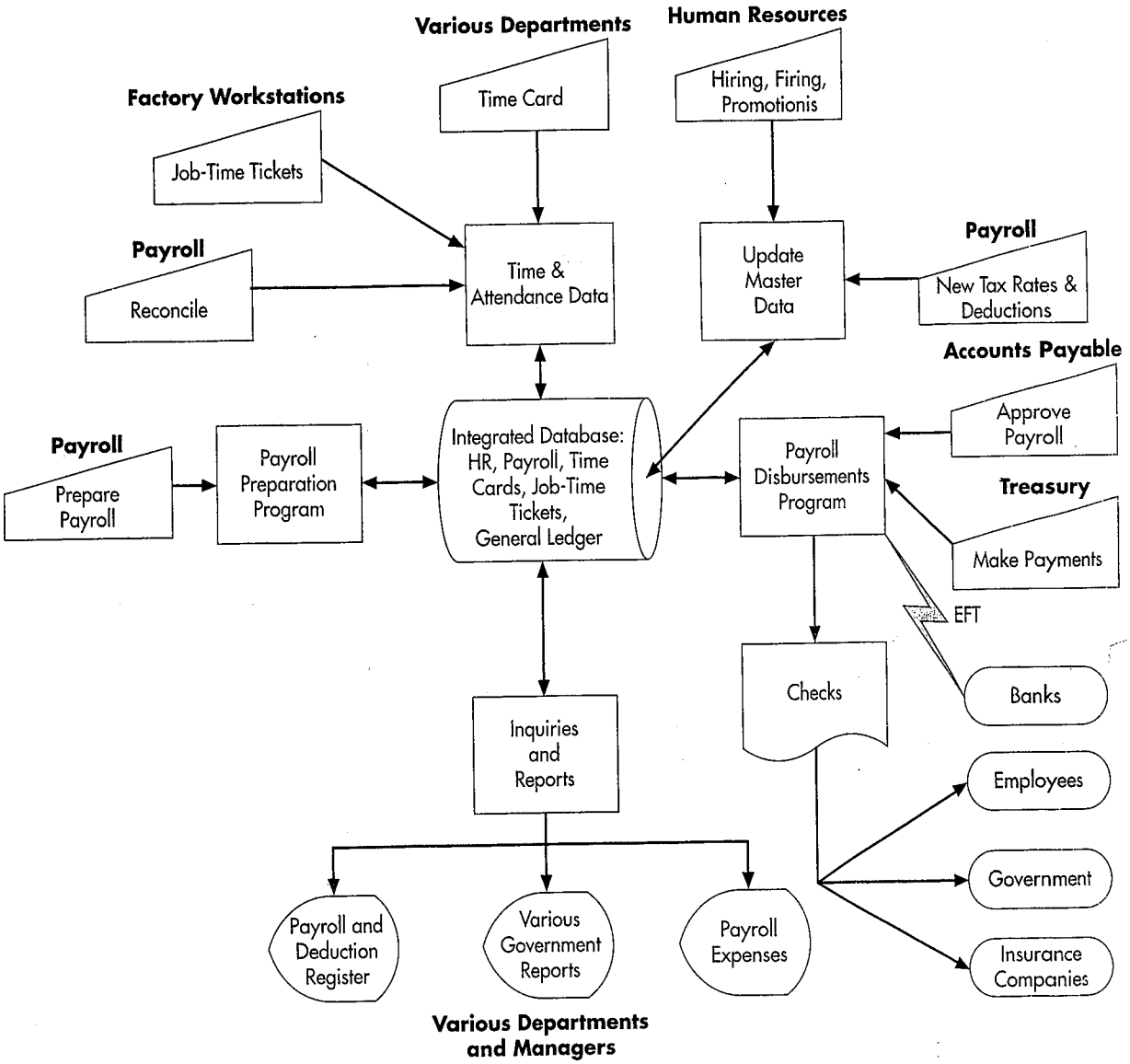


FIGURE 15-2
Portion of ERP System That Supports Human Resources Management and Payroll

To effectively utilize the organization's employees, the HRM/payroll system must collect and store the information managers need to answer the following kinds of questions:

- How many employees does the organization need to accomplish its strategic plans?
- Which employees possess specific skills?
- Which skills are in short supply? Which skills are in oversupply?
- How effective are current training programs in maintaining and improving employee skill levels?
- Is overall performance improving or declining?
- Are there problems with turnover, tardiness, or absenteeism?

The HRM/payroll master database (Figure 15-2) provides some of the information needed to answer those questions. However, it typically contains only descriptive information, such as which employees possess which skills and who has attended various training programs. Although such information enables managers to make staffing-related decisions, it does not help leverage the specific knowledge and expertise possessed by its employees.

To more effectively use employees' knowledge and skills, many organizations have invested in knowledge management systems. ***Knowledge management systems*** not only serve as a directory identifying the areas of expertise possessed by individual employees, but also capture and

store that knowledge so that it can be shared and used by others. Knowledge management systems can significantly improve productivity. For example, professional consulting firms often provide similar services to many different clients. Knowledge management software enables consultants to store their solutions to specific problems in a shared database. Oftentimes, those solutions can be used as a template to address the needs of other clients. Such reuse of knowledge saves time on future engagements. Access to the shared database also enables employees to learn from geographically dispersed colleagues who have had prior experience in addressing a particular issue.

Recognizing the value of employees' knowledge and skills can help companies better understand the true costs associated with excessive turnover. In addition to the direct expenses associated with the hiring process (advertising, background checks, interviewing candidates, etc.), there are also the costs associated with hiring temporary help, training new employees, and the reduced productivity of new employees until they fully learn how to perform their tasks. Thus, estimates place the total costs to replace an employee at about 1.5 times the annual salary. Consequently, organizations that experience below-industry-average turnover rates reap considerable cost savings compared to rivals with higher turnover rates. For example, consider two companies, each with 1,500 employees earning on average $40,000. One company experiences 20% annual turnover, the other only 5%. The company with 20% annual turnover would incur costs of $18 million (300 employees times $60,000) to replace employees, compared to only $4.5 million for the company experiencing only 5% annual turnover. Of course, some turnover will always occur and may even be desirable. For example, professional consulting organizations have traditionally encouraged some level of turnover because they believe it provides an important source of new ideas. The key is to control and manage turnover rates so that they are not excessive.

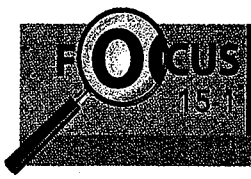
Employee morale is also important. Low employee morale creates financial costs when it results in turnover. Conversely, there is increasing evidence that high employee morale provides financial benefits. For example, Sears collected detailed data on employee satisfaction, actual behavior, and customer satisfaction. Statistical analysis revealed that employee attitudes about their jobs and the company significantly predicted how they behaved with customers, which in turn affected customer satisfaction as measured by repeat sales. Sears' results are not isolated; research has found a positive correlation between employee attitudes and financial performance, particularly in highly competitive industries[1]. Thus, it is not surprising that many companies are monitoring employee attitudes. Focus 15-1 describes some of the methods companies use to better understand employees' job-related concerns and how they use that information to improve working conditions and morale.

Threats and Controls

Figure 15-2 shows that all HRM/payroll cycle activities depend on the integrated database that contains information about employees, payroll, and use of employee time. Therefore, the first general threat listed in Table 15-1 is inaccurate or invalid master data. Inaccurate employee master data could result in over- or understaffing. It can also create inefficiencies due to assigning employees to perform tasks for which they are not fully qualified. Inaccurate payroll master data that results in errors in paying employees can create significant morale issues. In addition, the organization may incur fines for errors made in paying payroll taxes. Errors in data about use of employee time can result in inaccurate performance evaluations and mistakes in calculating the costs of the organization's products and services.

One way to mitigate the threat of inaccurate or invalid master data is to use the various processing integrity controls discussed in Chapter 10 to minimize the risk of data input errors. It is also important to restrict access to that data and configure the system so that only authorized employees can make changes to master data. This requires changing the default configurations of employee roles in ERP systems to appropriately segregate incompatible duties. For example, consider the situation where a payroll clerk types in the name of an employee who is not currently in the database. The default configurations of most integrated ERP systems would respond by asking

[1] Alex Edmans, "Does the Stock Market Fully Value Intangibles? Employee Satisfaction and Equity Prices," (June 2010), SSRN.com/abstract=985735; Rajiv D. Banker and Raj Mashruwala, "The Moderating Role of Competition in the Relationship between Nonfinancial Measures and Future Financial Performance," Contemporary Accounting Research (24:3, Fall 2007): pp. 763–793.



The Value of Understanding Employee Jobs and Attitudes

A growing number of companies, including Walt Disney, Continental Airlines, Sysco, and Amazon.com, periodically require some of their upper-level executives to spend time in the trenches to better understand job duties and pressures. The experience can help executives identify needed changes in working conditions. For example, when the CEO of Loews Hotels assumed the roles of bellman, pool attendant, and housekeeper at a Florida hotel, he found that the company's polyester uniform caused him to sweat profusely. He immediately ordered that the style and material be altered for all employees. Immersion experiences also enable top executives to better empathize with rank-and-file workers. For example, after the vice president of DaVita Inc., a major provider of dialysis treatment, spent three days working in one of the company's clinics, she understood how physically demanding and stressful the work is. She also personally experienced how the need to respond to life-threatening emergencies can result in delays in completing corporate-mandated reports. As a result of these experiences, the vice president now strives to ensure that new initiatives and changes in procedures are implemented in a manner that does not interfere with clinic technicians' primary patient care responsibilities.

Executive immersion experiences are important because there is a growing body of evidence that employees who have positive attitudes contribute to improved profitability by being more willing to take initiative, to step in when needed to help fulfill customer requests, and to promote the company when not at work. Thus, it is not surprising to find that many companies regularly survey employees to learn about their concerns. These new surveys replace traditional questions about job satisfaction with ones specially designed to better reveal employees' true attitudes about their job, coworkers, and managers. The answers can help managers take specific steps to improve employee morale and motivation. For example, such surveys informed the manager of a fast food franchise in Houston that some employees were unhappy because they were assigned too few hours to work but that others were unhappy because they had to work too many hours. The manager now makes a point to review work schedules for the following month early enough to accommodate employees' desires as much as possible. As with executive immersion experience, follow-through on such survey data is critical because if companies do not act on feedback obtained from employees by these methods, employee morale and performance drop sharply.

TABLE 15-1 Threats and Controls in the Payroll/HRM Cycle

Activity	Threat	Controls (first number refers to the corresponding threat)
General issues throughout entire HRM/ payroll cycle	1. Inaccurate or invalid master data 2. Unauthorized disclosure of sensitive information 3. Loss or destruction of data 4. Hiring unqualified or larcenous employees 5. Violations of employment laws	1.1 Data processing integrity controls 1.2 Restriction of access to master data 1.3 Review of all changes to master data 2.1 Access controls 2.2 Encryption 3.1 Backup and disaster recovery procedures 4.1 Sound hiring procedures, including verification of job applicants' credentials, skills, references, and employment history 4.2 Criminal background investigation checks of all applicants for finance-related positions 5.1 Thorough documentation of hiring, performance evaluation, and dismissal procedures 5.2 Continuing education on changes in employment laws
Update payroll master data	6. Unauthorized changes to payroll master data 7. Inaccurate updating of payroll master data	6.1 Segregation of duties: HRM department updates master data, but only payroll department issues paychecks 6.2 Access controls 7.1 Data processing integrity controls 7.2 Regular review of all changes to master payroll data
Validate time and attendance data	8. Inaccurate time and attendance data	8.1 Source data automation for data capture 8.2 Biometric authentication 8.3 Segregation of duties (reconciliation of job-time tickets to time cards) 8.4 Supervisory review

(*Continued*)

TABLE 15-1 (*Continued*)

Activity	Threat	Controls (first number refers to the corresponding threat)
Prepare payroll	9. Errors in processing payroll	9.1 Data processing integrity controls: batch totals, cross-footing of the payroll register, use of a payroll clearing account and a zero-balance check 9.2 Supervisory review of payroll register and other reports 9.3 Issuing earnings statements to employees 9.4 Review of IRS guidelines to ensure proper classification of workers as either employees or independent contractors
Disburse payroll	10. Theft or fraudulent distribution of paychecks	10.1 Restriction of physical access to blank payroll checks and the check signature machine 10.2 Restriction of access to the EFT system 10.3 Prenumbering and periodically accounting for all payroll checks and review of all EFT direct deposit transactions 10.4 Require proper supporting documentation for all paychecks 10.5 Use of a separate checking account for payroll, maintained as an imprest fund 10.6 Segregation of duties (cashier versus accounts payable; check distribution from hiring/firing; independent reconciliation of the payroll checking account) 10.7 Restriction of access to payroll master database 10.8 Verification of identity of all employees receiving paychecks 10.9 Redepositing unclaimed paychecks and investigating cause
Disburse payroll taxes and miscellaneous deductions	11. Failure to make required payments 12. Untimely payments 13. Inaccurate payments	11.1 Configuration of system to make required payments using current instructions from IRS (Publication Circular E) 12.1 Same as 11.1 13.1 Processing integrity controls 13.2 Supervisory review of reports 13.3 Employee review of earnings statement

whether the clerk wants to create a new employee record. This violates segregation of duties by permitting the person who does the recording (payroll) to also authorize the creation of new accounts. Similarly, the default configurations of many systems permit payroll staff not only to read but also to change the salary information in the employee payroll master file. These examples are just some of the many areas that the controller or CFO needs to review to ensure that various users are assigned only those privileges necessary to perform their specified job duties. Although the procedures for modifying configurations vary across different software packages, knowing what changes need to be made requires only a sound understanding of proper segregation of duties for different business processes. However, since such preventive controls can never be 100% effective, Table 15-1 also indicates that an important detective control is to regularly produce a report of all changes to master data and review them to verify that the database remains accurate.

A second general threat in the HRM/payroll cycle is unauthorized disclosure of sensitive information, such as salary and performance evaluations for individual employees. Such disclosures can create morale problems if employees learn that their pay differs significantly from coworkers. In addition, unauthorized disclosure of performance evaluations or reasons for firing an employee may subject the organization to lawsuits. The best control procedure for reducing the risk of unauthorized disclosure of payroll data is using multifactor authentication and physical security controls to restrict access to HRM/payroll master data to only those employees who need such access to perform their jobs. It is also important to configure the system to limit employees' ability to use the system's built-in query capabilities to indirectly infer sensitive information. For example, queries about salary averages should be allowed only if the query set is sufficiently large. Otherwise, someone could infer another employee's salary by writing a query that calculates the average salary for two people: the query writer and the employee of interest. Encrypting the database (control 2.2) provides additional protection by making the information unintelligible to anyone who succeeds in obtaining unauthorized access to the database. Encryption also prevents information technology (IT) employees who do not have access to the ERP system from using operating system utilities to view sensitive information.

A third general threat in the HRM/payroll cycle concerns the loss or destruction of master data. The best way to mitigate the risk of this threat is to employ the backup and disaster recovery procedures that were discussed in Chapter 10.

A fourth general threat in the HRM/payroll cycle is hiring unqualified or larcenous employees. Hiring unqualified employees can increase production expenses, and hiring a larcenous employee can result in the theft of assets. Both problems are best dealt with by appropriate hiring procedures. Skill qualifications for each open position should be stated explicitly in the position control report. Candidates should be asked to sign a statement on the job application form that confirms the accuracy of the information being submitted and provides their consent to a thorough background check of their credentials and employment history. Independent verification of an applicant's credentials is important because resumes often contain false or embellished information. For example, in November 2008 the *Wall Street Journal* reported a number of cases where resumes for senior executives at companies contained information that could not be verified. To reduce the risk of hiring larcenous employees, organizations should hire a professional firm to perform thorough background checks of all applicants for positions that involve access to financial data and assets, to identify applicants with a prior criminal record.

The fifth general threat in the HRM/payroll cycle is violation of applicable laws and regulations concerning the proper hiring and dismissal of employees. The government imposes stiff penalties on firms that violate provisions of employment law. In addition, organizations can also be subject to civil suits by alleged victims of employment discrimination. Table 15-1 shows that the best control procedure to mitigate these potential problems is to carefully document all actions relating to advertising for, recruiting, and hiring new employees and to the dismissal of employees; this will demonstrate compliance with the applicable government regulations. Continued training to keep current with employment law is also important.

Payroll Cycle Activities

Figure 15-3 presents a context diagram of the payroll system. It shows that there are five major sources of inputs to the payroll system. The HRM department provides information about hirings, terminations, and pay-rate changes due to raises and promotions. Employees initiate changes in their discretionary deductions (e.g., contributions to retirement plans). The various departments provide data about actual hours employees work. Government agencies provide tax rates and instructions for meeting regulatory requirements. Similarly, insurance companies and other organizations provide instructions for calculating and remitting various withholdings.

Figure 15-3 shows that checks (which may be electronic) are the payroll system's principal output. Employees receive individual *paychecks* in compensation for their services. A *payroll check* is sent to the bank to transfer funds from the company's regular accounts to its payroll account. Checks also are issued to government agencies, insurance companies, and other organizations to meet company obligations (e.g., taxes, insurance premiums). In addition, the payroll system produces a variety of reports, which we discuss later, for internal and external use.

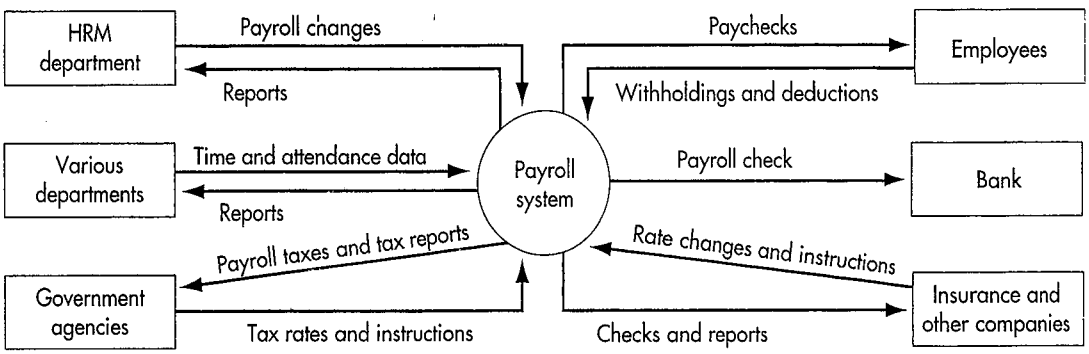


FIGURE 15-3
Context Diagram of the Payroll Portion of the HRM/Payroll Cycle

Figure 15-4 shows the basic activities performed in the payroll cycle. We now discuss each of those activities. For each activity, we describe how the information needed to perform and manage the activity is collected, processed, and stored. We also explain the controls necessary to ensure not only the reliability of that information but also the safeguarding of the organization's resources.

Update Payroll Master Database

The first activity in the HRM/payroll cycle involves updating the payroll master database to reflect various types of internally initiated changes: new hires, terminations, changes in pay rates, or changes in discretionary withholdings (circle 1.0 in Figure 15-4). In addition, periodically the master data needs to be updated to reflect changes in tax rates and deductions for insurance.

PROCESS Figure 15-2 shows that the HRM department is responsible for updating the payroll master database for internally initiated changes related to employment, whereas the payroll department updates information about tax rates and other payroll deductions when it receives notification of changes from various government units and insurance companies. Although payroll is processed in batch mode, the HRM department has online access to update the payroll master database so that all payroll changes are entered in a timely manner and are properly reflected in the next pay period. Records of employees who quit or are fired should not be deleted immediately, however, because some year-end tax reports, including W-2 forms, require data about all employees who worked for the organization at any time during the year.

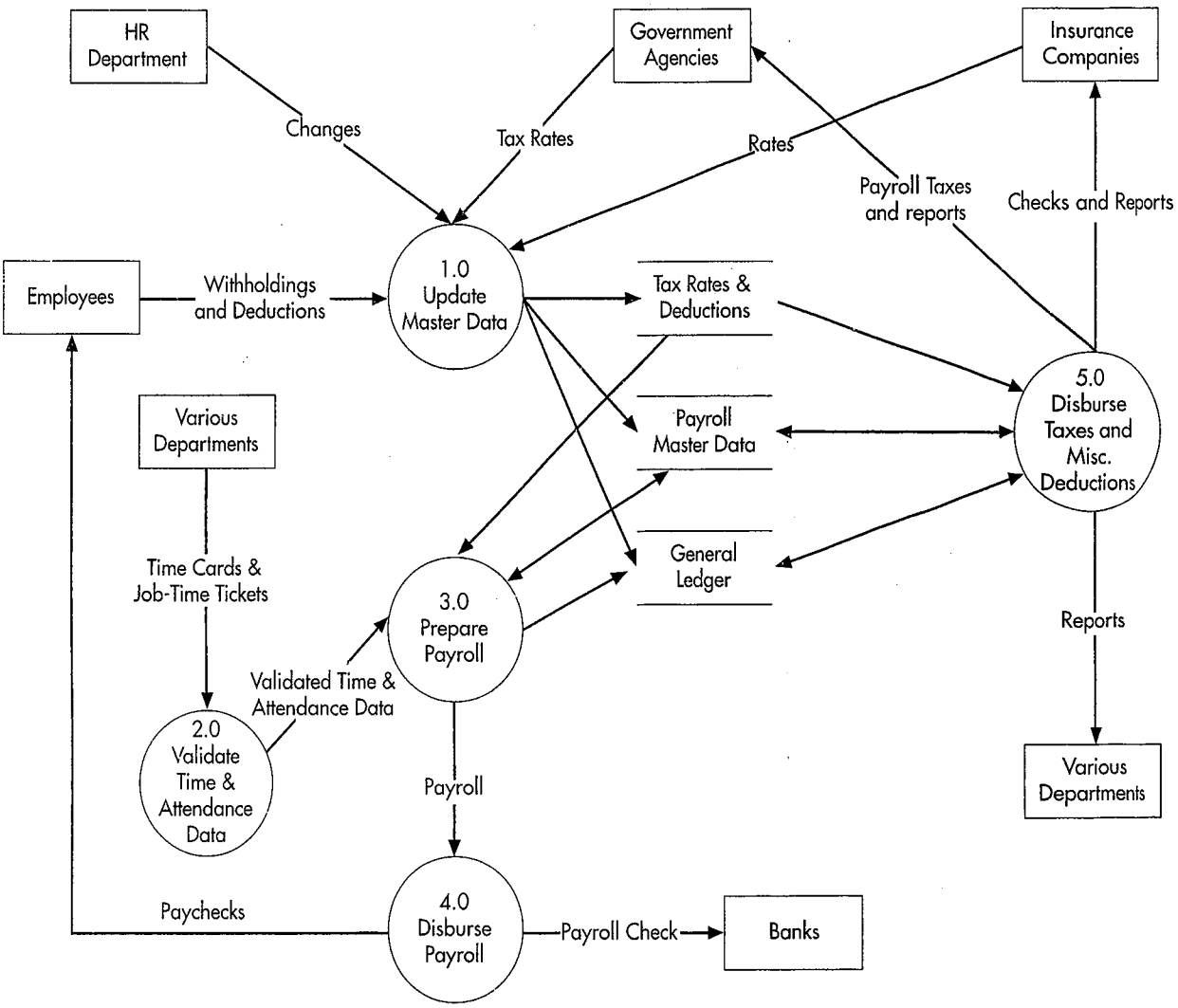


FIGURE 15-4
Level 0 Data Flow Diagram for the Payroll Cycle

THREATS AND CONTROLS Unauthorized changes to payroll master data (threat 6 in Table 15-1) can result in increased expenses from unjustified payments to employees. Proper segregation of duties is the key control procedure for dealing with this threat. As shown in Figure 15-2, only the HRM department should be able to update the payroll master file for hirings, firings, pay raises, and promotions. HRM department employees in turn should not directly participate in payroll processing or paycheck distribution. This segregation of duties prevents someone with access to paychecks from creating fictitious employees or altering pay rates and then intercepting those fraudulent checks. In addition, all changes to the payroll master file should be reviewed and approved by someone other than the person recommending the change. To facilitate this review, the system should be configured to produce a report listing all payroll-related changes and send the report to each affected department supervisor for review.

Controlling access to the payroll system (control 6.2) is also important. The system should be configured to compare user IDs and passwords with an access control matrix that (1) defines what actions each employee is allowed to perform and (2) confirms what files each employee is allowed to access.

Another threat is inaccurate updating of payroll master data, which can result in errors in paying employees and fines for not remitting proper amounts of payroll taxes to the government. To mitigate this threat, appropriate processing integrity controls discussed in Chapter 10, such as validity checks on employee number and reasonableness tests for the changes being made, should be applied to all payroll change transactions. In addition, having department managers review reports of all changes to employees in their department provides a timely way to detect errors.

Validate Time and Attendance Data

The second step in the payroll cycle is to validate each employee's time and attendance data (circle 2.0 in Figure 15-4).

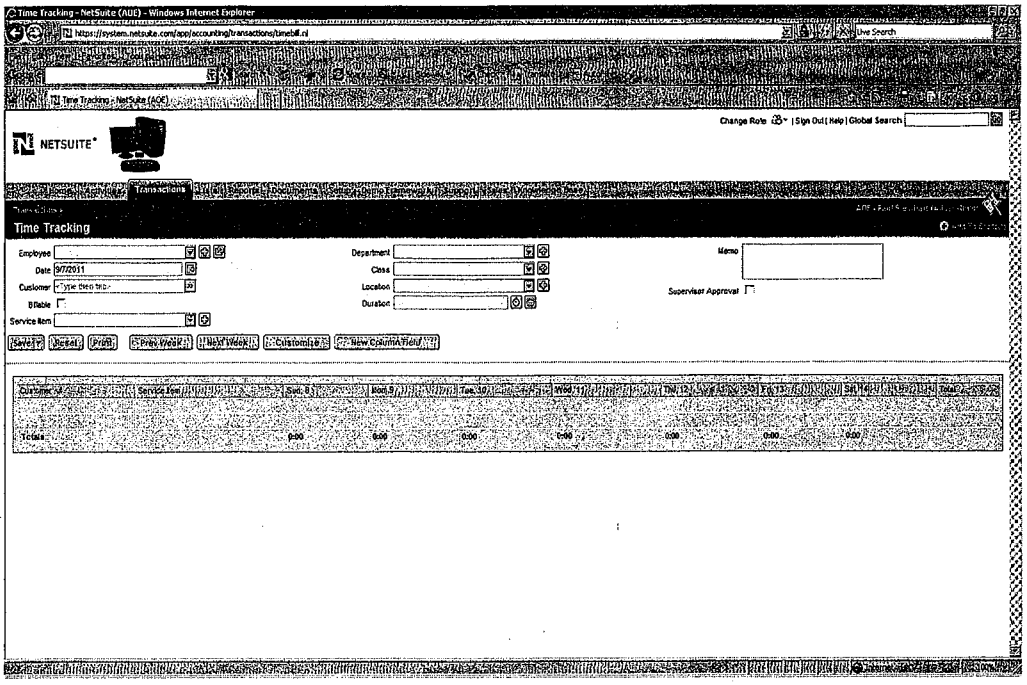
PROCESS How employee time and attendance data is collected differs depending on the employee's pay status. For employees paid on an hourly basis, many companies use a ***time card*** to record the employee's daily arrival and departure times. Employees who earn a fixed salary (e.g., managers and professional staff) seldom record their labor efforts on time cards. Instead, their supervisors informally monitor their presence on the job.

As discussed in Chapter 14, manufacturing companies also use job-time tickets to record detailed data about how employees use their time (i.e., which jobs they perform). The job-time ticket data are used to allocate labor costs among various departments, cost centers, and production jobs. Professionals in such service organizations as accounting, law, and consulting firms similarly track the time they spend performing various tasks and for which clients, recording that data on ***time sheets*** (see Figure 15-5 for an example of a data entry screen to track time). Their employers use the time sheets to assign costs and accurately bill clients for services provided.

Sales staff often are paid either on a straight commission or on a salary plus commission basis. This requires the staff to carefully record the amount of their sales. In addition, some sales staff are paid bonuses for exceeding targets. An increasing number of companies in the United States are extending such incentive bonuses to employees other than sales staff, to motivate employees to improve their productivity and work quality. For example, Nucor Corporation, one of the largest steel producers in the United States, pays its steelworkers an hourly rate set at approximately 60% of the industry average, plus a bonus based on the tons of steel they produce and ship. Companies have long used stock options to reward executives; in recent years, many companies have extended this practice to their nonexecutive employees as well. The argument is that stock options motivate employees to actively look for ways to improve service and cut costs so that the value of their compensation package rises.

Using incentives, commissions, and bonuses requires linking the payroll system and the information systems of sales and other cycles to collect the data used to calculate bonuses. Moreover, the bonus/incentive schemes must be properly designed with realistic, attainable goals that can be objectively measured. It is also important that goals be congruent with corporate objectives and that managers monitor goals to ensure that they continue to be appropriate. Indeed, poorly designed incentive pay schemes can result in undesirable behavior. For example, Sears Automotive experienced unintended negative effects from implementing a new incentive plan in

FIGURE 15-5
Example of Data Entry Screen to Track Time (Time Sheet)



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the early 1990s that paid its repair staff a commission based on the amount of parts sold and number of hours worked. The intent was to focus employees' attention on how their efforts affected the company's bottom line. The result, however, was a scandal in which it was alleged that Sears employees recommended unnecessary repairs to boost their own pay. The alleged abuses reduced public trust in Sears Automotive and led to lower revenues. Although Sears discontinued use of this incentive system, it took years to fully regain the consumer trust it had lost. Besides the possibility of creating unintended and undesirable behaviors, poorly designed incentive pay schemes can also run afoul of legal, tax, and regulatory requirements. Thus, as Focus 15-2 explains, accountants should be involved in reviewing a company's compensation practices.

THREATS AND CONTROLS The main threat to this payroll activity is inaccurate time and attendance data. Inaccuracies in time and attendance records can result in increased labor expenses and erroneous labor expense reports. Moreover, inaccuracies can either hurt employee morale (if paychecks are incorrect or missing) or result in payments for labor services not rendered.

Source data automation can reduce the risk of *unintentional* errors in collecting time and attendance data. For example, badge readers can be used to collect job-time data for production employees and automatically feed the data to the payroll processing system. Using technology to capture time and attendance data can also improve productivity and cut costs. For example, the retail chain Meijer, Inc., installed fingerprint readers at its cash registers so that employees could log in and immediately begin working. The company estimates that this eliminated several minutes of wasted time spent walking from the time clock in the back of the store to the register. Saving a few minutes per employee may not sound dramatic, but when multiplied across thousands of employees in an industry with a profit margin of less than 1%, the effect on the bottom line can be significant. Source data automation can also be used to collect time and attendance data for professional service staff. For example, AT&T's internal service staff uses touch-tone telephones to log in time spent on various tasks, thereby eliminating the use of paper time sheets. Various data processing integrity checks discussed in Chapter 10, such as a limit check on hours worked and a validity check on employee number, ensure the accuracy of that information.

Information technology can also reduce the risk of *intentional* inaccuracies in time and attendance data. For example, some manufacturing companies now use biometric authentication techniques (control 8.2), such as hand scans, to verify the identity of the employee who is clocking in and out of work. The objective is to prevent an employee from leaving work early but having a friend falsely record that person as being at work. Segregation of duties is also important. Time card data, used for calculating payroll, should be reconciled to the job-time ticket data, used for

FOCUS 15-2 Accountants and Compensation Policies

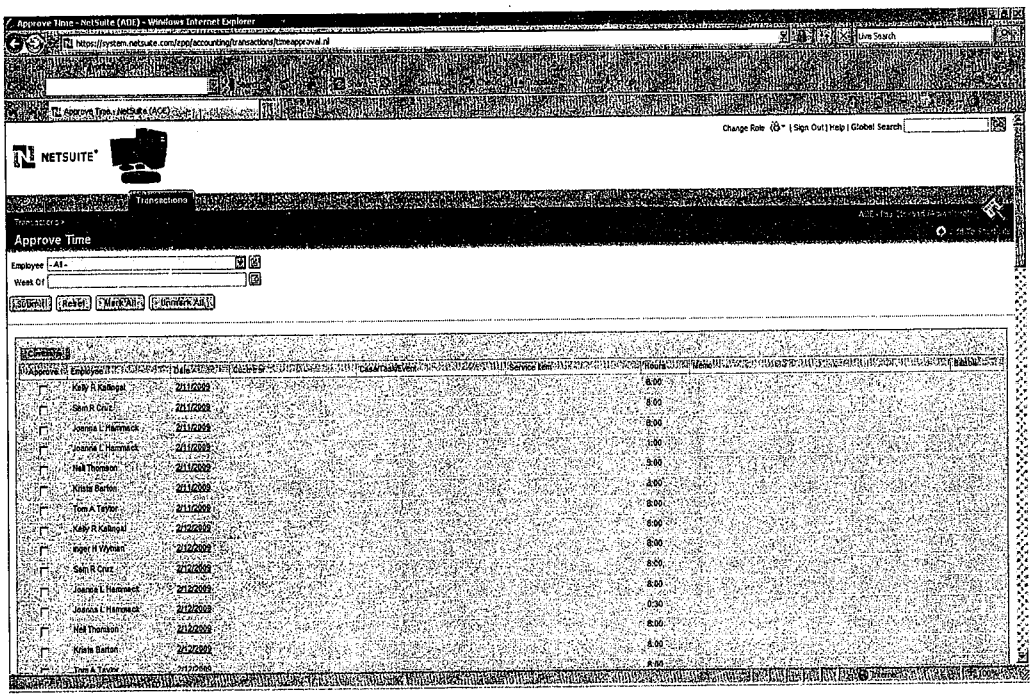
Recent revelations of multimillion-dollar bonuses and large severance packages for top executives of companies with declining financial performance have created the impression that some top executives are more concerned about their own compensation than shareholders' interests. As a result, regulators and Congress have begun to scrutinize executive compensation practices more closely. In particular, the use of stock options attracted a great deal of attention. The Financial Accounting Standards Board (FASB) issued new rules requiring that stock options be expensed, and the major U.S. stock exchanges now require companies to obtain shareholder approval of all equity-based compensation.

In the past, top executives often were involved indirectly in crafting their own compensation packages by hiring the consultants who designed those packages. Now, in response to recent scandals, the role of board compensation committees is increasing. Accountants can help these committees improve their company's compensation plans by providing advice concerning the financial and tax effects of proposed changes in executive compensation. One area where accounting expertise can be especially helpful is in identifying the appropriate metrics to use when linking compensation to performance. To be useful, those metrics need to be linked to the factors most important to a particular company's success. Obviously, this varies from company to company. For example, the key measures for a retail organization such as Walmart or Home Depot will be different from those used by an insurance company such as Prudential, which will differ from those that are important to a basic manufacturer such as Alcoa.

Accountants can also help board compensation committees comply with legal and regulatory requirements. For example, members of compensation committees may not understand all the details of tax regulations, such as the Employee Retirement Income Security Act (ERISA), which limit the allowable differences between benefit packages offered to executives and those made available to other employees. Accountants can review proposed changes for compliance with such rules. Finally, accountants can help companies improve shareholder relations by suggesting the best ways to go beyond minimum disclosure rules concerning executive compensation without revealing information vital to continued competitive success.

costing and managerial purposes, by someone not involved in generating that data. The total time spent on all tasks, as recorded on the job-time tickets, should not exceed the attendance time indicated on an employee's time card. Conversely, all time spent at work should be accounted for on the job-time tickets.

In addition, requiring departmental supervisors to review and approve time cards and job-time tickets (see Figure 15-6, which illustrates one way to implement control 8.4) provides a



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FIGURE 15-6
Example of Supervisory Approval of Time Worked Screen

detective control on the accuracy of time and attendance data. Supervisory review is particularly important for employees who telecommute. Analysis of system logs can provide assurance that telecommuters are truly working the amount of time for which they are getting paid and that they are not operating a personal business on the side, using company-provided assets.

Prepare Payroll

The third step in the payroll cycle is preparing payroll (circle 3.0 in Figure 15-4).

PROCESS Figure 15-7 shows the sequence of activities in processing payroll. First, payroll transaction data is edited, and the validated transactions are then sorted by employee number. If the organization is processing payrolls from several divisions, each of these payroll transaction files must also be merged. The sorted payroll transactions file is then used to prepare employee paychecks. For each employee, the payroll master file record and corresponding transaction record are read, and gross pay is calculated. For hourly employees, the number of hours worked is multiplied by the wage rate, and then any applicable premiums for overtime or bonuses are

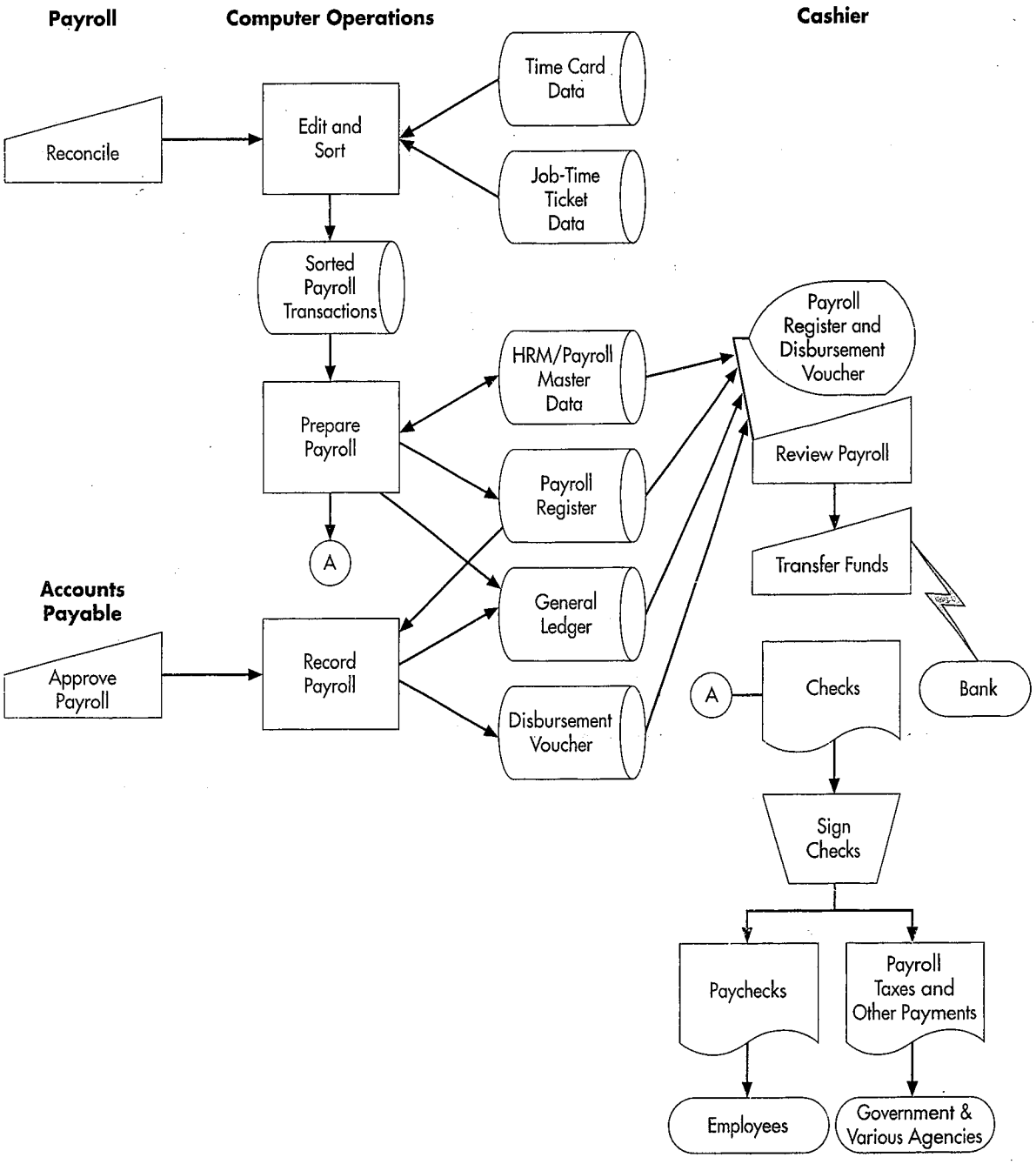


FIGURE 15-7
Flowchart of Payroll Batch Processing

added. For salaried employees, gross pay is a fraction of the annual salary, where the fraction reflects the length of the pay period. For example, salaried employees paid monthly would receive one-twelfth of their annual salary each pay period. Any applicable commissions, bonuses, and other incentives are also included in calculating gross pay.

Next, all payroll deductions are summed, and the total is subtracted from gross pay to obtain net pay. Payroll deductions fall into two broad categories: payroll tax withholdings and voluntary deductions. The former includes federal, state, and local income taxes, as well as Social Security taxes. Voluntary deductions include contributions to a pension plan; premiums for group life, health, and disability insurance; union dues; and contributions to various charities.

Once net pay is calculated, the year-to-date fields for gross pay, deductions, and net pay in each employee's record in the payroll master file are updated. Maintaining accurate cumulative earnings records is important for two reasons. First, because Social Security tax withholdings and other deductions have cutoffs, the company must know when to cease deductions for individual employees. Second, this information is needed to ensure that the appropriate amounts of taxes and other deductions are remitted to government agencies, insurance companies, and other organizations (such as the United Way). This information also must be included in the various reports filed with those agencies.

Next, the payroll and deduction registers are created. The ***payroll register*** lists each employee's gross pay, payroll deductions, and net pay in a multicolumn format. It also serves as the supporting documentation to authorize transferring funds to the organization's payroll checking account. The ***deduction register*** lists the miscellaneous voluntary deductions for each employee. Figure 15-8 presents examples of these two reports.

Finally, the system prints employee paychecks (or facsimiles, in the case of direct deposit). These also typically include an ***earnings statement,*** which lists the amount of gross pay, deductions, and net pay for the current period and year-to-date totals for each category.

As each payroll transaction is processed, the system also allocates labor costs to the appropriate general ledger accounts by checking the code on the job-time ticket record. The system maintains a running total of these allocations until all employee payroll records have been processed. These totals, and the column totals in the payroll register, form the basis for the summary journal entry, which is posted to the general ledger after all paychecks have been printed.

The payroll system also produces a number of detailed reports. Table 15-2 describes the content of the most common reports. Some of these are for internal use, but many are required by various government agencies. Consequently, as Figure 15-9 shows, the HRM/payroll portion of ERP systems provides extensive support for meeting the reporting requirements of federal, state, and local governments.

Alpha Omega Electronics — **PAYROLL REGISTER** — **Period Ended 12/03/2011**

					Deductions				
Employee No.	Name	Hours	Pay Rate	Gross Pay	Fed. Tax	FICA	State Tax	Misc.	Net Pay
37884	Jarvis	40.0	6.25	250.00	35.60	18.75	16.25	27.60	151.80
37885	Burke	43.6	6.50	295.10	42.40	22.13	19.18	40.15	171.24
37886	Lincoln	40.0	6.75	270.00	39.20	20.25	17.55	27.90	165.10
37887	Douglass	44.2	7.00	324.10	46.60	24.31	21.07	29.62	202.50

Alpha Omega Electronics — **DEDUCTION REGISTER** — **Period Ended 12/03/2011**

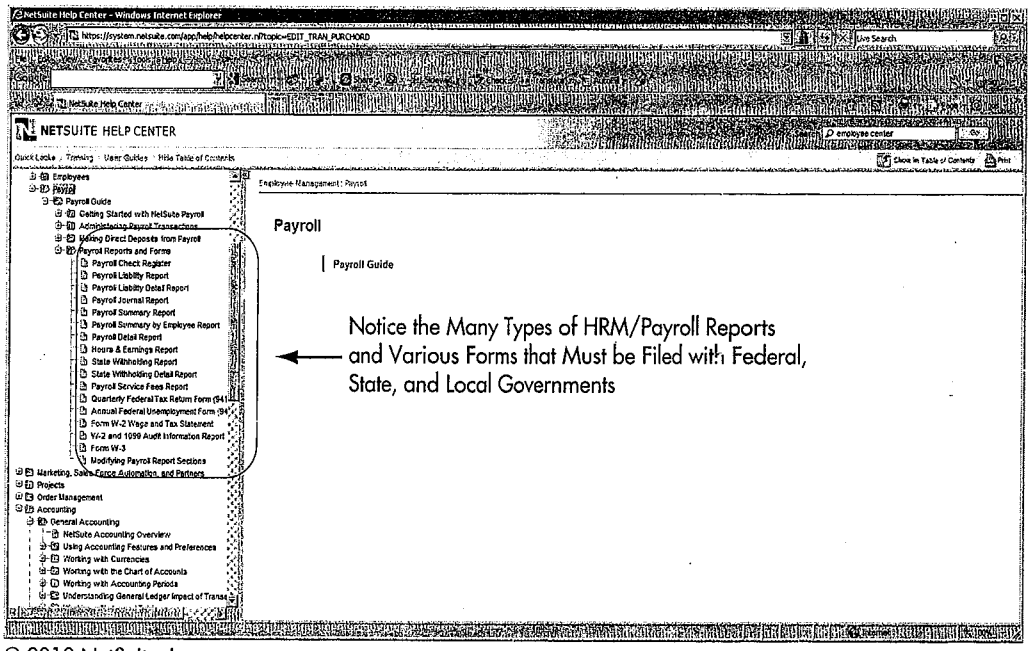
		Miscellaneous Deductions					
Employee No.	Name	Health Ins.	Life Ins.	Retirement	Union Dues	Savings Bond	Total Misc.
37884	Jarvis	10.40	5.50	7.50	4.20	0.00	27.60
37885	Burke	11.60	5.50	8.85	4.20	10.00	40.15
37886	Lincoln	10.40	5.20	8.10	4.20	0.00	27.90
37887	Douglass	10.20	5.50	9.72	4.20	0.00	29.62

FIGURE 15-8
Examples of Payroll and Deduction Registers

TABLE 15-2 Contents and Purpose of Commonly Generated HRM/Payroll Reports

Report Name	Contents	Purpose
Cumulative earnings register	Cumulative year-to-date gross pay, net pay, and deductions for each employee	Used for employee information and annual payroll reports
Workforce inventory	List of employees by department	Used in preparing labor-related reports for government agencies
Position control report	List of each authorized position, job qualifications, budgeted salary, and position status (filled or vacant)	Used in planning future workforce needs
Skills inventory report	List of employees and current skills	Useful in planning future workforce needs and training programs
Form 941	Employer's quarterly federal tax return (showing all wages subject to tax and amounts withheld for income tax and FICA)	Filed quarterly to reconcile monthly tax payments with total tax liability for the quarter
Form W-2	Report of wages and withholdings for each employee	Sent to each employee for use in preparing individual tax returns; due by January 31
Form W-3	Summary of all W-2 forms	Sent to federal government along with a copy of all W-2 forms; due by February 28
Form 1099-Misc.	Report of income paid to independent contractors	Sent to recipients of income for use in filing their income tax returns; due by January 31
Various other reports to government agencies	Data on compliance with various regulatory provisions, state and local tax reports, etc.	To document compliance with applicable regulations

FIGURE 15-9
Screenshot Showing Typical ERP System Support for Payroll-Related Reports Required for Federal, State, and Local Governments



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THREATS AND CONTROLS The complexity of payroll processing, especially the various tax law requirements, makes it susceptible to errors (threat 9 in Table 15-1). Errors obviously can hurt employee morale, particularly if paychecks are late. In addition to incorrect payroll expense records and reports, processing errors can lead to penalties if the errors result in failure to remit the proper amount of payroll taxes due the government. Similarly, failure to accurately accurately garnishments on employees' wages and remit those funds to the appropriate party can also lead to financial penalties.

Table 15-1 lists three types of data processing integrity controls that can mitigate the threat of payroll errors:

1. *Batch totals.* Even advanced HRM/payroll systems will continue to use batch processing for payroll. Consequently, batch totals should be calculated at the time of data entry and then

checked against comparable totals calculated during each stage of processing. Hash totals of employee numbers, for example, are particularly useful. If the original and subsequent hash totals of employee numbers agree, it means that (1) all payroll records have been processed, (2) data input was accurate, and (3) no bogus time cards were entered during processing. If the batch totals do not agree, the organization has timely evidence of a payroll error (most likely a failure to generate a paycheck for an employee) so that the problem can be promptly corrected.

2. *Cross-footing the payroll register.* The total of the net pay column should equal the total of gross pay less total deductions. If it does not, an error occurred in processing that needs to be promptly investigated and corrected.
3. *A payroll clearing account.* The *payroll clearing account* is a general ledger account that is used in a two-step process to check the accuracy and completeness of recording payroll costs and their subsequent allocation to appropriate cost centers. First, the payroll clearing account is debited for the amount of gross pay; cash is credited for the amount of net pay, and the various withholdings are credited to separate liability accounts. Second, the cost accounting process distributes labor costs to various expense categories and credits the payroll clearing account for the sum of these allocations. The amount credited to the payroll clearing account should equal the amount that was previously debited when net pay and the various withholdings were recorded. This particular internal check is an example of a *zero-balance check* (discussed in Chapter 10), because the payroll clearing account should equal zero once both entries have been posted.

In addition, supervisory review of the payroll register and other reports serves as a detective control to identify payroll processing errors. Issuing employees an earnings statement provides another layer of detective controls, because employees are likely to report obvious errors.

It is also important to properly classify workers as either employees or independent contractors, because misclassification can cause companies to owe substantial back taxes, interest, and even penalties. This issue often arises when department managers attempt to circumvent a general hiring freeze by using independent contractors. The HRM department always should review any decisions to hire temporary or outside help. The IRS provides a checklist of questions that can be used to determine whether a worker should be classified as an employee or an independent contractor.

Disburse Payroll

The next step is the actual disbursement of paychecks to employees (circle 4.0 in Figure 15-4). Most employees are paid either by check or by direct deposit of the net pay amount into their personal bank account. Unlike cash payments, both methods provide a means to document the amount of wages paid.

PROCESS After paychecks have been prepared, accounts payable reviews and approves the payroll register. A disbursement voucher is then prepared to authorize the transfer of funds from the company's general checking account to its payroll bank account. The disbursement voucher is then used to update the general ledger.

After reviewing the payroll register and disbursement voucher, the cashier then prepares and signs a check (or initiates an EFT transaction) transferring funds to the company's payroll bank account. If the organization still issues paper checks, the cashier also reviews, signs, and distributes the employee paychecks. The cashier promptly redeposits any unclaimed paychecks in the company's bank account. A list of unclaimed paychecks is then sent to the internal audit department for further investigation.

Direct deposit is one way to improve the efficiency and reduce the costs of payroll processing. Employees who are paid by direct deposit generally receive a copy of the paycheck indicating the amount deposited along with an earnings statement. The payroll system must generate a series of payroll deposit files, one for each bank through which payroll deposits are made. Each file contains a record for each employee whose account is maintained at a particular bank. Each record includes the employee's name, Social Security number, bank account number, and net pay amount. These files are sent electronically, using electronic data interchange (EDI), to each participating bank. The funds are then electronically transferred from the employer's bank account to the employee's account. Direct deposit thus eliminates the need for the cashier to sign individual payroll checks. The cashier does, however, still have to authorize the release of funds from the organization's regular checking account.

Direct deposit provides savings to employers by eliminating the cost of purchasing, processing, and distributing paper checks. It also reduces bank fees and postage expenses. Consequently, most companies now offer their employees the option of direct deposit payment and encourage them to elect this form of payment. Some employees, however, may not have bank accounts and, therefore, cannot elect direct deposit. Organizations can still eliminate the need to issue paper payroll checks by paying such employees with payroll debit cards. Employees can use payroll debit cards to make purchases and can withdraw available cash at ATM machines. Payroll debit cards are stored value cards that cannot be overdrawn, but they can be replenished with additional funds each payday.

THREATS AND CONTROLS As Table 15-1 indicates, another major threat in the payroll process is the theft of paychecks or the issuance of paychecks to fictitious or terminated employees. This can result in increased expenses and the loss of cash.

Applying to payroll the controls related to other cash disbursements, discussed in Chapter 13, can mitigate this threat. Specifically:

- Access to blank payroll checks and to the check signature machine should be restricted. Similarly, ability to authorize electronic funds transfer (EFT) transactions should be restricted and controlled through the use of strong multifactor authentication.
- All payroll checks should be sequentially prenumbered and periodically accounted for. If payroll is made via direct deposit, all EFT transactions should be reviewed.
- The cashier should sign all payroll checks only when supported by proper documentation (the payroll register and disbursement voucher).

In addition, payroll checks should not be drawn on the organization's regular bank account. Instead, for control purposes, a separate payroll bank account should be used (control 10.5). Doing so limits the company's loss exposure to the amount of cash in the separate payroll account. It also makes it easier to reconcile payroll and to detect paycheck forgery. Like petty cash, the payroll account should be operated as an imprest fund. Each payday, the amount of the check written (or EFT funds transfer) to replenish the payroll checking account should equal the amount of net pay for that period. Thus, when all paychecks have been cashed, the payroll account should have a zero balance. A separate payroll checking account also makes it easier to spot any fraudulent checks when the account is reconciled. As with the other cash disbursements discussed in Chapter 13, segregation of duties is another important control. Thus, accounts payable has responsibility for recording payroll, but the cashier is responsible for distributing paychecks. It is also important that the person who distributes paychecks or authorizes EFT transactions for direct deposit has no other HRM-related duties. To see why this segregation of duties is so important, assume that the person responsible for hiring and firing employees also distributes paychecks. This combination of duties could enable that person to conveniently forget to report an employee's termination and subsequently keep that employee's future paychecks. In addition, the payroll bank account should be reconciled by someone who performs no other payroll or HRM duties.

Use of multifactor authentication and other controls to restrict access to the payroll master database (control 10.7) reduces the risk of creating checks for non-existent employees. In addition, the person responsible for distributing paychecks should be required to positively identify each person picking up a paycheck. Further control is provided by having the internal audit department periodically observe, on a surprise basis, the paycheck distribution process to verify that all paychecks are picked up by valid employees.

Special procedures should be used to handle unclaimed paychecks because they indicate the possibility of a problem, such as a nonexistent or terminated employee. Unclaimed paychecks should be returned to the treasurer's office for prompt redeposit. They should then be traced back to time records and matched against the employee payroll master file to verify that they are indeed legitimate.

Calculate and Disburse Employer-Paid Benefits Taxes and Voluntary Employee Deductions

The final payroll activity is to calculate and remit payroll taxes and employee benefits to the appropriate government or other entity (circle 5.0 in Figure 15-4).

PROCESS Employers must pay Social Security taxes in addition to the amounts withheld from employee paychecks. Federal and state laws also require employers to contribute a specified

percentage of each employee's gross pay, up to a maximum annual limit, to federal and state unemployment compensation insurance funds.

In addition to mandatory tax-related disbursements, employers are responsible for ensuring that other funds deducted from employee paychecks are correctly calculated and remitted in a timely manner to the appropriate entity. Such deductions include court-ordered payments for alimony, child support, or bankruptcy. Many employers also contribute some or all of the amounts to pay for their employees' health, disability, and life insurance premiums as well as making matching contributions to retirement plans.

Many employers also offer their employees ***flexible benefit plans***, under which each employee chooses some minimum coverage in medical insurance, retirement plans, and charitable contributions. Flexible benefit plans place increased demands on a company's HRM/payroll system. For example, the HRM staff of a large company with thousands of employees can spend a considerable amount of time just responding to 401(k) plan inquiries. Moreover, employees want to be able to make changes in their investment decisions on a timely basis. Organizations can satisfy employee demands for such services without increasing costs by providing access to HRM/payroll information on the company's intranet.

THREATS AND CONTROLS The primary threats in this activity are failing to make the necessary remittances, untimely remittances, or errors in those remittances (threats 11-13 in Table 15-1). These problems can result in fines from government agencies and employee complaints if the errors adversely affect their retirement or other benefits.

Circular E, *Employer's Tax Guide*, published by the IRS, provides detailed instructions about an employer's obligations for withholding and remitting payroll taxes and for filing various reports. To mitigate the threats of omitted or untimely remittances, the information in Circular E should be used to configure the payroll system to automatically disburse the funds when payroll is processed. Processing integrity controls, such as cross-footing checks and batch totals, minimize the risk of inaccuracies. Regular supervisory review of payroll reports provides a detective control. In addition, providing employees with earnings statements enables them to timely detect and report any problems.

Outsourcing Options: Payroll Service Bureaus and Professional Employer Organizations

In an effort to reduce costs, many organizations are outsourcing their payroll and HRM functions to payroll service bureaus and professional employer organizations. A ***payroll service bureau*** maintains the payroll master data for each of its clients and process payroll for them. A ***professional employer organization (PEO)*** not only processes payroll but also provides HRM services such as employee benefit design and administration. Because they provide a narrower range of services, payroll service bureaus are generally less expensive than PEOs.

When organizations outsource payroll processing, they send time and attendance data along with information about personnel changes to the payroll service bureau or PEO at the end of each pay period. The payroll service bureau or PEO then uses that data to prepare employee paychecks, earnings statements, and a payroll register. The payroll processing service also periodically produces employee W-2 forms and other tax-related reports.

Payroll service bureaus and PEOs are especially attractive to small and midsized businesses for the following reasons:

- ***Reduced costs.*** Payroll service bureaus and PEOs benefit from the economies of scale associated with preparing paychecks for a large number of companies. They can charge fees that are typically less than the cost of doing payroll in-house. A payroll service bureau or PEO also saves money by eliminating the need to develop and maintain the expertise required to comply with the constantly changing tax laws.
- ***Wider range of benefits.*** PEOs pool the costs of administering benefits across all their clients. Consequently, a PEO enables smaller companies to offer the same wide range of benefits that large companies typically provide.

- ***Freeing up of computer resources.*** A payroll service bureau or PEO eliminates one or more AIS applications (payroll and benefits management). The freed-up computing resources can then be used to improve service in other areas, such as sales order entry.

As the basis for competitive advantage increasingly hinges on employees' skills and knowledge, the effective and efficient management of the payroll and HRM functions becomes increasingly important. Outsourcing may provide a way to reduce costs. However, companies need to be sure to carefully monitor service quality to ensure that the outsourced system effectively integrates HRM and payroll data in a manner that supports effective management of employees.

Summary and Case Conclusion

The HRM/payroll cycle information system consists of two related, but separate, subsystems: HRM and payroll. The HRM system records and processes data about the activities of recruiting, hiring, training, assigning, evaluating, and discharging employees. The payroll system records and processes data used to pay employees for their services.

The HRM/payroll system must be designed to comply with a myriad of government regulations related to both taxes and employment practices. In addition, adequate controls must exist to prevent (1) overpaying employees due to invalid (overstated) time and attendance data and (2) disbursing paychecks to fictitious employees. These two threats can be best minimized by proper segregation of duties, specifically by having the following functions performed by different individuals:

1. Authorizing and making changes to the payroll master file for such events as hirings, firings, and pay raises
2. Recording and verifying time worked by employees
3. Preparing paychecks
4. Distributing paychecks
5. Reconciling the payroll bank account

Although the HRM and payroll systems have traditionally been separated, many companies, including AOE, are trying to integrate them to manage their human resources more effectively and to provide employees with better benefits and service. Elizabeth Venko and Ann Brandt showed Peter Wu how AOE's new ERP system would facilitate integrating these two functions. Peter was impressed with how easily he could retrieve data about employee skills and attendance at training classes from this database. He agreed that this would satisfy the needs of department managers for quick and easy access to such information. Peter also realized that the HRM staff could similarly use this query capability to provide quick response to employee requests for information about their benefits, deductions, or retirement plans. He was even more impressed when Elizabeth and Ann explained that another recently implemented add-on feature would also allow employees to make direct changes in their retirement savings allocations, medical plan choices, and other benefit options. Peter realized that freeing the HRM staff from these routine clerical tasks would allow them to devote more time to helping him organize the information needed to make strategic decisions, such as planning for future workforce needs, career counseling, employee development, and negotiations with service providers to improve benefits.

Elizabeth explained that payroll processing itself could continue to be performed in batch mode, because there is no need for online processing (employees would continue to be paid only at periodic intervals). However, she wants to require employees to either sign up for direct deposit of their paychecks or receive payroll debit cards, thereby eliminating the need to issue paychecks. An access control matrix would be created to maintain adequate segregation of duties in the new system and protect the integrity of the HRM/payroll database. For example, only HRM employees would add new employees, and only from terminals located in the HRM department.

Linda Spurgeon was pleased with Elizabeth and Ann's work on improving the company's HRM/payroll systems. She indicated that their next task would be to work with Stephanie Cromwell, AOE's chief financial officer, to improve the financial closing process and to help develop reports that would provide better insight into AOE's performance.

Key Terms

human resource management (HRM)/payroll cycle 455
knowledge management systems 457
time card 463
time sheet 463
payroll register 467
deduction register 467
earnings statement 467
payroll clearing account 469
flexible benefit plans 471
payroll service bureau 471
professional employer organization (PEO) 471

AIS IN ACTION

Chapter Quiz

1. Traditionally, accountants have been most involved with which portion of the HRM/payroll cycle?
   a. hiring
   b. payroll
   c. training
   d. performance evaluation

2. Which of the following statements is true?
   a. Financial statements report the value of employee knowledge and skills.
   b. Turnover and absenteeism are costly.
   c. All employees must fill out time cards.
   d. Default configurations of ERP packages typically provide good segregation of duties.

3. Which document lists the current amount and year-to-date totals of gross pay, deductions, and net pay for one employee?
   a. payroll register
   b. time card
   c. paycheck
   d. earnings statement

4. Online processing is most useful for which of these tasks?
   a. preparing payroll checks
   b. reconciling job-time tickets and time cards
   c. paying payroll tax obligations
   d. making changes in employee benefit choices

5. Use of a payroll service bureau or a PEO provides which of the following benefits?
   a. fewer staff needed to process payroll
   b. lower cost of processing payroll
   c. less need for developing and maintaining payroll tax expertise
   d. all of the above

6. Which control procedure would be most effective in detecting the failure to prepare a paycheck for a new employee *before* paychecks are distributed?
   a. validity checks on the employee number on each time card
   b. record counts of time cards submitted and time cards processed
   c. zero-balance check
   d. use of a separate payroll bank account

7. Which department should have responsibility for authorizing pay-rate changes?
   a. timekeeping
   b. payroll
   c. HRM
   d. accounting

8. To maximize effectiveness of internal controls over payroll, which of the following persons should be responsible for distributing employee paychecks?
   a. departmental secretary
   b. payroll clerk
   c. controller
   d. departmental supervisor

9. Where should unclaimed paychecks be returned?
   a. HRM department
   b. cashier
   c. payroll department
   d. absent employee's supervisor

10. Which of the following is an important supporting document to authorize the transfer of funds to the payroll bank account?
   a. earnings statement
   b. time card
   c. payroll register
   d. W-2 form

Discussion Questions

15.1. This chapter noted many of the benefits that can arise by integrating the HRM and payroll databases. Nevertheless, many companies maintain separate payroll and HRM information systems. Why do you think this is so? (*Hint*: Think about the differences in employee background and the functions performed by the HRM and payroll departments.)

15.2. Some accountants have advocated that a company's human assets be measured and included directly in the financial statements. For example, the costs of hiring and training an employee would be recorded as an asset that is amortized over the employee's expected term of service. Do you agree or disagree? Why?

15.3. You are responsible for implementing a new employee performance measurement system that will provide factory supervisors with detailed information about each of their employees on a weekly basis. In conversation with some of these supervisors, you are surprised to learn they do not believe these reports will be useful. They explain that they can already obtain all the information they need to manage their employees simply by observing the shop floor. Comment on that opinion. How could formal reports supplement and enhance what the supervisors learn by direct observation?

15.4. One of the threats associated with having employees telecommute is that they may use company-provided resources (laptop, printer, etc.) for a side business. What are some other threats? What controls can mitigate the risk of these threats?

15.5. How would you respond to the treasurer of a small charity who tells you that the organization does not use a separate checking account for payroll because the benefits are not worth the extra monthly service fee?

15.6. This chapter discussed how the HR department should have responsibility for updating the HRM/payroll database for hiring, firing, and promotions. What other kinds of changes may need to be made? What controls should be implemented to ensure the accuracy and validity of such changes?

Problems

15.1. Match the terms in the left column with the appropriate definition from the right column.

____ 1. Payroll service bureau	a. A list of each employee's gross pay, payroll deductions, and net pay in a multicolumn format
____ 2. Payroll clearing account	b. Used to record the activities performed by a salaried professional for various clients
____ 3. Earnings statement	c. Used to record time worked by an hourly-wage employee
____ 4. Payroll register	d. An organization that processes payroll and provides other HRM services

___ 5. Time card
___ 6. Time sheet

e. An organization that processes payroll
f. A list of all the deductions for each employee
g. A document given to each employee that shows gross pay, net pay, and itemizes all deductions both for the current pay period and for the year-to-date
h. Special general ledger account used for payroll processing

15.2. What internal control procedure(s) would be most effective in preventing the following errors or fraudulent acts?

a. An inadvertent data entry error caused an employee's wage rate to be overstated in the payroll master file.
b. A fictitious employee payroll record was added to the payroll master file.
c. During data entry, the hours worked on an employee's time card for one day were accidentally entered as 80 hours, instead of 8 hours.
d. A computer operator used an online terminal to increase her own salary.
e. A factory supervisor failed to notify the HRM department that an employee had been fired. Consequently, paychecks continued to be issued for that employee. The supervisor pocketed and cashed those paychecks.
f. A factory employee punched a friend's time card in at 1:00 P.M. and out at 5:00 P.M. while the friend played golf that afternoon.
g. A programmer obtained the payroll master file and increased his salary.
h. Some time cards were lost during payroll preparation; consequently, when paychecks were distributed, several employees complained about not being paid.
i. A large portion of the payroll master file was destroyed when the disk pack containing the file was overwritten when used as a scratch file for another application.
j. The organization was fined $5,000 for making a late quarterly payroll tax payment to the IRS.

15.3. You have been hired to evaluate the payroll system for the Skip-Rope Manufacturing Company. The company processes its payroll in-house. Use Table 15-1 as a reference to prepare a list of questions to evaluate Skip-Rope's internal control structure as it pertains to payroll processing for its factory employees. Each question should be phrased so that it can be answered with either a yes or a no; all "no" answers should indicate potential internal control weaknesses. Include a third column listing the potential problem that could arise if that particular control were not in place. *(CPA Examination, adapted)*

15.4. Although most medium and large companies have implemented sophisticated payroll and HRM systems like the one described in this chapter, many smaller companies still maintain separate payroll and HRM systems that employ many manual procedures. Typical of such small companies is the Kowal Manufacturing Company, which employs about 50 production workers and has the following payroll procedures:

- The factory supervisor interviews and hires all job applicants. The new employee prepares a W-4 form (Employee's Withholding Exemption Certificate) and gives it to the supervisor. The supervisor writes the hourly rate of pay for the new employee in the corner of the W-4 form and then gives the form to the payroll clerk as notice that a new worker has been hired. The supervisor verbally advises the payroll department of any subsequent pay raises.
- A supply of blank time cards is kept in a box near the entrance to the factory. All workers take a time card on Monday morning and fill in their names. During the week they record the time they arrive and leave work by punching their time cards in the time clock located near the main entrance to the factory. At the end of the week the workers drop the time cards in a box near the exit. A payroll clerk retrieves the completed time cards from the box on Monday morning. Employees are automatically removed from the payroll master file when they fail to turn in a time card.
- The payroll checks are manually signed by the chief accountant and then given to the factory supervisor, who distributes them to the employees. The factory supervisor arranges for delivery of the paychecks to any employee who is absent on payday.
- The payroll bank account is reconciled by the chief accountant, who also prepares the various quarterly and annual tax reports.

Required

a. Identify weaknesses in current procedures, and explain the threats that they may allow to occur.
b. Suggest ways to improve the Kowal Manufacturing Company's internal controls over hiring and payroll processing.
(CPA Examination, adapted)

15.5. Arlington Industries manufactures and sells engine parts for large industrial equipment. The company employs over 1,000 workers for three shifts, and most employees work overtime when necessary. Figure 15-10 depicts the procedures followed to process payroll. Additional information about payroll procedures follows:

- The HRM department determines the wage rates of all employees. The process begins when a form authorizing the addition of a new employee to the payroll master file is sent to the payroll coordinator for review and approval. Once the information about the new employee is entered in the system, the computer automatically calculates the overtime and shift differential rates for that employee.
- A local accounting firm provides Arlington with monthly payroll tax updates, which are used to modify the tax rates.
- Employees record their time worked on time cards. Every Monday morning, the previous week's time cards are collected from a bin next to the time clock, and new time cards are left for employees to use. The payroll department manager reviews the time cards to ensure that hours are correctly totaled; the system automatically determines whether overtime has been worked or a shift differential is required.
- The payroll department manager performs all the other activities depicted in Figure 15-10.
- The system automatically assigns a sequential number to each payroll check. The checks are stored in a box next to the printer for easy access. After the checks are printed, the payroll department manager uses an automatic check-signing machine to sign the checks. The signature plate is kept locked in a safe. After the checks have been signed, the payroll manager distributes the paychecks to all first-shift employees. Paychecks for the other two shifts are given to the shift supervisor for distribution.
- The payroll master file is backed up weekly, after payroll processing is finished.

Required

a. Identify and describe at least three weaknesses in Arlington Industries' payroll process.
b. Identify and describe at least two different areas in Arlington's payroll processing system where controls are satisfactory.
(CMA Examination, adapted)



15.6. Excel Problem

Objective: Learn how to find and correct errors in complex spreadsheets used for payroll.

Required (Continues on next two pages)

(a) Read the article "Ferret Out Spreadsheet Errors" by Mark G. Simkin, in the *Journal of Accountancy* (February 2004). You can find a copy online by accessing www.aicpa.org.
(b) Download the worksheet referenced in the article.
(c) Disable data validation on the hours worked column in order to input the following erroneous data:

- Change hours worked for Adams to 400.
- Change hours worked for Englert to 4.
- Change hours worked for Hartford to –40.
- Create a chart like that shown in Exhibit 2 of the article. Which of the errors are easily found by the chart? What are the strengths and limitations of creating such charts to detect errors? Print out your chart and save your work.

(d) Create the three data validation rules described in the article (Exhibits 4–7 in the article illustrate how to create the first rule). Print out screen shots of how you create

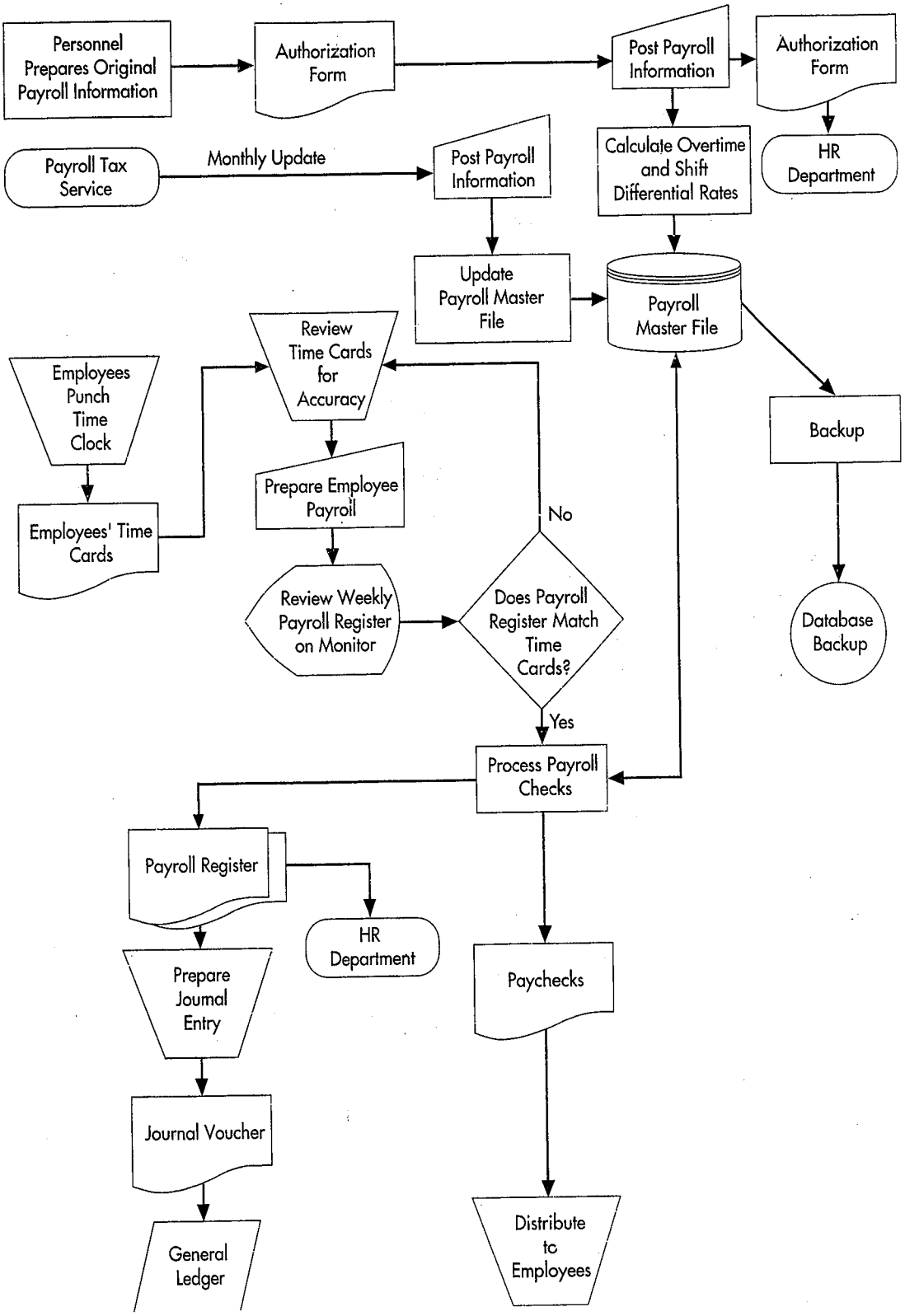


FIGURE 15-10
Arlington Industries Flowchart for Problem 15.4

each rule, and save your work. (*Note:* The article "Block That Spreadsheet Error" by Theo Callahan, in the *Journal of Accountancy* (August 2002) provides additional examples of data validation rules.)

(e) Follow the instructions for using the formula auditing tool. Print out a screen shot showing use of the tool to circle invalid data (yours should be similar to Exhibit 9 in the article).

(f) Follow the article's instructions to run the "trace precedents" audit tool. Print screen shots that show the results, and save your work. How useful is this tool? What are its limitations, if any?

(g) Enter the following data for new employees (insert new rows in the proper order to maintain the alphabetical listing of employees):

- Name = Able, pay rate = 11.11, regular hours = 40, overtime hours = 5
- Name = Easton, pay rate = 10.00, regular hours = 40, overtime hours = 0
- Name = Johnson, pay rate = 12.00, regular hours = 35, overtime hours = 10

Which audit tests and validation rules change? Why? Print screen shots, and save your work.



15.7. Excel Problem

Objective: Learn how to use the VLOOKUP function for payroll calculations.

Required

a. Read the article "Make Excel a Little Smarter" by Lois S. Mahoney and Charles Kelliher in the *Journal of Accountancy* (July 2003). You can find a copy at www.aicpa.org.
b. Read the section titled "Data in Different Places," and create the spreadsheet illustrated in Exhibit 6. Print a screen shot of your work, and save your spreadsheet.
c. Create a formula that calculates total bonuses. Also create a cell entry that indicates what that number represents. Print a screen shot of your work, and save it.
d. Add the following data validation controls to your spreadsheet, including explanatory error messages. Save your work.
   - Sales must be positive.
   - Sales cannot exceed 125.
   - Amount of bonus must be non-negative.
   - Amount of bonus cannot exceed 20% of unit sales.
e. Modify your worksheet by placing the sales data and resulting bonus on a different worksheet from the bonus table. Name your table array, and modify the VLOOKUP function accordingly. Then add another employee: Johnson, who sold 150 units. Print a screen shot of your new worksheet showing the bonuses for each employee, including Johnson. Save your work.

15.8. The local community feels that secondary school education is a necessity and that lack of education leads to a number of social problems. As a result, the local school board has decided to take action to reverse the rising dropout rate. The board has voted to provide funds to encourage students to remain in school and earn their high school diplomas. The idea is to treat secondary education like a job and pay students. The board, however, could not agree on the details for implementing this new plan. Consequently, you have been hired to devise a system to compensate students for staying in school and earning a diploma.

As you devise your compensation scheme, be sure it meets the following general control objectives for the payroll cycle:

- All transactions are properly authorized.
- Everyone is assigned to do productive work, and they do it efficiently and effectively.
- All transactions are accurately recorded and processed.
- Accurate records are maintained.
- All disbursements are proper.

Required

Write a proposal that addresses these five questions:

a. How should the students be compensated (e.g., for attendance, grades)?
b. How and by whom will the payments be authorized?
c. How will the payments be processed?
d. How should the payments be made (e.g., in cash or other means)?
e. When will the payments be made?

(Adapted from Carol F. Venable, "Development of Diversity Awareness and Critical Thinking," Proceedings of the Lilly Conference on Excellence in College and University Teaching—West (Lake Arrowhead, Calif., March 1995); and American Accounting Association Teaching and Curriculum Demonstration Session (Orlando, Fla., August 1995). Reprinted with permission of Dr. Carol Venable.)

15.9. What is the purpose of each of the following control procedures (i.e., what threats is it designed to mitigate)?

a. Comparison of a listing of current and former employees to the payroll register.
b. Reconciliation of labor costs (based on job-time ticket data) with payroll (based on time card data).
c. Direct deposit of paychecks.
d. Validity checks on Social Security numbers of all new employees added to the payroll master file.
e. Cross-footing the payroll register.
f. Limit checks on hours worked for each time card.
g. Use of a fingerprint scanner for employees to record the time they started and the time they quit working each day.
h. Encryption of payroll data both when it is electronically sent to a payroll service bureau and while at rest in the HR/payroll database.
i. Establishing a separate payroll checking account and funding it as an imprest account.
j. Comparison of hash totals of employee numbers created prior to transmitting time-worked data to payroll provider with hash totals of employee numbers created by payroll provider when preparing paychecks.
k. Periodic reports of all changes to payroll database sent to each department manager.
l. Providing employees with earnings statements every pay period.

15.10. Excel Problem



Objective: Learn how to use text and array formulas to locate potential payroll problems.

Required

a. Download the spreadsheet for this problem from the course Web site.
b. In column I, under the label "Ghost Employee?" write a function that compares the employee# in the time cards column to the employee# in the payroll master data column and displays the message: "Time card employee# does not exist in master data" for any employee in the time cards column who is not listed in the payroll master data column. The function should leave the cell blank if the employee# in the time cards worksheet does exist in the payroll master file worksheet. (*Hint:* Use the ISNA and MATCH functions.)
c. In column L, titled "Invalid SSN?" write a function to identify invalid Social Security numbers. Assume that Social Security numbers that begin with the digit 9 or that have the digits 00 for the middle two numbers are invalid. Your function should display a message that flags either of these two conditions or that displays nothing otherwise. (*Hint:* There are text functions that examine specific portions of a string, such as the left three characters, and there are also functions that convert text to numeric values.)
d. In column P, titled "Missing Paycheck?" write a function to check whether a time card exists for each employee in the master payroll data section of the worksheet. The formula should either return the message "No paycheck created for this employee" or display nothing.

Case 15-1 Research Report: HRM/Payroll Opportunities for CPAs

Payroll has traditionally been an accounting function, and some CPAs have provided payroll processing services to their clients. Today, CPAs are finding additional new lucrative opportunities to provide not only payroll processing but also various HR services. Write a brief report that compares the provision of payroll and HR services by CPAs with that of national payroll providers. Perform the following research to collect the data for your report:

1. Read the articles "Be an HR Resource for Your Clients," by Michael Hayes and "Hired Help: Finding the Right Consultant," by Joanne Sammer, both of which were published in the November 2006 issue of the *Journal of Accountancy.*
2. Contact a local CPA firm that provides payroll and HR services, and find out what types of services they perform and what types of clients they serve.

AIS IN ACTION SOLUTIONS

Chapter Quiz Key

1. Traditionally, accountants have been most involved with which portion of the HRM/payroll cycle?
   a. hiring (Incorrect. This has traditionally been handled by the HR department.)
   ▶ b. payroll (Correct. The payroll system has traditionally been the part of the HRM/payroll system used by accountants.)
   c. training (Incorrect. This has traditionally been handled by the HR department.)
   d. performance evaluation (Incorrect. This has traditionally been handled by supervisors.)

2. Which of the following statements is true?
   a. Financial statements report the value of employee knowledge and skills. (Incorrect. Costs associated with acquiring the use of employees' skills and knowledge have traditionally been recognized as an expense on the income statement.)
   ▶ b. Turnover and absenteeism are costly. (Correct. Turnover costs 1.5 times the departing employee's salary, and absenteeism increases overtime and short-term hiring costs.)
   c. All employees must fill out time cards. (Incorrect. Hourly employees typically fill out time cards to record hours worked. Salaried professionals, however, do not because their periodic pay is a set fraction of their annual salary. Salaried employees in professional services firms, however, do record the time spent performing various activities for different clients on time sheets so that their employers can accurately assign costs and bill clients for services rendered.)
   d. Default configurations of ERP packages typically provide good segregation of duties. (Incorrect. Default configurations of ERP systems typically provide users with far too much authority.)

3. Which document lists the current amount and year-to-date totals of gross pay, deductions, and net pay for one employee?
   a. payroll register (Incorrect. The payroll register lists this information for all employees.)
   b. time card (Incorrect. Time cards collect data about time worked during a specific pay period.)
   c. paycheck (Incorrect. The paycheck is a means of transferring funds.)
   ▶ d. earnings statement (Correct. The earnings statement attached to each paycheck provides the information listed.)

4. Online processing is most useful for which of these tasks?
   a. preparing payroll checks (Incorrect. Because paychecks are issued only periodically, batch processing is appropriate.)
   b. reconciling job-time tickets and time cards (Incorrect. Because this occurs only when payroll is calculated, batch processing is appropriate.)
   c. paying payroll tax obligations (Incorrect. Payment is periodic, so batch processing is appropriate.)
   ▶ d. making changes in employee benefit choices (Correct. Employees want to be able to have access to this information and make changes whenever desired.)

5. Use of a payroll service bureau or a PEO provides which of the following benefits?
   ▶ a. fewer staff needed to process payroll (Incorrect. Outsourcing not only typically reduces staffing requirements, but also lowers costs (answer b) and reduces the need for in-house expertise (answer c).)
   b. lower cost of processing payroll (Incorrect. Outsourcing usually not only reduces costs, but also requires fewer staff (answer a) and reduces the need for in-house expertise (answer c).)

c. less need for developing and maintaining payroll tax expertise (Incorrect. Outsourcing does reduce the need to maintain in-house payroll tax expertise, but it also provides the benefits listed in answers a and b.)
d. all of the above (Correct.)

6. Which control procedure would be most effective in detecting the failure to prepare a paycheck for a new employee before paychecks are distributed?
a. validity checks on the employee number on each time card (Incorrect. This control is designed to ensure that only valid employees are paid.)
▶ b. record counts of time cards submitted and time cards processed (Correct. Batch totals, such as record counts, would identify failure to process all transaction records.)
c. zero-balance check (Incorrect. This control is designed to verify the accuracy of payroll disbursements.)
d. use of a separate payroll bank account (Incorrect. This control is designed to limit the amount of cash that could be lost as a result of forged or altered paychecks.)

7. Which department should have responsibility for authorizing pay-rate changes?
a. timekeeping (Incorrect. Timekeeping is a recording function.)
b. payroll (Incorrect. Payroll calculates the pay for the current period and should not also authorize changes.)
▶ c. HRM (Correct. HRM has no other role in the payroll process.)
d. accounting (Incorrect. Accounting maintains records related to payroll and should not authorize changes in pay rates.)

8. To maximize effectiveness of internal controls over payroll, which of the following persons should be responsible for distributing employee paychecks?
▶ a. departmental secretary (Correct. This person has no other payroll duties so cannot conceal theft of paychecks.)
b. payroll clerk (Incorrect. The payroll clerk prepares and records the checks and so could create checks for nonexistent employees and cash them.)
c. controller (Incorrect. The controller is in charge of the recording function and should not have custody of checks.)
d. departmental supervisor (Incorrect. The supervisor authorizes payment by reviewing time cards and should not also have custody of assets.)

9. Where should unclaimed paychecks be returned?
a. HRM department (Incorrect. Unclaimed checks should be returned to the cashier for redeposit.)
▶ b. cashier (Correct. This permits funds to be quickly redeposited.)
c. payroll department (Incorrect. Unclaimed checks should be returned to the cashier for redeposit.)
d. absent employee's supervisor (Incorrect. Unclaimed checks should be returned to the cashier for redeposit.)

10. Which of the following is an important supporting document to authorize the transfer of funds to the payroll bank account?
a. earnings statement (Incorrect. This is the stub attached to each paycheck, providing the employee with YTD information about pay and various deductions.)
b. time card (Incorrect. This document records time worked.)
▶ c. payroll register (Correct. This document summarizes the amount to be paid to each employee and is sent to the accounts payable department for use in preparing a disbursement voucher to authorize the transfer of funds to the payroll account.)
d. W-2 form (Incorrect. This is a year-end statement given to each employee summarizing net pay, taxes witheld, and other deductions.)

Chapter 16

General Ledger and Reporting System

Learning Objectives

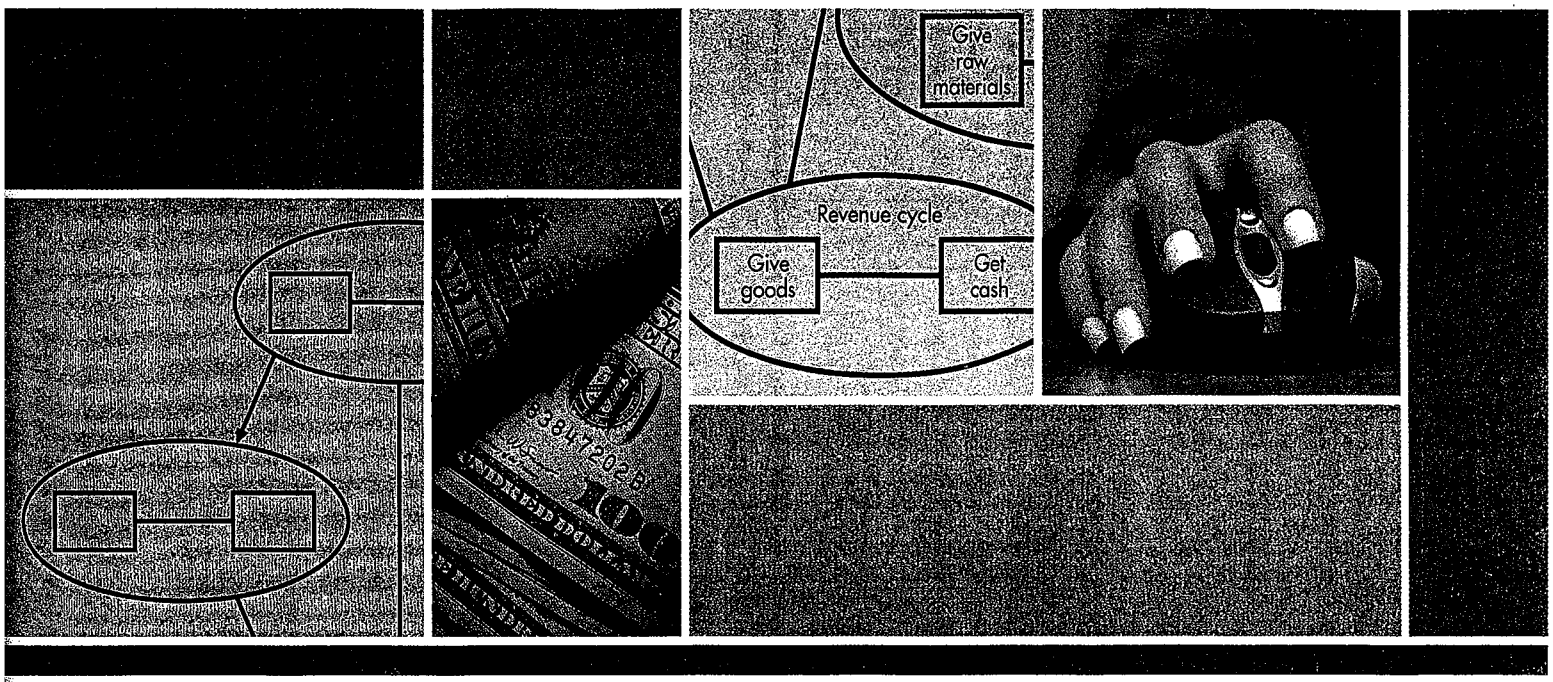
After studying this chapter, you should be able to:

1. Describe the information processing operations required to update the general ledger and to produce reports for internal and external users.
2. Identify the major threats in general ledger and reporting activities and evaluate the adequacy of various control procedures for dealing with them.
3. Understand the implications of new IT developments, such as XBRL, and changes in external reporting requirements, such as IFRS, for the design and operation of the general ledger and reporting system.
4. Discuss how tools like responsibility accounting, balanced scorecards, and graphs can be used to provide information managers need to effectively monitor performance.

INTEGRATIVE CASE ALPHA OMEGA ELECTRONICS

Linda Spurgeon, president and CEO of Alpha Omega Electronics (AOE), is not satisfied with the reporting capabilities of AOE's new enterprise resource planning (ERP) system. Although the monthly closing process now takes less than two days, the system only provides management with timely information about the firm's financial performance. Linda wants a report that integrates financial information with operational measures about how the firm is doing. She is also concerned about how to prepare AOE to transition from U.S. Generally Accepted Accounting Principles (GAAP) to International Financial Reporting Standards (IFRS) and about satisfying the SEC's new requirements to begin submitting financial information using XBRL.

Linda calls a meeting with Stephanie Cromwell, AOE's chief financial officer, Elizabeth Venko, AOE's controller, and Ann Brandt, AOE's vice president of information



systems, to discuss these issues. Stephanie mentions that she has been reading about something called a balanced scorecard that might provide the kind of multidimensional report Linda desires. Ann and Elizabeth agree to research the balanced scorecard and investigate how AOE's new ERP system could be configured to produce one. Stephanie asks them to also look at how AOE could make better use of the reporting and graphing capabilities of its new ERP system. In addition, they will report back on what needs to be done to prepare for IFRS and to use XBRL. As you read this chapter, think about how both technological and regulatory changes affect the design and operation of an organization's general ledger and reporting systems.

Introduction

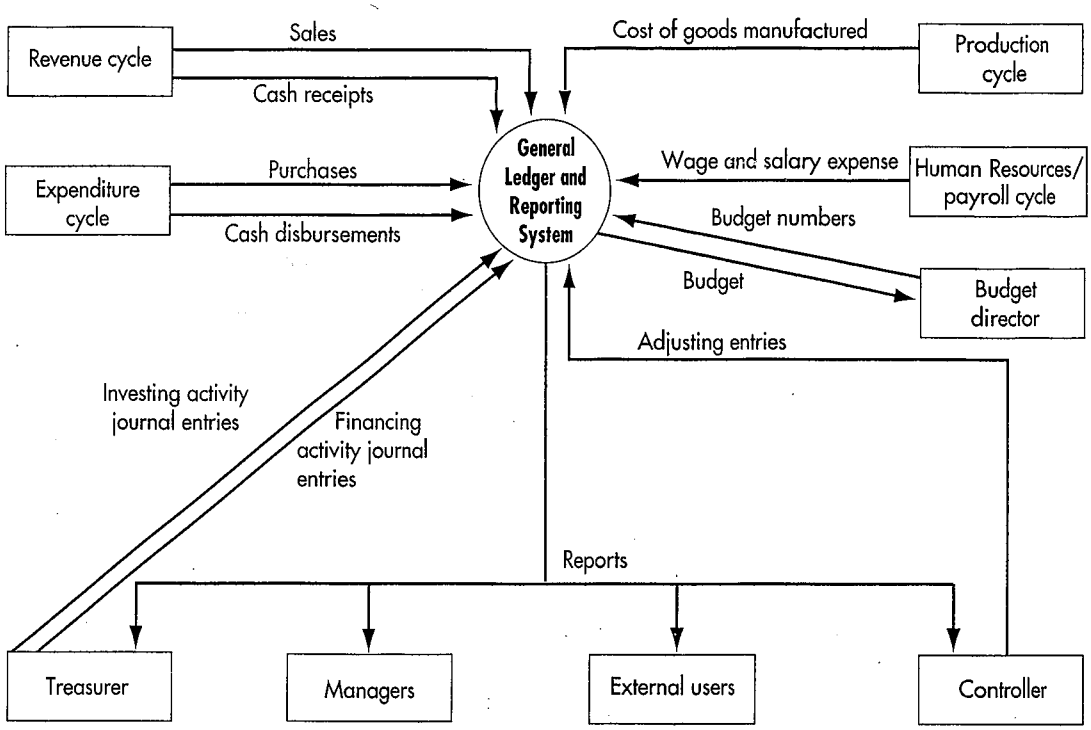
This chapter discusses the information processing operations involved in updating the general ledger and preparing reports that summarize the results of an organization's activities. As shown in Figure 16-1, the general ledger and reporting system plays a central role in a company's accounting information system. Its primary function is to collect and organize data from the following sources:

- Each of the accounting cycle subsystems described in Chapters 12 through 15 provides information about regular transactions. (Only the principal data flows from each subsystem are depicted, to keep the figure uncluttered.)
- The treasurer provides information about financing and investing activities, such as the issuance or retirement of debt and equity instruments and the purchase or sale of investment securities.
- The budget department provides budget numbers.
- The controller provides adjusting entries.

Figure 16-2 shows the basic activities performed in the general ledger and reporting cycle. The first three activities represent the basic steps in the accounting cycle, which culminate in the production of the traditional set of financial statements. The fourth activity indicates that, in addition to financial reports for external users, an organization's accounting system produces a variety of reports for internal management.

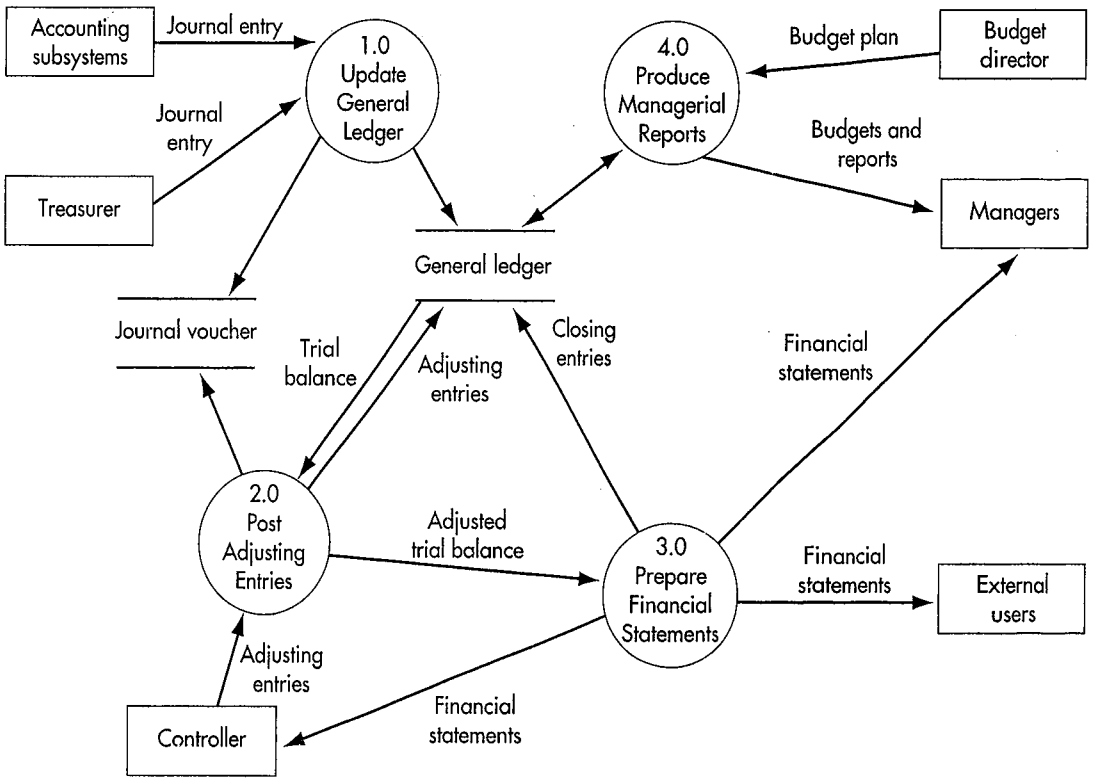
We begin by describing the design of a typical general ledger and reporting system and discuss the basic controls necessary to ensure that it provides management and various external stakeholders with reliable information. We then discuss in detail each of the basic general ledger and reporting cycle activities depicted in Figure 16-2. For each activity, we describe

FIGURE 16-1
Context Diagram of the General Ledger and Reporting System



how the information needed to perform and manage the activity is collected, processed, and stored. We also explain the controls necessary to ensure not only the reliability of that information but also the safeguarding of the organization's resources. In addition, we discuss the impact of regulatory and technological changes, such as the proposed switch from GAAP to IFRS and the SEC's mandate to use XBRL for electronic filing, on the design and operation of the general ledger and reporting system. We also explore how tools such as responsibility accounting, balanced scorecards, and well-designed graphs can improve the quality of information provided to managers.

FIGURE 16-2
Level 0 Data Flow Diagram of the General Ledger and Reporting Cycle



General Ledger and Reporting System

Figure 16-3 shows the typical design of an online general ledger and reporting system.

Process

The centralized database must be organized in a manner that facilitates meeting the varied information needs of both internal and external users. Managers need timely detailed information about the results of operations in their particular area of responsibility. Investors and creditors want periodic financial statements and timely updates to help them assess the organization's performance. Various government agencies also mandate specific information requirements. To satisfy these multiple needs, the general ledger and reporting system not only produces periodic reports but also supports online inquiries.

Threats and Controls

Figure 16-3 shows that all general ledger and reporting cycle activities depend on the integrated database. Therefore, the first general threat listed in Table 16-1 is inaccurate or invalid general ledger data. Inaccurate general ledger data can result in misleading reports that cause managers to make erroneous decisions. Similarly, errors in financial statements provided to creditors, investors, and government agencies can cause those stakeholders to make wrong decisions. In addition, errors in financial statements and reports provided to external stakeholders can also result in fines and negative reactions from the capital markets.

One way to mitigate the threat of inaccurate or invalid general ledger data is to use the various processing integrity controls discussed in Chapter 10 to minimize the risk of data input errors when the treasurer and controller make direct journal entries. It is also important to restrict access to the general ledger and configure the system so that only authorized employees can make changes to master data. Thus, multifactor authentication should be used to restrict access to

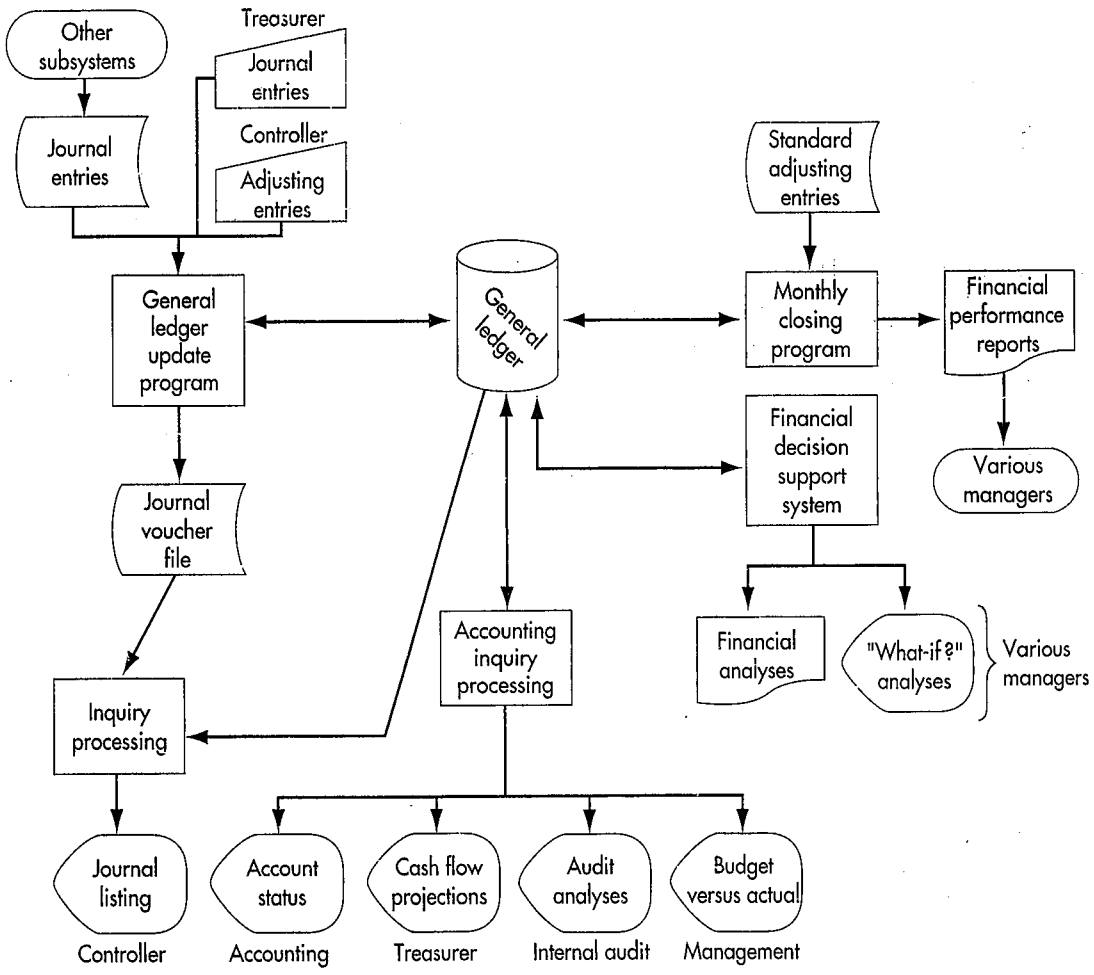


FIGURE 16-3
Typical Design of Online General Ledger and Reporting System

the general ledger. In addition, authorization controls (an access control matrix and compatibility tests) should also be used to limit the functions that each legitimate user may perform. For example, most managers should be given read-only access to the general ledger, as depicted at the bottom of Figure 16-3. Otherwise, an unscrupulous manager can conceal theft of assets or poor performance by altering the information in the general ledger. In addition, the access control matrix should also be designed to limit the functions that can be performed at various terminals. Adjusting entries, for example, should be allowed only from terminals in the controller's office. However, because such preventive controls can never be 100% effective, Table 16-1 also indicates that an important detective control is to regularly produce a report of all changes to the general ledger and review them to verify that the database remains accurate.

A second general threat in the general ledger and reporting cycle is unauthorized disclosure of financial information. In particular, it is important not to prematurely release financial statements; doing so is likely to result in fines from various regulatory agencies and possible shareholder lawsuits. The best control procedure for reducing the risk of unauthorized disclosure of financial statements is to use multifactor authentication and physical security controls to restrict access to the general ledger to only those employees who need such access to perform their jobs. Encrypting the database provides additional protection by making the information unintelligible to anyone who succeeds in obtaining unauthorized access to the database. Encryption also prevents IT employees who do not have access to the ERP system from using operating system utilities to view sensitive information. In addition, general ledger data should be encrypted when it is being transmitted over the Internet to other corporate offices, analysts, or government agencies.

A third general threat in the general ledger and reporting cycle concerns the loss or destruction of master data. The best way to mitigate the risk of this threat is to employ the backup and disaster recovery procedures that were discussed in Chapter 10.

TABLE 16-1 Threats and Controls in the General Ledger and Reporting System

Activity	Threat	Controls (first number refers to the corresponding threat)
General issues throughout entire general ledger and reporting cycle	1. Inaccurate or invalid general ledger data 2. Unauthorized disclosure of financial statement 3. Loss or destruction of data	1.1 Data processing integrity controls 1.2 Restriction of access to general ledger 1.3 Review of all changes to general ledger data 2.1 Access controls 2.2 Encryption 3.1 Backup and disaster recovery procedures
Update general ledger	4. Inaccurate updating of general ledger 5. Unauthorized journal entries	4.1 Data entry processing integrity controls 4.2 Reconciliations and control reports 4.3 Audit trail creation and review 5.1 Access controls 5.2 Reconciliations and control reports 5.3 Audit trail creation and review
Post adjusting entries	6. Inaccurate adjusting entries 7. Unauthorized adjusting entries	6.1 Data entry processing integrity controls 6.2 Spreadsheet error protection controls 6.3 Standard adjusting entries 6.4 Reconciliations and control reports 6.5 Audit trail creation and review 7.1 Access controls 7.2 Reconciliations and control reports 7.3 Audit trail creation and review
Prepare financial statements	8. Inaccurate financial statements 9. Fraudulent financial reporting	8.1 Processing integrity controls 8.2 Use of packaged software 8.3 Training and experience in applying IFRS and XBRL 8.4 Audits 9.1 Audits
Produce managerial reports	10. Poorly designed reports and graphs	10.1 Responsibility accounting 10.2 Balanced scorecard 10.3 Training on proper graph design

Update General Ledger

As shown in Figure 16-2, the first activity in the general ledger system (circle 1.0) is updating the general ledger.

Process

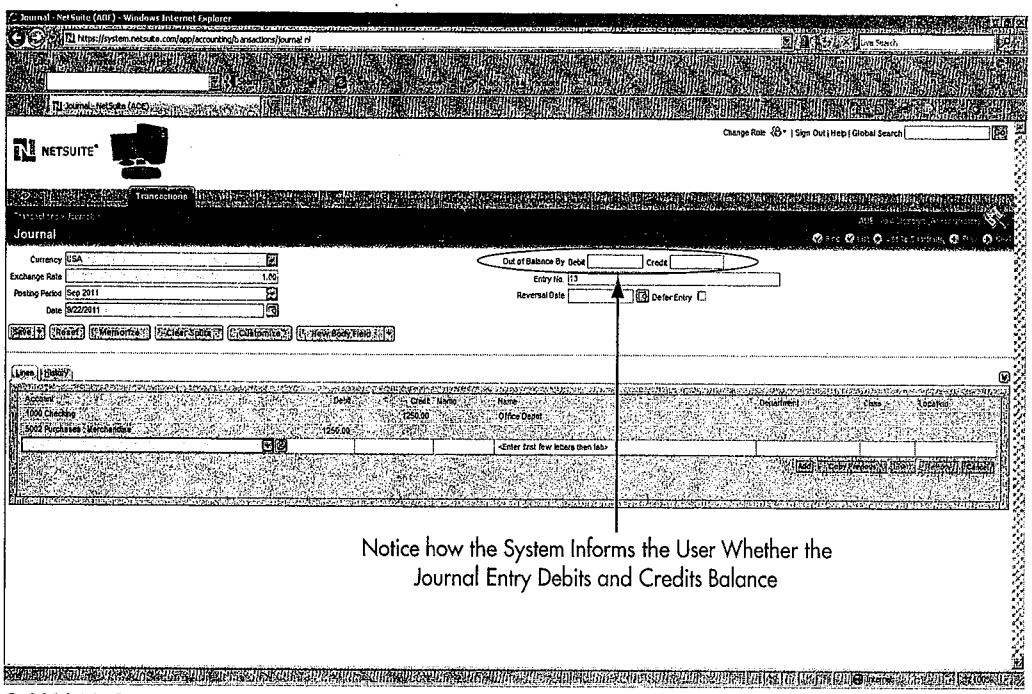
Updating consists of posting journal entries that originate from two sources:

1. *Accounting subsystems.* Each of the accounting subsystems described in Chapters 12 through 15 creates a journal entry to update the general ledger. In theory, the general ledger could be updated for each individual transaction. In practice, however, the various accounting subsystems usually update the general ledger by means of summary journal entries that represent the results of all transactions that occurred during a given period of time (day, week, or month). For example, the revenue cycle subsystem would generate a summary journal entry debiting accounts receivable and cash and crediting sales for all sales made during the update period. Similarly, the expenditure cycle would generate summary journal entries to record the purchase of supplies and inventories and to record cash disbursements in payment for those purchases.
2. *Treasurer.* The treasurer's office provides information for journal entries to update the general ledger for nonroutine transactions such as the issuance or retirement of debt, the purchase or sale of investment securities, or the acquisition of treasury stock. Figure 16-4 shows an example of a typical journal entry screen for an ERP system.

Figure 16-3 shows that the individual journal entries used to update the general ledger are stored in the ***journal voucher file.*** The journal voucher file contains the information that would be found in the general journal in a manual accounting system: the date of the journal entry, the accounts debited and credited, and the amounts. Note, however, that the journal voucher file is a by-product of, not an input to, the posting process. As we will explain later, the journal voucher file forms an important part of the audit trail, providing evidence that all authorized transactions have been accurately and completely recorded.

Threats and Controls

Table 16-1 shows that two related threats at this stage are inaccurate and unauthorized journal entries to update the general ledger. Both can lead to poor decision making based on erroneous information in financial performance reports.



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FIGURE 16-4
Example of Journal Entry Input Screen

As Figure 16-3 shows, there are two sources of journal entries for updating the general ledger: summary journal entries from the other AIS cycles and direct entries made by the treasurer. The former are themselves the output of a series of processing steps, each of which was subject to a variety of application control procedures designed to ensure accuracy and completeness, as described in the preceding four chapters. Consequently, the primary input edit control for summary journal entries from the other cycles is configuring the system to verify that the entries represent activity for the most recent time period.

Journal entries made by the treasurer, however, are original data entry. Consequently, the following types of input edit and processing controls are needed to ensure that they are accurate and complete:

1. A *validity check* to ensure that general ledger accounts exist for each account number referenced in a journal entry.
2. *Field (format) checks* to ensure that the amount field in the journal entry contains only numeric data.
3. A *zero-balance check* to verify that total debits equal total credits in a journal entry.
4. A *completeness test* to ensure that all pertinent data are entered, especially the source of the journal entry.
5. *Closed-loop verification* matching account numbers with account descriptions, to ensure that the correct general ledger account is being accessed.
6. A *sign check* of the general ledger account balance, once updating is completed, to verify that the balance is of the appropriate nature (debit or credit).
7. Calculating *run-to-run totals* to verify the accuracy of journal voucher batch processing. (The computer calculates the new balance of the general ledger account, based on its beginning balance and the total debits and credits applied to that account, then compares that with the actual account balance in the updated general ledger. Any discrepancies indicate a processing error that must be investigated.)

Strong access controls, including multifactor authentication and compatibility tests based on access control matrices, reduce the risk of unauthorized journal entries. In addition to these preventive controls, Table 16-1 lists two types of detective controls that should be used to identify inaccurate and unauthorized journal entries: reconciliations and control reports, and maintenance of an adequate audit trail.

RECONCILIATIONS AND CONTROL REPORTS Reconciliations and control reports can detect whether any errors were made during the process of updating the general ledger. One form of reconciliation is the preparation of a trial balance. The ***trial balance*** is a report that lists the balances for all general ledger accounts (see Figure 16-5). Its name reflects the fact that if all activities have been properly recorded, the total of all debit balances in various accounts should equal the total of all credit balances; if not, a posting error has occurred.

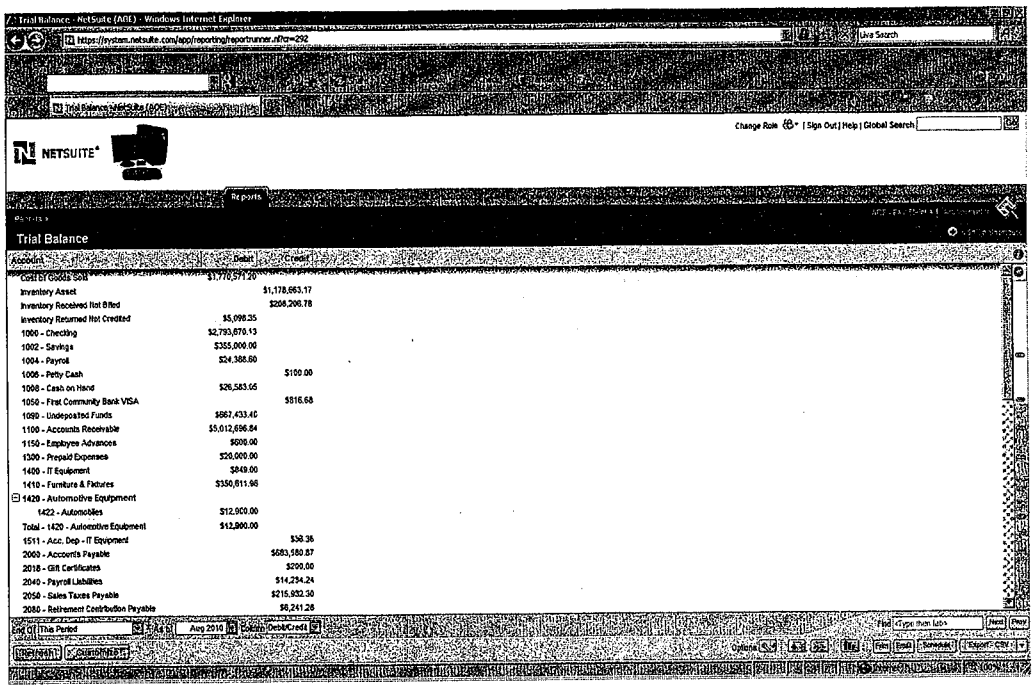
Another important reconciliation is comparing the general ledger control account balances to the total balance in the corresponding subsidiary ledger. For example, the sum of the balances of individual customer accounts should equal the amount of the accounts receivable control account in the general ledger. If these two totals do not agree, the difference must be investigated and corrected. It is also important to examine all transactions occurring near the end of an accounting period to verify that they are recorded in the proper time period.

At the end of a fiscal period it is also important to verify that any temporary "suspense" or "clearing" accounts have zero balances. Clearing and suspense accounts provide a means to ensure that the general ledger is always in balance. To illustrate how these types of special accounts are used, assume that one clerk is responsible for recording the release of inventory to customers and that another clerk is responsible for recording the billing of customers. The first clerk would make the following journal entry:

Unbilled shipments	x x x	
Inventory		x x x

The second clerk would make this entry:

Accounts receivable	x.xx	
Unbilled shipments		x.xx



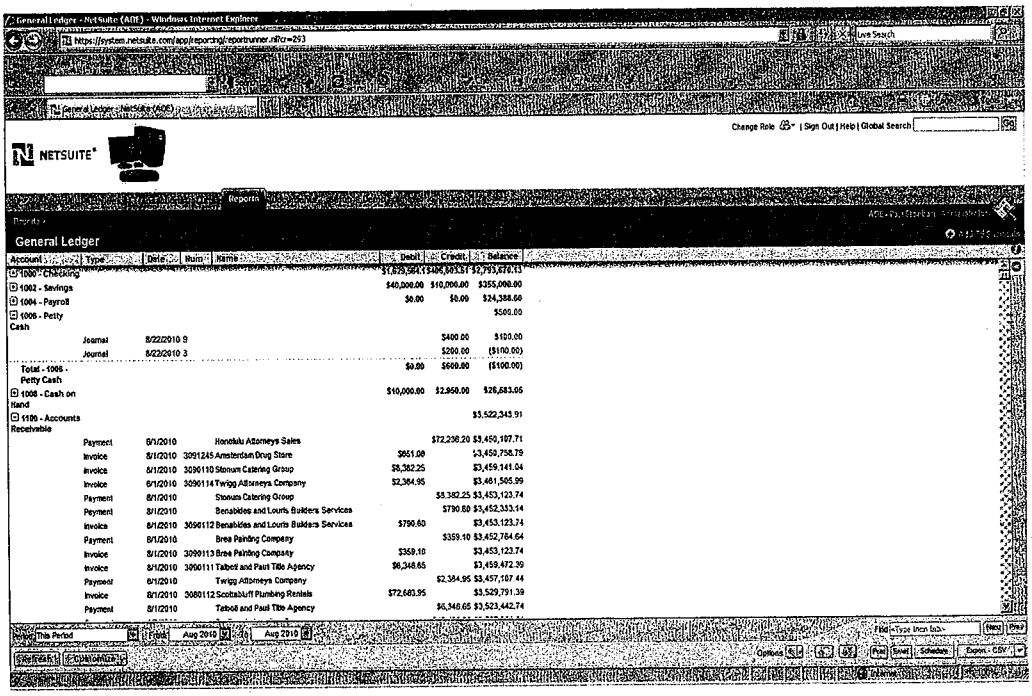
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FIGURE 16-5
Example Portion of Trial Balance

Once both entries have been completed, the special clearing account, unbilled shipments, should have a zero balance. If not, an error has been made and must be investigated and corrected.

Figure 16-6 is an example of one of the many kinds of control reports that ERP systems provide to help identify the source of any errors that occurred in the general ledger update process. Listing journal vouchers by general account number facilitates identifying the cause of errors affecting a specific general ledger account. Listing the journal vouchers by numerical sequence, date, and account number can indicate the absence of any journal entry postings. These reports often include totals to show whether total debits and credits posted to the general ledger were equal.

THE AUDIT TRAIL The *audit trail* is a traceable path that shows how a transaction flows through the information system to affect general ledger account balances. It is an important detective



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FIGURE 16-6
Example of Control Report Providing Details About Changes to a General Ledger Account Balance

control that provides evidence about the causes of changes in general ledger account balances. A properly designed audit trail provides the ability to perform the following tasks:

1. Trace any transaction from its original source document (whether paper or electronic) to the journal entry that updated the general ledger and to any report or other document using that data. This provides a means to verify that all authorized transactions were recorded.
2. Trace any item appearing in a report back through the general ledger to its original source document (whether paper or electronic). This provides a means to verify that all recorded transactions were indeed authorized and that they were recorded correctly.

In legacy accounting systems, the journal voucher file is an important part of the audit trail, providing information about the source of all entries made to update the general ledger. The same capability is provided by the business workflow features in ERP systems, which make it easy to trace every step performed in processing a transaction. The usefulness of the audit trail depends on its integrity. Therefore, it is important to periodically make backups of all audit trail components and to control access to them to ensure that they cannot be altered. Thus, as Figure 16-7 shows, access to the audit trail is typically restricted to managers. In addition, ERP systems provide built-in tools to ensure the integrity of the audit trail. SAP, for example, creates prenumbered records (called documents) for every action that is performed. These documents cannot be deleted; thus, enabling this built-in feature ensures that SAP creates and maintains a secure audit trail.

Post Adjusting Entries

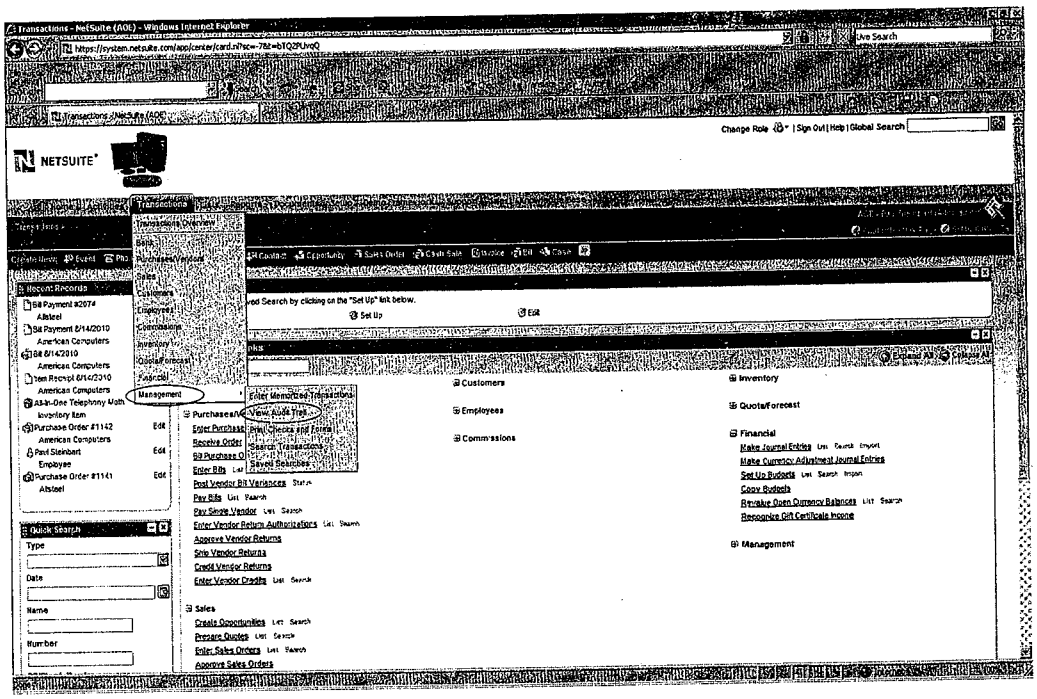
The second activity in the general ledger system is posting various adjusting entries (circle 2.0 in Figure 16-2).

Process

Adjusting entries originate from the controller's office, after the initial trial balance has been prepared. Adjusting entries fall into five basic categories:

1. *Accruals* are entries made at the end of the accounting period to reflect events that have occurred but for which cash has not yet been received or disbursed. Examples include the recording of interest revenue earned and wages payable.

FIGURE 16-7
Illustration of How Access to Audit Trail is Restricted to Managers



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2. *Deferrals* are entries made at the end of the accounting period to reflect the exchange of cash prior to performance of the related event. Examples include recognizing advance payments from customers as a liability and recording certain payments (e.g., rent, interest, and insurance) as prepaid assets.
3. *Estimates* are entries that reflect a portion of expenses expected to occur over a number of accounting periods. Examples include depreciation and bad-debt expenses.
4. *Revaluations* are entries made to reflect either differences between the actual and recorded value of an asset or a change in accounting principle. Examples include a change in the method used to value inventory, reducing the value of inventory to reflect obsolescence, or adjusting inventory records to reflect the results noted during a physical count of inventory.
5. *Corrections* are entries made to counteract the effects of errors found in the general ledger.

As shown in Figure 16-3, information about these adjusting entries is also stored in the journal voucher file. After all adjusting entries have been posted, an adjusted trial balance is prepared. The adjusted trial balance serves as the input to the next step in the general ledger and financial reporting cycle, the preparation of financial statements.

Threats and Controls

As Table 16-1 shows, inaccurate and unauthorized adjusting journal entries are threats that need to be addressed because they can produce erroneous financial statements that lead to poor decisions. To reduce the risk of erroneous input, the same types of data entry processing integrity controls discussed earlier to prevent the threat of erroneous journal entries by the treasurer should also be applied to adjusting journal entries made by the controller. Often, however, adjusting journal entries are calculated in spreadsheets. Therefore, it is also important to employ the various spreadsheet error protection controls discussed in Chapter 10 to minimize the risk of mistakes. Additional control is provided by creating a standard adjusting entry file for recurring adjusting entries made each period, such as depreciation expense. A standard adjusting entry file improves input accuracy by eliminating the need to repeatedly key in the same types of journal entries. It also reduces the risk of forgetting to make a recurring adjusting entry, thereby ensuring input completeness.

Strong access controls reduce the risk of unauthorized adjusting entries. In addition to the preceding preventive controls, periodic reconciliations and audit trails provide a means to detect unauthorized or inaccurate adjusting entries.

Prepare Financial Statements

The third activity in the general ledger and reporting system is preparing financial statements (circle 3.0 in Figure 16-2).

Process

Most organizations "close the books" to produce financial statements both monthly and annually. A closing journal entry zeroes out all revenue and expense accounts in the adjusted trial balance and transfers the net income (or loss) to retained earnings. The income statement summarizes performance for a period of time (usually either a month or a year). The balance sheet presents information about the organization's assets, liabilities, and equity at a point in time. The statement of cash flows provides information about how the organization's operating, investing, and financing activities affected its cash balance. We now discuss two important recent regulatory and technological developments that are likely to significantly affect the process of preparing financial statements: the proposed upcoming change from U.S. GAAP to IFRS and the mandatory use of XBRL to submit reports to the SEC.

TRANSITION FROM GAAP TO IFRS In 2010, the SEC reaffirmed its commitment to decide in 2011 whether it will require American companies to switch from U.S.-based Generally Accepted Accounting Principles (GAAP) to International Financial Reporting Standards (IFRS) as the basis for preparing financial statements. Although the switch to IFRS will not likely occur until 2015 at the earliest, companies need to begin planning for the transition now because it will likely require extensive changes to their general ledger and reporting systems.

IFRS differs from GAAP in several ways that affect the design of a company's general ledger and reporting systems. One major difference concerns accounting for fixed assets. Under GAAP, most major fixed assets are recorded and depreciated on a composite basis. For example, the entire cost of a new corporate headquarters building would be recorded as one asset and depreciated over its estimated useful life, which, for buildings, is typically 40 years. In contrast, IFRS generally requires componentization of fixed assets, to recognize the fact that different elements (components) may have different economic lives. In terms of a corporate headquarters building, that would mean that the costs of the roof and of the heating and air conditioning systems would be recorded separately from the building itself, because they are not likely to last 40 years. Componentization will require companies to dig through their databases to identify and disaggregate the costs of many fixed assets. For large companies that may have tens of thousands of fixed assets, componentization will be a major undertaking that carries the risk of classification and recording errors as they change the structure of their general ledgers.

Another difference involves accounting for research and development (R&D) costs. IFRS permits capitalization of development costs at an earlier stage of the process than does GAAP. Consequently, American companies may need to improve the way that they collect and record R&D related costs so that they can properly decide which costs must be expensed and which can be capitalized. At a minimum, this process will require creating additional fields in data records to capture information about the stage of the R&D process when costs were incurred. In turn, this will necessitate careful modification and testing of existing programs to ensure that they correctly process the redesigned transaction records.

A third difference is that IFRS does not permit use of the last-in first-out (LIFO) method of accounting for inventory. Consequently, companies that use LIFO will have to modify their cost accounting systems and the calculations used to value inventory. Those changes will need to be carefully reviewed and tested to minimize the risk of errors.

XBRL: REVOLUTIONIZING THE REPORTING PROCESS *XBRL* stands for eXtensible **B**usiness **R**eporting **L**anguage; it is a special programming language designed specifically to facilitate the communication of business information. Beginning in June 2009, the SEC required the 500 largest U.S. public companies to use XBRL when submitting their filings. By June 2011 all public companies will have to use XBRL.

To understand the revolutionary nature of XBRL, examine Figure 16-8. The top portion shows that prior to XBRL, preparers had to manually create reports in various formats for different users. Although those reports were then sent electronically to users, the recipients then had to reenter the data into their own systems in order to manipulate it. The entire process was inefficient and prone to error.

The bottom portion of Figure 16-8 shows how XBRL improves the reporting process. Preparers encode the data and transmit it electronically in various formats to users, who can directly analyze it. Thus, XBRL saves time and reduces the chances for data entry errors.

Without XBRL, electronic documents, regardless of format (text, HTML, PDF, etc.) were essentially just digital versions of paper reports. Humans could read the data, but computers could not automatically process it until the recipient manually entered it in the appropriate format. XBRL changes that by encoding information about what a particular data item means so that other computer programs can understand what to do with it. To illustrate, Figure 16-9 shows how XBRL can annotate a number in a spreadsheet to indicate that it represents sales for a particular time period, following U.S. GAAP and measured in U.S. dollars. (The top portion of Figure 16-9 shows the spreadsheet that most users would see; the XBRL code in the bottom portion is intended for use by software, although it can be viewed by programmers, auditors, or anyone who needs or wants to see it).

XBRL Process and Terminology Figure 16-10 provides a high-level view of the basic steps in preparing and delivering XBRL reports. The XBRL file containing the tagged data that is delivered to users is called an ***instance document***. The instance document contains facts about specific financial statement line items, including their values and contextual information such as the measurement unit (dollars, euros, yuans, etc.) and whether the value is for a specific point in time (e.g., a balance sheet item) or a period of time (e.g., an income statement item). Each specific data item in an XBRL document is called an ***element***. An element's specific value is displayed in an instance document between tags. Angle brackets are used to identify tags. Two tags are used for

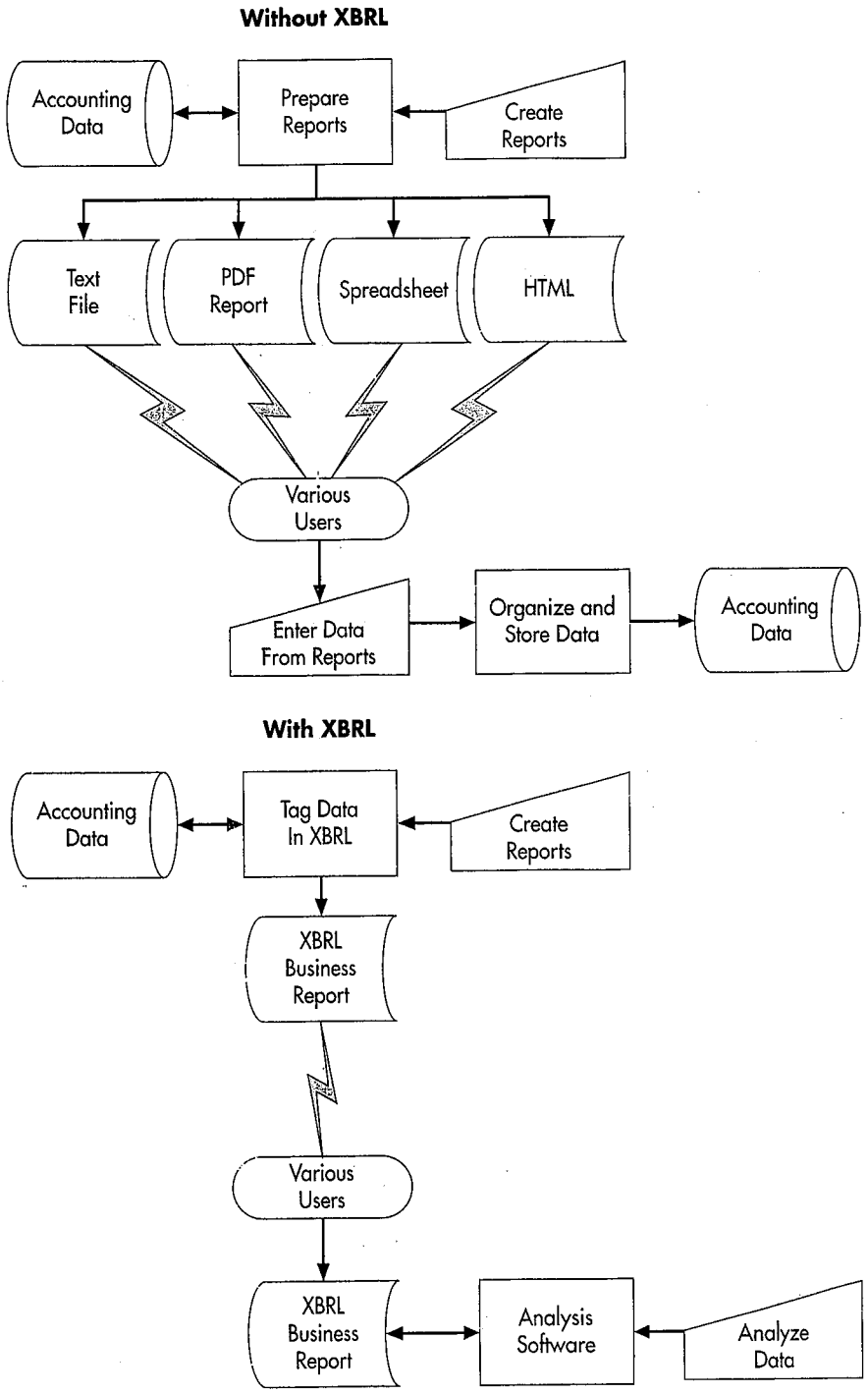


FIGURE 16-8
How XBRL Transforms the Reporting Process

each element. The first tag presents the element name inside a pair of angle brackets; the second tag also uses a pair of angle brackets but precedes the element name with a slash. For example, the XBRL code *2590* indicates that value of the element called Net Sales equals 2590. Additional information is needed to properly interpret that value, such as the monetary units used to measure net sales and the time period during which those sales occurred. That context information is also presented in the instance document between tags. For example, the XBRL code *ISO 4217:USD* indicates that items are being measured in U.S. dollars, and *P1Y 2011-12-31* indicates that sales are being reported for the 1-year period ending December 31, 2011.

An instance document is created by applying a taxonomy to a set of data. A ***taxonomy*** is a set of files that defines the various elements and the relationships between them. One part of the taxonomy is called the ***schema,*** which is a file that contains the definitions of every element that could appear in an instance document. The following are some of the basic attributes used to define each element:

- A unique identifying *name* used by the software
- A *description* that can be used to correctly interpret the element

Panel A: Portion of XBRL-Encoded Spreadsheet

Statement Of Income Alternative (USD $) (in Millions, except per share data)	12 Months Ended		
	Dec. 31, 2008	Dec. 31, 2007	Dec. 31, 2006
Sales (Q)	26,901	29,280	28,950
Cost of goods sold (exclusive of expenses below)	22,175	22,803	21,955
Selling, general administrative, and other expenses	1,167	1,444	1,372
Research and development expenses	246	238	201
Provision for depreciation, depletion, and amortization	1,234	1,244	1,252
Restructuring and other charges (D)	939	268	507
Interest expense (V)	407	401	384
Other income, net (O)	-59	-1,920	-236
Total costs and expenses	26,109	24,478	25,435
Income from continuing operations before taxes on income	792	4,802	3,515
Provision for taxes on income (T)	342	1,623	853
Income from continuing operations before minority interests' share	450	3,179	2,662
Minority interests	221	365	436
Income from continuing operations (Statement [Line Items])	229	2,814	2,226
(Loss) income from discontinued operations (B)	-303	-250	22
Net (Loss) Income (Statement [Line Items])	-74	2,564	2,248
Income from continuing operations (Basic:)	0.28	3.27	2.56
(Loss) income from discontinued operations (Basic:)	-0.37	-0.29	0.03
Net (loss) income (Basic:)	-0.09	2.98	2.59
Income from continuing operations (Diluted:)	0.28	3.23	2.54
(Loss) income from discontinued operations (Diluted:)	-0.37	-0.28	0.03
Net (loss) income (Diluted:)	-0.09	2.95	2.57

Panel B: Portion of XBRL Code

```
<us-gaap:ResearchAndDevelopmentExpense contextRef="eol_0001193125-09-029469_STD_p12m_20061231_0"
    decimals="-6" unitRef="USD">201000000</us-gaap:ResearchAndDevelopmentExpense>
 <us-gaap:RestructuringCharges contextRef="eol_0001193125-09-029469_STD_p12m_20061231_0" decimals="-6"
    unitRef="USD">507000000</us-gaap:RestructuringCharges>
 <us-gaap:SalesRevenueGoodsNet contextRef="eol_0001193125-09-029469_STD_p12m_20061231_0" decimals="-6"
    unitRef="USD">28950000000</us-gaap:SalesRevenueGoodsNet>
 <us-gaap:SellingGeneralAndAdministrativeExpense contextRef="eol_0001193125-09-029469_STD_p12m_20061231_0"
    decimals="-6" unitRef="USD">1372000000</us-gaap:SellingGeneralAndAdministrativeExpense>
```

Explanation:

The spreadsheet shows that the company had sales of $28,950,000,000 for the year ended December 31, 2006. The XBRL code reveals that:

- The number 28950 appearing on the spreadsheet is based on us-gaap (the element begins with <usgaap: SalesRevenueGoodsNet and closes with </us-gaap:SalesRevenueGoodsNet>).
- The context is the SEC Edgar Online filing (eol) for a 12-month period (p12m) ending on December 31, 2006.
- The numbers on the spreadsheet are rounded to the nearest million (decimals = -6, raw value = 28950000000).
- The value is in U.S. dollars ("USD").

FIGURE 16-9 Example of an XBRL Report

- The element's *data type* (monetary unit, text, date, etc.)
- The element's normal *balance type* (debit or credit)
- The element's *period type* (one point in time, called an instant, or a period of time, called a duration)

Attribute information is enclosed within tags. Thus, to continue our example, the schema would contain the following portion of a definition of the *Net Sales* element:

<element name="NetSales" description="Sales net of returns and allowances" type=monetaryItemType balance="credit" periodType="duration" </element>

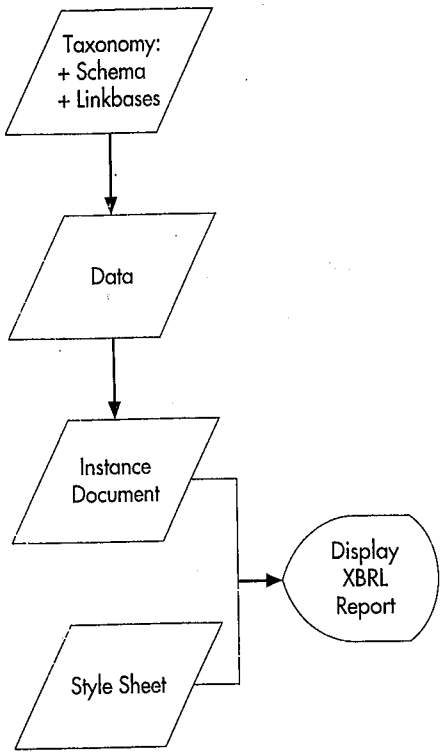


FIGURE 16-10
Electronic Reporting with XBRL

The taxonomy also includes a set of files called ***linkbases,*** which define the relationships among elements. Important linkbases include the following:

- The *Reference* linkbase identifies relevant authoritative pronouncements (e.g., U.S.-GAAP, IFRS) for that element.
- The *Calculation* linkbase specifies how to combine elements (e.g., that "Current Assets" equals the sum of Cash, Accounts Receivable, and Inventory).
- The *Definition* linkbase indicates hierarchical relationships among elements (e.g., that "Current Assets" is a subset of "Assets").
- The *Presentation* linkbase describes how to group elements (e.g., Assets, Liabilities, and Equities).
- The *Label* linkbase associates human-readable labels with elements.

As Figure 16-10 shows, the information in an XBRL taxonomy is used to tag the data and create an instance document. The same taxonomy is usually used to create a set of separate instance documents, one for each reporting year. Instance documents, however, contain only the data values.. Another document, called the ***style sheet,*** provides the instructions on how to appropriately display the content of an instance document, either on a computer screen or in a printed report.

The benefits of XBRL are not limited to its use for external reporting. Internal reporting will also benefit because data can be exported from the basic ERP system in a format that managers can import directly into a variety of applications, saving time and eliminating the errors arising from having to manually reenter data.

The Accountant's Role Accountants can, and should, play a major role in all phases of producing XBRL reports, beginning with the selection of an appropriate taxonomy. To ensure comparability across XBRL reports produced by different organizations, standard taxonomies have been developed for many different countries and industries. Accountants use their knowledge of the organization's business practices plus general accounting principles to select the standard taxonomy that best fits the organization. They then map each data item in the organization's accounting system to its corresponding element in the taxonomy.

However, standard taxonomies cannot cover every possible situation. Sometimes, an organization needs to record financial information in a different manner or level of detail to reflect its unique way of doing business. In such cases, accountants can create new tags to more accurately

present information about the organization's business activities. These new tags create what is called an ***extension taxonomy.*** This ability to modify XBRL is why it is referred to as an *extensible* language.

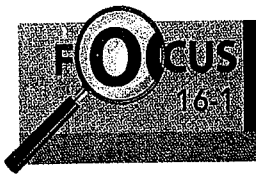
Accountants are also likely to use software to apply the taxonomy (and any extensions) to tag their organization's data, create instance documents, and then validate those instance documents before they are submitted. Accountants will also typically participate in creating style sheets to ensure that the information is displayed appropriately.

Not only do accountants use XBRL; as Focus 16-1 explains, the accounting profession played a major role in its creation. XBRL is a work in process. You should bookmark and regularly visit both the xbrl.org and sec.gov Web sites to stay abreast of continued developments in this important reporting tool.

Threats and Controls

Table 16-1 shows that one threat is the creation of inaccurate financial statements. The data processing integrity controls for journal entries discussed earlier combined with the use of packaged software (e.g., an ERP system) to produce the financial statements minimizes the risk numerical errors in the data. However, because both IFRS and XBRL require numerous judgments about how to classify information, there is a risk that financial statements may not accurately represent the results of operations. For example, mistakes in componentizing fixed assets can result in inaccurate depreciation expenses for IFRS financial statements. XBRL standard taxonomies offer many fine-grained choices (e.g., more than 20 elements define the concept "Cash and Cash Equivalents"), which can result in selecting an inappropriate tag unless the person doing the mapping has extensive knowledge both about the organization's business practices and the XBRL taxonomies. Unnecessarily creating taxonomy extensions instead of using a standard tag is another potential problem. Training and experience will likely reduce the risk of making such mistakes. In addition, an independent external audit is necessary as a detective control.

Fraudulent financial reporting (threat 9) is another potential problem. Financial statement fraud often involves journal entries by upper-level management that cause the organization's financial statements to either overstate revenues or understate liabilities. It is difficult to prevent



The Accounting Profession's Role in XBRL

The origins of XBRL can be traced back to the early 1990s. At that time, a software engineer named Jon Bosak recognized that a critical shortcoming of HTML is its inability to describe the content of the data being presented. Bosak convinced the World Wide Web Consortium (W3C) to sponsor the development of a language with this capability. That project resulted in Bosak and two other software engineers creating a programming language called XML, which stands for extensible markup language. XML is a general-purpose tool that can tag any data with identifying markers.

XML was a step in the right direction. Charlie Hoffman, a CPA who worked for a local accounting firm in Tacoma, Washington realized, however, that XML did not go far enough to be a general-purpose language for communicating financial information. What was needed was the ability not only to identify each piece of data but also how to process it and how to relate it to other data items. Hoffman started work on adding the desired capabilities to XML but realized that the project required additional support. He sought and obtained the AICPA's help to pursue the development of a prototype set of XML-enhanced financial statements.

As the work progressed, the results were shared with major software companies, who recognized the value of such a common business language and joined the project. Eventually, many leading software companies, and important user groups, cooperated in the venture with the AICPA. The result: XBRL. The continued development and maintenance of XBRL is now overseen by a nonprofit international organization (XBRL International). Vendors are currently working on making a wide range of financial and decision support software capable of supporting XBRL. Industry-specific coding taxonomies have been developed in many countries. XBRL is on its way to becoming the global computer language for communicating financial data. And it all started with one CPA who was looking for a better way to disseminate financial data on the Internet!

Postscript: In December 2006, the AICPA formally recognized Charlie Hoffman's pioneering work in developing XBRL with a special achievement award.

such journal entries because upper-level management inherently has the ability to override most internal controls. Therefore, the best control to mitigate the threat of financial statement fraud is an independent review (audit) of all special journal entries to the general ledger (i.e., all entries other than the summary journal entries automatically generated by the various cycles discussed in Chapters 12 to 15). Although Statement of Auditing Standards number 99 requires external auditors to "test the appropriateness of journal entries recorded in the general ledger and other adjustments," internal auditors should also regularly review all adjustments to the general ledger. To be effective, however, such testing requires proper configuration of the accounting system, so that every change to general ledger accounts is captured and recorded as part of the audit trail.

Produce Managerial Reports

The final activity in the general ledger and reporting system (circle 4.0 in Figure 16-2) is to produce various managerial reports, including budgets.

Process

ERP systems like the one depicted in Figure 16-3 can produce a number of budgets to help managers plan and evaluate performance. An operating budget depicts planned revenues and expenditures for each organizational unit. A capital expenditures budget shows planned cash inflows and outflows for each capital project. Cash flow budgets compare estimated cash inflows from operations with planned expenditures and are used to determine borrowing needs.

In addition to budgets, the inquiry processing capabilities of ERP systems enable managers to easily create an almost unlimited number of performance reports. For example, sales can be broken down by products, by salesperson, and by customer. Displaying the data in graphs can help managers quickly identify important trends and relationships, as well as areas in need of more detailed analysis. Accountants should understand how to use the flexible reporting and graphing capabilities of ERP systems so that they can add value by suggesting alternative ways to organize and analyze data about business processes.

Threats and Controls

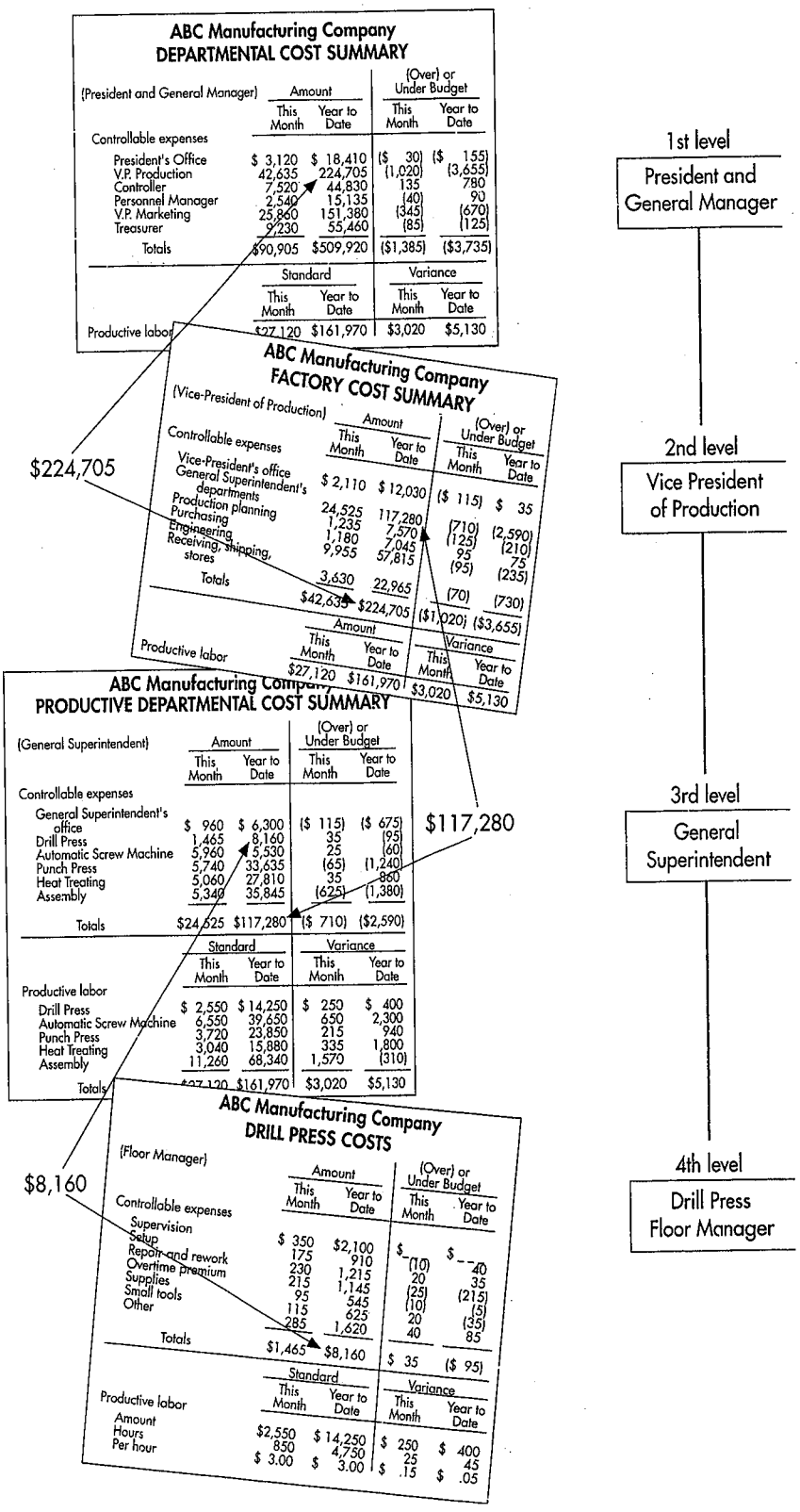
Poorly designed reports and graphs (threat 10 in Table 16-1) can cause managers to make biased or erroneous decisions. The following subsections discuss three important controls to mitigate that threat: the use of responsibility accounting and flexible budgets to design performance reports, the balanced scorecard, and understanding the principles of proper graph design.

RESPONSIBILITY ACCOUNTING AND FLEXIBLE BUDGETING To properly evaluate performance, reports should highlight the results that can be directly controlled by the person or unit being evaluated. ***Responsibility accounting*** does this by producing a set of correlated reports that break down the organization's overall performance by the specific subunits which can most directly control those activities, as shown in Figure 16-11. Note how each report shows actual costs and variances from budget for the current month and the year to date, but only for those items that the manager of that subunit controls. Note also the hierarchical nature of the reports: The total cost of each individual subunit is displayed as a single line item on the next-higher-level report.

It is also important to design the budget so that its content matches the nature of the unit being evaluated. For example, the performance reports depicted in Figure 16-11 focus on costs, because production departments are usually treated as cost centers. In contrast, sales departments are often evaluated as revenue centers. Consequently, their performance reports should compare actual to forecasted sales, broken down by appropriate product and geographic categories. Similarly, reports for departments that are treated as profit centers should include both revenues and expenses.

No matter which basis is used to prepare a unit's budgetary performance report, the method used to calculate the budget standard is crucial. The easiest approach is to establish fixed targets for each unit, store those figures in the database, and compare actual performance with those preset values. A major drawback to this approach is that the budget number is static and does not reflect unforeseen changes in the operating environment. Consequently, individual managers may be penalized or rewarded for factors beyond their control. For example, assume that the

FIGURE 16-11
Sample Set of Reports to Illustrate Responsibility Accounting



budgeted amounts in Figure 16-11 for the general superintendent are based on planned output of 2,000 units. If, however, actual production is 2,200 units because of greater-than-anticipated sales, then the negative variances for each expense category may indicate not inefficiency, but rather the increased level of output.

A ***flexible budget,*** in which the budgeted amounts vary in relation to some measure of organizational activity, mitigates such problems. In terms of our previous example, flexible budgeting would entail dividing the budget for each line item in the general superintendent's department into its fixed and variable cost components. In this way, budget standards would be automatically adjusted for any unplanned increases (or decreases) in production. Thus, any differences between these adjusted standards and actual costs can more appropriately be interpreted.

TABLE 16-2 Example of a Balanced Scorecard

Dimension Goals	Measure	Target	Current Period	Prior Period
FINANCIAL				
New revenue streams	Sales of new products (000s)	104	103	100
Improve profitability	Return on equity (%)	12.5%	12.6%	12.2%
Positive cash flow	Cash from operations (000s)	156	185	143
CUSTOMER				
Improve satisfaction	Rating (0–100)	95	93	92
Be a preferred supplier	Percentage of key customers' electronics purchases made from us	20%	20%	18%
INTERNAL OPERATIONS				
Service quality	Orders filled without error (%)	98%	97%	95%
Speed of delivery	Order cycle time (days)	10.4	10.5	11.2
Process efficiency	Defect rate	1.0%	1.1%	1.05%
INNOVATION AND LEARNING				
New products	Number of new products	4	4	3
Employee learning	Personnel attending advanced training courses (%)	10%	25%	9%

THE BALANCED SCORECARD[1] As the chapter opening case illustrated, one problem with the reports produced by many accounting systems is that the reports too narrowly focus on just one dimension of performance: that reflected in the financial statements. Balanced scorecards attempt to solve that problem. A ***balanced scorecard*** is a report that provides a multidimensional perspective of organizational performance. As shown in Table 16-2, a balanced scorecard contains measures reflecting four perspectives of the organization: financial, customer, internal operations, and innovation and learning. The financial section contains lagging indicators of past performance, whereas the other three sections provide leading indicators about likely future performance. For each dimension, the balanced scorecard shows the organization's goals and specific measures that reflect performance in attaining those goals. Together, the four dimensions of the balanced scorecard provide a much more comprehensive overview of organizational performance than that provided by financial measures alone. Let us now examine Table 16-2 to see how the four parts of the balanced scorecard reflect key aspects of an organization's strategy and important causal relationships between various measures.

AOE's top management, like many companies, agreed on three key financial goals: increased revenue streams through sales of new products, increased profitability as reflected in return on equity, and maintaining adequate cash flow to meet obligations. As shown in Table 16-2, specific measures and targets were developed to track the attainment of those goals. Both the choice of key metrics and the setting of target values are important management decisions. Many organizations make the mistake of setting targets that reflect industry benchmark values. The problem with such an approach is that the organization's aspirations and, hence, its performance are limited by its competitors' performance. Although industry benchmarks may provide a useful reference point, management should set targets that take into consideration the organization's unique strengths and weaknesses.

For every organization, customers are the key to achieving financial goals. Accordingly, the customer perspective of AOE's balanced scorecard contains two key goals: Improve customer satisfaction and become the preferred supplier for key customers. In turn, meeting those customer-oriented goals requires efficiently and effectively performing internal business processes. Consequently, the internal operations perspective portion of AOE's balanced scorecard focuses on those activities most likely to directly affect customer perceptions: service quality, speed of delivery, and process efficiency. Finally, AOE's top management acknowledged the

[1]This section is based on two articles by Robert S. Kaplan and David P. Norton: "The Balanced Scorecard—Measures That Drive Performance," *Harvard Business Review* (January–February 1992): 71–79; and "Using the Balanced Scorecard as a Strategic Management System," *Harvard Business Review* (January–February 1996): 75–85. Additional information about the balanced scorecard can be found at www.balancedscorecard.org.

importance of developing new products and training its workforce to continuously improve service and results. Therefore, measures of those two items are included in the innovation and learning perspective of AOE's balanced scorecard.

Note that the preceding discussion implied a number of hypotheses about cause-and-effect relationships. For example, increased employee training is expected to improve service quality, as reflected in the percentage of customer orders filled correctly. In turn, improved service quality is expected to result in increased customer satisfaction and in more purchases from key customers. Finally, increased customer satisfaction is expected to result in improved profitability and cash flow. Thus, the measures in the innovation and learning, internal operations, and customer perspective portions of the balanced scorecard can be thought of as leading indicators of financial measures of the organization's strategy. Analyzing trends in the actual measures allows AOE's management to test the validity of those hypotheses. If improvements in one perspective do not generate expected improvements in other areas in subsequent time periods, top management must reevaluate and probably revise hypotheses about the determinants of organizational success. Indeed, this ability to test and refine strategy is one of the major benefits the balanced scorecard provides.

Accountants and systems professionals should participate in the development of a balanced scorecard. Top management's role is to specify the goals to be pursued in each dimension. Accountants and information systems professionals can then help management choose the most appropriate measures for tracking achievement of those goals. In addition, they can provide input concerning the feasibility of collecting the data that would be required to implement various proposed measures.

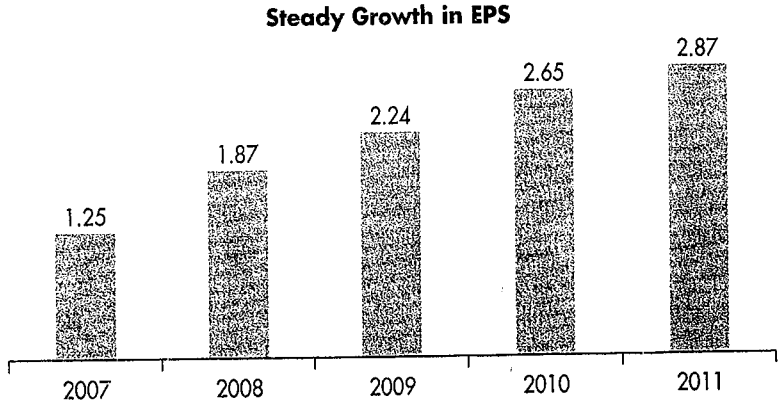
Although the balanced scorecard was initially developed as a strategic management tool, it can also be used as a vehicle to better manage enterprise risk by incorporating appropriate risk-based goals and measures in the various dimensions. For example, an organization might want to increase information security awareness among employees. One way to motivate attention to that objective is to explicitly list increased security awareness as one of the goals in the Innovation and Learning section of the scorecard and then measure employee knowledge about security best practices. Similarly, listing reduced inventory shrinkage as one of the Internal Operations Process goals and measuring it can help focus attention on reducing the risk of employee theft. External threats, such as loss of market share, can likewise be addressed by including appropriate measures (e.g., sales to repeat customers, number of new customers) in the Customer and Financial sections of the balanced scorecard. Thus, the balanced scorecard can be used as one tool to monitor and evaluate an organization's controls and risk management program.

PRINCIPLES OF PROPER GRAPH DESIGN Well-designed graphs make it easy to identify and understand trends and relationships. Poorly designed graphs, however, can impair decision making by misdirecting attention, hiding important changes in the data, or causing erroneous initial impressions.

Although many types of graphs exist, bar charts are the most common type used to display trends in financial data. Therefore, we will focus on some basic principles that make bar charts easy to read. Figure 16-12 illustrates the following principles of good graph design:

1. Use a title that summarizes the basic message.
2. Include data values with each element to facilitate mental calculations and analyses.

FIGURE 16-12
Example of a Well-Designed Graph



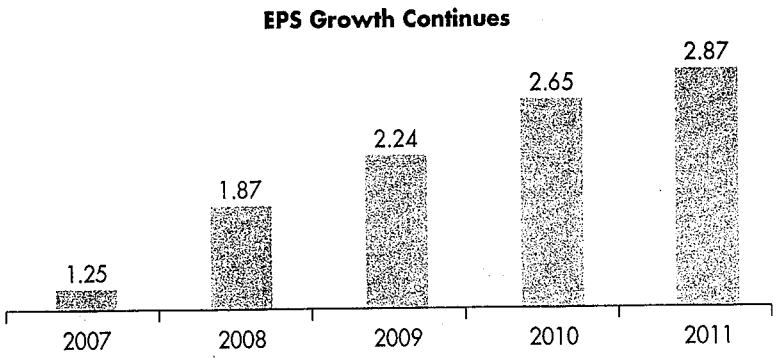


FIGURE 16-13
Example of a Poorly Designed Graph: Vertical Axis Does Not Begin at Zero

3. Use 2-D, instead of 3-D, bars because that makes it easier to accurately assess the magnitude of changes and trends.

However, graphs not only must be easy to read but also must lead to accurate interpretations of the underlying data. The following two principles are essential for properly designing bar charts of financial data so that they are accurately interpreted:

1. ***Begin the vertical axis at zero.*** Doing so ensures that the depicted magnitude of change in the data *accurately* reflects the actual change in the data. Beginning at a value other than zero, by contrast, magnifies the visual appearance of a trend. To see the importance of this rule, compare Figure 16-12, which follows this principle, to Figure 16-13, which does not. Exception: Beginning the vertical axis at a value other than zero may be useful if there is a need to monitor minor fluctuations in the data. For example, a day trader may need to quickly identify small changes in stock prices.
2. ***For graphs that depict time-series data, order the x-axis chronologically from left to right.*** This principle is illustrated in Figure 16-12. Otherwise, the viewer may form an erroneous initial impression of the nature of the change in the data. For example, the initial visual impression created by Figure 16-14 is that of a declining trend.

The rules for proper graph design are simple, but they are easy to violate. Sometimes, such violations are created automatically by the software program used to create the graph. For example, many financial spreadsheets display the data in reverse chronological order, with the most recent year's data in the column immediately to the right of the descriptive labels. In this case, selecting the data and using the spreadsheet's built-in charting functions automatically produces a graph in which the *x*-axis is in reverse chronological order. Other times, however, violations occur because of deliberate choices made by the graph designer. Regardless of the reason, violating the principles of proper graph design can result in graphs that mislead viewers. Therefore, it is important for accountants and information systems professionals to understand the principles for properly designing graphs so that they can avoid inadvertently creating misleading graphs and identify and correct any such graphs they encounter.

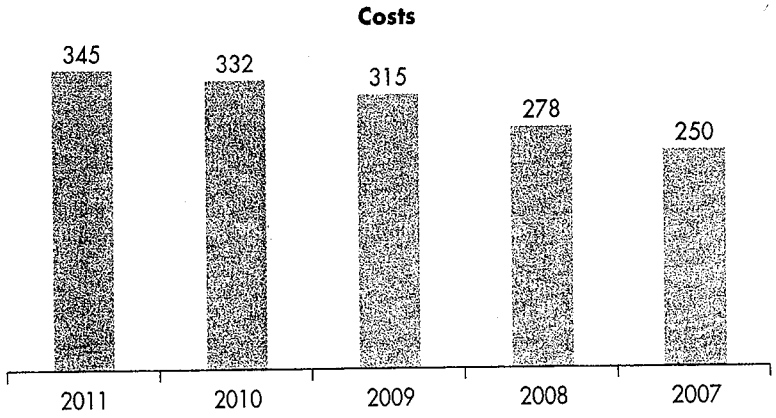


FIGURE 16-14
Example of a Poorly Designed Graph: X-Axis in Reverse Chronological Order

Summary and Case Conclusion

The general ledger and financial reporting system integrates and summarizes the results of the various accounting subsystems for the revenue, expenditure, production, and human resources cycles. The general ledger is the central master file in the accounting system. Consequently, it is important to implement control procedures to ensure its accuracy and security. Important controls include data processing integrity checks of the journal voucher records posted to the general ledger, access controls, an adequate audit trail, and appropriate backup and disaster recovery procedures.

The outputs produced by the general ledger system fall into two primary categories: financial statements and managerial reports. The former are prepared periodically in accordance with regulatory frameworks (GAAP or IFRS) and are distributed to both internal and external users. The latter are prepared for internal use only and therefore often include comparisons between actual and budgeted performance. The usefulness of these reports, whether presented in the form of tables or graphs, is affected by how well they are designed.

Organizations must provide information to a wide variety of users, including government agencies, industry analysts, financial institutions, and individual decision makers. XBRL provides a mechanism for improving the efficiency of generating such information, as well as for using information obtained from external sources. Elizabeth Venko and Ann Brandt proposed that AOE purchase special software designed to create XBRL documents from data in AOE's system. Linda Spurgeon approved their request.

Elizabeth and Ann also explained that AOE's new integrated transaction processing database provides much of the data needed to create a balanced scorecard. They told Linda that they could help her design a balanced scorecard that included metrics that would reflect AOE's strategic goals. Elizabeth also suggested that managers should be trained on how to design graphs properly to depict accurately key performance trends. Linda and Stephanie agreed with those suggestions. They asked Elizabeth and Ann to to oversee the development of some classes in graph design. Finally, Linda approved Elizabeth and Ann's request for two accountants and two IS staff to be assigned to begin work on reconfiguring AOE's new ERP system to generate financial statements in accordance with IFRS.

This chapter concludes our examination of the various cycles in an integrated accounting system. This chapter and the previous four explained how an accounting system should be designed: (1) to process transactions for accountability purposes, (2) to maintain adequate controls to ensure the integrity of the organization's data and the safeguarding of its assets, and (3) to provide information to support decision making. One other theme that appears throughout this book is the need for accountants to move beyond the traditional role of scorekeeper and actively seek to add value to their organization. Accountants should participate in decisions about adopting new technology and implementing new information systems because they have the training to properly evaluate the relative costs and benefits, as well as the economic risks, underlying such investments. Effectively participating in decisions concerning technology, however, requires accountants not only to keep abreast of current accounting developments but also to stay informed about advances in IT. Thus, as an accountant, you must make a commitment to lifelong learning. We wish you well in this endeavor.

Key Terms

journal voucher file 487
trial balance 488
audit trail 489
XBRL 492
instance document 492
element 492
taxonomy 493
schema 493
linkbases 495
style sheet 495
extension taxonomy 496
responsibility accounting 497
flexible budget 498
balanced scorecard 499

AIS IN ACTION

Chapter Quiz

1. From where do adjusting entries usually come?
   a. treasurer
   b. controller
   c. various accounting cycle subsystems, such as sales order entry
   d. unit managers

2. Preparing performance reports that contain data only about items that a specific organizational unit controls is an example of which of the following?
   a. flexible budget system
   b. responsibility accounting system
   c. closing the books
   d. management by exception

3. The definition of an XBRL element, including such information as whether its normal account balance is a debit or a credit, is found in which of the following?
   a. linkbase
   b. instance document
   c. schema
   d. style sheet

4. Which of the following shows the implied linkages among the portions of the balanced scorecard?
   a. Financial → Internal → Innovation and learning → Customer
   b. Innovation and learning → Internal → Customer → Financial
   c. Customer → Financial → Internal → Innovation and learning
   d. Internal → Customer → Innovation and learning → Financial

5. Which of the following XBRL documents contains the actual data values for a company's net income for a particular year?
   a. style sheets
   b. schema
   c. linkbases
   d. instance document

6. The number of orders shipped per warehouse worker each day is a metric that would most likely appear in which part of the balanced scorecard?
   a. innovation and learning
   b. customer
   c. internal operations
   d. financial

7. Which of the following is an important part of the audit trail?
   a. journal vouchers
   b. flexible budgets
   c. trial balance
   d. data warehouse

8. An adjusting journal entry to record interest revenue that has been earned but not yet received is an example of which of the following?
   a. accrual
   b. deferral
   c. estimate
   d. revaluation

9. Which of the following is designed primarily to improve the efficiency of financial reporting?
   a. XML
   b. XBRL
   c. IFRS
   d. the balanced scorecard

10. Which of the following graph design principles is most important for ensuring that financial data are accurately interpreted?
    a. including a title that summarizes the point of the graph
    b. attaching data values to specific elements in the graph
    c. starting the *y*-axis of the graph at zero
    d. using different colors for different variables

Discussion Questions

16.1. Although XBRL facilitates the electronic exchange of financial information, some external users do not think it goes far enough. They would like access to the entire general ledger, not just to XBRL-tagged financial reports that summarize general ledger accounts. Should companies provide external users with such access? Why or why not?

16.2. How can responsibility accounting and flexible budgets improve morale?

16.3. Why is the audit trail an important control?

16.4. The balanced scorecard measures organizational performance along four dimensions. Is it possible that measures on the customer, internal operations, and innovation and learning dimensions could be improving without any positive change in the financial dimension? If so, what are the implications of such a pattern?

16.5. Do you think that mandatory standards should be developed for the design of graphs of financial data that are included in annual reports and other periodic communications to investors? Why or why not?

Problems

16.1. Match the term in the left column with its appropriate definition from the right column:

____ 1. Journal voucher file	a. An individual financial statement item
____ 2. Instance document	b. Evaluating performance based on controllable costs
____ 3. XBRL element	c. Evaluating performance by computing standards in light of actual activity levels
____ 4. Balanced scorecard	d. The set of journal entries that updated the general ledger
____ 5. XBRL extension taxonomy	e. A set of files that defines XBRL elements and specifies the relationships among them
____ 6. Audit trail	f. A multidimensional performance report
____ 7. XBRL taxonomy	g. A file that defines relationships among XBRL elements
____ 8. XBRL linkbase	h. A file that defines the attributes of XBRL elements
____ 9. XBRL schema	i. A detective control that can be used to trace changes in general ledger account balances back to source documents
____ 10. XBRL style sheet	j. A file that explains how to display an XBRL instance document
____ 11. Responsibility accounting	k. A file that contains specific data values for a set of XBRL elements for a specific time period or point in time
____ 12. Flexible budget	l. A file containing a set of customized tags to define new XBRL elements that are unique to a specific organization

16.2. Which control procedure would be most effective in addressing the following problems?

a. When entering a journal entry to record issuance of new debt, the treasurer inadvertently transposes two digits in the debit amount.
b. The spreadsheet used to calculate accruals had an error in a formula. As a result, the controller's adjusting entry was for the wrong amount.
c. The controller forgot to make an adjusting entry to record depreciation.
d. A sales manager tipped off friends that the company's financial results, to be released tomorrow, were unexpectedly good.

e. The general ledger master file is stored on disk. For some reason, the disk is no longer readable. It takes the accounting department a week to reenter the past month's transactions from source documents in order to create a new general ledger master file.
f. The controller sent a spreadsheet containing a preliminary draft of the income statement to the CFO by e-mail. An investor intercepted the e-mail and used the information to sell his stock in the company before news of the disappointing results became public.
g. A company's XBRL business report was incorrect because the controller selected the wrong element from the taxonomy.
h. Instead of a zero, an employee entered the letter o when typing in data values in an XBRL instance document.

16.3. Explain the components of an audit trail for verifying changes to accounts payable. Your answer should specify how those components can be used to verify the accuracy, completeness, and validity of all purchases, purchase returns, purchase discounts, debit memos, and cash disbursements.

16.4. As manager of a local pizza parlor, you want to develop a balanced scorecard so you can more effectively monitor the restaurant's performance.

Required

a. Propose at least two goals for each dimension, and explain why those goals are important to the overall success of the pizza parlor. One goal should be purely performance oriented, and the other should be risk related.
b. Suggest specific measures for each goal developed in part a.
c. Explain how to gather the data needed for each measure developed in part b.

16.5. Use Table 16-1 to create a questionnaire checklist that can be used to evaluate controls in the general ledger and reporting cycle.
a. For each control issue, write a Yes/No question such that a "No" answer represents a control weakness. For example, one question might be "Is access to the general ledger restricted?"
b. For each Yes/No question, write a brief explanation of why a "No" answer represents a control weakness.

16.6. Visit the SEC website (www.sec.gov), and explore what is available in terms of interactive data (the SEC's term for XBRL reports). Use the SEC's viewer software, and examine the annual reports for two companies.



16.7. Obtain the annual report of a company assigned by your professor. Read the management discussion and analysis section, and develop a balanced scorecard that reflects that company's vision, mission, and strategy. Create both performance-oriented and risk-based goals and measures for each section of the balanced scorecard.

16.8. Excel Problem. Objective: Practice graph design principles.



Required (continues on next page)

Use the data in Table 16-3 to create the following graphs:
a. Sales
b. Sales and Gross Margin
c. Earnings per Share

TABLE 16-3 Data for Problem 16-8

	2010	2009	2008	2007	2006
Sales	598,000	640,000	575,000	560,000	530,000
Cost of Goods Sold	350,000	400,000	375,000	330,000	300,000
Gross Margin	248,000	240,000	200,000	230,000	230,000
Earnings Per Share	12.52	12.10	11.95	11.66	10.50

Which principles of graph design, if any, did you have to manually implement to override the default graphs created by Excel?



16.9. Excel Problem

Objective: Create pivot tables for what-if analysis.

Required

Read the article "Make Excel an Instant Know-It-All" by Roberta Ann Jones in the March 2004 issue of the *Journal of Accountancy* (available at www.aicpa.org).

a. Follow the instructions in the article to create a spreadsheet with pivot tables.
b. Print out a report that shows sales by month for each salesperson.
c. Assume that Brown and David are in sales group 1 and that the other three salespeople are in sales group 2. Print out a report that shows monthly sales for each group.



16.10. Excel Problem

Objective: How to do what-if analysis with graphs.

Required

a. Read the article "Tweaking the Numbers," by Theo Callahan in the June 2001 issue of the *Journal of Accountancy* (available at www.aicpa.org). Follow the instructions in the article to create a spreadsheet with graphs that do what-if analysis.
b. Now create a spreadsheet to do graphical what-if analysis for the "cash gap." Cash gap represents the number of days between when a company has to pay its suppliers and when it gets paid by its customers. Thus,

$$\text{Cash gap} = \text{Inventory days on hand} + \text{Receivables collection period} - \text{Accounts payable period}$$

The purpose of your spreadsheet is to display visually what happens to cash gap when you "tweak" policies concerning inventory, receivables, and payables. Thus, you will create a spreadsheet that looks like Figure 16-15.

c. Set the three spin buttons to have the following values:

	Spin Button for Inventory	Spin Button for Receivables	Spin Button for Payables
Linked cell	C2	C3	C4
Maximum	120	120	90
Minimum	0	30	20
Value	30	60	20
Small change	10	10	10

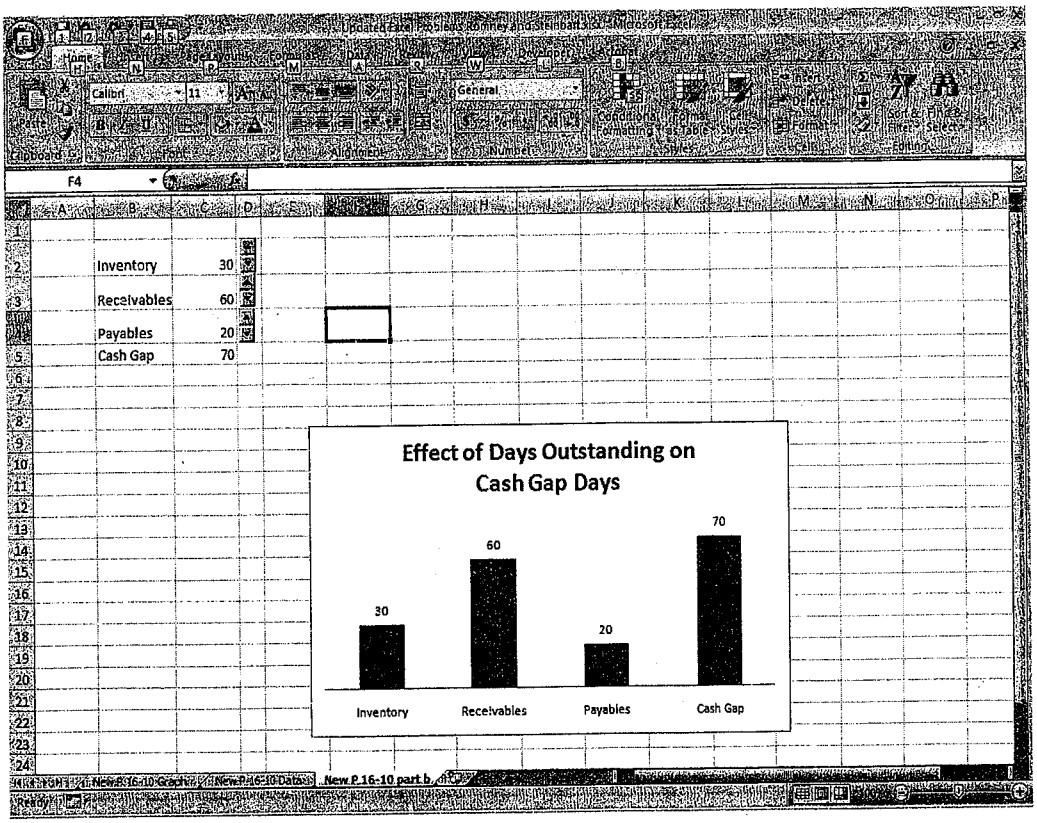


FIGURE 16-15
Spreadsheet for Problem 16-10, part b

Case16-1 Keeping Current with XBRL

Like IT in general, XBRL is continually evolving. Visit xbrl.org to identify developments in the standard, the use of XBRL by companies and regulatory agencies, and XBRL-related products that have come out during the past twelve months. Write a report summarizing your findings.

Case16-2 Evaluating a General Ledger Package

Accounting magazines such as *Journal of Accountancy* and *Strategic Finance* periodically publish reviews of accounting software. Obtain a copy of a recent software review article, and read its comments about a general ledger package to which you have access. Using the software, write a report that indicates whether, and why, you agree or disagree with the review's opinions about the following features of the general ledger package:

a. Ease of installation
b. Flexibility in the initial setup of the chart of accounts and during subsequent modifications
c. Frequency of updates from subsystems (sales, cash receipts, etc.)
d. Control procedures available to restrict access
e. Control procedures to ensure accuracy of input and processing
f. Report flexibility (how easy it is to design reports, etc.)
g. Adequacy of the audit trail (e.g., what reference data are automatically provided versus how much of the audit trail has to be manually constructed)



AIS IN ACTION SOLUTIONS

Quiz Key

1. From where do adjusting entries usually come?
   a. treasurer (Incorrect. Adjusting entries are entered by the controller after the trial balance has been prepared. The treasurer makes regular journal entries to record financing activities, such as issuing or retiring debt.)
   ▶ b. controller (Correct. Adjusting entries are entered by the controller after the trial balance has been prepared.)
   c. various accounting cycle subsystems, such as sales order entry (Incorrect. Subsystems send summary regular journal entries, not adjusting entries, to the general ledger.)
   d. unit managers (Incorrect. Unit managers should not make any journal entries.)

2. Preparing performance reports that contain data only about items that a specific organizational unit controls is an example of which of the following?
   a. flexible budget system (Incorrect. Flexible budgets adjust targets based on actual inputs.)
   ▶ b. responsibility accounting system (Correct. This is the essence and purpose of responsibility accounting.)
   c. closing the books (Incorrect. Closing the books is a process performed at the end of a fiscal period to prepare financial statements.)
   d. management by exception (Incorrect. Management by exception is a reporting technique that focuses on unusual variations from standards.)

3. The definition of an XBRL element, including such information as whether its normal account balance is a debit or a credit, is found in which of the following?
   a. linkbase (Incorrect. The linkbase files in the taxonomy provide information about relationships among elements.)
   b. instance document (Incorrect. The instance document contains the value of an element and contextual information, but not its full definition.)
   ▶ c. schema (Correct. The schema file in the taxonomy contains definitions of XBRL elements.)
   d. style sheet (Incorrect. The style sheet specifies how to display an instance document on either a computer screen or on a printed report.)

4. Which of the following shows the implied linkages among the portions of the balanced scorecard?
   a. Financial → Internal → Innovation and learning → Customer (Incorrect.)
   ▶ b. Innovation and learning → Internal → Customer → Financial (Correct. The theory underlying the balanced scorecard is that learning and innovation will improve internal measures of performance, which will in turn improve customer satisfaction, which will then be reflected in better financial performance.)
   c. Customer → Financial → Internal → Innovation and learning (Incorrect.)
   d. Internal → Customer → Innovation and learning → Financial (Incorrect.)

5. Which of the following XBRL documents contains the actual data values for a company's net income for a particular year?
   a. style sheets (Incorrect. Style sheets provide information about how to display the information in an instance document.)
   b. schema (Incorrect. Schemas define elements of financial statements, such as net income, but do not provide actual data values for those elements.)
   c. linkbases (Incorrect. Linkbases describe relationships among taxonomy elements.)
   ▶ d. instance document (Correct. An instance document contains specific values for financial statement elements.)

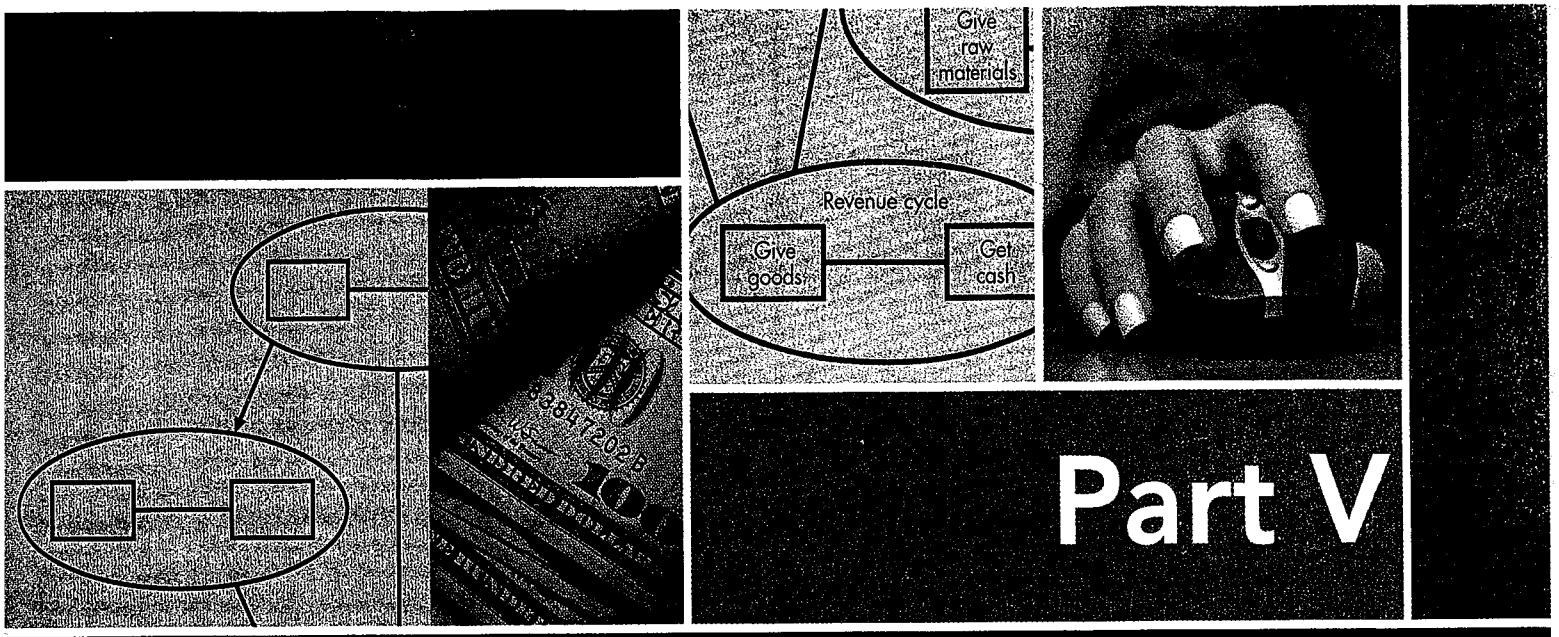
6. The number of orders shipped per warehouse worker each day is a metric that would most likely appear in which part of the balanced scorecard?
   a. innovation and learning (Incorrect. The proposed metric is a measure of process efficiency and, therefore, would appear in the internal operations section of the balanced scorecard.)
   b. customer (Incorrect. The proposed metric is a measure of process efficiency and, therefore, would appear in the internal operations section of the balanced scorecard.)
   ▶ c. internal operations (Correct.)
   d. financial (Incorrect. The proposed metric is a measure of process efficiency and, therefore, would appear in the internal operations section of the balanced scorecard.)

7. Which of the following is an important part of the audit trail?
   ▶ a. journal vouchers (Correct. Journal vouchers provide information concerning the source of changes to the general ledger accounts.)
   b. flexible budgets (Incorrect. Flexible budgets are a performance evaluation tool.)
   c. trial balance (Incorrect. The trial balance is a step in the preparation of financial statements.)
   d. data warehouse (Incorrect. A data warehouse is used for business intelligence.)

8. An adjusting journal entry to record interest revenue that has been earned but not yet received is an example of which of the following?
   ▶ a. accrual (Correct.)
   b. deferral (Incorrect. A deferral would involve postponing recognition of an event for which cash has already been exchanged in advance of performing the event.)
   c. estimate (Incorrect. An estimate is an entry used to record the results of judgmental analysis.)
   d. revaluation (Incorrect. A revaluation entry is used to correct a prior error.)

9. Which of the following is designed primarily to improve the efficiency of financial reporting?
   a. XML (Incorrect. XML is a general-purpose language but is not designed for financial reporting.)
   ▶ b. XBRL (Correct. The eXtensible Business Reporting Language was developed, in part, by accountants to facilitate business reporting.)
   c. IFRS (Incorrect. IFRS is an alternative to GAAP.)
   d. the The balanced scorecard (Incorrect. The balanced scorecard is a multidimensional performance report.)

10. Which of the following graph design principles is most important for ensuring that financial data is accurately interpreted?
    a. including a title that summarizes the point of the graph (Incorrect. This principle improves readability but is not specifically designed to ensure that the graph is accurately interpreted.)
    b. attaching data values to specific elements in the graph (Incorrect. This principle facilitates making mental calculations but is not specifically designed to ensure that the graph is accurately interpreted.)
    ▶ c. starting the *y*-axis of the graph at zero (Correct. Starting the *y*-axis at zero accurately depicts the magnitude of changes in the data.)
    d. using different colors for different variables (Incorrect. This principle improves readability but is not specifically designed to ensure that the graph is accurately interpreted.)



Part V

The Systems Development Process

Chapter 20 Introduction to Systems Development and Systems Analysis

Chapter 21 AIS Development Strategies

Chapter 22 Systems Design, Implementation, and Operation

Chapter 20

Introduction to Systems Development and Systems Analysis

Learning Objectives

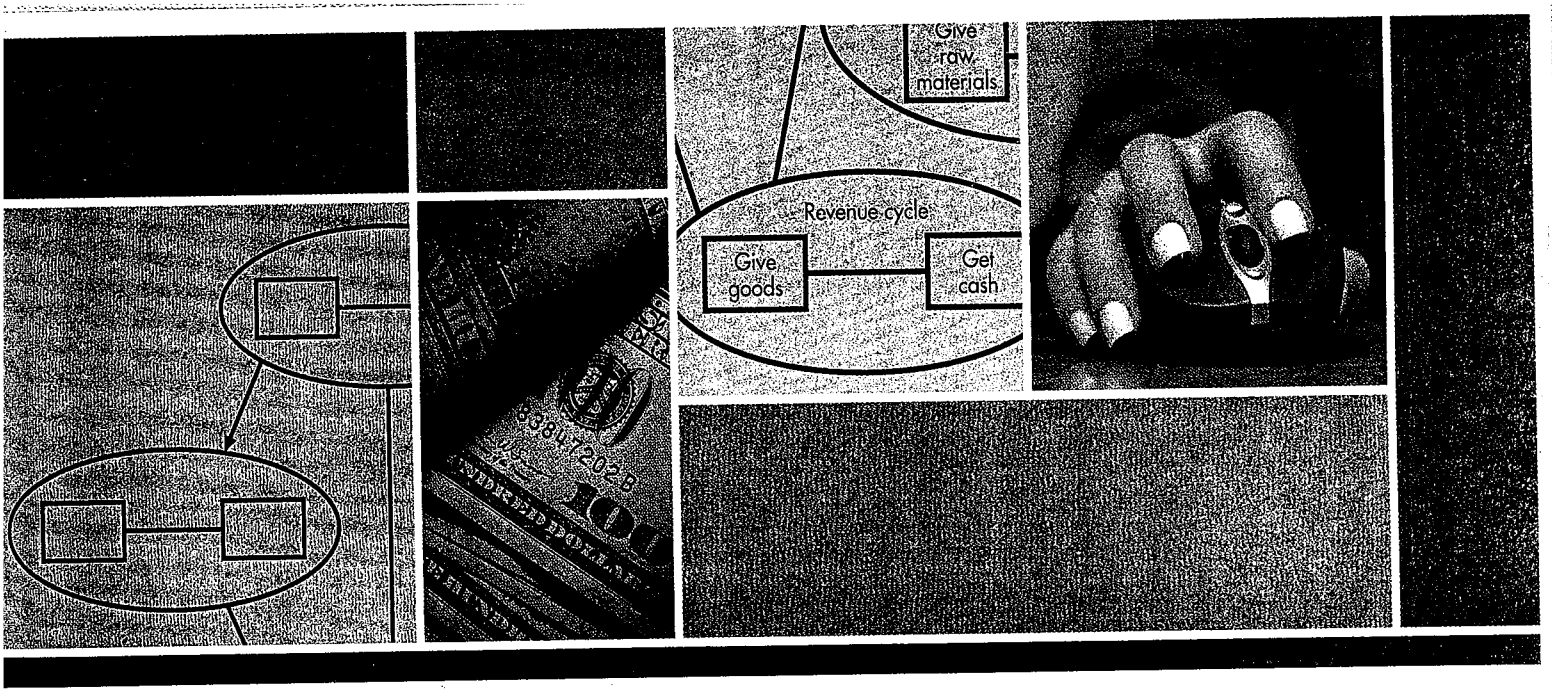
After studying this chapter, you should be able to:

1. Explain the five phases of the systems development life cycle.
2. Discuss the people involved in systems development and the roles they play.
3. Explain the importance of systems development planning and describe planning techniques.
4. Discuss the various types of feasibility analysis and calculate economic feasibility.
5. Explain why system changes trigger behavioral reactions, what form this resistance to change takes, and how to avoid or minimize the resulting problems.
6. Discuss the key issues and steps in systems analysis.

INTEGRATIVE CASE SHOPPERS MART

Ann Christy is the new controller of Shoppers Mart, a rapidly growing chain of discount stores. To assess how she can better serve Shoppers Mart, she held meetings with top management and visited with store managers and employees. Her findings are as follows:

1. Store managers cannot obtain information other than what is contained in periodic, preformatted reports. If they request information from several functional areas, the system bogs down.
2. Because timely information about product sales is not available, stores are often out of popular items and overstocked with products customers are not buying.
3. Management is concerned about losing market share to rivals with better prices and selection. The current system cannot provide the information management needs to solve this problem.



Ann is convinced that Shoppers Mart needs a new information system that is flexible, efficient, and responsive to user needs. Ann knows the new system will not be successful without management's complete support. Before asking for approval and funding for the new system, Ann met with systems development to ask the following questions:

1. What process must be followed to obtain and implement a new system?
2. What planning is necessary to ensure the system's success? Who will be involved, and how? Do special committees need to be formed? What resources are needed? How should the planning be documented?
3. How will employees react to a new system? What problems might this change cause, and how can they be minimized?
4. How should the new system be "sold" to top management? How can expected costs and benefits be quantified to determine whether the system will be cost-effective?

Introduction

Because we live in a highly competitive and ever-changing world, at any given time most organizations are improving or replacing their information systems. It is estimated that each year corporate America spends over $300 billion on more than 200,000 software projects. Companies change their systems for the following reasons:

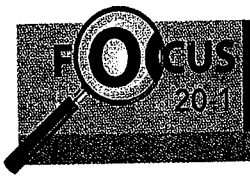
- *Changes in user or business needs.* Increased competition, business growth or consolidation, downsizing operations, mergers and divestitures, or new regulations can alter an organization's structure and purpose. To remain responsive, the system must change.
- *Technological changes.* As technology advances and becomes less costly, organizations adopt new technologies. For example, a New York utility downsized from a mainframe to a client/server system and eliminated 100 clerical positions. The new system does much more than the old one, including handling workflow management, user contact, database queries, automatic cash processing, and voice/data integration.
- *Improved business processes.* Many companies change their systems to improve inefficient business processes. At Nashua, an office supply manufacturer, processing a customer's telephone order took two days because three separate systems had to be accessed. The new system requires three minutes.

- *Competitive advantage.* Companies invest heavily in technology to increase the quality, quantity, and speed of information; to improve products or services; to lower costs; and to provide other competitive advantages.
- *Productivity gains.* Information systems can automate clerical tasks, decrease task performance time, and provide employees with specialized knowledge. Carolina Power and Light eliminated 27% of its information systems staff with a system that significantly outperformed the old one.
- *Systems integration.* Organizations with incompatible systems integrate them to remove incompatibilities and to consolidate databases. The U.S. Department of Defense is trying to integrate over 700 separate systems.
- *Systems age and need to be replaced.* As systems age and are updated numerous times, they become less stable and eventually need to be replaced. Focus 20-1 describes how the Internal Revenue Service is trying to replace its aged information system.

Developing quality, error-free software is a difficult, expensive, and time-consuming task. Most software development projects deliver less, cost more, and take longer than expected. A study by Standish Group found that 70% of software development projects were late, 54% were over budget, 66% were unsuccessful, and 30% were canceled before completion. An American Management Systems study revealed that 75% of all large systems are not used, are not used as intended, or generate meaningless reports or inaccurate data. Nike implemented a forecasting system that did not work and had to take a multimillion-dollar inventory write-down. The system told Nike to order $90 million of shoes that did not sell, while it had $100 million of orders on popular models that it could not meet.

Skipping or skimping on systems development processes cause runaways that consume time and money and produce no usable results, as illustrated by the following examples:

- Pacific Gas & Electric pulled the plug on a system that was five years in development. It was a financial disaster with no usable product.
- When jeweler Shane Co. upgraded its enterprise resource planning (ERP) system, cost and deadline overruns pushed the cost from $10 million to over $36 million and caused inventory problems that, combined with a faltering economy, resulted in bankruptcy.



The IRS Attempts to Replace Its Aging Information System

The IRS recognizes that it needs to modernize its 40-year-old system to provide better customer service, improve compliance with the nation's tax laws, and reduce the volume of paper tax returns. The system processes and stores all taxpayer records and takes in over $2 *trillion* a year.

Critics claim the fragile and antiquated system has been updated so many times that a software meltdown is a very real possibility. In a worst-case scenario, the IRS would not know who had paid taxes, hundreds of billions of dollars of revenue would not be collected, and the government would have to borrow money to meet its obligations, throwing the financial markets into a panic.

The need to modernize is no secret; the IRS has been trying for some time. Years ago, the IRS spent $3.3 billion on an upgrade effort that failed. More recently, the IRS embarked on an $8 billion effort called the Business Systems Modernization (BSM) program. This program involves more than 20,000 major tasks and scores of organizations and is one of the largest and most complex information system challenges in history. At the same time, the IRS is trying to change its management culture and the way it is organized; some critics claim both are more out of date than its information system.

The IRS cannot change the entire system at once; instead, it will occur in stages over 15 to 20 years. The effort has been compared to rebuilding all New York City buildings, streets, sewers, and communication and transportation systems, all while its inhabitants do not notice the changes as they go about their daily lives.

How is the IRS doing? Reports are not encouraging. The BSM spent almost $4 million on a project that was canceled. The effort has had a number of significant cost overruns, management delays, performance shortfalls, and missed project completion dates. One report indicates the project runs a "significant risk of not succeeding."

- California's Department of Motor Vehicles attempted to overhaul its system. Developed in 1965, it was so difficult to maintain that it took 18 programmers working an entire year to add a Social Security number file to the drivers' license and vehicle registration system. After seven years, $44 million, and not a single usable application, the project was canceled.

This chapter discusses five topics. The first is the systems development life cycle, the process followed to obtain and implement a new accounting information system (AIS). The second is the planning activities needed during development. The third is preparing a feasibility analysis. The fourth is the behavioral aspects of change that must be dealt with to implement a new system. The fifth topic is systems analysis, the first step in the systems development life cycle.

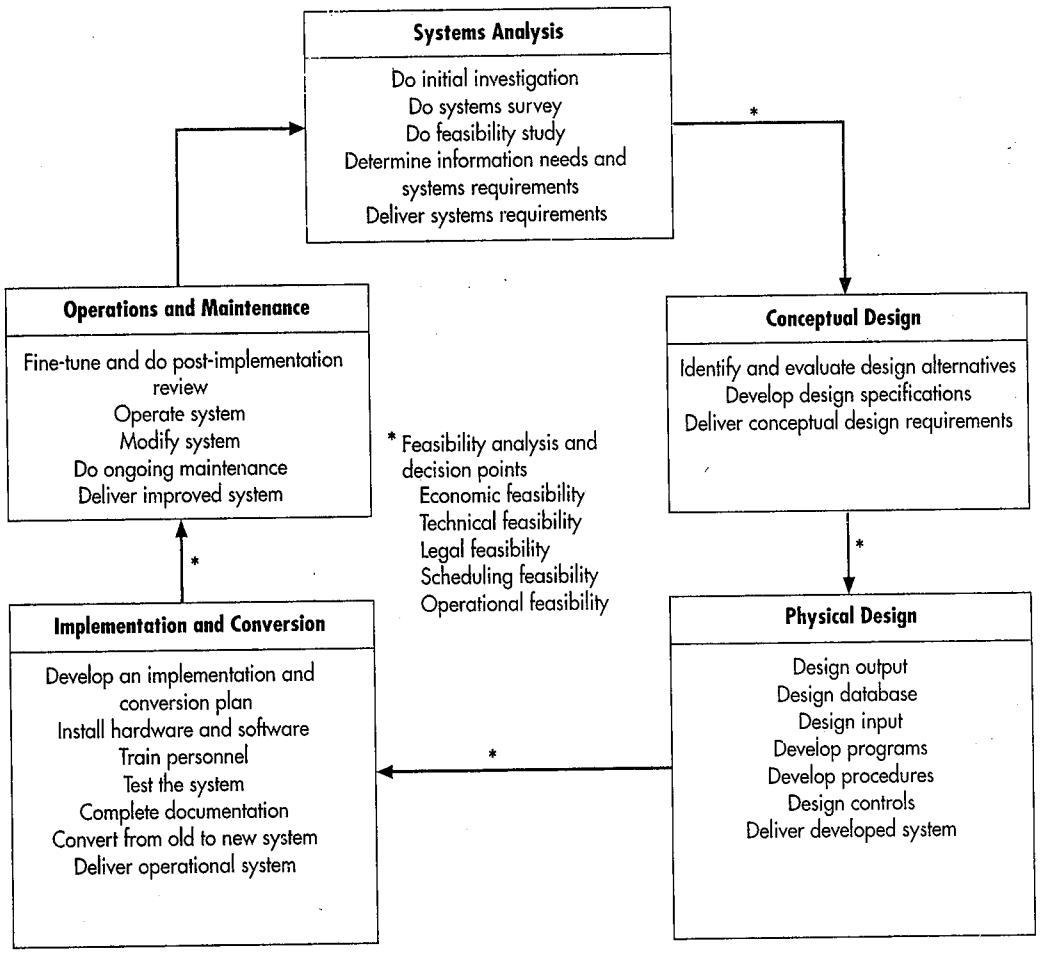
Systems Development

This section discusses the systems development life cycle and the people involved in systems development.

The Systems Development Life Cycle

Ann Christy asked the manager of systems development to explain the process Shoppers Mart uses to design and implement a new system. He sketched the five-step *systems development life cycle (SDLC)* shown in Figure 20-1 and briefly explained here.

SYSTEMS ANALYSIS The first step in systems development is *systems analysis,* where the information needed to purchase, develop, or modify a system is gathered. To better use limited resources, development requests are screened and prioritized. If a decision is made to move forward, the nature and scope of the proposed project is identified, the current system is surveyed



Throughout the life cycle, planning must be done and behavioral aspects of change must be considered.

FIGURE 20-1
The Systems Development Life Cycle

to identify its strengths and weaknesses, and the feasibility of the proposed project is determined. If the proposed project is feasible, the information needs of system users and managers are identified and documented. These needs are used to develop and document the systems requirements that are used to select or develop a new system. A systems analysis report is prepared and submitted to the information systems steering committee.

CONCEPTUAL DESIGN During ***conceptual design***, the company decides how to meet user needs. The first task is to identify and evaluate appropriate design alternatives, such as buying software, developing it in-house, or outsourcing system development to someone else. Detailed specifications outlining what the system is to accomplish and how it is to be controlled are developed. This phase is complete when conceptual design requirements are communicated to the information systems steering committee.

PHYSICAL DESIGN During ***physical design***, the company translates the broad, user-oriented conceptual design requirements into the detailed specifications used to code and test computer programs, design input and output documents, create files and databases, develop procedures, and build controls into the new system. This phase is complete when the results of the physical system design are communicated to the information systems steering committee.

IMPLEMENTATION AND CONVERSION All the elements and activities of the system come together in the ***implementation and conversion*** phase. An implementation and conversion plan is developed and followed, new hardware and software are installed and tested, employees are hired and trained or existing employees relocated, and processing procedures are tested and modified. Standards and controls for the new system are established and system documentation completed. The organization converts to the new system and dismantles the old one, makes needed adjustments, and conducts a post-implementation review to detect and correct design deficiencies. When the operational system is delivered, system development is complete. A final report is prepared and sent to the information systems steering committee.

OPERATIONS AND MAINTENANCE During ***operations and maintenance,*** the new system is periodically reviewed and modifications are made as problems arise or as new needs become evident. Eventually, a major modification or system replacement is necessary, and the SDLC begins again.

In addition to these five phases, three activities (planning, managing behavioral reactions to change, and assessing the ongoing feasibility of the project) are performed throughout the life cycle. These three activities, as well as systems analysis, are discussed in this chapter. The different approaches to obtaining an AIS are discussed in chapter 21. The last four SDLC phases are explained in chapter 22.

The Players

A number of people must cooperate to successfully develop and implement an AIS.

MANAGEMENT Management's most important systems development roles are to emphasize the importance of involving users in the process, to provide support and encouragement for development projects, and to align systems with corporate strategies. Other key roles include establishing system goals and objectives, selecting system department leadership and reviewing their performance, establishing policies for project selection and organizational structure, and participating in important system decisions. User management determine information requirements, assist analysts with cost and benefit estimates, assign staff to development projects, and allocate funds for development and operation.

ACCOUNTANTS AND OTHER USERS AIS users communicate their information needs to system developers. As project development team or steering committee members, they help manage systems development. As requested, accountants help design, test, and audit the controls that ensure the accurate and complete processing of data. Control and audit issues are discussed in depth in chapters 5 through 11.

INFORMATION SYSTEMS STEERING COMMITTEE An executive-level ***information systems steering committee*** plans and oversees the information systems function. It consists of high-level management, such as the controller and systems and user-department management. The steering committee sets AIS policies; ensures top-management participation, guidance, and control; and facilitates the coordination and integration of systems activities.

PROJECT DEVELOPMENT TEAM Each development project has a team of systems analysts and specialists, managers, accountants, and users to guide its development. Team members plan each project, monitor it to ensure timely and cost-effective completion, make sure proper consideration is given to the human element, and communicate project status to top management and the steering committee. They should communicate frequently with users and hold regular meetings to consider ideas and discuss progress so that there are no surprises upon project completion. A team approach usually produces better results and facilitates user acceptance of the system.

SYSTEMS ANALYSTS AND PROGRAMMERS *Systems analysts* study existing systems, design new ones, and prepare the specifications used by computer programmers. Analysts interact with employees throughout the organization to bridge the gap between the user and technology. Analysts are responsible for ensuring that the system meets user needs.

Computer programmers write programs using the specifications developed by the analysts. They also modify and maintain existing computer programs.

EXTERNAL PLAYERS Customers, vendors, external auditors, and governmental entities play a role in systems development. For example, Walmart vendors are required to implement and use electronic data interchange (EDI).

Planning Systems Development

This section discusses the planning performed throughout the SDLC (see Figure 20-1).

Imagine that you built a two-bedroom house. Over the years, you add two bedrooms, a bathroom, a family room, a recreation room, a deck, a two-car garage and expand the kitchen. Without a long-range plan, your house will end up as a poorly organized and costly patchwork of rooms surrounding the original structure. This scenario also applies to an AIS; the result is a costly and poorly integrated system that is difficult to operate and maintain.

Planning has distinct advantages. It enables the system's goals and objectives to correspond to the organization's overall strategic plan. Systems are more efficient, subsystems are coordinated, and there is a sound basis for selecting new applications for development. The company remains abreast of the ever-present changes in information technology (IT). Duplication, wasted effort, and cost and time overruns are avoided. The system is less costly and easier to maintain. Finally, management is prepared for resource needs, and employees are prepared for the changes that will occur.

When development is poorly planned, a company must often return to a prior phase and correct errors and design flaws, as shown in Figure 20-2. This is costly and results in delays, frustration, and low morale.

Two systems development plans are needed:

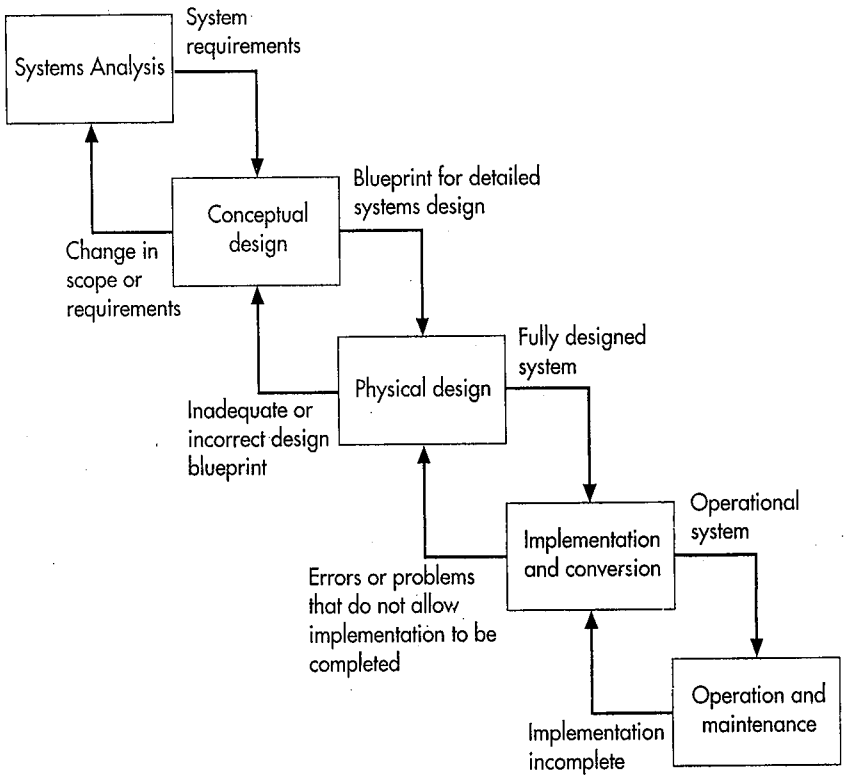
1. *Project development plan.* A *project development plan,* prepared by the project team, contains a cost/benefit analysis, developmental and operational requirements (people, hardware, software, and financial), and a schedule of the activities required to develop and operate the new application.
2. *Master plan.* A long-range *master plan,* prepared by the information systems steering committee, specifies what the system will consist of, how it will be developed, who will develop it, how needed resources will be acquired, and where the AIS is headed. It describes the status of projects in process, prioritizes planned projects, describes the criteria used for prioritization, and provides development timetables. Projects with the highest priority are developed first. A three-year planning horizon is common, with the plan updated quarterly or monthly. Table 20-1 shows the master plan components at Shoppers Mart.

As explained in Focus 20-2, inadequate planning was one reason why Electronic Data Systems (EDS) lost a significant amount of money in its contract with the U.S. military.

Planning Techniques

PERT and the Gantt charts are techniques for scheduling and monitoring systems development activities. The *program evaluation and review technique (PERT)* requires that all activities and

FIGURE 20-2
Reasons for Returning to a Prior SDLC Phase



the precedent and subsequent relationships among them be identified. The activities and relationships are used to draw a PERT diagram, which is a network of arrows and nodes representing project activities that require an expenditure of time and resources and the completion and initiation of activities. Completion time estimates are made, and the ***critical path***—the path requiring the greatest amount of time—is determined. If any activity on the critical path is delayed, then the whole project is delayed. If possible, resources can be shifted to critical path activities to reduce project completion time.

A *Gantt chart* (Figure 20-3) is a bar chart with project activities on the left-hand side and units of time across the top. For each activity, a bar is drawn from the scheduled starting date to the ending date, thereby defining expected project completion time. As activities are completed, they are recorded on the Gantt chart by filling in the bar; thus, at any time it is possible to determine which activities are on schedule and which are behind. The primary advantage of the Gantt chart is the ability to show graphically the entire schedule for a large, complex project, including

TABLE 20-1 Components of the Master Plan at Shoppers Mart

Organizational goals and objectives
- Company mission statement and goals
- Information systems strategic plan and goals
- Organizational constraints
- Organizational approach to AIS
- Organizational and AIS priorities

Inventory and assessments
- Current systems
- Approved systems
- Current hardware
- Current software
- Current AIS staff
- Assessment of strengths and weaknesses

Status of systems being developed
- Proposed systems priorities
- Approved systems development
- Proposals under consideration
- Development timetables and schedules

Forecast of future developments
- Forecasts of information needs
- Technological forecasts
- Environmental/regulatory forecasts
- Audit and control requirements
- External user needs

FOCUS 20-2 EDS Loses Billions in Its Contract with the Navy

The U.S. military hired Electronic Data Systems (EDS) to develop a secure network to link 350,000 computers at 4,000 Navy sites. The $10 billion contract resulted in significant headaches and estimated losses of $1.7 billion. EDS made the following mistakes:

- With little military experience, EDS did not plan for their delays and requests. Congress delayed the project for 18 months by asking for network-performance tests EDS was not used to handling. EDS also failed to plan for the 200 technical hurdles the military imposed.
- EDS did not verify Navy estimates, such as the 5,000 software programs to be installed on the new PCs; in reality, there were 67,000. EDS underestimated cost and time requirements to customize individual computers. They also had to revamp the Navy's old software before it could be installed.
- EDS did not plan and coordinate project tasks. When EDS went to Navy bases to install the computers, they did not have proper military clearances and some sailors and officers were busy or overseas.
- EDS did not give the Navy adequate instructions. EDS could not complete an order without a service member's rank, but EDS did not tell the Navy to send the rank.
- EDS did not track computer inventory. Some servicemen ordered PCs and then changed their orders to laptops. EDS did not require them to cancel the first order, so two computers were prepared. Duplicate and incomplete orders sat in warehouses for months.

To get the project back on track, EDS made some changes. Rather than installing computers at many different locations simultaneously, it installed computers at the largest bases first, reused expensive hardware, installed the warehoused computers before buying new ones, and customized computers by job function rather than by individual.

progress to date and status. A disadvantage is that the charts do not show the relationships among project activities.

Feasibility Analysis

As shown in Figure 20-1, a ***feasibility study*** (or business case) is prepared during systems analysis and updated as necessary during the SDLC. The extent varies; for a large-scale system, it is generally extensive, whereas one for a desktop system might be informal. The feasibility study is prepared with input from management, accountants, systems personnel, and users.

PROJECT PLANNING CHART

Project Number 01 - 650
Project Name Labor Cost Analysis Module
Project Leader J. Flaherty

Page 1 **of** 1
Prepared by S. Doe
Date 12 / 09 / 2013

ACTIVITY		WEEK STARTING																			
No.	Name	11/17	11/24	12/1	12/8	12/15	12/22	12/29	1/5	1/12	1/19	1/26	2/2	2/9	2/16	2/23	3/2	3/9	3/16	3/23	3/30
1-1	Organize implementation team																				
1-2	Prepare system support procedures																				
1-3	Develop conversion plan																				
1-4	Develop testing plan																				
2-1	Prepare program specifications																				
2-2	Revise system documentation																				
2-3	Perform programming tasks																				
3-1	System test																				
4-1	Install system support procedures																				
5-1	Acceptance test																				
6-1	Conversion																				

FIGURE 20-3
Sample Gantt chart

At major decision points, the steering committee reassess feasibility to decide whether to terminate a project, proceed unconditionally, or proceed if specific problems are resolved. Early go/no-go decisions are particularly important because each subsequent SDLC step requires more time and monetary commitments. The further along a development project is, the less likely it is to be canceled if a proper feasibility study has been prepared and updated.

Although uncommon, systems have been scrapped after implementation because they did not work or failed to meet an organization's needs. Bank of America, for example, hired a software firm to replace a 20-year-old system used to manage billions of dollars in institutional trust accounts. After two years of development, the new system was implemented despite warnings that it was not adequately tested. Ten months later the system was scrapped, top executives resigned, and the company took a $60 million write-off. The company lost 100 institutional accounts with $4 billion in assets. Focus 20-3 describes a Blue Cross/Blue Shield project that was scrapped after six years and a $120 million investment.

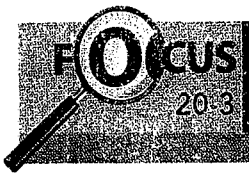
There are five important aspects to be considered during a feasibility study:

1. *Economic feasibility.* Will system benefits justify the time, money, and resources required to implement it?
2. *Technical feasibility.* Can the system be developed and implemented using existing technology?
3. *Legal feasibility.* Does the system comply with all applicable federal and state laws, administrative agency regulations, and contractual obligations?
4. *Scheduling feasibility.* Can the system be developed and implemented in the time allotted?
5. *Operational feasibility.* Does the organization have access to people who can design, implement, and operate the proposed system? Will people use the system?

Economic feasibility is now discussed in greater depth. Ann's feasibility analysis for Shoppers Mart is shown in Table 20-8 at the end of this chapter.

Capital Budgeting: Calculating Economic Feasibility

During systems design, alternative approaches to meeting system requirements are developed. Too often, companies overspend on technology because IT costs and payoffs are not measured and evaluated like other corporate investments. Merrill Lynch overcame significant philosophical and bureaucratic obstacles to implement a return-on-investment program for IT



Blue Cross/Blue Shield Abandons Runaway

Blue Cross/Blue Shield of Massachusetts had high hopes for its new information system. After six years and $120 million, however, the System 21 project was behind schedule and way over budget.

Although system failures of this magnitude are unusual, KPMG found that 35% of major information system projects become a runaway—a project that is millions of dollars over budget and months or years behind schedule. Other surveys show that almost every Fortune 200 company has had at least one runaway.

One reason for the problems was that Blue Cross hired an independent contractor to develop the software but neglected to appoint an in-house person to coordinate and manage the project. Nor did management establish a firm set of priorities regarding essential features and the sequence of application development.

The developers presented claims processing software to Blue Cross, but managers and users were not happy and requested numerous changes. As a result, the whole project was delayed. This led to ever-increasing cost overruns. By the time System 21 was launched, Blue Cross had fallen far behind its competitors' ability to process an ever-swelling paperwork load. During the six-year period, it lost 1 million subscribers and came close to bankruptcy.

Blue Cross learned a painful lesson. It abandoned the system it spent six years building and turned its hardware over to EDS. Fortunately, although the system died, the patient survived.

expenditures. Merrill Lynch now requires a 15% cash return on equity investment within five years, and all IT purchases are made by business, finance, and IT professionals working together.

Many organizations now use capital budgeting return-on-investment techniques to evaluate the economic merits of the alternatives. In a ***capital budgeting model,*** benefits and costs are estimated and compared to determine whether the system is cost beneficial. Benefits and costs that are not easily quantifiable are estimated and included. If they cannot be accurately estimated, they are listed, and their likelihood and expected impact on the organization evaluated. Tangible and intangible benefits include cost savings, improved customer service, productivity increases, improved data processing, better decision making, greater management control, increased job satisfaction, and increased employee morale. Initial outlay and operating costs are shown in Table 20-2. Between 65% and 75% of yearly systems-related expenditures are for maintaining current systems.

The following are three commonly used capital budgeting techniques:

1. *Payback period.* The ***payback period*** is the number of years required for the net savings to equal the initial cost of the investment. The project with the shortest payback period is usually selected.
2. *Net present value (NPV).* All estimated future cash flows are discounted back to the present, using a discount rate that reflects the time value of money. The initial outlay costs are deducted from the discounted cash flows to obtain the ***net present value (NPV).*** A positive NPV indicates the alternative is economically feasible. The highest positive NPV is usually selected.
3. *Internal rate of return (IRR).* The ***internal rate of return (IRR)*** is the effective interest rate that results in an NPV of zero. A project's IRR is compared with a minimum acceptable rate to determine acceptance or rejection. The proposal with the highest IRR is usually selected.

Payback, NPV, and IRR are illustrated in the feasibility analysis shown in Table 20-8.

TABLE 20-2 Initial Outlay and Operating Costs

Hardware
- Central processing unit
- Peripherals
- Communications hardware
- Special input/output devices
- Replacement, upgrade, expansion costs

Software
- Application, system, general-purpose, utility, and communications software
- Updated versions of software
- Application software design, programming, modification, testing, and documentation

Staff
- Supervisors
- Analysts and programmers
- Computer operators
- Input (data conversion) personnel
- Hiring, training, and relocating staff
- Consultants

Supplies and overhead
- Preprinted forms
- Data storage devices
- Supplies (paper, toner)
- Utilities and power

Maintenance/backup
- Hardware/software maintenance
- Backup and recovery operations
- Power supply protection

Documentation
- Systems documentation
- Training program documentation
- Operating standards and procedures

Site preparation
- Air-conditioning, humidity, dust controls
- Physical security (access)
- Fire and water protection
- Cabling, wiring, and outlets
- Furnishings and fixtures

Installation
- Freight and delivery charges
- Setup and connection fees

Conversion
- Systems testing
- File and data conversions
- Parallel operations

Financial
- Finance charges
- Legal fees
- Insurance

Behavioral Aspects of Change

Individuals participating in systems development are change agents who are continually confronted by resistance to change. The ***behavioral aspects of change*** are crucial, because the best system will fail without the support of the people it serves. Niccolo Machiavelli discussed resistance to change over 400 years ago:[1]

> *It must be considered that there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things. For the reformer has enemies in all those who could profit by the old order, and only lukewarm defenders in all those who could profit by the new order. This lukewarmness arises partly from fear of their adversaries, who have the laws in their favor, and partly from the incredulity of mankind, who do not truly believe in anything new until they have had an actual experience of it.*

Organizations must be sensitive to and consider the feelings and reactions of persons affected by change. This section discusses the type of behavioral problems that can result from change.

Why Behavioral Problems Occur

An individual's view of change, as either good or bad, usually depends on how that individual is personally affected by it. Management views change positively if it increases profits or reduces costs. Employees view the same change as bad if their jobs are terminated or adversely affected.

To minimize adverse behavioral reactions, one must understand why resistance takes place. Some of the more important factors include the following:

- *Fear.* People fear the unknown, losing their jobs, losing respect or status, failure, technology and automation, and the uncertainty accompanying change.
- *Top management support.* Employees who sense a lack of top-management support for change wonder why they should endorse it.
- *Experience with prior changes.* Employees who had a bad experience with prior changes are more reluctant to cooperate.
- *Communication.* Employees are unlikely to support a change unless the reasons behind it are explained.
- *Disruptive nature of change.* Requests for information and interviews are distracting and place additional burdens on people, causing negative feelings toward the change that prompted them.
- *Manner in which change is introduced.* Resistance is often a reaction to the methods of instituting change rather than to change itself. The rationale used to sell the system to top management may not be appropriate for lower-level employees. The elimination of menial tasks and the ability to advance and grow are often more important to users than are increasing profits and reducing costs.
- *Biases and emotions.* People with emotional attachments to their duties or coworkers may not want to change if those elements are affected.
- *Personal characteristics and background.* Generally speaking, the younger and more highly educated people are, the more likely they are to accept change. Likewise, the more comfortable people are with technology, the less likely they are to oppose changes.

How People Resist Change

Behavioral problems begin when people find out a change is being considered. Initial resistance is often subtle, manifested by failure to provide developers with information, tardiness, or subpar performance. Major behavioral problems often occur when the new system is implemented and the change becomes a reality. Focus 20-4 explains the resistance the U.S. Department of Defense experienced.

Resistance often takes one of three forms: aggression, projection, or avoidance.

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[1]Niccolo Machiavelli, *The Prince*, translated by Luigi Rice, revised by E.R.P. Vincent (New York: New American Library, 1952).

FOCUS 20.4 Resistance to Change at the Department of Defense

The U.S. Department of Defense (DOD) has a budget of $417 billion, 3.3 million employees, and over $1 trillion in assets. It also has one of the most antiquated and inefficient information systems in the world and cannot produce accurate accounting information or get a clean audit. Only a few of its 4,000 systems communicate effectively with other systems. Most systems require data that are transferred between systems to be manually reentered.

The DOD has been trying to modernize its AIS for over 20 years, at a cost of over $35 billion. After three notable failures, it is trying a fourth time. The Business Management Modernization Project's (BMMP) goal is to integrate DOD systems and business processes and produce a user-transparent system. Unfortunately, many people would rather not see the DOD realize this transparency. Past reforms failed because system developers could not break through the barriers DOD agencies created to protect their processes, procedures, and chains of command.

Users resist integration because what is optimal for one user is often suboptimal for the DOD. Government bureaucrats resist because an integrated, transparent system will reveal many unnecessary or obsolete programs that further personal agendas. For example, managers are often promoted for their ability to generate, receive funding for, and operate programs, regardless of their effectiveness. Senators and congressional representatives resist because a new system could adversely affect their ability to steer spending to constituents and thereby get reelected.

To overcome these behavioral problems, the DOD is trying to convince the armed forces to rid themselves of their "program protection" mindset. In one notable success, the Air Force now promotes personnel based on actions that improve the Air Force as a whole, rather than on actions that defend a specific turf or program.

AGGRESSION *Aggression* is behavior that destroys, cripples, or weakens system effectiveness, such as increased error rates, disruptions, or deliberate sabotage. After one organization introduced an online AIS, data input devices had honey poured on them, were run over by forklifts, or had paper clips inserted in them. Employees also entered erroneous data into the system. In another organization, disgruntled workers punched in to an unpopular supervisor's department and worked in other areas. This adversely affected the supervisor's performance evaluation because he was charged for hours that did not belong to him.

PROJECTION *Projection* is blaming the new system for everything that goes wrong. The system becomes the scapegoat for all real and imagined problems and errors. If these criticisms are not controlled or answered, system integrity can be damaged or destroyed.

AVOIDANCE *Avoidance* is ignoring a new AIS in the hope that the problem (the system) will eventually go away. Davis Controls, a struggling manufacturer, processed its orders using e-mail, but pertinent information was frequently lost or forgotten. Davis invested $300,000 in software that efficiently captured customer information, properly handled purchase orders, helped managers make better daily decisions, and made it possible to process four times as many transactions. Employees avoided it, even though the CEO explained the system's benefits and told them the company's survival and their jobs were at stake. Finally, the CEO disabled the uncooperative employees' e-mail accounts and terminated the employees who continued to avoid the system.

Preventing Behavioral Problems

The human element, which is often the most significant problem a company encounters in implementing a system, can be improved by observing the following guidelines:

- *Obtain management support.* Appoint a champion who can provide resources and motivate others to assist and cooperate with systems development.
- *Meet user needs.* It is essential that the system satisfy user needs.
- *Involve users.* Those affected by the system should participate in its development by making suggestions and helping make decisions. To avoid misunderstandings, users

should be told which suggestions are being used and how, and which are not and why. Participation is ego enhancing, challenging, and intrinsically satisfying. Users who participate in development are more knowledgeable, better trained, and more committed to using the system.

- *Allay fears, and stress new opportunities.* Users are vitally interested in how system changes affect them personally. Address their concerns and provide assurances (to the extent possible) that job losses and responsibility shifts will not occur—for example, through relocation, attrition, and early retirement. If employees are terminated, provide severance pay and outplacement services. Emphasize that the system may provide advancement opportunities and greater job satisfaction because the job has become more interesting and challenging.
- *Avoid emotionalism.* When logic vies with emotion, it rarely stands a chance. Emotional issues should be allowed to cool, handled in a nonconfrontational manner, or sidestepped.
- *Provide training.* Effective use and support is not possible if users do not understand the system. User training needs are often underestimated.
- *Reexamine performance evaluation.* Performance standards and criteria should be reevaluated to ensure that they are congruent with the new system.
- *Keep communication lines open.* Everyone affected by systems development should have an attitude of trust and cooperation. If employees become hostile, it is difficult to change their attitude and to implement the system. As soon as possible, employees should be told what changes are being made and why and be shown how the new system benefits them. This helps employees identify with the company's efforts and feel they are key players in the company's future goals and plans. It also helps prevent rumors and misunderstandings. Employees should be told whom they can contact if they have questions or concerns.
- *Test the system.* The system should be properly tested prior to implementation to minimize initial bad impressions.
- *Keep the system simple, and humanize it.* Avoid complex systems that cause radical changes. Make the change as simple as possible by conforming to existing organizational procedures. The new system is unlikely to be accepted if individuals believe the computer is controlling them or has usurped their positions.
- *Control users' expectations.* A system is sold too well if users have unrealistic expectations of its capabilities and performance. Be realistic when describing the merits of the system.

These guidelines are time-consuming and expensive, and workers may skip them to speed systems development and installation. However, the problems caused by not following the guidelines are usually more expensive and time-consuming to fix than to prevent.

Systems Analysis

When a new or improved system is needed, a written ***request for systems development*** is prepared. The request describes the current problems, the reasons for the change, the proposed system's objectives, and its anticipated benefits and costs. The five steps in the analysis phase and their objectives are shown in Figure 20-4 and discussed in this section.

Initial Investigation

An *initial investigation* is conducted to screen the requests for systems development. The exact nature of the problem(s) must be determined. In some instances, the perceived problem is not the real problem. A government accountant once asked a consultant to develop an AIS to produce the information he needed regarding fund expenditures and available funds. An investigation showed that the system provided the information and he did not understand the reports he received.

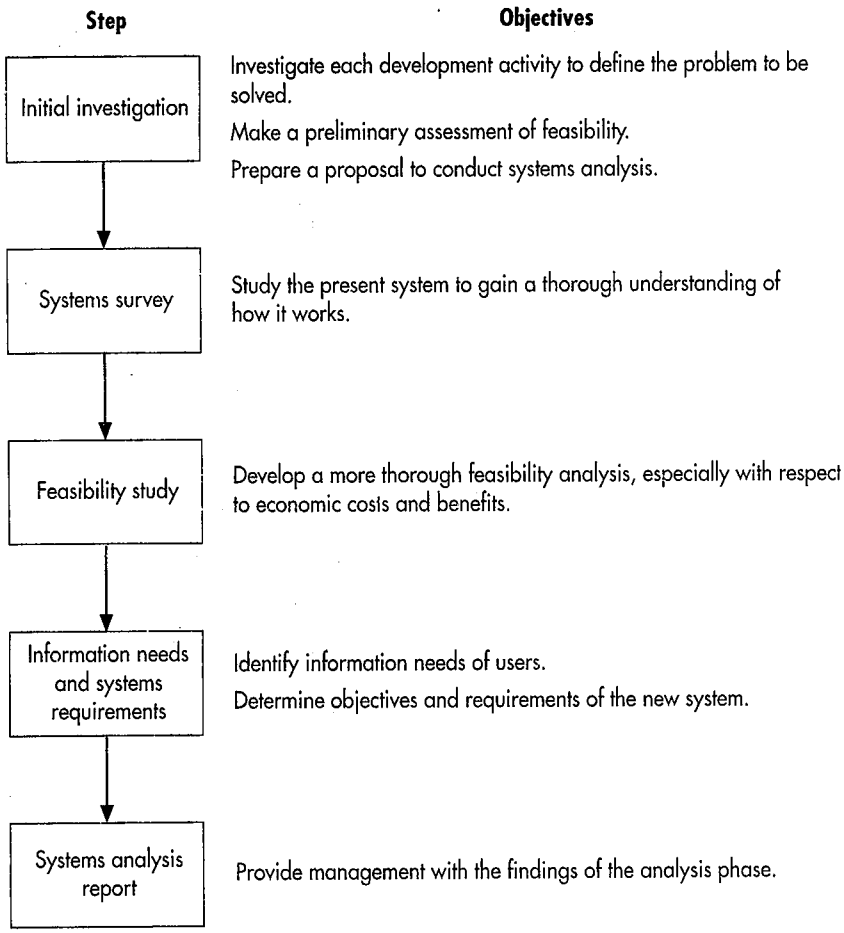


FIGURE 20-4
Steps in Systems Analysis

The project's scope (what it should and should not accomplish) is determined. Scope creep (adding additional requirements to the scope after it has been agreed to) is a real problem. Because of scope creep, a plan to have Census Bureau employees compile and transmit 2010 census information to headquarters with handheld computers was scrapped after two years of work. After spending $595 million on handhelds, the Census Bureau reverted back to pen-and-paper census taking.

A new AIS is useful when problems result from lack of information, inaccessibility of data, and inefficient data processing. A new AIS is not the answer to organizational problems. Likewise, if a manager lacks organizational skills, or if failure to enforce existing procedures causes control problems, a new AIS is not the answer. The initial investigation should also determine a project's viability and preliminary costs and benefits, and it should recommend whether to initiate the project as proposed, modify it, or abandon it.

A ***proposal to conduct systems analysis*** is prepared for approved projects. The project is assigned a priority and added to the master plan. Table 20-3 shows the information contents of a proposal to conduct systems analysis.

Systems Survey

A *systems survey* is an extensive study of the current AIS that has the following objectives:

- Gain an understanding of company operations, policies, procedures, and information flow; AIS strengths and weaknesses; and available hardware, software, and personnel.
- Make preliminary assessments of current and future processing needs, and determine the extent and nature of the changes needed.
- Develop working relationships with users, and build support for the AIS.
- Collect data that identify user needs, conduct a feasibility analysis, and make recommendations to management.

TABLE 20-3 Table of Contents for Reports Prepared During Systems Analysis at Shoppers Mart

Proposal to Conduct Systems Analysis	Systems Survey Report	Systems Analysis Report
Table of Contents	Table of Contents	Table of Contents
I. Executive Summary	I. Executive Summary	I. Executive Summary
II. System Problems and Opportunities	II. System Goals and Objectives	II. System Goals and Objectives
III. Goals and Objectives of Proposed System	III. System Problems and Opportunities	III. System Problems and Opportunities
IV. Project Scope	IV. Current System Operations	IV. Project Scope
V. Anticipated Costs and Benefits	A. Policies, Procedures, and Practices Affecting System	V. Relationship of Project to Overall Strategic Information Systems Plan
VI. Participants in Development Project	B. System Design and Operation (Intended and Actual)	VI. Current System Operations
VII. Proposed System Development Tasks and Work Plan	C. System Users and Their Responsibilities	VII. User Requirements
VIII. Recommendations	D. System Outputs, Inputs, and Data Storage	VIII. Feasibility Analysis
	E. System Controls	IX. System Constraints
	F. System Strengths, Weaknesses, and Constraints	X. Recommendations for New System
	G. Costs to Operate System	XI. Proposed Project Participants and Work Plan
	V. User Requirements Identified	XII. Summary
		XIII. Approvals
		XIV. Appendix of Documents, Tables, Charts, Glossary

Data about the current AIS is gathered from employees and from documentation such as organizational charts and procedures manuals. External sources include consultants, customers and suppliers, industry associations, and government agencies. The advantages and disadvantages of four common methods of gathering data are summarized here and in Table 20-4.

An *interview* gathers answers to "why" questions. Care must be taken to ensure that personal biases, self-interest, or a desire to say what the employee thinks the interviewer wants to hear does not produce inaccurate information. Ann's Shoppers Mart interviews were successful because of her approach and preparation. For each interview, Ann made an appointment, explained the purpose beforehand, indicated the amount of time needed, and arrived on time. Before each session, Ann studied the interviewee's responsibilities and listed points she wanted to cover. Ann put each interviewee at ease by being friendly, courteous, and tactful. Her questions dealt with the person's responsibilities, how she interacted with the AIS, how the system might be improved, and the person's information needs. Ann let the interviewee do most of the talking and paid special attention to nonverbal communication, because subtle overtones and body language can be as significant as direct responses to questions. Ann took notes, augmented them with detailed impressions shortly after the interview, and asked permission to tape especially important interviews.

Questionnaires are used when the amount of information to be gathered is small and well defined, is obtained from many people or from those who are located elsewhere, or is intended to verify data from other sources. Questionnaires take relatively little time to administer, but developing a quality questionnaire can be challenging and requires significant time and effort.

Observation is used to verify information gathered using other approaches and to determine how a system actually works, rather than how it should work. It is difficult to interpret observations because people may change their normal behavior or make mistakes when they know they are being observed. Identifying what is to be observed, estimating how long it will take, obtaining permission, and explaining what will be done and why can maximize the effectiveness of observation. The observer should not make value judgments and should document notes and impressions as soon as possible.

TABLE 20-4 Advantages and Disadvantages of Data-Gathering Methods

	Advantages	Disadvantages
Interviews	Can answer "why" questions Interviewer can probe and follow up Questions can be clarified Builds positive relationships with interviewee Builds acceptance and support for new system	Time-consuming Expensive Personal biases or self-interest may produce inaccurate information
Questionnaires	Can be anonymous Not time-consuming Inexpensive Allows more time to think about responses	Does not allow in-depth questions or answers Cannot follow up on responses Questions cannot be clarified Impersonal; does not build relationships Difficult to develop Often ignored or completed superficially
Observation	Can verify how system actually works, rather than how it should work Results in greater understanding of the system	Time-consuming Expensive Difficult to interpret properly Observed people may alter behavior
Systems Documentation	Describes how system should work Written form facilitates review, analysis	Time-consuming May not be available or easy to find

Systems documentation describes how the AIS is intended to work. Throughout the survey, the project team should be alert to differences between intended and actual systems operation as they provide important insights into problems and weaknesses.

Systems analysis work is documented so it can be used throughout the development project. Documentation consists of questionnaire copies, interview notes, memos, document copies, and models. ***Physical models*** illustrate *how* a system functions by describing document flow, computer processes performed, the people performing them, and the equipment used. ***Logical models*** focus on essential activities (*what* is being done) and the flow of information, not on the physical processes of transforming and storing data. Table 20-5 lists analysis and design tools and techniques used to create an AIS and identifies the chapter where each is discussed.

Once data gathering is complete, the team evaluates the AIS's strengths and weaknesses to develop ideas for designing and structuring the new AIS. When appropriate, strengths are retained and weaknesses corrected.

The systems survey culminates with a ***systems survey report***. Table 20-3 shows the table of contents for the Shoppers Mart systems survey report. The report is supported by documentation such as memos, interview and observation notes, questionnaire data, file and record layouts and

TABLE 20-5 Systems Analysis and Design Tools and Techniques

CASE (chapter 21)	Gantt charts (chapter 20)
Data dictionary (chapter 4)	PERT charts (chapter 20)
Data flow diagrams (chapter 3)	Prototyping (chapter 21)
Document flowcharts (chapter 3)	REA data models (chapter 17)
E-R diagrams (chapter 17)	Record layouts (chapter 4)
Forms design checklist (chapter 22)	System flowcharts (chapter 3)

descriptions, input and output descriptions, copies of documents, E-R diagrams, flowcharts, and data flow diagrams.

Feasibility Study

At this point, the thorough feasibility analysis discussed earlier in the chapter is conducted to determine the project's viability. The feasibility analysis is updated regularly as the project proceeds and costs and benefits become clearer.

Information Needs and Systems Requirements

Once a project is deemed feasible, the company identifies the information needs of users and documents systems requirements. Table 20-6 is an example of systems requirements.

Determining information needs is a challenging process because of the sheer quantity and variety of information that must be specified. In addition, it may be difficult for employees to articulate their information needs, or they may identify them incorrectly. According to *CIO* magazine, 70% of project failures are due to insufficient, inaccurate, or outdated systems requirements. Figure 20-5 is a humorous view of the types of communication problems associated with this process.

TABLE 20-6 Possible Contents of System Requirements

Processes	Business process descriptions, including what is to be done and by whom
Data elements	The name, size, format, source, and significance of required data elements
Data structure	How the data elements will be organized into logical records
Outputs	Description of the purpose, frequency, and distribution of system outputs
Inputs	Description of contents, source, and person responsible for system inputs
Documentation	How the new system and each subsystem will operate
Constraints	Deadlines, schedules, security requirements, staffing limitations, and statutory or regulatory requirements
Controls	Controls to ensure the accuracy and reliability of inputs, outputs, and processing
Reorganizations	Organizational reorganization needed to meet users' information needs, such as increasing staff levels and adding new job functions

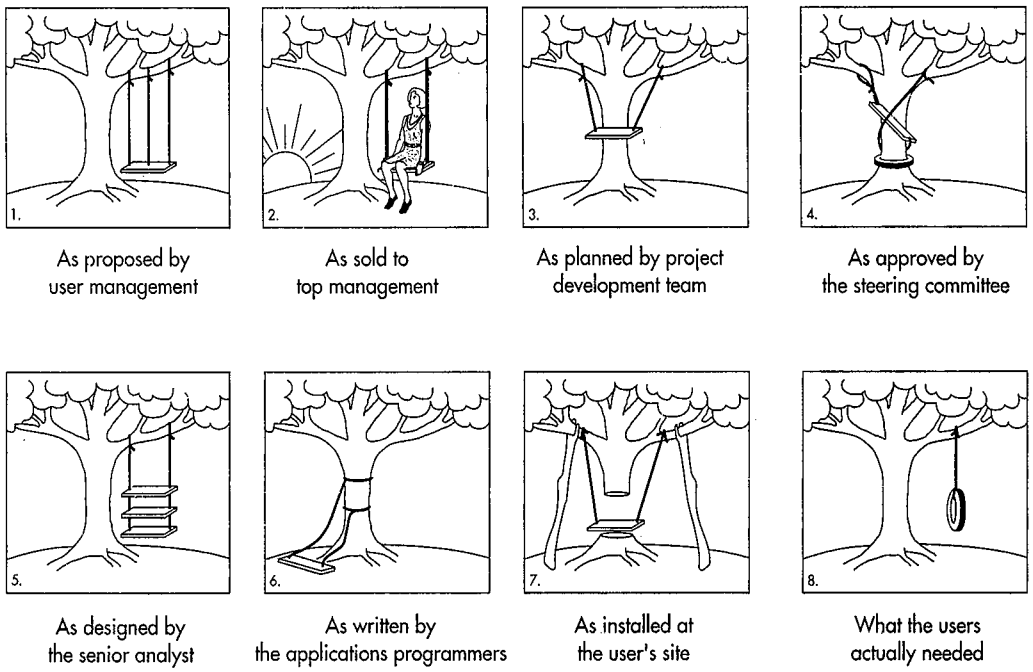


FIGURE 20-5
Communications Problems in Systems Analysis and Design

When Corning Corporation investigated the ophthalmic pressings it manufactures, it found that 35% of its drafting documents contained errors. Drafting errors are increasingly more expensive to correct at each subsequent manufacturing stage: $250 before toolmakers cut the tools, $20,000 before production begins, and $100,000 after the tools are sold. Several corrective actions reduced the error rates from 35% to 0.2%. The same cost relationships exist in systems development; error correction costs increase as development proceeds through the SDLC.

System objectives, such as those shown in Table 20-7, are the elements most vital to an AIS's success. It is difficult for a system to satisfy every objective. For example, designing adequate internal controls is a trade-off between the objectives of economy and reliability.

Because organizational constraints make it difficult to develop all AIS components simultaneously, the system is divided into modules that are developed and installed independently. When changes are needed, only the affected module is changed. The modules must be properly integrated into a workable system.

A system's success often depends on the ability to cope with organizational constraints. Common constraints include governmental agency requirements, management policies, lack of qualified staff, user capabilities and attitudes, technology, and limited finances. To maximize system performance, these constraints must be minimized.

The following four strategies are used to determine AIS requirements:

1. *Ask users what they need.* This is the simplest and fastest strategy, but many people do not understand their needs. They know their job but may be unable to break it down into the individual information elements they use. It is sometimes better to ask what decisions they make and what processes they are involved in and then design systems to address their answers. Users must think beyond current information needs so that new systems do not simply replicate current information in improved formats.
2. *Analyze external systems.* If a solution already exists, do not "reinvent the wheel."
3. *Examine existing systems.* Determine if existing modules are used as intended, may be augmented by manual tasks, or may be avoided altogether. This approach helps determine whether a system can be modified or must be replaced.
4. *Create a prototype.* When it is difficult to identify requirements, a developer can quickly rough out a system for users to critique. Users identify what they like and dislike about the system and request changes. This iterative process of looking at what is developed and improving it continues until users agree on their needs. Prototyping is discussed in Chapter 21.

TABLE 20-7 AIS Objectives

Usefulness	Information output should help management and users make decisions.
Economy	System benefits should exceed the cost.
Reliability	System should process data accurately and completely.
Availability	Users should be able to access the system at their convenience.
Timeliness	Crucial information is produced first, less important items as time permits.
Customer service	Customer service must be courteous and efficient.
Capacity	System capacity must be sufficient to handle periods of peak operation and future growth.
Ease of use	System should be user-friendly.
Flexibility	System should be able to accommodate reasonable requirement changes.
Tractability	System is easily understood and it facilitates problem solving and future development.
Auditability	Auditability is built into the system from the beginning.
Security	Only authorized users are granted access to or allowed to change system data.

Detailed AIS requirements that explain exactly what the system is to produce are created and documented. The requirements are supported by sample input and output forms, as well as charts, so users can conceptualize the system. A nontechnical summary of important user requirements and development efforts to date is often prepared for management. The project team meets with the users, explains the requirements, and obtains their approval. When an agreement is reached, user management signs the system requirements documents to indicate approval.

Systems Analysis Report

The concluding step in systems analysis is preparing a ***systems analysis report*** to summarize and document analysis activities. The Shoppers Mart systems analysis report, shown in Table 20-3, shows the information typically contained in the report.

A go/no-go decision is made up to three times during systems analysis: first, during the initial investigation, to determine whether to conduct a systems survey; second, at the end of the feasibility study, to determine whether to proceed to the information requirements phase; third, at the completion of the analysis phase, to decide whether to proceed to conceptual systems design. The remaining phases in the SDLC are discussed in the next two chapters.

Summary and Case Conclusion

After an extensive analysis of Shoppers Mart's current system and core business processes, Ann Christy has proposed some changes. She has asked the corporate office to produce daily sales data for each store to help them adapt quickly to customer needs and to help suppliers avoid stockouts and overstocking. Shoppers Mart will coordinate buying at the corporate office to minimize inventory levels and negotiate lower wholesale prices. Stores will electronically send daily orders to the corporate office. Based on store orders and warehouse inventory, the corporate office will send purchase orders to suppliers. Suppliers will process orders and ship goods to regional warehouses or directly to the stores the day orders are received. Each store will have the flexibility to respond to local sales trends and conditions by placing local orders. Accounts payable will be centralized so payments can be made electronically.

Ann reviews the proposed system with the legal department and the AIS staff. She is told it complies with all legal considerations and is technologically feasible. Top management and the information systems steering committee will decide how to allocate time and resources for the project and will communicate all staff assignments to systems management and personnel.

Ann's team conducts an economic feasibility study (see Table 20-8) and determines that the project makes excellent use of funds. The team estimates that initial outlay costs for the system are $5 million. The team estimates recurring operating costs and expected savings for years 1 through 6, which are expected to rise from year to year. Ann calculates the net annual savings and then calculates the after-tax cash savings for each year.

The $5 million system can be depreciated over its six-year expected life. Because the company does not have to pay taxes on the $1 million depreciation in year 1, it ends up saving an additional $340,000. Finally, Ann calculates the net savings for each year.

Ann uses Shoppers Mart's 10% cost of capital rate to calculate the NPV of the investment, which is over $3 million. The internal rate of return is a lofty 25%, and payback occurs in the fourth year. Ann realizes how advantageous it would be for the company to borrow the money (at a 10% interest rate) to produce a 25% return.

Ann presents the system to management and describes its objectives. Challenges to her estimates are plugged into her spreadsheet model to show their effect. Even the stiffest challenges to Ann's numbers show a positive return. Top management votes to support the new system, requests some changes, and tells Ann to proceed.

Ann has found management's enthusiastic support crucial to the system's success. Several employees with vested interests in the current system are critical of her ideas. Some employees remember the problems Shoppers Mart had when the current system was implemented years ago. Ann concludes that people resisting the new system are afraid of the change's effect on them personally. To counter negative behavioral reactions, Ann takes great pains to explain how the new system would benefit employees individually and how it will affect the company as a whole.

TABLE 20-8 Economic Feasibility of Shoppers Mart's New Information System

	Initial Outlay	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Initial outlay costs							
Hardware	$2,000,000						
Software	400,000						
Training	200,000						
Site preparation	200,000						
Initial systems design	2,000,000						
Conversion	200,000						
Total initial outlays	$5,000,000						
Recurring costs							
Hardware expansion			$260,000	$300,000	$340,000	$380,000	$400,000
Software			150,000	200,000	225,000	250,000	250,000
Systems maintenance		$60,000	120,000	130,000	140,000	150,000	160,000
Personnel costs		500,000	800,000	900,000	1,000,000	1,100,000	1,300,000
Communication charges		100,000	160,000	180,000	200,000	220,000	250,000
Overhead		300,000	420,000	490,000	560,000	600,000	640,000
Total costs		$960,000	$1,910,000	$2,200,000	$2,465,000	$2,700,000	$3,000,000
Savings							
Clerical cost savings		$600,000	$1,200,000	$1,400,000	$1,600,000	$1,800,000	$2,000,000
Working capital savings		900,000	1,200,000	1,500,000	1,500,000	1,500,000	1,500,000
Profits from sales increases			500,000	900,000	1,200,000	1,500,000	1,800,000
Warehousing efficiencies			400,000	800,000	1,200,000	1,600,000	2,000,000
Total savings		$1,500,000	$3,300,000	$4,600,000	$5,500,000	$6,400,000	$7,300,000
Savings minus recurring costs		$540,000	$1,390,000	$2,400,000	$3,035,000	$3,700,000	$4,300,000
Less income taxes (34% rate)		(183,600)	(472,600)	(816,000)	(1,031,900)	(1,258,000)	(1,462,000)
Cash savings (net of tax)		$356,400	$917,400	$1,584,000	$2,003,100	$2,442,000	$2,838,000
Savings on taxes due to depreciation deduction		340,000	544,000	326,400	195,500	195,500	98,600
Net savings	($5,000,000)	$696,400	$1,461,400	$1,910,400	$2,198,600	$2,637,500	$2,936,600

Payback occurs in the fourth year when the savings net of taxes of $6,266,800 exceed the costs of $5,000,000.

Net present value (interest rate of 10%):

	($5,000,000)
696,400 × 0.9091 =	633,097
1,461,400 × 0.8265 =	1,207,847
1,910,400 × 0.7513 =	1,435,284
2,198,600 × 0.6830 =	1,501,644
2,637,500 × 0.6209 =	1,637,624
2,936,600 × 0.5645 =	1,657,711
Net present value is	$3,073,207
Internal rate of return is	25.04%

Depreciation on initial investment of $5,000,000:

Tax Rate 34%

Year	Rate (%)	Depreciation	Tax Savings
1	20.00	$1,000,000	$340,000
2	32.00	1,600,000	544,000
3	19.20	960,000	326,400
4	11.50	575,000	195,500
5	11.50	575,000	195,500
6	5.80	290,000	98,600

With management's approval, she assures employees they will not lose their jobs and that all affected employees will be retrained. She involves the two most vocal opponents in planning activities, and they soon become two of the new system's biggest advocates.

Ann invites the managers of all affected departments to be on a steering committee. A master plan for developing the system is formulated, and the system is broken down into manageable projects. The projects are prioritized, and project teams are formed to begin work on the highest-priority projects. Documentation standards are developed and approved.

Key Terms

systems development life cycle (SDLC) 601
systems analysis 601
conceptual design 602
physical design 602
implementation and conversion 602
operations and maintenance 602
information systems steering committee 602
systems analyst 603
computer programmer 603
project development plan 603
master plan 603
program evaluation and review technique (PERT) 603
critical path 604
Gantt chart 604
feasibility study 605
economic feasibility 606
technical feasibility 606
legal feasibility 606
scheduling feasibility 606
operational feasibility 606
capital budgeting model 607
payback period 607
net present value (NPV) 607
internal rate of return (IRR) 607
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systems documentation 613
physical models 613
logical models 613
systems survey report 613
systems analysis report 616

AIS IN ACTION

Chapter Quiz

1. Which of the following is NOT a reason why companies make changes to their AIS?
   a. gain a competitive advantage
   b. increase productivity
   c. keep up with business growth
   d. downsize company operations
   e. All of the above are reasons why companies change an AIS.

2. Which of the following is the planning technique that identifies implementation activities and their relationships, constructs a network of arrows and nodes, and then determines the critical path through the network?
   a. Gantt chart
   b. PERT diagram
   c. physical model
   d. data flow diagram

3. The purchasing department is designing a new AIS. Who is best able to determine departmental information requirements?
   a. steering committee
   b. controller
   c. top management
   d. purchasing department

4. Which of the following is the correct order of the steps in systems analysis?
   a. initial investigation, determination of information needs and system requirements, feasibility study, system survey
   b. determination of information needs and system requirements, system survey, feasibility study, initial investigation
   c. system survey, initial investigation, determination of information needs and system requirements, feasibility study
   d. initial investigation, system survey, feasibility study, determination of information needs and system requirements

5. Which of the following is the long-range planning document that specifies what the system will consist of, how it will be developed, who will develop it, how needed resources will be acquired, and its overall vision?
   a. steering committee agenda
   b. master plan
   c. systems development life cycle
   d. project development plan

6. Resistance is often a reaction to the methods of instituting change rather than to change itself.
   a. true
   b. false

7. Increased error rates, disruptions, and sabotage are examples of which of the following?
   a. aggression
   b. avoidance
   c. projection
   d. payback

8. What is often the most significant problem a company encounters in designing, developing, and implementing a system?
   a. the human element
   b. technology
   c. legal challenges
   d. planning for the new system

9. Determining whether the organization has access to people who can design, implement, and operate the proposed system is referred to as which of the following?
   a. technical feasibility
   b. operational feasibility
   c. legal feasibility
   d. scheduling feasibility
   e. economic feasibility

10. Which of the following is NOT one of the tangible or intangible benefits a company might obtain from a new system?
    a. cost savings
    b. improved customer service and productivity
    c. improved decision making
    d. improved data processing
    e. All are benefits of a new system.

Comprehensive Problem



Riverbend Software Support Administrators (RSSA) provides online and telephone help desk services. Because RSSA's labor costs have steadily increased, it is outsourcing its call center. RSSA's executive-level committee, who oversees the information systems (IS) function, selected a project development team to create a system to move the help desk and manage it from corporate headquarters.

Two incidents delayed the help desk conversion date by 15 days. A server was damaged when an unidentified employee put a hot coffee pot on it, and several backup tapes were found floating in a restroom sink.

The five-year contract requires an initial payment of $1,750,000 and yearly payments of $525,000. Each year, the contract will save $750,000 in salary, benefits, and equipment costs. There is a $150,000 one-time charge for breaking the current call center's building lease, but doing so will save $360,000 a year. RSSA's cost of capital is 11%.

Required

a. What is the executive-level committee commonly called, who typically serves on it, and what is its primary function?
b. Who typically serves on the project development team?
c. What steps would the development team take during system analysis?
d. Why do you think the server and data tapes were damaged?
e. Calculate the following capital budgeting metrics for RSSA's outsourcing plan:
   1. payback period
   2. net present value (NPV)
   3. internal rate of return (IRR)

Discussion Questions

20.1. The approach to long-range AIS planning described in this chapter is important for large organizations with extensive investments in computer facilities. Should small organizations with far fewer information systems employees attempt to implement planning programs? Why or why not? Be prepared to defend your position to the class.

20.2. You are a consultant advising a firm on the design and implementation of a new system. Management has decided to let several employees go after the system is implemented. Some have many years of company service. How would you advise management to communicate this decision to the affected employees? To the entire staff?

20.3. While reviewing a list of benefits from a computer vendor's proposal, you note an item that reads, "Improvements in management decision making—$50,000 per year." How would you interpret this item? What influence should it have on the economic feasibility and the computer acquisition decision?

20.4. For the following, discuss which data-gathering method(s) are most appropriate and why:
a. Examining the adequacy of internal controls in the purchase requisition procedure
b. Identifying the controller's information needs
c. Determining how cash disbursement procedures are actually performed
d. Surveying employees about the move to a total quality management program
e. Investigating an increase in uncollectible accounts

20.5. The following problems occurred in a manufacturing firm. What questions should you ask to understand the problem?
- Customer complaints about product quality have increased.
- Accounting sees an increase in the number and dollar value of bad-debt write-offs.
- Operating margins have declined each of the past four years because of higher-than-expected production costs from idle time, overtime, and reworking products.

20.6. Give some examples of systems analysis decisions that involve a trade-off between each of the following pairs of objectives:
a. economy and usefulness
b. economy and reliability
c. economy and customer service
d. simplicity and usefulness
e. simplicity and reliability
f. economy and capacity
g. economy and flexibility

20.7. For years, Jerry Jingle's dairy production facilities have led the state in sales volume, but recent declines worry him. Customers are satisfied with his products but are troubled by the dairy's late deliveries and incomplete orders. Production employees (not the cows) are concerned about bottlenecks in milk pasteurization and homogenization due to poor job scheduling, mix-ups in customers' orders, and improperly labeled products. How should Jerry address the problems? What data-gathering techniques would be helpful at this early stage?

20.8. A manufacturing firm needed a specialized software program to identify and monitor cost overruns. After an extensive analysis, the company purchased prepackaged software and assigned three programmers to modify it to meet its individual circumstances and processes. After six months of work, during final testing, the company told the programmers to stop all work until further notice. While reading the software vendor's sales agreement, the manufacturing manager found a clause stating that the software could not be changed without the prior written consent of the vendor. The firm had to pay the software vendor an additional fee so it could use the modified software in its manufacturing process. Which aspect(s) of feasibility did the manufacturing firm fail to consider prior to purchasing the software?

20.9. Ajax Manufacturing installed a new bar-code-based inventory tracking system in its warehouse. To close the books each month on a timely basis, the six people who work in the warehouse must scan each item in a 36-hour period while still performing their normal duties. During certain months, when inventory expands to meet seasonal demands, the scan takes as many as 30 hours to complete. In addition, the scanners do not accurately record some inventory items that require low operating temperatures. A recent audit brought to management's attention that the inventory records are not always accurate. Which aspect(s) of feasibility did Ajax fail to consider prior to installing the inventory tracking system?

Problems

20.1. How do you get a grizzled veteran police officer who is used to filling out paper forms to use a computer to process his arrests and casework—especially when he has little or no experience using a computer? That was the problem facing the Chicago Police Department when it decided to implement a relational database system. The system is capable of churning through massive amounts of data to give officers the information they need to fight crime more effectively.

Initially, the department rolled out the case component of the CLEAR (Citizen Law Enforcement Analysis and Reporting) system that provided criminal history and arrest records. The officers hated it, complaining that the system was not user-friendly, that approval from supervisors was complex and involved multiple screens, and that they did not feel properly trained on the system. After listening to the officers' complaints for a year, the department clearly had to do something. *(Adapted from Todd Datz, "No Small Change,"* CIO *(February 15, 2004): 66–72)*

Required

a. Identify as many system analysis and design problems as you can.
b. What could the department have done differently to prevent the officers' complaints?
c. What principles of system analysis and design were violated in this case?

20.2. Mary Smith is the bookkeeper for Dave's Distributing Company, a distributor of soft drinks and juices. Because the company is rather small, Mary performs all daily accounting tasks herself. Dave, the owner of the company, supervises the warehouse/delivery and front office staff, but he also spends much of his time jogging and skiing.

For several years, profits were good, and sales grew faster than industry averages. Although the accounting system was working well, bottlers were pressuring Dave to computerize. With a little guidance from a CPA friend and with no mention to Mary, Dave bought a new computer system and some accounting software. Only one day was required to set up the hardware, install the software, and convert the files. The morning the vendor installed the computer system, Mary's job performance changed dramatically. Although the software company provided two full days of training, Mary resisted learning the new system. As a result, Dave decided she should run both the manual and computer systems for a month to verify the new system's accuracy.

Mary continually complained that she lacked the time and expertise to update both systems by herself. She also complained that she did not understand how to use the new computer system. To keep accounts up to date, Dave spent two to three hours a day running the new system himself. Dave found that much of the time spent running the system was devoted to identifying discrepancies between the computer and manual results. When the error was located, it was usually in the manual system. This significantly increased Dave's confidence in the new system.

At the end of the month, Dave was ready to scrap the manual system, but Mary said she was not ready. Dave went back to skiing and jogging, and Mary went on with the manual system. When the computer system fell behind, Dave again spent time catching it up. He also worked with Mary to try to help her understand how to operate the computer system.

Months later, Dave was very frustrated because he was still keeping the computer system up to date and training Mary. He commented, "I'm sure Mary *knows* how to use the system, but she doesn't seem to *want* to. I can do all the accounting work on the computer in two or three hours a day, but she can't even do it in her normal eight-hour workday. What should I do?"

Required

a. What do you believe is the real cause of Mary's resistance to computers?
b. What events may have contributed to the new system's failure?
c. In retrospect, how should Dave have handled the accounting system computerization?
d. At what point in the decision-making process should Mary have been informed? Should she have had some say in whether the computer was purchased? If so, what should have been the nature of her input? If Mary had not agreed with Dave's decision to acquire the computer, what should Dave have done?
e. A hard decision must be made regarding Mary. Significant efforts have been made to train her, but they have been unsuccessful. What would you recommend at this point? Should she be fired? Threatened with the loss of her job? Moved somewhere else in the business? Given additional training?

20.3. Wright Company's information system was developed in stages over the past five years. During the design process, department heads specified the information and reports they needed. By the time development began, new department heads were in place, and they requested additional reports. Reports were discontinued only when requested by a department head. Few reports were discontinued, and a large number are generated each period.

Management, concerned about the number of reports produced, asked internal auditing to evaluate system effectiveness. They determined that more information was generated than could be used effectively and noted the following reactions:

- Many departments did not act on reports during peak activity periods. They let them accumulate in the hope of catching up later.
- Some had so many reports they did not act at all or misused the information.
- Frequently, no action was taken until another manager needed a decision made. Department heads did not develop a priority system for acting on the information.
- Department heads often developed information from alternative, independent sources. This was easier than searching the reports for the needed data.

Required

a. Explain whether each reaction is a functional or dysfunctional behavioral response.
b. Recommend procedures to eliminate dysfunctional behavior and prevent its recurrence. *(CMA Examination, adapted)*



20.4. The controller of Tim's Travel (TT) is deciding between upgrading the company's existing computer system or replacing it with a new one. Upgrading the four-year-old system will cost $97,500 and extend its useful life for another seven years. The book value is $19,500, although it would sell for $24,000. Upgrading will eliminate one employee at a salary of $19,400; the new computer will eliminate two employees. Annual operating costs are estimated at $15,950 per year. Upgrading is expected to increase profits 3.5% above last year's level of $553,000.

The BetaTech Company has quoted a price of $224,800 for a new computer with a useful life of seven years. Annual operating costs are estimated to be $14,260. The average processing speed of the new computer is 12% faster than that of other systems in its price range, which would increase TT's profits by 4.5%.

Tim's present tax rate is 35%, and the cost of financing is 11%. After seven years, the salvage value, net of tax, would be $12,000 for the new computer and $7,500 for the present system. For tax purposes, computers are depreciated over five full years

(six calendar years; a half year the first and last years), and the depreciation percentages are as follows:

Year	Percent (%)
1	20.00
2	32.00
3	19.20
4	11.52
5	11.52
6	5.76

Required

Using a spreadsheet package, prepare an economic feasibility analysis to determine whether TT should rehabilitate the old system or purchase the new computer. As part of the analysis, compute the after-tax cash flows for years 1 through 7 and the payback, NPV, and IRR of each alternative.



20.5. Rossco is considering the purchase of a new computer with the following estimated costs: initial systems design, $54,000; hardware, $74,000; software, $35,000, one-time initial training, $11,000; system installation, $20,000; and file conversion, $12,000. A net reduction of three employees is expected, with average yearly salaries of $40,000. The system will decrease average yearly inventory by $150,000. Annual operating costs will be $30,000 per year.

The expected life of the machine is four years, with an estimated salvage value of zero. The effective tax rate is 40%. All computer purchase costs will be depreciated using the straight-line method over its four-year life. Rossco can invest money made available from the reduction in inventory at its cost of capital of 11%. All cash flows, except for the initial investment and start-up costs, are at the end of the year. Assume 365 days in a year.

Required

Use a spreadsheet to perform a feasibility analysis to determine whether Rossco should purchase the computer. Compute the following as part of the analysis: initial investment, after-tax cash flows for years 1 through 4, payback period, net present value, and internal rate of return.



20.6. A recently completed feasibility study to upgrade XYZ's computer system shows the following benefits. Compensation figures in parentheses include wages, benefits, and payroll taxes.

1. Production
   a. Market forecasts, which take two $400 person-days a month, will be more accurate with software making the calculations.
   b. Effective inventory control will prevent part stockouts and reduce inventory by $1,000,000. XYZ's cost of capital is 20%.
   c. Detailed evaluations of plan changes will increase production flexibility, reduce sales losses, and eliminate two clerks ($75,000 each).
2. Engineering
   a. Computerized updating of bills of material and operations lists will save 40% of an engineer's ($100,000) and 25% of a clerk's ($60,000) time.
   b. Computerized calculations of labor allocations, rates, and bonus details will save 40% of a clerk's ($80,000) time.
3. Sales. Improved reporting will enable the five-person sales staff to react more quickly to the market, producing a $10,000 per person sales increase.
4. Marketing. Revised reports and an improved forecasting system will increase net income by $50,000.
5. Accounting
   a. Quickly determining new product costs will save 30% of the accountant's ($100,000) time.
   b. An incentive earnings system will save 40% of the payroll clerk's ($60,000) time.

Required

As a board member, which of the benefits can you defend as relevant to the system's cost justification? Calculate how much XYZ will save with the new system.

(SMAC Examination, adapted)



20.7. The following list presents specific project activities and their scheduled starting and completion times:

Activity	Starting Date	Ending Date
A	Jan. 5	Feb. 9
B	Jan. 5	Jan. 19
C	Jan. 26	Feb. 23
D	Mar. 2	Mar. 23
E	Mar. 2	Mar. 16
F	Feb. 2	Mar. 16
G	Mar. 30	Apr. 20
H	Mar. 23	Apr. 27

Required

a. Using a format similar to that in Figure 20-3, prepare a Gantt chart for this project. Assume that each activity starts on a Monday and ends on a Friday.
b. Assume that today is February 16 and that activities A and B have been completed, C is half completed, F is a quarter completed, and the other activities have not commenced. Record this information on your Gantt chart. Is the project behind schedule, on schedule, or ahead of schedule? Explain.
c. Discuss the relative merits of the Gantt chart and PERT as project planning and control tools.

20.8. Recent years have brought an explosive growth in electronic communication. Laptops, netbooks, e-readers, personal digital assistants, sophisticated cell phones, fax machines, e-mail, teleconferencing, office productivity software, and sophisticated management information systems have changed the way information is received, processed, and transmitted. With the decreasing costs of computer equipment and the increasing power of automation, the full impact of computerization has yet to be felt. Although the development of computer applications is directed at being user friendly or user oriented, the integration of computers into the organization has had both positive and negative effects on employees.

Required

a. Describe the benefits companies and employees receive from electronic communications.
b. Discuss the organizational impact of introducing new electronic communication systems.
c. Explain (1) why an employee might resist the introduction of electronic communication systems and (2) the steps an organization can take to alleviate this resistance.

(CMA Examination, adapted)

20.9. PWR manufactures precision nozzles for fire hoses. Ronald Paige, an engineer, started the corporation and it has experienced steady growth. Reporting to Ronald are six vice presidents representing marketing, production, research and development, information services, finance, and human resources. The information services department was established last year when PWR began developing a new information system consisting of a server connected to each employee's personal computer. The PCs can download and upload data to the server. PWR is still designing and developing applications for its new system. Ronald received a letter from the external auditor and called a meeting with his vice presidents to review the recommendation that PWR form an information systems steering committee.

Required

a. Explain why the auditors would recommend an information systems steering committee, and discuss its specific responsibilities. What advantages can the committee offer PWR?
b. Identify the PWR managers most likely to serve on the committee. *(CMA Examination, adapted)*

20.10. Businesses often modify or replace their financial information system to keep pace with their growth and take advantage of improved IT. This requires a substantial time and resource commitment. When an organization changes its AIS, a systems analysis takes place.

Required

a. Explain the purpose and reasons for surveying an organization's existing system.
b. Explain the activities commonly performed during systems analysis.
c. Systems analysis is often performed by a project team composed of a systems analyst, a management accountant, and other knowledgeable and helpful people. What is the management accountant's role in systems analysis? *(CMA Examination, adapted)*

20.11. Don Richardson, JEM Corporation's vice president of marketing, is part of a management team that for several months has been discussing plans to develop a new line of business. Rumors about the major organizational changes that may be required to implement the strategic plan have been circulating for months.

Several employees who are anxious about the expected changes confronted Don. The sales manager said, "It is imperative that we speak to you right away. The employees are very apprehensive about the proposed changes, and their job performance has slacked off." The accounting manager added, "That's right. My staff are asking me all sorts of questions about this new line of business, and I don't have any answers for them. They're not buying the 'We will make an official announcement soon' line any longer. I suspect that some of them are already looking for jobs in case the department changes phase out their positions."

Implementing organizational change is one of the most demanding assignments an executive faces. It has been suggested that every change requires three steps: unfreezing the current situation, implementing the change, and refreezing the effected change. This view, however, lacks the specific details needed by an operating manager who must initiate the change.

Required

a. Explain why employees resist organizational change.
b. Discuss ways JEM Corporation can alleviate employee resistance to change. *(CMA Examination, adapted)*

20.12. Remnants, Inc., with headquarters in St. Louis, manufactures designer clothing. The company markets and services its products by region, with each functioning as a profit center. Each region has a manager, an accounting department, a human resources department, and several area offices to market and service the products. Each area office has sales, service, and administrative departments whose managers report to an area manager.

The New York area office departed from the standard organizational structure by establishing a branch office to market and service the firm's products in Boston. A branch manager who reports directly to the New York area manager heads the local office.

The Boston branch manager is encouraging the New York area manager to consider a new information system to handle the local branch's growing information needs. The New York area manager and the eastern region manager want to establish a project team with employees from the region, area, and branch office. The team will assess the information needs at the Boston branch office and develop system

recommendations. The following employees have been appointed to the project team, with Keith Nash as chairperson:

Eastern Region Office
Kurt Johnson, Budget Supervisor
Sally Brown, Training Director

New York Area Office
Keith Nash, Administrative Director

Boston Branch
Heidi Meyer, Branch and Sales Manager
Bobby Roos, Assistant Branch and Service Manager
Joe Gonzalez, Salesperson
Juana Martinez, Serviceperson

Required

a. Project team members contribute their skills to help accomplish a given objective. Characteristics of group members can influence the functioning and effectiveness of a project team. Identify some of these characteristics.
b. Given the team's composition, what sources of conflict can you see arising among its members? Do you think the group will succeed in its objective to develop an IS for the Boston branch office? Why or why not?
c. What contribution would a budget supervisor make in a project team?

20.13. Managers at some companies face an ongoing systems development crisis: IS departments develop systems that businesses cannot or will not use. At the heart of the problem is a "great divide" that separates the world of business and the world of IS. Few departments seem able or ready to cross this gap.

One reason for the crisis is that many companies are looking for ways to improve existing, out-of-date systems or to build new ones. Another is the widespread use of PC-based systems that have spawned high user expectations that IS departments are not meeting. Users seek more powerful applications than are available on many older systems.

The costs of the great divide can be devastating. An East Coast chemical company spent over $1 million on a budgeting and control system that was never used. The systems department's expertise was technical excellence, not budgets. As a result, the new system completely missed the mark when it came to meeting business needs. A Midwestern bank used an expensive computer-aided software engineering (CASE) tool to develop a system that users ignored because there had been no design planning. A senior analyst for the bank said, "They built the system right; but unfortunately they didn't build the right system."

Required

a. What is the great divide in the systems development process? What causes the gap?
b. What would you suggest to solve this information crisis?
c. Discuss the role a systems designer, business manager, and end user can take to narrow the great divide.
d. Who plays the most vital role in the effective development of the system?

20.14. Joanne Grey, a senior consultant, and David Young, a junior consultant, are conducting a systems analysis for a client to determine the feasibility of integrating and automating clerical functions. Joanne had previously worked for the client, but David was a recent hire.

The first morning on the job, Joanne directed David to interview a departmental supervisor and learn as much as possible about department operations. David introduced himself and said, "Your company has hired us to study how your department works so we can make recommendations on how to improve its efficiency and lower its cost. I would like to interview you to determine what goes on in your department."

David questioned the supervisor for 30 minutes but found him to be uncooperative. David gave Joanne an oral report on how the interview went and what he learned about the department.

Required

Describe several flaws in David's approach to obtaining information. How should this task have been performed?

Case 20-1 Audio Visual Corporation

Audio Visual Corporation (AVC) manufactures and sells visual display equipment. Headquartered in Boston, it has seven sales offices with nearby warehouses that carry its inventory of new equipment and replacement parts. AVC has a departmentalized manufacturing plant with assembly, maintenance, engineering, scheduling, and cost accounting departments as well as several component parts departments.

When management decided to upgrade its AIS, they installed a mainframe at headquarters and local area networks at each sales office. The IS manager and four systems analysts were hired shortly before they integrated the new computer and the existing AIS. The other IS employees have been with the company for years.

During its early years, AVC had a centralized decision-making organization. Top management formulated all plans and directed all operations. As the company expanded, decision making was decentralized, although data processing was highly centralized. Departments coordinated their plans with the corporate office but had the freedom to develop their own sales programs. However, information problems developed, and the IS department was asked to improve the company's information processing system once the new equipment was installed.

Before acquiring the new computer, the systems analysts studied the existing AIS, identified its weaknesses, and designed applications to solve them. In the 18 months since the new equipment was acquired, the following applications were redesigned or developed: payroll, production scheduling, financial statement preparation, customer billing, raw materials usage, and finished goods inventory. The departments affected by the changes were rarely consulted until the system was operational.

Recently the president stated, "The systems people are doing a good job, and I have complete confidence in their work. I talk to them frequently, and they have encountered no difficulties in doing their work. We paid a lot of money for the new equipment, and the systems people certainly cost enough, but the new equipment and new IS staff should solve all our problems."

Two additional conversations regarding the new AIS took place.

BILL TAYLOR, IS MANAGER AND JERRY ADAMS, PLANT MANAGER

JERRY: Bill, you're trying to run my plant for me. I'm the manager, and you keep interfering. I wish you would mind your own business.

BILL: You've got a job to do, and so do I. As we analyzed the information needed for production scheduling and by top management, we saw where we could improve the workflow. Now that the system is operational, you can't reroute work and change procedures, because that would destroy the value of the information we're processing. And while I'm on that subject, we can't trust the information we're getting from production. The documents we receive from production contain a lot of errors.

JERRY: I'm responsible for the efficient operation of production. I'm the best judge of production efficiency. The system you installed reduced my workforce and increased the workload of the remaining employees, but it hasn't improved anything. In fact, it might explain the high error rate in the documents.

BILL: This new computer cost a lot of money, and I'm trying to make sure the company gets its money's worth.

JERRY ADAMS, PLANT MANAGER AND TERRY WILLIAMS, HUMAN RESOURCES MANAGER

JERRY: My best production assistant, the one I'm grooming to be a supervisor, told me he was thinking of quitting. When I asked why, he said he didn't enjoy the work anymore. He's not the only one who is unhappy. The supervisors and department heads no longer have a voice in establishing production schedules. This new computer system took away the contribution we made to company planning and direction. We're going back to when top management made all the decisions. I have more production problems now than I ever had. It boils down to my management team's lack of interest. I know the problem is in my area, but I thought you could help me.

TERRY: I have no recommendations, but I've had similar complaints from purchasing and shipping. We should explore your concerns during tomorrow's plant management meeting.

ANSWER THE FOLLOWING QUESTIONS:

1. Identify the problems the new computer system created, and discuss what caused them.
2. How could AVC have avoided the problems? How can they prevent them in the future?

(CMA Examination, adapted)

AIS IN ACTION SOLUTIONS

Quiz Key

1. Which of the following is NOT a reason why companies make changes to their AIS?
   a. gain a competitive advantage [AIS changes can help a company increase the quality, quantity, and speed of information, which leads to improved decision making and a greater competitive advantage.]
   b. increase productivity [Using computers in an AIS can automate repetitive tasks, which allows more work to be done in the same amount of time. This increases productivity.]
   c. keep up with business growth [As a company grows, its old system will likely not be able to handle the increase in demand and thus will require changes to the AIS to accommodate the growth.]
   d. downsize company operations [A smaller company requires a smaller AIS. For instance, downsizing may prompt a company to move from centralized decision making to decentralized decision making. As a result, the AIS would most likely shift from using a mainframe computer to a set of networked workstations.]
   ▶ e. All of the above are reasons why companies change an AIS. [Correct.]

2. Which of the following is the planning technique that identifies implementation activities and their relationships, constructs a network of arrows and nodes, and then determines the critical path through the network?
   a. Gantt chart [Incorrect. A Gantt chart is a bar chart that displays dates and stages of completion for each project task. See Figure 20-3.]
   ▶ b. PERT diagram [Correct.]
   c. physical model [Incorrect. A physical model illustrates how a system functions. It describes document flows, computer processes, equipment used, and other physical elements of the system.]
   d. data flow diagram [Incorrect. A data flow diagram is used to document a system with four basic symbols—i.e., squares, circles, parallel lines, and arrows.]

3. The purchasing department is designing a new AIS. Who is best able to determine departmental information requirements?
   a. steering committee [Incorrect. The steering committee is a high-level executive committee that oversees the function of the information system; they probably do not understand the purchasing department's information requirements.]
   b. controller [Incorrect. The controller is the manager of the accounting department and probably does not understand all of the purchasing department's information requirements.]
   c. top management [Incorrect. Top management in such cases should provide direction and resources, not detailed analysis of the purchasing department's information requirements.]
   ▶ d. purchasing department [Correct. The people who will actually be using the new system are in the best position to determine the system's information requirements.]

4. Which of the following is the correct order of the steps in systems analysis?
   a. initial investigation, determination of information needs and system requirements, feasibility study, system survey [Incorrect. See Figure 20-4.]
   b. determination of information needs and system requirements, system survey, feasibility study, initial investigation [Incorrect. See Figure 20-4.]
   c. system survey, initial investigation, determination of information needs and system requirements, feasibility study [Incorrect. See Figure 20-4.]
   ▶ d. initial investigation, system survey, feasibility study, determination of information needs and system requirements [Correct. See Figure 20-4.]

5. Which of the following is the long-range planning document that specifies what the system will consist of, how it will be developed, who will develop it, how needed resources will be acquired, and its overall vision?
   a. steering committee agenda [Incorrect. The steering committee's agenda would involve discussing all aspects of the information system, not just system development.]
   ▶ b. master plan [Correct.]
   c. systems development life cycle [Incorrect. The systems development life cycle is not a long-range planning document but a conceptual framework that applies to systems development in general.]
   d. project development plan [Incorrect. The project development plan is used for individual projects. It includes such items as cost/benefit analyses, developmental and operational requirements, and a schedule of activities for developing and operating the new system.]

6. Resistance is often a reaction to the methods of instituting change rather than to change itself.
   ▶ a. true [Correct. Although change is generally difficult, the way change is instituted can either facilitate the change or hinder the change.]
   b. false [Incorrect.]

7. Increased error rates, disruptions, and sabotage are examples of which of the following?
   ▶ a. aggression [Correct. These are classic symptoms of aggression as a reaction to change.]
   b. avoidance [Incorrect. Avoidance is best illustrated by the statement that if a person does not use the new system, maybe it will go away.]
   c. projection [Incorrect. Projection refers to blaming all problems on the new system.]
   d. payback [Incorrect. Payback is an economic feasibility metric.]

8. What is often the most significant problem a company encounters in designing, developing, and implementing a system?
   ▶ a. the human element [Correct. A system will fail without the support of the people it is designed to serve—for a variety of reasons, including fear of change, poor communication and training, disruption of work, and lack of top-management support.]
   b. technology [Incorrect. The technology a system employs is normally tested for functionality prior to its implementation in a new system.]
   c. legal challenges [Incorrect. With proper system planning and design, systems can meet all laws and regulations.]
   d. planning for the new system [Incorrect. Proper planning can actually prevent problems from occurring.]

9. Determining whether the organization has access to people who can design, implement, and operate the proposed system is referred to as which of the following?
   a. technical feasibility [Incorrect. Technical feasibility refers to whether the system can be developed and implemented with existing technology.]
   ▶ b. operational feasibility [Correct. Operational feasibility refers to whether the organization and its people can actually design, implement, and operate the system.]
   c. legal feasibility [Incorrect. Legal feasibility refers to whether the system complies with all applicable laws and regulations.]
   d. scheduling feasibility [Incorrect. Scheduling feasibility refers to whether the system can be analyzed, planned, designed, and implemented in the time allocated.]
   e. economic feasibility [Incorrect. Economic feasibility refers to whether the system's benefits outweigh its costs.]

10. Which of the following is NOT one of the tangible or intangible benefits a company might obtain from a new system?
    a. cost savings [Although this answer is correct, there are other correct answers. Automated systems can reduce clerical costs, as well as other related costs.]

b. improved customer service and productivity [Although this answer is correct, there are other correct answers. New systems can integrate data from several sources to provide fast, reliable information to assist customers and increase productivity.]
c. improved decision making [Although this answer is correct, there are other correct answers. Better information greatly increases the likelihood of better decisions.]
d. improved data processing [Although this answer is correct, there are other correct answers. Better-designed systems using newer technology improve data processing and reduce the likelihood of human error.
▶ e. All are benefits of a new system. [Correct.]

Comprehensive Problem Solution

a. *What is the executive-level committee commonly called, who typically serves on it, and what is its primary function?*

An information systems steering committee, which plans and oversees the IS function, consists of high-level management people, such as the controller and systems and user-department management. The committee sets IS policies; ensures top-management participation, guidance, and control; and facilitates the coordination and integration of systems activities.

b. *Who typically serves on the project development team?*

The project development team includes systems analysts, systems specialists, managers, accountants, systems auditors, and users.

c. *What steps would the development team take during system analysis?*

RSSA's development team will do an initial assessment of management's plans for moving the help desk. They will survey the existing system to determine what it does, what the company should continue to use, and what should be changed for the new system. They will complete a feasibility analysis to determine the technical, operational, legal, scheduling, and economic feasibility of the new system. Then the team will determine the system's information needs and requirements. Lastly, the team will prepare a systems analysis report.

d. *Why do you think the server and data tapes were damaged?*

Change is usually difficult for people and organizations. When operations are outsourced, employees can lose their jobs. Apparently, some employees exhibited aggressive behavior toward the new system.

e. *Calculate the following capital budgeting metrics for RSSA's outsourcing plan:*

1. payback period
2. net present value (NPV)
3. internal rate of return (IRR)

Table 20-9 summarizes the cash spent or saved each year of RSSA's proposed project. The initial contract payment and the lease cancellation penalty occur at the beginning of the project, referred to as year 0. For simplicity's sake, we assume cash flows take place at the end of the year. For years 1 through 5, the $525,000 expenditure for operations, the $750,000 personnel savings, and the $360,000 lease cancellation savings are entered. The last line of Table 20-9 shows the net cash flows for each period, which are total cash inflows less total cash outflows.

1 Payback

The payback period is when cash inflows equal cash outflows. Table 20-10, which shows cumulative net cash flow totals, indicates that breakeven occurs during year 4. To determine how far into year 4, divide year-3 negative cumulative cash flows of $145,000 by year-4 net cash flows of $585,000. It took 25% of the year (145,000/585,000), or 3.25 years, to get to payback.

2 Net present value

Payback period does not take into consideration the time value of money (a dollar received today is worth more than the same dollar received a year from now). The net present value (NPV)

techniques takes the time value of money into consideration by using the company's cost of capital, called its discount rate. This rate is the company's average cost of borrowing capital.

Net present value is calculated by multiplying each year's net cash flow by a discount factor calculated using the formula $1/(1+r)n$, where r = the company's discount rate and n = the number of time periods between time 0 and the designated cash flow. For example, if the cash flow occurred at the end of year 4, n would equal 4. The discount factor is calculated for each time period and multiplied by the net cash flow for that period. When all net cash flows have been discounted to their present value, they are totaled to determine the project's NPV.

As a practical matter, most people do not use the formula to make the calculations, but rather use a business calculator or the NFV function in Microsoft Excel.

Projects with a positive NPV earn an estimated return in excess of the company's discount rate and are financially feasible. Projects with a negative NPV are usually rejected. As shown in Table 20-11, RSSA's NPV is $262,100 and the project would likely be acceptable to management.

3 Internal rate of return

The NPV calculation does not calculate an estimated rate of return. This limitation is resolved by calculating an internal rate of return (IRR), which is the discount rate that produces a NPV of zero. Calculating an IRR is a trial-and-error process of changing the discount rate until NPV equals zero. Because this is so tedious, IRR is usually calculated using a business calculator or the IRR function in a spreadsheet program. The internal rate of return for this project is 16.35% (rounded).

TABLE 20-9 Cash Flows for RSSA

Year	0	1	2	3	4	5
CASH OUTFLOWS						
Initial Contract	–$1,750,000					
Lease Cancellation Penalty	–$150,000					
Center Operations Cost		–$525,000	–$525,000	–$525,000	–$525,000	–$525,000
Total Cash Outflows	–$1,900,000	–$525,000	–$525,000	–$525,000	–$525,000	–$525,000
CASH INFLOWS						
Personnel Savings		$750,000	$750,000	$750,000	$750,000	$750,000
Lease Cancellation Savings		$360,000	$360,000	$360,000	$360,000	$360,000
Total Cash Inflows	$0	$1,110,000	$1,110,000	$1,110,000	$1,110,000	$1,110,000
NET CASH FLOWS	–$1,900,000	$585,000	$585,000	$585,000	$585,000	$585,000

TABLE 20-10 Payback for RSSA's Proposed Project

Year	0	1	2	3	4	5
Net Cash Flows	–$1,900,000	$585,000	$585,000	$585,000	$585,000	$585,000
Cumulative Cash Flows	–$1,900,000	–$1,315,000	–$730,000	–$145,000	$440,000	$1,025,000
Payback	3.25 years or 3 years, 3 months					

TABLE 20-11 The Net Present Value of RSSA's Proposed Project

NET CASH FLOWS	–$1,900,000	$585,000	$585,000	$585,000	$585,000	$585,000
Present Value Factors	1	0.9009	0.8116	0.7312	0.6587	0.5935
Present Value Amounts	–$1,900,000	$527,027	$474,786	$427,752	$385,340	$347,198
Net Present Value	$262,103					
IRR	16.35%					

Chapter 21

AIS Development Strategies

Learning Objectives

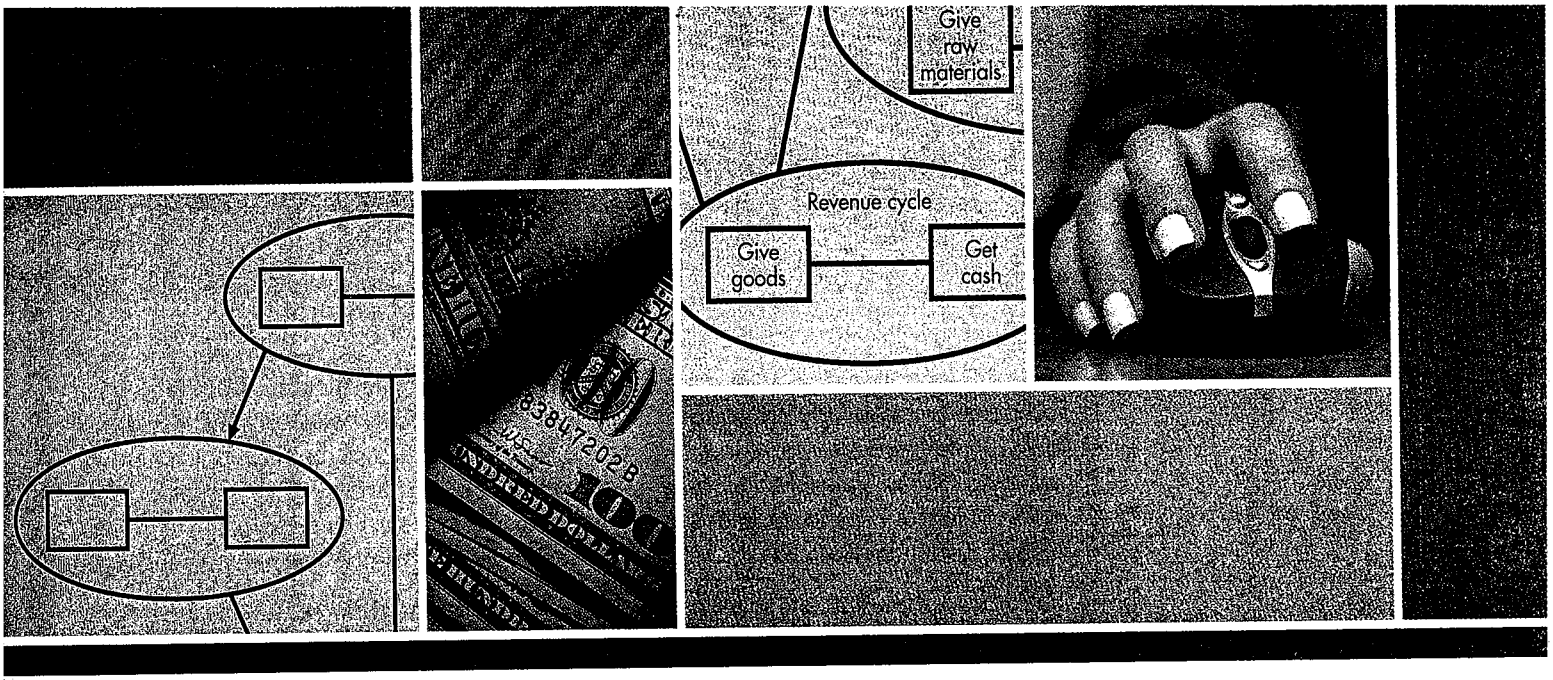
After studying this chapter, you should be able to:

1. Describe how organizations purchase application software, vendor services, and hardware.
2. Explain how information system departments develop custom software.
3. Explain how end users develop, use, and control computer-based information systems.
4. Explain why organizations outsource their information systems and evaluate the benefits and risks of this strategy.
5. Explain the principles and challenges of business process management.
6. Describe how prototypes are used to develop an AIS, and discuss the advantages and disadvantages of doing so.
7. Explain what computer-aided software engineering is and how it is used in systems development.

INTEGRATIVE CASE SHOPPERS MART

Ann Christy is elated that the system Shoppers Mart (SM) so badly needed was approved and that she and her team have accurately assessed company needs. Now Ann needs to determine whether to purchase the software, develop it in-house, or outsource system development and operation. More specifically, she needs answers to these questions:

1. Can Ann buy the software she needs? If so, how should she buy hardware and software and select a vendor?



2. How do companies develop software in-house? Is this the best approach for SM?
3. How extensively should SM use end-user-developed software?
4. Should SM improve its existing system or redesign its business processes and develop a system to support them?
5. Is outsourcing the information system a viable alternative to obtain a new system? Do the benefits of outsourcing outweigh its risks?
6. If SM decides to develop the system in-house, should it use prototyping or computer-assisted software engineering?

Ann decided to investigate design alternatives to determine the best course of action for Shoppers Mart.

Introduction

Companies have experienced the following difficulties when developing an AIS:

- Development requests are so numerous that projects are backlogged for years.
- Users discover that the new AIS does not meet their needs. This occurs because users find it hard to visualize how the AIS will operate by reviewing design documentation and because developers who do not understand business or user needs find it hard to make meaningful suggestions for improvement.
- Development takes so long the system no longer meets company needs. Fannie Mae spent eight years and $100 million developing the world's largest loan accounting system. Unfortunately, it no longer met many of Fannie Mae's needs.
- Users do not adequately specify their needs because they do not know what they need or they cannot communicate the needs to systems developers.
- Changes are difficult to make after requirements are frozen. If users keep changing requirements, the AIS may take forever to finish.

In this chapter, you learn three ways to obtain an information system: purchasing software, developing software in-house, and hiring a company to develop and operate the system. You also learn three ways to improve the development process: business process redesign, prototyping, and computer-aided software engineering tools.

Purchasing Software

In the early days of computers, it was difficult to buy software that met user needs. That is no longer the case. A Deloitte & Touche survey found that most chief information officers expect to replace their current systems with commercially available packages. Consider the following examples:

- Hard Rock Café purchased customer relationship software and mailed promotional offers to 225,000 customers. A year later, profits from the increased traffic paid for the new system.
- WellPoint Health Networks installed payroll, benefits, and human resources software so employees could manage their benefits, saving $400,000 a year.
- Pacific Gas & Electric responded to California's power deregulation by spending three years and $204 million installing the largest customer information system in the utility industry.

Canned software is sold to users with similar requirements. ***Turnkey systems*** are software and hardware sold as a package. The vendor installs the system and the user "turns on the key." Many turnkey systems are written by vendors who specialize in a particular industry, such as doctors, auto repair shops, restaurants, and retail stores.

A major problem with canned software is that it may not meet all of a company's information needs. This is overcome by modifying the software. About 90% of Dow Chemical's software has been modified to match its business processes. The rest was written in-house. It is best when the vendor modifies the software, as unauthorized modifications may not be supported by the vendor and may make the program unreliable.

Companies can rent software from ***application service providers (ASPs)***, who deliver software over the Internet. This provides scalability as the business grows and global access to information. It automates software upgrades, allows companies to focus on core financial competencies rather than information technology (IT) issues, and can reduce software costs and administrative overhead.

Companies that buy AIS software follow the normal systems development life cycle (SDLC) except for the following:

- During conceptual systems design, companies determine whether software that meets AIS requirements is available and, if so, whether to buy it or create their own.
- Some physical design and implementation and conversion steps can be omitted. For example, the company usually does not need to design, code, and test program modules or document the computer program.

Selecting a Vendor

Hardware, service, maintenance, and other AIS resource decisions can be made independently of the decision to make or purchase software, although they may depend on the software decision.

Vendors are found by referrals, at conferences, in industry magazines, on the Internet, or in the phone book. Choosing must be done carefully because vendors with little experience, insufficient capital, or a poor product go out of business and leave their customers and products with no support or recourse. Problems can occur even when established vendors are selected. For example, when Texas selected IBM to consolidate data centers across the state, service levels dropped dramatically, and routine tasks took far too long to perform. The problem was attributed to poor project requirements and selecting the vendor with the lowest bid. IBM almost lost the contract after it failed to back up critical systems.

Acquiring Hardware and Software

Companies that buy large or complex systems send vendors a ***request for proposal (RFP)***, asking them to propose a system that meets their needs by a specified date. The best proposals are investigated to verify that company requirements can be met. Using an RFP is important because it:

1. *Saves time.* The same information is provided to all vendors, eliminating repetitive interviews and questions.
2. *Simplifies the decision-making process.* All responses are in the same format and based on the same information.
3. *Reduces errors.* The chances of overlooking important factors are reduced.

4. *Avoids potential for disagreement.* Both parties possess the same expectations, and pertinent information is captured in writing.

RFPs for exact hardware and software specifications have lower total costs and require less time to prepare and evaluate, but they do not permit the vendor to recommend alternative technology. Requesting a system that meets specific performance objectives and requirements leaves technical issues to the vendor but is harder to evaluate and often results in more costly bids.

The more information a company provides vendors, the better their chances of receiving a system that meets its requirements. Vendors need detailed specifications, including required applications, inputs and outputs, files and databases, frequency and methods of file updating and inquiry, and unique requirements. It is essential to distinguish mandatory requirements from desirable features.

Evaluating Proposals and Selecting a System

Proposals that lack important information, fail to meet minimum requirements, or are ambiguous are eliminated. Proposals passing this preliminary screening are compared with system requirements to determine whether all mandatory requirements are met and how many desirable requirements are met. Top vendors are invited to demonstrate their system using company-supplied data to measure system performance and validate vendor's claims. Table 21-1 presents hardware, software, and vendor evaluation criteria.

TABLE 21-1 Hardware, Software, and Vendor Evaluation Criteria

Hardware evaluation	Are hardware costs reasonable, based on capabilities and features? Are processing speed and capabilities adequate for the intended use? Are secondary storage capabilities adequate? Are the input and output speeds and capabilities adequate? Is the system expandable? Is the hardware based on old technology that will soon to be out-of-date? Is the hardware available now? If not, when? Is the hardware compatible with existing hardware, software, and peripherals? How do performance evaluations compare with competitors? What are the availability and cost of support and maintenance? What warranties come with the system? Is financing available (if applicable)?
Software evaluation	Does the software meet all mandatory specifications? How well does the software meet desirable specifications? Will program modifications be required to meet company needs? Does the software have adequate control capabilities? Is the performance (speed, accuracy, reliability) adequate? How many companies use the software? Are they satisfied? Is documentation adequate? Is the software compatible with existing software? Was the software demonstration/test drive adequate? Does the software have an adequate warranty? Is the software flexible, easily maintained, and user-friendly? Is online inquiry of files and records possible? Will the vendor keep the package up to date?
Vendor evaluation	How long has the vendor been in business? Is the vendor financially stable and secure? How experienced is the vendor with the hardware and software? Does the vendor stand behind its products? How good is its warranty? Does the vendor regularly update its products? Does the vendor provide financing? Will the vendor put promises in a contract? Will the vendor supply a list of customer references? Does the vendor have a reputation for reliability and dependability? Does the vendor provide timely support and maintenance? Does the vendor provide implementation and installation support? Does the vendor have high-quality, responsive, and experienced personnel? Does the vendor provide training?

System performance can be compared several ways. A ***benchmark problem*** is an input, processing, and output task typical of what the new AIS will perform. ***Point scoring*** assigns a weight to each evaluation criterion based on its importance. For each criterion, vendors are scored based on how well their proposals meet the requirement, and the weighted score totals are compared. In Table 21-2, vendor 3 offers the best system because its system scored 190 points more than vendor 2 did.

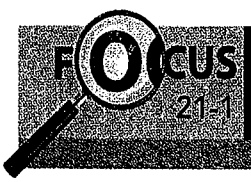
A ***requirement costing*** estimates the cost of purchasing or developing unavailable features. Total AIS costs, which is the cost of acquiring the system and the cost of developing the unavailable features, provides an equitable basis for comparing systems.

Because neither point scoring nor requirements costing is totally objective, the final choice among vendor proposals is not clear-cut. Point scoring weights and scores are assigned subjectively, and dollar estimates of costs and benefits are not included. Requirement costing overlooks intangible factors such as reliability and vendor support.

Once the best AIS is identified, the software is thoroughly test-driven, other users are contacted to determine their satisfaction with the choice, vendor personnel are evaluated, and proposal details are confirmed to verify that the best AIS on paper is the best in practice. The lessons the Rawash Group learned from its vendor selection highlight the importance of a thorough vendor evaluation (see Focus 21-1).

TABLE 21-2 Point Scoring Evaluation of Vendor Proposals

		Vendor 1		Vendor 2		Vendor 3	
Criterion	Weight	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Hardware compatibility	60	6	360	7	420	8	480
Hardware speed	30	6	180	10	300	5	150
Memory expansion	60	5	300	7	420	8	480
Hardware current	30	9	270	9	270	6	180
Software compatibility	90	7	630	7	630	9	810
Online inquiry capabilities	40	9	360	10	400	8	320
Controls	50	7	350	6	300	9	450
Positive references	40	10	400	8	320	6	240
Documentation	30	9	270	8	240	7	210
Easily maintained; updated regularly	50	7	350	8	400	9	450
Network capabilities	50	8	400	7	350	8	400
Vendor support	70	6	420	9	630	10	700
Totals			**4,290**		**4,680**		**4,870**



FOCUS 21-1 What Went Wrong in ERP System Implementation by the Rawash Group?

The Rawash Group, an Egyptian company specializing in manufacturing and selling passenger and commercial vehicles, implemented an ERP system in 1997. The implementer of the system was the regional agent of the Baan ERP system. Although the Rawash Group ran the system for seven years, it was never utilized as an integrated system. Despite spending over $50 million over several years, the group never saw the benefits of this ERP because of poor vendor support in the region, lack of trained professionals, and extensive system customizations. Databases were open to access by end users who downloaded and manipulated data using Excel spreadsheets, compromising the integrity of data and destroying audit trails. The ERP system functionalities were subsequently abandoned in favour of end-user computing.

This is a classic failure of systems development in environments where selection and due diligence are not practiced. Verifying vendors' support capabilities, the availability of trained professionals, the proximity of support, and vendor commitment to the marketplace are deciding factors for implementing such a platform.

Development by In-House Information Systems Departments

Organizations develop ***custom software*** when doing so provides a significant competitive advantage. There is little benefit to a custom-written payroll or accounts receivable system, whereas there may be significant benefits to sophisticated, just-in-time inventory management or product manufacturing software.

The hurdles that must be overcome to develop quality software are the significant amounts of time required, the complexity of the system, poor requirements, insufficient planning, inadequate communication and cooperation, lack of qualified staff, and poor top management support.

Custom software is created in-house or by an outside company hired to write the software or assemble it from its inventory of program modules. When using an outside developer, a company maintains control over the development process as follows:

- Carefully select a developer that has experience in the company's industry and an in-depth understanding of how the company conducts its business.
- Sign a contract that rigorously defines the relationship between the company and the developer, places responsibility for meeting system requirements on the developer, and allows the project to be discontinued if key conditions are not met.
- Plan the project in detail and frequently monitor each step in the development.
- Communicate frequently and effectively.
- Control all costs and minimize cash outflows until the project is accepted.

There is no single right answer to the build-or-buy decision. Different companies come to different conclusions. After developing its own software, Gillette decided to purchase canned software when possible to gain a greater competitive advantage from deciding *how* software should be used rather than determining *what* software should be used and then creating it. If canned software does not meet all of Gillette's needs, it is modified using high-level development tools.

Pepsi moved in the opposite direction. It bought most of its mainframe software but, after moving to a client/server architecture, it could not find software sophisticated enough to meet its needs. Although Pepsi still buys software when it can find it, it has created most of its software.

Chapter 20 discusses in more depth the process used to develop custom software.

End-User-Developed Software

After the automobile was introduced, a famous sociologist predicted that the automobile market would not exceed 2 million cars because only that many people would be willing to serve as chauffeurs. It was once predicted that the telephone system would collapse because the geometric growth in calls would require everyone to be telephone operators. Instead, equipment was developed that automated operator functions.

After the introduction of computers, an expert claimed that the demand for information systems would grow so astronomically that almost everyone would have to become a programmer. Does this sound familiar? The solution is to help end users meet their own information needs. As with telephones, technology is being developed to automate much of the process for us. Just as most people have learned to drive automobiles, so will inexpensive PCs, a wide variety of powerful and inexpensive software, increased computer literacy, easier-to-use programming tools, and the Internet allow most organizations and people to meet their information needs.

End-user computing (EUC) is the hands-on development, use, and control of computer-based information systems by users. EUC is people using IT to meet their information needs rather than relying on systems professionals. For example, a savings and loan in California wanted a system to track loan reserve requirements. When the information systems (IS) department said the system would take 18 months to develop, the loan department used a PC and a database program to develop a functional program in one day. Enhancing the program took several more days. The loan department not only cut the development time from 18 months to a few days, but also got the exact information it needed because users developed the system themselves.

The following are examples of appropriate end-user development:

- Retrieving information from company databases to produce simple reports or to answer one-time queries
- Performing "what-if," sensitivity, or statistical analyses
- Developing applications using software such as a spreadsheet or a database system
- Preparing schedules, such as depreciation schedules and loan amortizations

End-user development is inappropriate for complex systems, such as those that process a large number of transactions or update database records. Therefore, it is not used for processing payroll, accounts receivables and payables, general ledger, or inventory.

As end users meet their information needs, they realize they can use computers to meet more and more information needs. Increased access to data also creates many new uses and information needs. The result is a tremendous ongoing growth in end-user computing.

The growth in end-user computing has altered the information system staff's role. They continue to develop and maintain transaction processing systems and companywide databases. In addition, they provide users with technical advice and operational support and make as much information available to end users as possible. Although this has created more work for the IS staff, it is counterbalanced by a decreased demand for traditional services. If the trend in end-user computing continues, it will represent 75% to 95% of all information processing by the end of the next decade.

Advantages and Disadvantages of End-User Computing

End-user computing offers the following advantages:

- *User creation, control, and implementation.* Users, rather than the IS department, control the development process. Users decide whether a system should be developed and what information is important. This ownership helps users develop better systems.
- *Systems that meet user needs.* Systems that are developed by end users are more likely to meet user needs. Users discover flaws that IS people do not catch. Many of the user-analyst-programmer communication problems in traditional program development are avoided.
- *Timeliness.* Much of the lengthy delay inherent in traditional systems development is avoided, such as time-consuming cost/benefit analyses, detailed requirements definitions, and the delays and red tape of the approval process.
- *Freeing up of systems resources.* The more information needs users meet, the more time the IS department can spend on other development and maintenance activities. This reduces both the visible and the invisible backlog of systems development projects.
- *Versatility and ease of use.* Most end-user computing software is easy to understand and use. Users can change the information they produce or modify their application any time their requirements change. With a laptop computer, employees can complete work at home, on a plane—almost anywhere.

However, there are significant drawbacks to end-user computing and to eliminating the involvement of analysts or programmers in the development process.

- *Logic and development errors.* With little experience in systems development, end users are more likely to make errors and less likely to recognize when errors have occurred. They may solve the wrong problem, poorly define system requirements, apply an inappropriate analytical method, use the wrong software, use incomplete or outdated information, use faulty logic, or incorrectly use formulas or software commands. An oil and gas company developed a complex spreadsheet that showed that a proposed acquisition was profitable. When their CPA firm tested the model and agreed with it, a board of directors meeting was scheduled to propose the acquisition. Shortly before the meeting, a presenter tested the model so that he could understand how it worked and answer tough questions. He discovered formulas that distorted the projections, so he called in the creator and the CPA firm. The corrected formulas showed a significant loss on the acquisition. The board presentation was canceled, and the spreadsheet creator and CPA firm were fired.
- *Inadequately tested applications.* Users are less likely to test their applications rigorously, either because they do not recognize the need to do so or because of the difficulty or time involved. One Big Four CPA firm found that 90% of the spreadsheet models it tested had at least one calculation error.

- *Inefficient systems.* Most end users are not programmers nor are they trained in systems development. As a result, their systems are not always efficient. One bank clerk spent three weeks developing a program that examined each cell in a spreadsheet and changed its value to zero if it was a negative amount. When the 60-page program began returning a "too many nested ifs" error message, the clerk called in a consultant. Within five minutes, the consultant developed a finished application using a built-in spreadsheet function.
- *Poorly controlled and documented systems.* Many end users do not implement controls to protect their systems. User-created systems are often poorly documented because the user considers the task boring or unimportant. Users fail to realize that without documentation, others cannot understand how their system works.
- *System incompatibilities.* Companies that add end-user equipment without considering the technological implications have a diversity of hardware and software that is difficult to support or network. Aetna Life & Casualty spent over $1 billion a year on IT to gain a competitive advantage. The result was 50,000 PCs from a few dozen manufacturers, 2,000 servers, 19 incompatible e-mail systems, and 36 different communications networks. Aetna finally realized it needed to shift its emphasis from owning the latest technology to the effective use of technology. Aetna standardized its systems and now uses only a few different PCs, Microsoft software, two e-mail systems, and one network. The result is compatibility across all systems and significantly less cost.
- *Duplication of systems and data; wasted resources.* End users are typically unaware that other users have similar information needs, resulting in duplicate systems. Inexperienced users may take on more development than they are able to accomplish. Both of these problems end up wasting time and resources.
- *Increased costs.* A single PC purchase is inexpensive; buying hundreds or thousands is costly. So is updating the hardware and software every few years. End-user computing has a high opportunity cost if it diverts users' attention from their primary jobs. It also increases time and data demands on corporate information systems.

It is possible to achieve the proper balance between the benefits and risks of end-user systems by training users, using systems analysts as advisers, and requiring user-created systems to be reviewed and documented prior to use.

Managing and Controlling End-User Computing

Organizations must manage and control end-user computing. Giving the IS department control discourages end-user computing and eliminates its benefits. However, if the organization maintains no controls over end users, such as what end-user computing tools are purchased or how they are used, it is likely to lead to significant problems. It is best to provide enough guidance and standards to control the system yet allow users the flexibility they need.

A ***help desk*** supports and controls end-user activities. The 60 help desk analysts and technicians at Schering-Plough handle 9,000 calls a month. Front-line analysts use expert system software to find scripted answers to user questions. Second-line technicians handle queries that are more complicated. Other companies use multimedia software with animation or videos to help staffers walk callers through a complicated process.

Help desk duties include resolving problems, disseminating information, evaluating new hardware and software products and training end users how to use them, assisting with application development, and providing technical maintenance and support. Help desks also develop and implement standards for hardware and software purchases, documentation, application testing, and security. Lastly, the help desk controls access to and sharing of corporate data among end users, while ensuring that the data are not duplicated and that access to confidential data remains restricted.

Outsourcing the System

Outsourcing is hiring an outside company to handle all or part of an organization's data processing activities. In mainframe outsourcing agreements, outsourcers buy client computers, hire the client's IS employees, operate and manage the system on the client's site, or migrate the system

to the outsourcer's computers. Many outsourcing contracts are in effect for up to 10 years and cost millions of dollars a year. In a client/server or a PC outsourcing agreement, a service, function, or segment of business is outsourced. Most Fortune 500 companies outsource their PC support function. Royal Dutch Shell, the international oil company, has 80,000 PCs worldwide and outsources its installation, maintenance, training, help desk, and technical support.

Outsourcing was initially used for standardized applications such as payroll and accounting or by companies who wanted a cash infusion from selling their hardware. In 1989, Eastman Kodak surprised the business world by hiring IBM to run its data processing operations, DEC to run its telecommunications functions, and Businessland to run its PC operations. Kodak retained its IS strategic planning and development role, but outsourcers performed the implementation and operation responsibilities. The results were dramatic. Computer expenditures fell 90%. Operating expenses decreased 10% to 20%. Annual IS savings during the 10-year agreement were expected to be $130 million. Several years later, Xerox signed what was then the largest outsourcing deal in history: a $3.2 billion, 10-year contract with EDS to outsource its computing, telecommunications, and software management in 19 countries.

The success of Kodak and Xerox motivated others to outsource their systems. In one survey, some 73% of companies outsourced some or all of their information systems, and most outsourced to several companies to increase flexibility, foster competition, and reduce costs. Most companies do not, however, outsource strategic IT management, business process management, or IT architecture.

Many smaller companies outsource. One company with annual revenues of $1 million outsources all accounting functions to a local CPA. Whenever they want, the owners can view all their transactions on the CPA's Web site and produce a myriad of reports. They also outsourced all IT processes, including Web site design and maintenance.

Advantages and Disadvantages of Outsourcing

There are a number of significant advantages to outsourcing:

- *A business solution.* Outsourcing is a viable strategic and economic business solution that allows companies to concentrate on core competencies. Kodak focused on what it does best and left data processing to qualified computer companies. Kodak treats its outsourcers as partners and works closely with them to meet strategic and operational objectives.
- *Asset utilization.* Organizations improve their cash position and reduce expenses by selling assets to an outsourcer. Health Dimension outsourced data processing at its four hospitals so it could use its limited monetary resources to generate revenue.
- *Access to greater expertise and better technology.* Del Monte Foods turned to outsourcing because the cost and time involved in staying at the cutting edge of technology were rising significantly.
- *Lower costs.* IBM outsources programming to Chinese companies, whose labor costs are 30% of those in the United States. Outsourcers lower costs by standardizing user applications, buying hardware at bulk prices, splitting development and maintenance costs between projects, and operating at higher volumes. Continental Bank will save $100 million during its 10-year contract. However, Occidental Petroleum rejected outsourcing as costing more than internal AIS development and operation.
- *Less development time.* Experienced industry specialists develop and implement systems faster and more efficiently than in-house staff. Outsourcers also help cut through systems development politics.
- *Elimination of peaks-and-valleys usage.* Seasonal businesses require significant computer resources part of the year, and little the rest of the year. From January to March, W. Atlee Burpee's computers operated at 80% capacity processing seed and gardening orders and at 20% the rest of the time. Outsourcing cut Burpee's processing costs in half by paying based on how much the system is used.
- *Facilitation of downsizing.* Companies that downsize often have an unnecessarily large AIS function. General Dynamics downsized dramatically because of reductions in defense industry spending. It signed a $3 billion, 10-year outsourcing contract even though its IS function was rated number one in the aerospace industry. It sold its data centers to CSC for $200 million and transferred 2,600 employees to CSC.

However, not all outsourcing experiences have been successful. Between 25% and 50% of outsourcing agreements fail or are major disappointments. In one survey, company executives labeled 17% of them disasters and almost 50% were brought back in-house. There have been a number of significant outsourcing failures, including the problems EDS has had with its U.S. Navy contract (see Focus 20-2). Another is JPMorgan Chase's cancellation of its $5 billion, seven-year deal with IBM.

Outsourcing failures are caused by failure to prepare properly, lukewarm company buy-in, blind imitation of competitors, thinking that outsourcing will solve deeper problems, shifting responsibility for a bad process to someone else, and entering into ill-defined agreements that do not meet expectations. Finally, many companies do not realize that systems development is a more complex management challenge when performed by outsiders.

Companies that outsource often experience some of the following drawbacks:

- ***Inflexibility.*** Many contracts are for 10 years. If a company is dissatisfied or has structural changes, the contract is difficult or costly to break. Before they merged, Integra Financial and Equimark had contracts with different outsourcers. Canceling one of them cost $4.5 million.
- ***Loss of control.*** A company runs the risk of losing control of its system and its data. For that reason, Ford's outsourcing agreement prevents CSC from working with other automobile manufacturers.
- ***Reduced competitive advantage.*** Companies may lose sight of how their AIS produces competitive advantages. Outsourcers are not as motivated as their clients to meet competitive challenges. Companies can mitigate this problem by outsourcing standard business processes (payroll, cash disbursements, etc.) and customizing those that provide competitive advantages.
- ***Locked-in system.*** It is expensive and difficult to reverse outsourcing. A company may have to buy new equipment and hire a new data processing staff, often at prohibitive costs. When Blue Cross of California decided to end its agreement, it knew virtually nothing about its system and could not afford to discharge EDS. In contrast, LSI Logic brought its system back in-house at significant dollar and personnel savings when it installed an enterprise resource planning (ERP) system.
- ***Unfulfilled goals.*** Critics claim some outsourcing benefits, such as increased efficiency, are a myth. USF&G canceled its $100 million contract with Cigna Information Services after 18 months when Cigna could not make the system work properly.
- ***Poor service.*** Common complaints are that responsiveness to changing business conditions is slow or nonexistent and migration to new technologies is poorly planned.
- ***Increased risk.*** Outsourcing business processes can expose a company to significant operational, financial, technology, strategy, personnel, legal, and regulatory risks.

Business Process Management

As organizations seek to improve their information systems and comply with legal and regulatory reforms, they are paying greater attention to their business processes. ***Business process reengineering (BPR)*** is a drastic, one-time-event approach to improving and automating business processes. However, it has had a low success rate. With further improvements, BPR has evolved into ***business process management (BPM),*** a systematic approach to continuously improving and optimizing an organization's business processes. BPM is a more gradual and ongoing business process improvement that is supported and enabled by technology. As a result, BPM is a good way to introduce both a human and a technological change capability into an organization.

Some of the important principles underlying BPM are the following:

- ***Business processes can produce competitive advantages.*** Innovative processes that help business respond to changing consumer, market, and regulatory demands faster than competitors create competitive advantages. Good business process design is vital to an organization's success. For example, if a competitive bidding process is time sensitive and requires coordination between multiple functions, a poorly designed bid process can handicap the process so much that effective and profitable bids are not prepared.

- *Business processes must be managed end to end.* BPM views business processes as strategic organizational assets that should be understood, managed, and improved. Even if each part of a multi-functional business process functions well independently, the entire process may be suboptimal if there is inadequate communication and coordination among functional units (sales, production, etc). Managing business processes from inception to completion can control such problems. A process owner is designated, performance standards are set, and control and monitoring processes are established.
- *Business processes should be agile.* Organizations must continuously improve and adapt their business processes to compete. This requires flexibility and business process automation technology that supports rapid modifications.
- *Business processes must be aligned with organizational strategy and needs.* To be effective and efficienct, a company must align its business processes with its business strategy.

Business process management systems (BPMS) automate and facilitate business process improvements. A BPMS can improve communication and collaboration, automate activities, and integrate with other systems and with other partners in the value chain. Some people claim that BPMS is the bridge between IT and business. Many companies worldwide are successfully implementing BPMS-based processes.

Like enterprise resource planning (ERP) systems, BPMS are enterprise-wide systems that support corporate activities. However, ERP systems are data-centered and BPMS are process-centered. Most manufactures of ERP systems are now integrating BPM into their systems.

A BPMS has the following four major components:

- A process engine to model and execute applications, including business rules
- Business analytics to help identify and react to business issues, trends, and opportunities
- Collaboration tools to remove communication barriers
- A content manager to store and secure electronic documents, images, and other files

Internal Controls in a Business Process Management System

A BPMS can improve internal controls. In event-based (as opposed to process-based) systems, users are granted access only to certain activity types. When authorization is granted using other parameters, such as dollar amounts, system developers have to include complex and expensive authorization restrictions. A BPMS uses the organization's business process rules to determine the correct person to perform a task and authorizes that person to perform it.

Segregation of duties can also be improved in a BPMS. In many event-based systems, the procedures for obtaining management approvals lengthen the business process and add additional costs. BPMS reduces the delays and costs by instantaneously transferring items needing approval to the manager. Within a few minutes, the manager can inspect and authorize the electronic form and transfer it to the next step in the process. BPMS have several other innovative authorization mechanisms, such as delegating authority to co-managers and creating a pool of authorizing managers to reduce bottlenecks when managers are overburdened or unavailable.

Application controls are also strengthened by a BPMS. In event-based systems, users identify what actions must be done, such as billing a customer when goods are shipped. If the action is not taken, an error occurs, such as doing something twice, not doing it at all, or doing the wrong thing. A BPMS uses a proactive process management approach that eliminates such problems. Users do not have to decide whether to take action and then decide which action is correct. The BPMS, using the company's business rules, decides what action must take place and forwards the task to the appropriate person's task list, where it remains until it is executed. The person gets an e-mail informing them that the task awaits their attention. This process prevents errors because it prevents procedures from being circumvented, prevents users from performing a different action, prevents items from being removed from the task list before they are accomplished, and sends additional reminder messages until the task is performed.

Another control advantage of BPMS is its built-in audit trail. The process monitoring and tracking systems, which document and link all actions and process steps in the order they occur in a process log, make it easy to track everything that takes place. This allows the auditor to continuously audit the business processes while they are active and afterward.

Prototyping

Prototyping is a systems design approach in which a simplified working model of a system is developed. Developers who use prototyping still go through the SDLC discussed in Chapter 20, but prototyping allows them to condense and speed up some analysis and design tasks. Prototyping helps capture user needs and helps developers and users make conceptual and physical design decisions.

UNUM Life Insurance wanted to use image processing to link systems and users. When top management had a hard time getting middle managers to understand how the system would work and the issues involved in the change, they had a prototype prepared. After using it, the managers grasped the possibilities and issues. Up to that point, they thought image processing meant replacing file cabinets.

As shown in Figure 21-1, a prototype is developed using four steps. The first is to meet with users to agree on the size and scope of the system and to decide what the system should and should not include. Developers and users also determine decision-making and transaction processing outputs, as well as the inputs and data needed to produce the outputs. The emphasis is on *what* output should be produced rather than *how* it should be produced. The developer must ensure that users' expectations are realistic and that their basic information requirements can be met. The designer uses the information requirements to develop cost, time, and feasibility estimates for alternative AIS solutions.

The second step is to develop an initial prototype. The emphasis is on low cost and rapid development. Nonessential functions, controls, exception handling, input validation, and processing speed are ignored in the interests of simplicity, flexibility, and ease of use. Users need to see and use tentative data entry screens, menus, and source documents; respond to prompts; query the system; judge response times; and issue commands. The developer demonstrates the finished prototype and asks users to provide feedback on what they like and dislike, which is much easier to do than imagining what they want in a system. Even a simple system that is not fully functional demonstrates features better than diagrams, drawings, or verbal explanations.

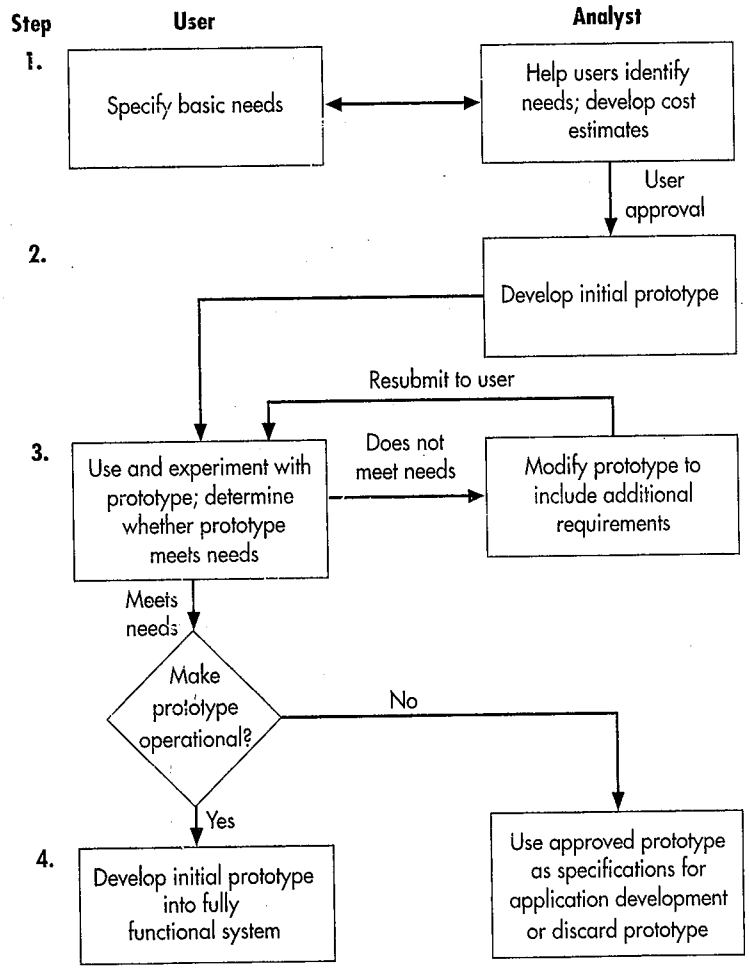


FIGURE 21-1
The Steps for Developing a System from a Prototype

In the third step, developers use the feedback to modify the system and return it to the users. Trial usage and modification continues until users are satisfied that the system meets their needs. A typical prototype goes through four to six iterations.

The fourth step is to use the system. An approved prototype is typically used in one of two ways. Half of all prototypes are turned into fully functional systems, referred to as ***operational prototypes***. To make the prototype operational, the developer incorporates the things ignored in step one, provides backup and recovery, and integrates the prototype with other systems. ***Nonoperational (throwaway) prototypes*** are used several ways. System requirements identified during prototyping can be used to develop a new system. The prototype can be used as the initial prototype for an expanded system designed to meet the needs of many different users. When an unsalvageable prototype is discarded, the company potentially saves itself years of development work and lots of money by avoiding the traditional SDLC process.

When to Use Prototyping

Prototyping is appropriate when there is a high level of uncertainty, it is unclear what questions to ask, the AIS cannot be clearly visualized, or there is a high likelihood of failure. Good candidates for prototyping include decision support systems, executive information systems, expert systems, and information retrieval systems. Prototyping is less appropriate for large or complex systems that serve major organizational components or cross organizational boundaries or for developing standard AIS components, such as accounts receivable or inventory management. Table 21-3 shows the conditions that make prototyping an appropriate design methodology.

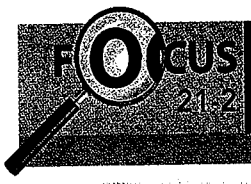
Advantages of Prototyping

Prototyping has the following advantages:

- *Better definition of user needs.* Prototyping generally requires intensive involvement from end users, resulting in well-defined user needs.
- *Higher user involvement and satisfaction.* Because users' requirements are met, there is less risk that the AIS will not be used. Early user involvement helps to build a climate of acceptance rather than skepticism and criticism.
- *Faster development time.* Prototypes are often functioning after a few days or weeks, allowing users to immediately evaluate the system. John Hancock Mutual Life Insurance developed an executive information system prototype in one month, as described in Focus 21-2.
- *Fewer errors.* The users test each version of the prototype, so errors are detected and eliminated early. It is also easier to identify and terminate infeasible systems before a great deal of time and expense is incurred.
- *More opportunity for changes.* Users can suggest changes until the system is exactly what they want.
- *Less costly.* Prototype systems can be developed for 20% of the cost of traditional systems. One utility company claimed a 13-to-1 improvement in development time over traditional methods when prototyping was used to develop 10 major applications.

TABLE 21-3 Conditions That Favor the Use of Prototyping

Users' needs are not understood, change rapidly, or evolve as the system is used.
System requirements are hard to define.
System inputs and outputs are not known.
The task to be performed is not well structured.
Designers are uncertain about what technology to use.
The system is crucial and needed quickly.
The risk associated with developing the wrong system is high.
User reactions are especially important development considerations.
Many design strategies must be tested.
The design staff has little experience developing the system or application.
The system will be used infrequently (processing efficiency is not a major concern).



Prototyping at John Hancock

John Hancock Mutual Life Insurance was dissatisfied with the traditional development process. Too often, after development the typical user reaction was, "I may have said this is what I wanted, but it isn't." To counter this problem, Hancock used prototyping to develop an executive information system (EIS) that would obtain data quickly and easily from the existing system.

The development team included IBM consultants, users, systems analysts, and programmers. The prototyping process was highly interactive, and continual user involvement eliminated many misunderstandings. Programming started immediately, preparing sample screens for the first user interviews. Developers showed the users how the system would work and gave them a chance to try the screens. Almost immediately, users could determine whether what they said they wanted was what they needed.

The EIS prototype, which took a month to build, allowed top management to query current and historical financial data and measurements. Top managers who were skeptical when the project began were impressed by how much the team was able to accomplish in a single month.

Disadvantages of Prototyping

Prototyping has the following disadvantages:

- *Significant user time.* Users must devote significant time to working with the prototype and providing feedback. It may require more involvement and commitment than users are willing to give.
- *Less efficient use of system resources.* Prototype development does not always achieve resource efficiency, sometime resulting in poor performance and reliability as well as high maintenance and support costs.
- *Inadequate testing and documentation.* Developers may shortchange testing and documentation because users are testing the prototype during development.
- *Negative behavioral reactions.* These can occur when requests for improvements are not made, there are too many iterations, or a prototype that users are invested in is thrown away.
- *Never-ending development.* This occurs when prototyping is not managed properly and the prototype is never completed due to recurring iterations and revision requests.

Computer-Aided Software Engineering

Computer-aided software (or systems) engineering (CASE) is an integrated package of tools that skilled designers use to help plan, analyze, design, program, and maintain an information system. CASE software typically has tools for strategic planning, project and system management, database design, screen and report layout, and automatic code generation. Many companies use CASE tools. Florida Power's $86 million customer information system was created using Accenture's CASE tool.

CASE tools provide a number of important advantages:

- *Improved productivity.* CASE can generate bug-free code from system specifications and can automate repetitive tasks. A programmer at Baptist Medical System used CASE to develop a system in one week that was estimated to take four months. Sony reported that CASE increased their productivity by 600%.
- *Improved program quality.* CASE tools simplify the enforcement of structured development standards, check the internal accuracy of the design, and detect inconsistencies.
- *Cost savings.* Savings of 80% to 90% are reported. At DuPont, an application estimated to require 27 months at a cost of $270,000 was finished in 4 months for $30,000. Over 90% of the code was generated directly from design specifications.
- *Improved control procedures.* CASE tools encourage system controls, security measures, and system auditability and error-handling procedures early in the design process.

- *Simplified documentation.* CASE automatically documents the system as the development progresses.

Some of the more serious problems with CASE technology include the following:

- *Incompatibility.* Some CASE tools do not interact effectively with other systems.
- *Cost.* CASE technology is expensive, putting it out of the reach of many small companies.
- *Unmet expectations.* A Deloitte & Touche survey indicated that only 37% of CIOs using CASE believe they achieved the expected benefits.

Summary and Case Conclusion

A company can use different strategies to obtain a new AIS. First, as the quality and quantity of vendor-written software increases, more companies are purchasing it. Second, IS departments develop the software or allow end users to develop it. Third, some companies buy software and modify it themselves or ask the vendor to modify it so it meets company needs. Fourth, companies outsource data processing activities.

There are many ways to speed up or improve the development process. One way is business process management, which is a systematic approach to continuously improving and optimizing an organization's business processes.

A second way is to design a prototype, a simplified working model of a system. A prototype is quickly and inexpensively built and is given to users to "test drive" so they can decide what they like and dislike about the system. Their reactions and feedback are used to modify the system, which is again given to the users to test. This iterative process of trial usage and modification continues until the users are satisfied that the system adequately meets their needs.

A third way to improve the development process is to use CASE tools to plan, analyze, design, program, and maintain an information system. They are also used to enhance the efforts of managers, users, and programmers in understanding information needs.

Ann has considered the different strategies and eliminated several of them. She has decided against outsourcing because she believes her team can do a better and faster job developing the system than an outsourcer could. Ann does not think prototyping would be effective because Shoppers Mart needs a large and complex system that would serve the needs of many users in many functional areas. Ann has narrowed her options down to purchasing a system or designing one in-house. If Shoppers Mart develops its own software, Ann will investigate the various CASE and BPMS packages on the market to see whether they will add value to the development process.

No matter which approach she chooses, Ann wants to facilitate as much end-user development as is practical and useful. Ann will make the final decision during the conceptual design phase (Chapter 22). To gather the information she needs to decide whether to purchase software, Ann prepares and sends an RFP to vendors asking them to propose software and hardware to meet the company's needs identified during systems analysis.

Key Terms

canned software 634
turnkey systems 634
application service provider (ASP) 634
request for proposal (RFP) 634
benchmark problem 636
point scoring 636
requirement costing 636
custom software 637
end-user computing (EUC) 637
help desk 639
outsourcing 639
business process reengineering (BPR) 641
business process management (BPM) 641
business process management system (BPMS) 642
prototyping 643
operational prototype 644
nonoperational (throwaway) prototype 644
computer-aided software (or systems) engineering (CASE) 645

AIS IN ACTION

Chapter Quiz

1. Which of the following is NOT one of the difficulties accountants have experienced using the traditional systems development life cycle?
   a. AIS development projects are backlogged for years.
   b. Changes are usually not possible after requirements have been frozen.
   c. The AIS that is developed may not meet their needs.
   d. All are difficulties with the SDLC.

2. Companies that buy rather than develop an AIS must still go through the systems development life cycle.
   a. true
   b. false

3. Which of the following statements is FALSE?
   a. As a general rule, companies should buy rather than develop software if they can find a package that meets their needs.
   b. As an AIS increases in size and complexity, there is a greater likelihood that canned software can be found that meets user needs.
   c. A company should not attempt to develop its own custom software unless experienced, in-house programming personnel are available and the job can be completed less expensively on the inside.
   d. As a general rule, a company should develop custom software only when it will provide a significant competitive advantage.

4. When a company is buying large and complex systems, vendors are invited to submit systems for consideration. What is such a solicitation called?
   a. request for quotation
   b. request for system
   c. request for proposal
   d. good-faith estimate

5. To compare system performance, a company can create a data processing task with input, processing, and output jobs. This task is performed on the systems under consideration, and the processing times are compared. The AIS with the lowest time is the most efficient. What is this process called?
   a. benchmarking
   b. requirements costing
   c. point scoring
   d. performance testing

6. Which of the following statements is true?
   a. Because the AIS is so crucial, companies never outsource parts of the AIS.
   b. Most mainframe outsourcing contracts are for two to three years and cost thousands of dollars a year.
   c. Outsourcers often buy the client's computers and hire all or most of its information systems employees.
   d. Only companies struggling to survive and wanting a quick infusion of cash from selling their hardware use outsourcing.

7. Which of the following is NOT a benefit of outsourcing?
   a. It offers a great deal of flexibility because it is relatively easy to change outsourcers.
   b. It can provide access to the expertise and special services provided by outsourcers.
   c. It allows companies to move to a more sophisticated level of computing at a reasonable cost.
   d. It is a cost-effective way to handle the peaks and valleys found in seasonal businesses.

8. Which of the following is a true statement with respect to prototyping?
   a. In the early stages of prototyping, system controls and exception handling may be sacrificed in the interests of simplicity, flexibility, and ease of use.
   b. A prototype is a scaled-down, first-draft model that is quickly and inexpensively built and given to users to evaluate.

c. The first step in prototyping is to identify system requirements.
d. All of the statements are true.

9. Which of the following is NOT an advantage of prototyping?
   a. better definition of user needs
   b. adequately tested and documented systems
   c. higher user involvement and satisfaction
   d. faster development time

10. When is it most appropriate to use prototyping?
   a. when there is little uncertainty about the AIS
   b. when it is clear what users' needs are
   c. when the final AIS cannot be clearly visualized because the decision process is still unclear
   d. when there is a very low likelihood of failure

Case 21-1 Freedom from Telemarketers—the Do Not Call List

In 1991, telemarketers placed 18 million calls per day; by 2003, it was 104 million. President Bush announced the Do Not Call Registry by saying, "Unwanted telemarketing calls are intrusive, they are annoying, and they're all too common. When Americans are sitting down to dinner, or a parent is reading to his or her child, the last thing they need is a call from a stranger with a sales pitch." Congress appropriated $18.1 million to fund the program, which made it a federal offense for telemarketers to call anyone of the list. Within 72 hours, more than 10 million phone numbers were added to the Do Not Call list when people accessed the donotcall.gov Web site or called the toll-free number. The Do Not Call Registry was hailed as one the most successful IT projects in the history of government.

Identify the benefits and risks of the FTC purchasing a prewritten software system, developing the system in-house, and outsourcing the system to an external vendor. What approach do you think the FTC should have used?

(Source: Adapted from Alice Dragoon, "How the FTC Rescued the Dinner Hour," *CIO* (June 1, 2004): 59–64.)

Discussion Questions

21.1. What is the accountant's role in the computer acquisition process? Should the accountant play an active role, or should all the work be left to computer experts? In what aspects of computer acquisition might an accountant provide a useful contribution?

21.2. In a Midwest city of 45,000, a computer was purchased, and in-house programmers began developing programs. Four years later, only one incomplete and poorly functioning application had been developed, none of the software met users' minimum requirements, and the hardware and the software frequently failed. Why do you think the city was unable to produce quality, workable software? Would the city have been better off purchasing software? Could the city have found software that met its needs? Why or why not?

21.3. You are a systems consultant for Ernst, Price, and Deloitte, CPAs. At your country club's annual golf tournament, Frank Fender, an automobile dealer, describes a proposal from Turnkey Systems and asks for your opinion. The system will handle inventories, receivables, payroll, accounts payable, and general ledger accounting. Turnkey personnel would install the $40,000 system and train Fender's employees. Identify the major themes you would touch on in responding to Fender. Identify the advantages and disadvantages of using a turnkey system to operate the organization's accounting system.

21.4. Sara Jones owns a rapidly growing retail store that faces stiff competition due to poor customer service, late and error-prone billing, and inefficient inventory control. For the company's growth to continue, its AIS must be upgraded, but Sara is not sure what the

company wants the AIS to accomplish. Sara has heard about prototyping but does not know what it is or whether it would help. How would you explain prototyping to Sara? Include an explanation of its advantages and disadvantages as well as when its use is appropriate.

21.5. Clint Grace has been in business over 30 years and has definite ideas about how his ten retail stores should be run. He is financially conservative and is reluctant to make expenditures that do not have a clear financial payoff. Store profitability has declined sharply, and customer dissatisfaction is high. Store managers never know how much inventory is on hand and when purchases are needed until a shelf is empty. Clint asks you to determine why profitability has declined and to recommend a solution. You determine that the current AIS is inefficient and unreliable and that company processes and procedures are out of date. You believe the solution is to redesign the systems and business processes using BPM. What are some challenges you might face in redesigning the system? How will you present your recommendations to Clint?

Problems

21.1. Don Otno has been researching software options but cannot decide among three alternatives. Don started his search at Computers Made Easy (CME) and almost wished he had looked no further. Steve Young, the manager of CME, appeared knowledgeable and listened attentively to Don's problems, needs, and concerns. Steve had software and hardware that would, with a few exceptions, meet Don's needs. Don could start using the system almost immediately. The system's price was unexpectedly reasonable.

After three hours at Custom Designed Software (CDS), Don left convinced that they could produce exactly what he needed. Cost and time estimates were not established, but CDS assured him that the cost would be reasonable and that the software would be complete in a few months.

At Modified Software Unlimited (MSU), the owner said that customized software was very good but expensive and that canned software was inexpensive but rarely met more than a few needs. The best of both worlds could be achieved by having MSU modify the package that came closest to meeting Don's needs.

Don returned to CME and asked Steve about customized and modified software. Steve expressed enough concerns about both that Don came full circle—to thinking canned software was best. That night, Don realized he could not make an objective decision. He was swayed by whichever vendor he was talking with at the time. The next morning he called you for help.

Required

a. List the advantages and disadvantages of each vendor's approach.
b. Recommend a course of action for Don, and support your decision.

21.2. A federal agency signed a 15-month contract for $445,158 for a human resources/payroll system. After 28 months and no usable software, the agency canceled the contract and withheld payment for poor performance. A negotiated settlement price of $970,000 was agreed on. The project experienced the following problems:

- The contractor did not understand what software was desired. The RFP did not have fully developed user requirements or system specifications, and user requirements were never adequately defined and frozen. Changes delayed completion schedules and caused disagreements about whether new requirements were included in the original scope of work.
- The contract did not specify systems requirements or performance criteria, and the terminology was vague. The contract was amended 13 times to add or delete requirements and to reimburse the contractor for the extra costs resulting from agency-caused delays. The amendments increased the cost of the contract to $1,037,448.

- The contractor complained of inexcusable agency delays, such as taking too much time to review items submitted for approval. The agency blamed the delays on the poor quality of the documentation under review.
- The agency did not require each separate development phase to be approved before work continued. When the agency rejected the general system design, the contractor had to scrap work already completed.

Required

a. What caused the problems? How could the agency have better managed the systems development project? What could the contractor have done differently?
b. Can we conclude from this case that organizations should not have custom software written for them? Explain your answer.

21.3. Wong Engineering Corp (WEC) operates in 25 states and three countries. WEC faced a crucial decision: choosing network software that would maximize functionality, manageability, and end-user acceptance of the system. WEC developed and followed a four-step approach:

Step 1. **Develop evaluation criteria.** WEC organized a committee that interviewed users and developed the following evaluation criteria:
- Ease of use
- Scope of vendor support
- Ease of network management and administration
- Cost, speed, and performance
- Ability to access other computing platforms
- Security and control
- Fault tolerance and recovery abilities
- Ability to connect workstations to the network
- Global naming services
- Upgrade and enhancement options
- Vendor stability

WEC organized the criteria into the following four categories and prioritized them. Criteria vital to short-term and long-term business goals were given a 5. "Wish list" criteria were weighted a 3. Inapplicable criteria were given a 1.
1. Business criteria: overall business, economic, and competitive issues
2. Operational criteria: tactical issues and operating characteristics
3. Organizational criteria: networks' impact on the information systems structure
4. Technical criteria: hardware, software, and communications issues

Step 2. **Define the operating environment.** Several data-gathering techniques were used to collect information from which an information systems model was developed. The model revealed the need to share accounting, sales, marketing, and engineering data at three organizational levels: district, division, and home office. District offices needed access to centralized financial information to handle payroll. WEC needed a distributed network that allowed users throughout the organization to access company data.

Step 3. **Identify operating alternatives.** Using the criteria from step 1, committee members evaluated each package and then compared notes during a roundtable discussion.

Step 4. **Test the software.** The highest-scoring products were tested, and the product that fit the organization's needs the best was selected.

Required

a. Discuss the committee's role in the selection process. How should committee members be selected? What are the pros and cons of using a committee to make the selection?
b. What data-gathering techniques could WEC use to assess user needs? To select a vendor?

c. What is the benefit of analyzing the operating environment before selecting the software? What data-gathering techniques help a company understand the operating environment?
d. In selecting a system using the point-scoring method, how should the committee resolve scoring disputes? List at least two methods.
e. Should a purchase decision be made on the point-scoring process alone? What other procedure(s) should the committee employ in making the final selection?



21.4. Mark Mitton, the liaison to the IS department, has eliminated all but the best three systems. Mark developed a list of required features, carefully reviewed each system, talked to other users, and interviewed appropriate systems representatives. Mark used a point-scoring system to assign weights to each requirement. Mark developed Table 21-4 to help him select the best system.

Required

a. Use a spreadsheet to develop a point-scoring matrix and determine which system Mark should select.
b. Susan Shelton did not agree with Mark's weightings and suggested the following changes:

Flexibility	60
Reputation and reliability	50
Quality of support utilities	10
Graphics capability	10

TABLE 21-4 An Evaluation Matrix

Selection Criteria	Weight	System 1	System 2	System 3
Software				
Fulfillment of business needs	100	6	8	9
Acceptance in marketplace	30	6	7	6
Quality of documentation	50	7	9	8
Quality of warranty	50	4	8	7
Ease of use	80	7	6	5
Control features	50	9	7	9
Flexibility	20	4	5	9
Security features	30	4	4	8
Modularity	30	8	5	4
Integration with other software	30	8	9	6
Quality of support utilities	50	9	8	5
Vendor				
Reputation and reliability	10	3	9	6
Experience with similar systems	20	5	5	6
Installation assistance	70	9	4	6
Training assistance	35	4	8	6
Timeliness of maintenance	35	5	4	4
Hardware				
Internal memory size (RAM)	70	5	6	8
Hard-drive capacity	40	9	9	5
Graphics capabilities	50	7	7	8
Processing speed	30	8	8	5
Overall performance	40	9	4	4
Expandability	50	7	2	5
Support for network technology	30	3	4	7

When the changes are made, which vendor should Mark recommend?

c. Mark's manager suggested the following changes to Susan's weightings:

Reputation and reliability	90
Installation assistance	40
Experience with similar systems	40
Training assistance	65
Internal memory size	10

Will the manager's changes affect the decision about which system to buy?

d. What can you conclude about point scoring from the changes made by Susan and Mark's manager? Develop your own weighting scale to evaluate the software packages. What other selection criteria would you use? Be prepared to discuss your results with the class.

e. What are the weaknesses of the point-scoring method?

21.5. Nielsen Marketing Research (NMR), with operations in 29 countries, produces and disseminates marketing information. Nielsen has been the primary supplier of decision support information for more than 70 years. NMR's most recognizable product is the Nielsen television ratings. Nielsen is one of the largest users of computer capacity in the United States. Its information system consistently ranks above average in efficiency for its industry. NMR hired IBM to evaluate outsourcing its information processing. NMR wanted to know whether outsourcing would allow it to concentrate on giving its customers value-added services and insights, increase its flexibility, promote rapid growth, and provide it with more real-time information.

Required

What are the benefits and risks of outsourcing for NMR? Do the benefits outweigh the risks? Explain your answer.

21.6. A large organization had 18 months to replace its old customer information system with a new one that could differentiate among customer levels and provide appropriate products and services on demand. The new system, which cost $1 million and was installed by the IS staff on time, did not work properly. Complex transactions were error-prone, some transactions were canceled and others were put on hold, and the system could not differentiate among customers. The system was finally shut down, and transactions were processed manually. New IS management was hired to build a new system and mend the strained relationship between operations and IS.

So what went wrong? IS couldn't—or wouldn't—say no to all the requests for systems enhancements. Eager to please top management, IS management ignored the facts and assured them they could build a scalable system that was on time and on budget. Another big mistake was a strict project schedule with little flexibility to deal with problems and unforeseen challenges. Developers never spoke up about any glitches they encountered along the way. More than a dozen people (including the CIO) lost their jobs because of their roles in this disaster.

Required

a. What could IS management have done differently to make this project successful?

b. What in-house development issues are demonstrated in this case?

c. How could the in-house issues have been addressed to prevent the system's failure?

21.7. Meredith Corporation publishes books and magazines, owns and operates television stations, and has a real estate marketing and franchising service. Meredith has 11 different systems that do not communicate with each other. Management wants an executive information system that provides them with the correct and timely information they need to make good business decisions. Meredith has decided to use prototyping to develop the system.

Required

a. Identify three questions you would ask Meredith personnel to determine systems requirements. What information are you attempting to elicit from each question?
b. Explain how prototyping works. What would system developers do during the iterative process? Why would you want the fewest iterations possible?
c. Would you want the prototype to be operational or nonoperational? Why? If it were an operational prototype, what would have to happen? If it were a nonoperational prototype, how could the prototype be used?
d. Suppose the company decides the prototype system is not practical, abandons it, and takes some other approach to solving its information problem. Does that mean prototyping is not a valid systems development approach? Explain your answer.

21.8. Norcom, a division of a large manufacturer, needed a new distribution and customer service system. The project was estimated to take 18 months and cost $5 million. The project team consisted of 20 business and IT staff members. After two years, the CIO was fired, and the company hired a CIO with expertise in saving troubled projects. The new CIO said three grave errors were committed.

1. IT picked the wrong software using a very naïve request for proposal process.
2. IT did not formulate a project plan.
3. No one "owned" the project. The IT staff assumed the users owned the project, the users believed the IT staff owned it, and management believed the vendor owned it.

The CIO developed a 2,000-line plan to rescue the project. Three months later, the system failed, even with IT staff and consultants working on it day and night. The failed system was to have been the company's preeminent system, but it could not even process customer orders correctly, resulting in complaints about late shipments and receiving the wrong goods.

After three years and $4 million, the new CIO polled the staff anonymously. Only two said the project could be saved, and they had staked their careers on the project. The message that the project was not worth saving was very hard for the CIO to give. It was likewise hard for the division president to receive it; he could not accept the idea of killing a project that cost so much money. He finally accepted the decision and all the ramifications involved, including corporate IT taking control of all IT operations at his division.

Required

a. List the primary components of an RFP.
b. Identify possible components or deficiencies in Norcom's RFP that could have led the new CIO to claim that it was naïve or insufficient.
c. Identify possible approaches Norcom could have used to evaluate RFP responses.

21.9. Quickfix is rapidly losing business, and management wants to redesign its computer repair processes and procedures to decrease costs and increase customer service. Currently, a customer needing help calls one of five regional service centers. A customer service representative records the relevant customer information, finds the closest qualified technician, and calls the technician's cell phone to see whether the repair fits into his or her schedule. If not, the representative finds the next closest technician. When a technician is located, customer repair information is provided over the phone. The technician calls the customer and arranges to pick up the computer and replace it with a loaner. Making these arrangements takes one to two days and sometimes more if technicians are not available or do not promptly return calls.

If a broken computer cannot be quickly repaired, it is sent to a repair depot. These repairs take another four to seven days. If problems arise, it can take up to two weeks for an item to be repaired. When a customer calls to see whether the computer is ready, the service representative calls the technician to find out the status and calls the customer back. The repair process usually takes five phone calls between the customer, the service representative, and the technician.

There are several problems with this process that have led to a significant drop in business: (1) it is time-consuming; (2) it is inconvenient for a customer to have a computer removed, a new one installed, and then the old one reinstalled; and (3) service representatives do not have immediate access to information about items being repaired. Quickfix decides to use BPM principles to redesign its business processes.

Required

a. Identify the repair processes that occur, and decide which should be redesigned.
b. Describe how the repair process can be redesigned to solve the problems identified.
c. What benefits can Quickfix achieve by redesigning the repair process?



21.10. Search written materials, the Internet, and electronic databases for successful and failed information system implementations. Prepare an oral or written summary of a successful and a failed implementation. Include the approach used to acquire or develop the system.

Case 21-2 Professional Salon Concepts

Steve Cowan owns Professional Salon Concepts (PSC), a hair salon products distribution company. After working for his father, a barber and beauty salon products distributor, he started his own business selling Paul Mitchell products. Business was poor until Steve conducted a free seminar demonstrating how to successfully use his products. He left with a $1,000 order and a decision to sell to salons that allowed him to demonstrate his products.

Steve's strategy paid off as PSC grew to 45 employees, 3,000 customers, and sales of $7 million. PSC carries 1,000 products, compared with 10,000 for most distributors. The smaller product line allows PSC to achieve a 24-hour order turnaround, compared to over two days for the competition. Steve occasionally has to work late packing orders and driving them to the UPS hub a few towns away so he can meet the 2:00 A.M. deadline.

After buying a computer and installing a $3,000 accounting package, Steve thought everything was going great until Terri Klimko, a consultant from a PSC supplier, stopped by. Terri asked the following questions to find out how well he knew his business:

- Do you know exactly how much you ship each month and to whom?
- Do you know how much each customer bought, by supplier?
- Can you rank your customer sales?
- Can you break your sales down by product?
- Do you know how the profit per client breaks down into product lines?
- Do you know how revenues per salesperson vary over the days of the week?

When Steve answered no to each question, Terri told him that people who cannot answer the questions were losing money. Upset, Steve terminated the session by politely dismissing Terri. Although unimpressed with Terri's advice, Steve was impressed with her and they were soon married. Shortly afterwards she joined the company.

Steve asked Terri to help the salons become more profitable. She developed a template to help salon owners determine how much each hairstylist brings in per client, how many clients receive extra services, and which clients buy hair products. The Cowans soon became more like partners to their customers than trainers. If a salon had employee problems, the Cowans would help settle it. If a salon needed help with a grand opening, they lent a hand. The more PSC products the salons bought, the more time the Cowans gave.

PSC sold turnkey systems and support services at cost to help salons answer Terri's questions. Unfortunately, PSC's computer could not answer those same questions. Steve asked consultant Mike Fenske for help. Mike entered all of PSC's raw data into a database and wrote a program to produce the desired information. The system worked but had problems. It was so slow that accounts payable and purchasing information was handled manually, it did not answer Terri's growing list of questions, and only a few months of detailed information were available at a time. To alleviate these problems, Steve hired Mike as the company controller.

After reading an industry report, Steve realized it was time to purchase a new system. Steve and Mike decided to evaluate and select the software themselves and rely on the vendor for installation help. They spent months researching software and attending demonstrations before settling on a $20,000 system. The vendor began installing the system and training PSC personnel.

Three days prior to conversion, Steve met a distributor who described how his system met his detailed accounting and customer reporting needs as well as his inventory management and order fulfillment needs. Steve was so impressed that they stopped the conversion, went to North Dakota to check out the distributor's system, and flew to Minneapolis to visit DSM, the software developer.

DSM did a great job of demonstrating the software and provided Steve and Mike with great references. The only hitch was DSM's inability to demonstrate two features that were particularly important: adjusting orders automatically to reflect outstanding customer credits and back orders, and determining the least expensive way to pack and ship each order. DSM's salespeople assured them that those features would be up and running by the time the package was delivered to PSC.

Their economic feasibility analysis showed $234,000 in yearly savings:

$144,000	Most PSC orders consist of several boxes, 95% of which are sent COD. The old PSC system had no way to prepare orders for multiple-box shipments; a five-box order required five sales invoices and five COD tickets. The new system allowed PSC to generate one sales order and ship one box COD and the other four by regular delivery. Not having to ship every box COD would save $144,000 a year.
$50,000	PSC paid a CPA firm $50,000 a year to prepare its financial statements. The new software would prepare the statements automatically.
$40,000	Because the old system did not have credit-managing capabilities, it was hard to detect past-due accounts. Earlier detection of past-due accounts would result in faster collections, fewer lost customers, and fewer write-offs.
Unknown	The major reason for acquiring the system was to improve customer service by making more detailed customer information available.

After estimated annual maintenance costs of $10,000, there was an annual return on investment of $224,000. Because the system would pay for itself in less than a year, Steve bought it and wrote off his $20,000 investment in the other system.

When DSM installed the software, Steve found out that the promised features were not available and that there was no immediate plan to add them. Although Steve and Mike were upset, they had to shoulder some of the blame for not insisting on the two features before signing the deal. They found a program that automatically determined the cheapest way to pack and ship an order. DSM agreed to pay half of the $10,000 cost to integrate it into the program. DSM offered to create the module to reflect customer credits and back orders for another $20,000, but Steve declined. These problems pushed the conversion date back several months.

PSC spent three months preparing to implement the new system. Training PSC employees to use the new system was particularly important. Adding a customer to the database required only one screen with the old system, the new software required six screens. Employees were taught to shout "Fire!" when they had a problem they could not handle. Mike or a DSM programmer explained the error and how to correct it. During implementation, the new system was tested for glitches by processing real data. Looking back, Mike admits three months were not nearly enough for the training and testing. They should have used twice as much time to identify and eliminate glitches.

When PSC converted to the new system, telephone operators were confronted with situations they had not been trained to handle. Soon everyone was yelling "Fire!" at the same time. In less than one hour, so many operators were waiting for help that the programmers stopped explaining the correct procedures and simply ran from operator to operator correcting problems. Mistakes were repeated numerous times, and the situation intensified. Some employees, frustrated by their inability to work the new system, broke down and cried openly.

In the warehouse, Steve was not having much fun either. On a normal day, PSC has 200 to 300 boxes ready for 3:30 P.M. shipment. On conversion day, a lone box sat ready to go. Facing the first default on his 24-hour turnaround promise, Steve, Terri, Mike, and a few others stayed past midnight packing and loading boxes on trucks. They barely made it to the UPS hub on time.

The next day, order entry and shipping proceeded more smoothly, but Steve could not retrieve data to monitor sales. That did not make him feel too kindly about his $200,000 system or DSM. It took Steve weeks to figure out how to get data to monitor sales. When he did, he was horrified that sales had dropped 15%. They had focused so hard on getting the system up and running that they took their eyes off the customers. To make matters worse, Steve could not get information on sales by customer, salesperson, or product, nor could he figure out why or where sales were falling.

Things quickly improved after "Hell Week." Orders were entered just as quickly, and warehouse operations improved thanks to the integrated add-in program. The new system provided pickers with the most efficient path to follow and told them which items to pack in which boxes based on destination and weight. The system selected a carrier and printed labels for the boxes. Order turnaround time was shaved to 20 minutes from five hours.

Months after the system was installed, it still did not do everything Steve needed, including some things the old system did. Nor did it answer all of Terri's questions. Steve is confident, however, that the system will eventually provide PSC with a distinct competitive advantage. He is negotiating with DSM to write the credit and back-order module.

Steve believes the step up to the new system was the right move for his growing company. With the exceptions of taking the DSM salesperson's word and not taking enough time to practice with the system, Steve feels PSC did as good a job as it could have in selecting, installing, and implementing a new system.

Required

1. Do you agree that PSC did a good job selecting, installing, and implementing the new system? If so, why? Or do you feel PSC could have done a better job? If so, what did it do wrong, and what should it have done differently?
2. How could PSC have avoided the missing features problem?

(*continued*)

3. How could PSC have avoided conversion and reporting problems?
4. Evaluate Steve's economic feasibility analysis. Do you agree with his numbers and his conclusions?
5. How could PSC's customers use the new multibox shipping approach to defraud PSC?
6. How would you rate the service PSC received from DSM? What did it do well, and what did it do poorly?

(Source: Adapted from David H. Freeman, "Computer Upgrade: To Hell and Back," *INC. Technology* (June 15, 1994): 46–53.)

AIS IN ACTION SOLUTIONS

Quiz Key

1. Which of the following is NOT one of the difficulties accountants have experienced using the traditional systems development life cycle?
   a. AIS development projects are backlogged for years. [Incorrect. This is one of the difficulties accountants have experienced using the traditional SDLC, but there is more than one correct answer.]
   b. Changes are usually not possible after requirements have been frozen. [Incorrect. This is one of the difficulties accountants have experienced using the traditional SDLC, but there is more than one correct answer.]
   c. The AIS that is developed may not meet their needs. [Incorrect. This is one of the difficulties accountants have experienced using the traditional SDLC, but there is more than one correct answer.]
   ▶ d. All are difficulties with the SDLC. [Correct.]

2. Companies that buy rather than develop an AIS must still go through the systems development life cycle.
   ▶ a. true [Correct. Purchasing a system still requires a company to follow the systems development life cycle of analyzing, designing (conceptual and physical), and implementing a new system. Otherwise, the company risks not purchasing the right system for its needs.]
   b. false [Incorrect.]

3. Which of the following statements is FALSE?
   a. As a general rule, companies should buy rather than develop software if they can find a package that meets their needs. [Incorrect. This is a true statement, not a false statement. Purchasing software is generally less expensive than developing software in-house.]
   ▶ b. As an AIS increases in size and complexity, there is a greater likelihood that canned software can be found that meets user needs. [Correct. This is a false statement. Large and complex systems need greater customization than smaller systems and thus are less likely to lend themselves to the one-size-fits-all approach of canned software.]
   c. A company should not attempt to develop its own custom software unless experienced, in-house programming personnel are available and the job can be completed less expensively on the inside. [Incorrect. This is a true statement, not a false statement. Skilled in-house programmers and the promise of lower costs are essential if companies decide to develop their own custom software.]

d. As a general rule, a company should develop custom software only when it will provide a significant competitive advantage. [Incorrect. This is a true statement, not a false statement. According to Arthur Little, companies should pursue custom software only when it provides a distinct competitive advantage.]

4. When a company is buying large and complex systems, vendors are invited to submit systems for consideration. What is such a solicitation called?
   a. request for quotation [Incorrect. A request for quotation asks for dollar bids on proposed systems or their components.]
   b. request for system [Incorrect. A request for system is not the terminology used to refer to inviting vendors to submit systems for consideration.]
   ▶ c. request for proposal [Correct. A request for proposal invites vendors to propose solutions to a company's needs.]
   d. good-faith estimate [Incorrect. A good-faith estimate provides a vendor's best guess on the cost of a proposal based on reliable parameters.]

5. To compare system performance, a company can create a data processing task with input, processing, and output jobs. This task is performed on the systems under consideration and the processing times are compared. The AIS with the lowest time is the most efficient. What is this process called?
   ▶ a. benchmarking [Correct. Benchmarking measures system performance by comparing processing times.]
   b. requirements costing [Incorrect. Requirement costing estimates the costs of purchasing or developing features that are not present in a particular AIS.]
   c. point scoring [Incorrect. Point scoring measures system performance by comparing each system based on weighted criteria.]
   d. performance testing [Incorrect. Performance testing is a general term applied to many types of comparison testing.]

6. Which of the following statements is true?
   a. Because the AIS is so crucial, companies never outsource parts of the AIS. [Incorrect. AIS functions are routinely outsourced.]
   b. Most mainframe outsourcing contracts are for two to three years and cost thousands of dollars a year. [Incorrect. Most mainframe outsourcing contracts are longer term (averaging 10 years) and cost hundreds of thousands to millions of dollars.]
   ▶ c. Outsourcers often buy the client's computers and hire all or most of its information systems employees. [Correct. Many large outsourcing deals involve purchasing the client's hardware and hiring the client's employees.]
   d. Only companies struggling to survive and wanting a quick infusion of cash from selling their hardware use outsourcing. [Incorrect. Many large and financially sound companies use outsourcing as a way to decrease costs and become even more profitable.]

7. Which of the following is NOT a benefit of outsourcing?
   ▶ a. It offers a great deal of flexibility because it is relatively easy to change outsourcers. [Correct. This is not a benefit of outsourcing. Because contracts are long term, outsourcers can be very inflexible, as well as difficult and costly to change.]
   b. It can provide access to the expertise and special services provided by outsourcers. [Incorrect. This is a benefit of outsourcing. Many companies cannot afford to retain information systems expertise on their payroll; therefore, outsourcing provides a less expensive way to acquire that expertise.]
   c. It allows companies to move to a more sophisticated level of computing at a reasonable cost. [Incorrect. This is a benefit of outsourcing. Many companies cannot afford to maintain the most effective and sophisticated hardware; therefore, outsourcing provides a less expensive way to gain access to that hardware.]
   d. It is a cost-effective way to handle the peaks and valleys found in seasonal businesses. [Incorrect. This is a benefit of outsourcing. For companies in cyclical industries, outsourcing provides an effective way to meet company needs during the busy times and to lower costs during the slow times of their business cycle.]

8. Which of the following is a true statement with respect to prototyping?
   a. In the early stages of prototyping, system controls and exception handling may be sacrificed in the interests of simplicity, flexibility, and ease of use. [Incorrect. This is a true statement. Prototyping provides simplicity, flexibility, and ease of use by sacrificing controls and exception handling. However, this is not the only true statement.]
   b. A prototype is a scaled-down, first-draft model that is quickly and inexpensively built and given to users to evaluate. [Incorrect. This is a true statement. Prototypes are essentially rough-draft models. However, this is not the only true statement.]
   c. The first step in prototyping is to identify system requirements. [Incorrect. This is a true statement. The first step in prototyping is to identify system requirements. However, this is not the only true statement.]
   ▶ d. All of the statements are true. [Correct.]

9. Which of the following is NOT an advantage of prototyping?
   a. better definition of user needs [Incorrect. This is an advantage of prototyping. Because users can test-drive the model, they can give better feedback to the developers regarding their needs and requirements.]
   ▶ b. adequately tested and documented systems [Correct. This is not an advantage of prototyping. Because prototypes are developed so quickly, developers often neglect documentation and a full testing before the system becomes operational.]
   c. higher user involvement and satisfaction [Incorrect. This is an advantage of prototyping. Prototyping success depends on high user involvement, which generally leads to greater user satisfaction.]
   d. faster development time [Incorrect. This is an advantage of prototyping. Prototypes can be developed in a matter of days or weeks, whereas a more traditional approach can take a year or longer.]

10. When is it most appropriate to use prototyping?
   a. when there is little uncertainty about the AIS [Incorrect. Prototyping is more effective when there is substantial uncertainty about how an AIS should work.]
   b. when it is clear what users' needs are [Incorrect. Prototyping is more effective when users are uncertain of their needs and benefit from working on models to help them identify and solidify their needs.]
   ▶ c. when the final AIS cannot be clearly visualized because the decision process is still unclear [Correct. Prototyping is more effective when there is substantial uncertainty about how an AIS should work, look, and feel.]
   d. when there is a very low likelihood of failure [Incorrect. Prototyping is the most effective when there is substantial uncertainty about whether a new system will work.]

Case 21-1 Solution

Identify the benefits and risks of the three courses of action facing the FTC: purchasing a prewritten software system, developing the system in-house, and outsourcing the system to an external vendor.

Purchasing Software

The primary benefit of purchasing software is greater availability and lower cost; because the product is sold to many companies, it can be sold at a lower price. The downside is that because the software is designed for as wide an audience as possible, it may not meet all the needs of the purchaser. In addition, software support is a problem if the vendor goes out of business.

Developing the System In-House

The primary benefit of in-house development is that the system should meet the entity's needs. The drawbacks are that it occupies significant time and resources, it is usually a very complex process, and problems—such as poor requirements planning, insufficient staff, poor top-management

support, inadequate communication, and a lack of cooperation between the developers and users—can easily derail a project.

Outsourcing the System

Outsourcing allows entities to devote time and resources to their core competencies instead of diverting attention to systems development. It also gives companies access to expertise at a much lower cost. Outsourcing can save 15% to 30% in overall systems development costs because of quicker development time, smoothing usage peaks and valleys, and facilitating corporate restructuring (downsizing). The risks involve a loss of control over the project, inflexible outsourcing contracts, and poor service. Entities can also lose their competitive advantage by not maintaining proprietary systems.

What the FTC Did

Given the short timeframe to implement such a large task, the Federal Trade Commission could not have built this system on its own. Instead, they outsourced it to AT&T, which had the expertise and staff to handle the system's analysis, design, and implementation. With AT&T's help, the project became one of the government's most successful IT projects.

Chapter 22

Systems Design, Implementation, and Operation

Learning Objectives

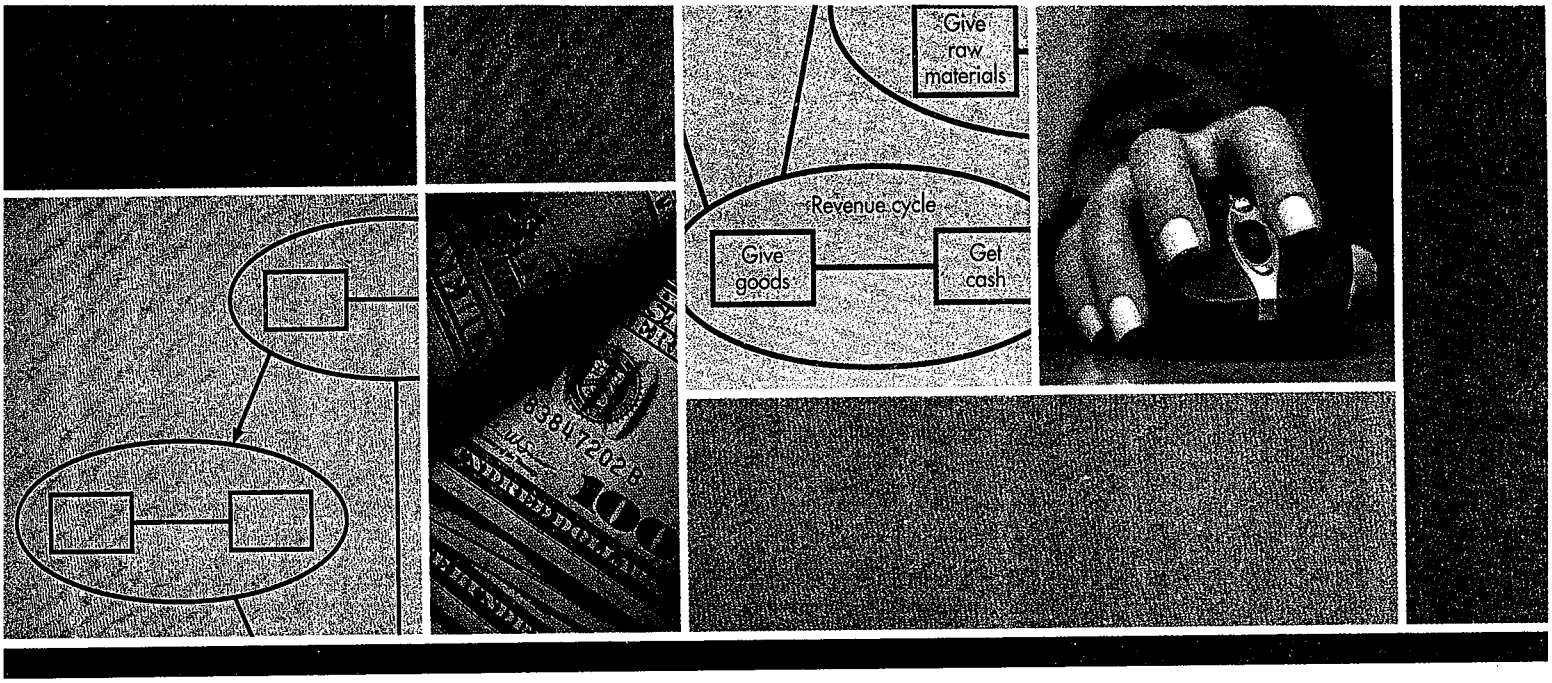
After studying this chapter, you should be able to:

1. Discuss the conceptual systems design process and the activities in this phase.
2. Discuss the physical systems design process and the activities in this phase.
3. Discuss the systems implementation and conversion process and the activities in this phase.
4. Discuss the systems operation and maintenance process and the activities in this phase.

INTEGRATIVE CASE SHOPPERS MART

Ann Christy received permission to develop a new AIS (Chapter 20 conclusion) for Shoppers Mart (SM). Ann is concerned because many development projects bog down during the design and implementation phases, and she does not want a runaway project that she cannot control. She wants to plan the rest of the project so that it is completed correctly, and her first task is to determine what type of system will best meet SM's needs. She scheduled a meeting with the head of systems development to discuss the following questions:

1. Should her team develop what it considers the best approach to meeting SM's needs, or should they develop several approaches?
2. How can she ensure that system output will meet user needs? When and how should input be captured, and who should capture it? Where should AIS data be stored, and how should it be organized and accessed?
3. How should SM convert from its current to its new AIS? How much time and effort will be needed to maintain the new AIS? In what capacity should Ann's accounting staff participate?



Introduction

Effective systems analysis and design can help developers correctly define business problems and create a system to solve those problems. As discussed in Chapter 20, system requirements are defined during systems analysis. This chapter discusses the other four systems development life cycle (SDLC) steps (see Figure 20-1): conceptual systems design, physical systems design, systems implementation and conversion, and operation and maintenance. Chapter 21 discusses how some SDLC steps can be shortened or made more effective.

Conceptual Systems Design

In ***conceptual systems design,*** the developer creates a general framework for implementing user requirements and solving the problems identified in the analysis phase. Figure 22-1 shows the conceptual design steps: evaluating design alternatives, preparing design specifications, and preparing the conceptual systems design report.

Evaluate Design Alternatives

There are many ways to design an AIS, so systems designers must make many design decisions. For example, should SM mail hard-copy purchase orders, use electronic data interchange (EDI), or enter orders over the Internet? Should SM have a large centralized mainframe and database or distribute computer power to the stores using a network of servers and PCs? Should data entry be by keyboard, optical character recognition, point-of-sale devices, barcodes, radio-frequency identification (RFID) tags, the Internet, or some combination?

There are many ways SM can approach the systems development process. It can purchase software, ask in-house information systems (IS) staff to develop it, or hire an outside company to develop and manage the system. The company could modify existing software or redesign its business processes and develop software to support the new processes. These conceptual design alternatives are discussed in Chapter 21.

The following standards should be used to evaluate design alternatives: (1) how well it meets organizational and system objectives, (2) how well it meets user needs, (3) whether it is economically feasible, and (4) how advantages weigh against disadvantages. The steering committee evaluates the alternatives and selects the one that best meets the organization's needs.

Table 22-1 summarizes design considerations and alternatives.

FIGURE 22-1
Conceptual Systems Design Activities

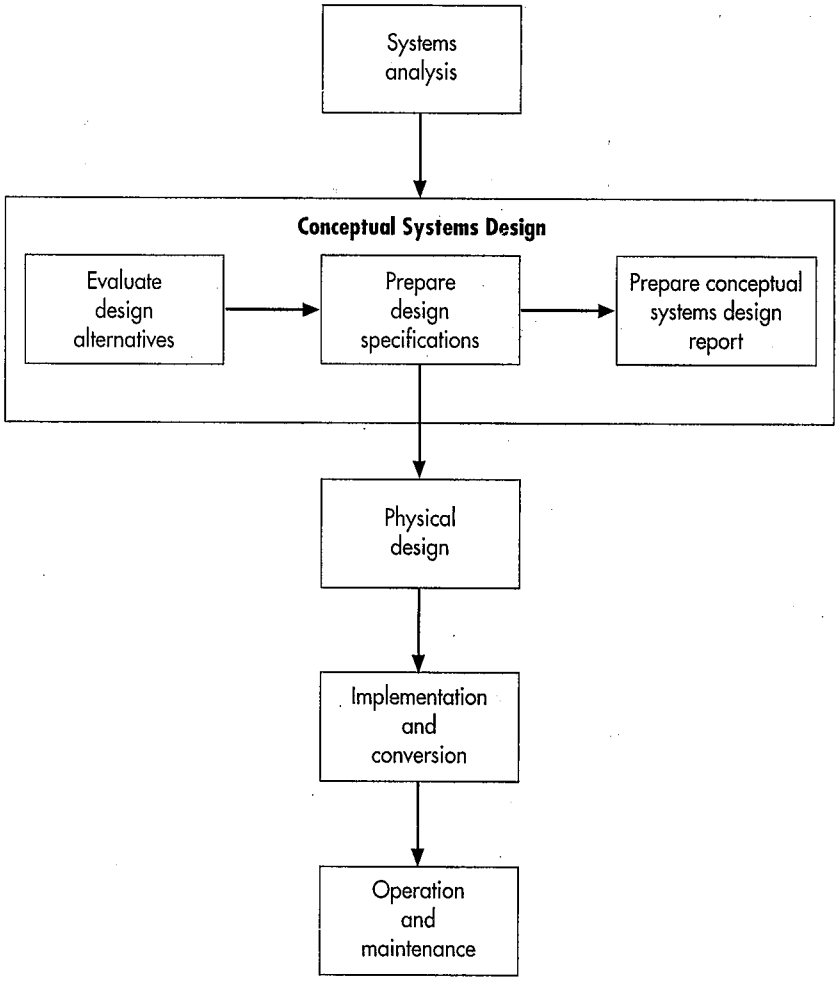


TABLE 22-1 Design Considerations and Alternatives

Design Considerations	Design Alternatives
Communications channels	Telephone, Internet, cable, fiber optics, or satellite
Communications network	Centralized, decentralized, distributed, or local area
Data storage medium	Tape, disk, hard drive, CD, or paper
Data storage structure	Files or database
File organization and access	Random, sequential, or indexed-sequential access
Input medium	Keying, optical character recognition (OCR), magnetic ink character recognition (MICR), point-of-sale (POS), EDI, or voice
Input format	Source document, turnaround document, source data automation, or screen
Operations	In-house or outsourcing
Output and update frequency	Instantaneous, hourly, daily, weekly, or monthly
Output medium	Paper, screen, voice, CD, or microfilm
Output scheduling	Predetermined times or on demand
Output format	Narrative, table, graph, file, or electronic
Printed output format	Preprinted forms or system-generated forms
Processing mode	Manual, batch, or real time
Processor	Personal computer, server, or mainframe
Software acquisition	Canned, custom, or modified
Transaction processing	Batch or online

Prepare Design Specifications and Reports

Once a design alternative is selected, *conceptual design specifications* are created for the following elements:

1. *Output.* Because the system is designed to meet user information needs, output specifications are prepared first. To evaluate store sales, SM must decide (a) how often to produce a sales analysis report, (b) what the report should contain, (c) what it will look like, and (d) whether it is a hard-copy or screen (or both) output.
2. *Data storage.* Data storage decisions include which data elements must be stored to produce the sales report, how they should be stored, and what type of file or database to use.
3. *Input.* Input design considerations include which sales data to enter, sale location and amount, and where, when, and how to collect the data.
4. *Processing procedures and operations.* Design considerations include how to process the input and stored data to produce the sales report, and in which sequence the processes must be performed.

A *conceptual systems design report* summarizes conceptual design activities, guides physical design activities, communicates how all information needs will be met, and helps the steering committee assess feasibility. The main component is a description of one or more recommended system designs. Table 22-8, in the chapter summary, shows what this report contains.

Physical Systems Design

During *physical systems design*, the broad, user-oriented AIS requirements of conceptual design are translated into detailed specifications that are used to code and test the computer programs. Figure 22-2 shows the physical system design phases that are described below in detail.

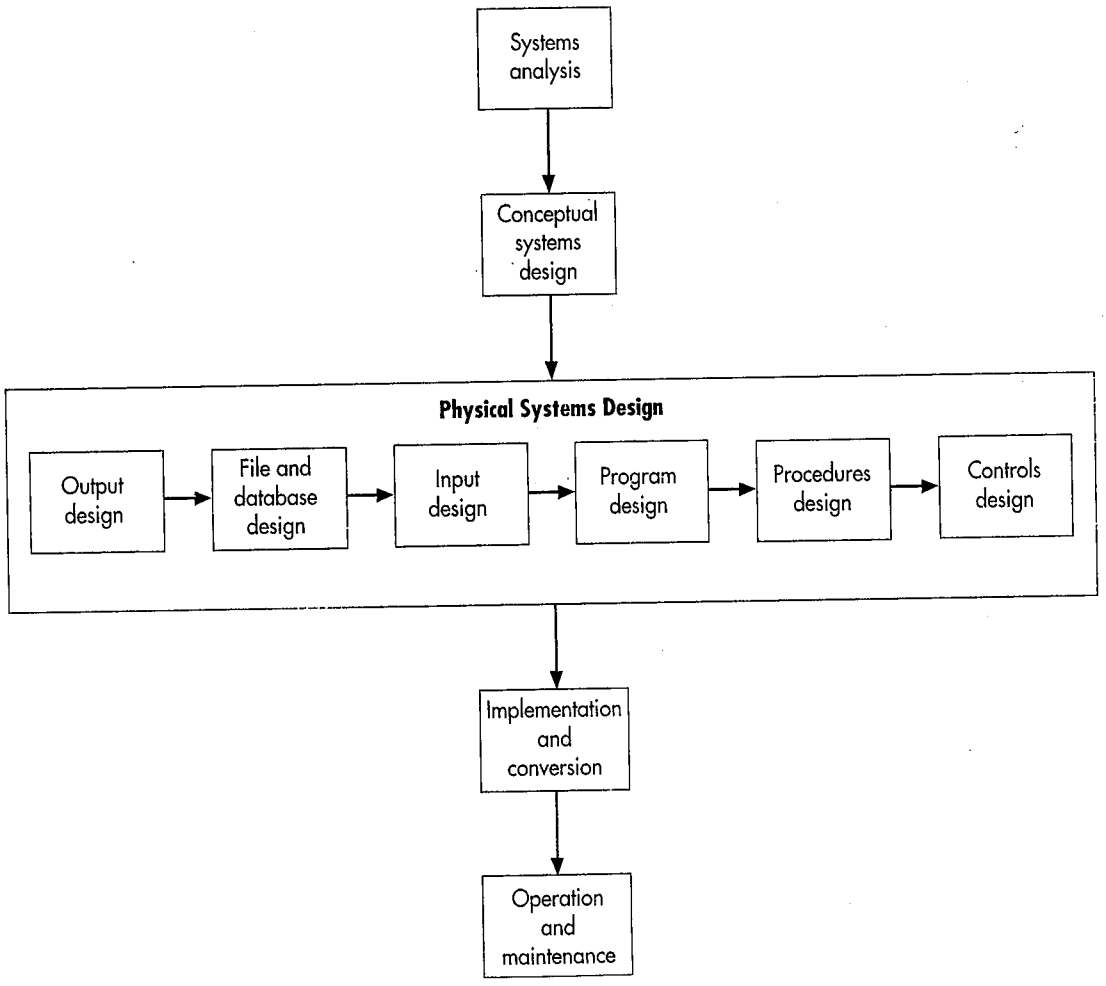


FIGURE 22-2
Physical Systems Design Activities

Failing to take sufficient time on conceptual and physical design can cause problems. A rush to implement an enterprise resource planning (ERP) package at Overstock.com caused early design problems. The result was a mistake-laden Oracle implementation. The ERP package was out-of-sync with the accounting software, causing the order tracking system to go down for a week. Ultimately, five years of earnings had to be restated, with revenue reduced by $12.9 million and increased losses of $10.3 million.

Output Design

The objective of output design is to determine the nature, format, content, and timing of reports, documents, and screen displays. Tailoring the output to user needs requires cooperation between users and designers. Important output design considerations are summarized in Table 22-2.

Output usually fits into one of the following four categories:

1. *Scheduled reports* have a prespecified content and format and are prepared on a regular basis. Examples include monthly performance reports, weekly sales analyses, and annual financial statements.
2. *Special-purpose analysis reports* have no prespecified content or format and are not prepared on a regular schedule. They are prepared in response to a management request to evaluate an issue, such as which of three new products would provide the highest profits.
3. *Triggered exception reports* have a prespecified content and format but are prepared only in response to abnormal conditions. Excessive absenteeism, cost overruns, inventory shortages, and situations requiring immediate corrective action trigger such reports.
4. *Demand reports* have a prespecified content and format but are prepared only on request. Both triggered exception reports and demand reports can be used effectively to facilitate the management process.

Designers often prepare sample outputs and ask users to evaluate whether they are complete, relevant, and useful. Unacceptable output is modified and reviewed again as many times as necessary to make it acceptable. To avoid expensive time delays later in the SDLC, many organizations require users to sign a document stating that the output form and content are acceptable.

File and Database Design

Data in various company units should be stored in compatible formats to help avoid the problem AT&T faced: 23 business units, a jumble of incompatible systems and data formats, and an inability to communicate and share data with other units. AT&T spent five years creating a "single view" of each customer so customer data could be shared across business units.

Chapter 4 discusses files and databases and how to design them. Important file and database design considerations are summarized in Table 22-3.

TABLE 22-2 Output Design Considerations

Consideration	Concern
Use	Who will use the output, why and when do users need it, and what decisions will they make based on it?
Medium	Use paper, screen, voice, e-mail, or some combination?
Format	Will narrative, table, or graphic format best convey information?
Preprinted	Use preprinted forms? Turnaround documents?
Location	Where should output be sent?
Access	Who should have access to hard-copy and screen output?
Detail	Should a summary or table of contents be included with lengthy output? Should headings organize data and highlight important items? Should detailed information be placed in an appendix?
Timeliness	How often should output be produced?

TABLE 22-3 File and Database Design Considerations

Consideration	Concern
Medium	Store data on hard drive, disk, CD, tape, or paper?
Processing mode	Use manual, batch, or real-time processing?
Maintenance	What procedures are needed to maintain data effectively?
Size	How many records will be stored in the database, how large will they be, and how fast will the number of records grow?
Activity level	What percentage of the records will be updated, added, or deleted each year?

Input Design

Input design considerations include what types of data will be input and the optimal input method. Considerations for input design are shown in Table 22-4.

FORM DESIGN Although systems are moving away from paper documents and toward source data automation, forms design is still an important topic. Forms design principles are summarized in Table 22-5.

COMPUTER SCREEN DESIGN It is more efficient to enter data directly into the computer than onto paper for subsequent entry. Computer input screens are most effective when these procedures are followed:

- Organize the screen so data can be entered quickly, accurately, and completely. Minimize data input by retrieving as much data as possible from the system. For example, entering a customer number could cause the system to retrieve the customer's name, address, and other key information.
- Enter data in the same order as displayed on paper forms that capture the data.
- Group logically related data together. Complete the screen from left to right and top to bottom.
- Design the screen so users can jump from one data entry location to another or use a single key to go directly to screen locations.
- Make it easy to correct mistakes. Clear and explicit error messages that are consistent across all screens are essential. There should be a help feature to provide online assistance.
- Restrict the data or the number of menu options on a screen to avoid clutter.

Program Design

Program development, one of the most time-consuming SDLC activities, takes place in the eight steps shown below. Step 1 is part of the systems analysis phase. Step 2 begins in

TABLE 22-4 Input Design Considerations

Consideration	Concern
Medium	Enter data using a keyboard, OCR, MICR, POS terminal, barcodes, RFID tags, EDI, or voice input?
Source	Where do data originate (computer, customer, remote location, etc.), and how does that affect data entry?
Format	What format (source or turnaround document, screen, source data automation) efficiently captures the data with the least effort and cost?
Type	What is the nature of the data?
Volume	How much data are to be entered?
Personnel	What are data entry operators' abilities, functions, and expertise? Is additional training necessary?
Frequency	How often must data be entered?
Cost	How can costs be minimized without adversely affecting efficiency and accuracy?
Error detection and correction	What errors are possible, and how can they be detected and corrected?

TABLE 22-5 Principles of Good Forms Design

General Considerations
- Are preprinted data used as much as possible?
- Are the weight and grade of the paper appropriate for the planned use?
- Do bold type, lines, and shading highlight different parts of the form?
- Is the form a standard size?
- Is the form size consistent with filing, binding, or mailing requirements?
- If the form is mailed, will the address show in a window envelope?
- Are copies printed in different colors to facilitate proper distribution?
- Do clear instructions explain how to complete the form?

Introduction
- Does the form name appear at the top in bold type?
- Is the form consecutively prenumbered?
- Is the company name and address preprinted on forms sent to external parties?

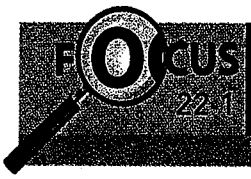
Main Body
- Is logically related information (e.g., customer name, address) grouped together?
- Is there sufficient room to record each data item?
- Is data entry consistent with the sequence the data is acquired?
- Are codes or check-offs that are used instead of written entries adequately explained?

Conclusion
- Is space provided to record the final disposition of the form?
- Is space provided for a signature(s) to indicate transaction approval?
- Is space provided to record the approval date?
- Is space provided for a dollar or numeric total?
- Is the distribution of each copy of the form clearly indicated?

conceptual systems design and may carry over to physical design. Most of steps 3 and 4 are done during systems design and are completed during systems implementation. Steps 5 and 6 are begun in systems design, but most of the work is done during systems implementation. Step 7 is done during systems implementation and conversion. Step 8 is part of operation and maintenance.

1. *Determine user needs.* Systems analysts consult with users and reach an agreement on user needs and software requirements.
2. *Create and document a development plan.*
3. *Write program instructions (computer code).* Program preparation time may range from a few days to a few years, depending on program complexity. Programming standards (rules for writing programs) contribute to program consistency, making them easier to read and maintain. Computer programs should be subdivided into small, well-defined modules to reduce complexity and enhance reliability and modifiability, a process called *structured programming.* Modules should interact with a control module rather than with each other. To facilitate testing and modification, each module should have only one entry and exit point.
4. *Test the program.* *Debugging* is the process of discovering and eliminating program errors. A program is tested for logic errors using test data that simulate as many real processing situations and input data combinations as possible. Large programs are often tested in three stages: individual program modules, the linkages between modules and a control module, and interfaces with other application programs.

   It is important to find errors as soon as possible during the development process. The Gartner Group estimates that bugs discovered later in the SDLC cost 80% to 1,000% more to fix than those discovered earlier. Focus 22-1 discusses the difficulty of testing software and the consequences of releasing software with undetected errors. Between 20% and 30% of software development costs should be allocated to testing, debugging, and rewriting software.



Software Bugs Take Their Toll

An $18.5 million rocket explodes seconds after liftoff. Because of three missing digits in several million lines of programming code, telephone networks crash, leaving 10 million customers without service. A nuclear plant releases hundreds of gallons of radioactive water near Lake Huron. A device that uses X-rays to treat cancer victims delivered a radiation overdose, killing one patient and leaving two others deeply burned and partly paralyzed. A software error prevents a Patriot missile from destroying an incoming Iraqi Scud missile that kills 28 people.

These events have one disturbing fact in common. They were caused by program errors called bugs. The term *bug* was coined during World War II when a researcher, puzzled by a computer shutdown, removed a moth stuck between two electric relays. A program containing bugs can work adequately for quite some time until, with no warning, the bug triggers something, and the computer goes haywire. One incorrect letter—even a missing period—can cause a computer to issue an incorrect command or no command at all.

Bugs exist in most software, and it is almost impossible to eliminate all of them. The sheer volume of software code in a complex program makes finding bugs difficult. There are over 2.5 million lines of code in systems that check for cracks in the engine wheel of the space shuttle and 12 million in a phone company's call-switching computer. Finding a flaw in this code is as difficult as looking for one misspelled name in the New York City phone book. It is estimated that flawed or bug-ridden software cost businesses worldwide over $175 billion last year.

Programmers go to great pains to detect and eliminate bugs, but no one has the time or money to find every bug or to simulate every situation the program will encounter in the real world. Instead, software is tested with assumptions about how it will be used and what processing volumes it must handle.

One product manager estimated that his company often found 5,000 bugs in each product. They fixed serious flaws and ignored minor flaws that were unlikely to cause a problem. If developers took the time to find and correct every flaw, they would risk not getting their product to market on a timely basis and losing market share.

Software developers also cannot predict whether computer users will work faster than the software itself. The linear accelerators that killed and maimed cancer patients were controlled by an operator who typed extremely fast. She accidentally selected the X-ray mode and then switched to the electron beam. The software was not quick enough to recognize the change, and the machine beamed radiation at full power to a tiny spot on the patients' bodies. The bug was so subtle it took programmers a year to detect and eliminate it.

5. ***Document the program.*** Documentation explains how programs work and is used to correct errors. Program documentation includes flowcharts, data flow diagrams, E-R diagrams, data models, record layouts, and narrative descriptions. These items are stored in a documentation manual.
6. ***Train program users.*** Program documentation is often used to train users.
7. ***Install the system.*** All system components, including the programs and the hardware, are combined, and the company begins to use the system.
8. ***Use and modify the system.*** Factors that require existing programs to be revised, referred to as ***program maintenance***, include requests for new or revised reports; changes in input, file content, or values such as tax rates; error detection; and conversion to new hardware.

Procedures and Controls Design

Everyone who interacts with a system needs procedures that answer the who, what, when, where, why, and how questions related to IS activities. Procedures should cover input preparation, transaction processing, error detection and correction, controls, reconciliation of balances, database access, output preparation and distribution, and computer operator instructions. Procedures documentation and training may take the form of system manuals, user instruction classes, training materials, or online help screens. Developers, users, or teams representing both groups may write procedures.

The adage "garbage in, garbage out" emphasizes that improperly controlled input, processing, and data storage functions produce unreliable information. Controls must be built into an AIS to ensure its effectiveness, efficiency, and accuracy. They should minimize errors as well as detect and correct them when they occur. Accountants play a vital role in this area. Important control concerns are summarized in Table 22-6. Controls are discussed in detail in Chapters 7 through 11.

TABLE 22-6 Controls Design Considerations

Consideration	Concern
Validity	Are system interactions valid (e.g., all cash disbursements are made to legitimate vendors)?
Authorization	Are input, processing, storage, and output activities authorized by the appropriate managers?
Accuracy	Is input verified to ensure accuracy? Are data processed and stored accurately?
Security	Is the system protected against (a) unauthorized physical and logical access to prevent the improper use, alteration, destruction, or disclosure of information and software and (b) the theft of system resources?
Numerical control	Are documents prenumbered to prevent errors and fraud and to detect when documents are misused, missing, or stolen?
Availability	Is the system available at times set forth in service-level agreements? Can users enter, update, and retrieve data during the agreed-upon times?
Maintainability	Can the system be modified without affecting system availability, security, and integrity? Are only authorized, tested, and documented changes made? Are resources available to manage, schedule, document, and communicate the changes?
Integrity	Is data processing complete, accurate, timely, and authorized? Is data processing free from unauthorized or inadvertent system manipulation?
Audit trail	Can transactions be traced from source documents to final output?

Failing to produce good policies and procedures and failing to implement controls can be devastating. Nonexistent governance kept Kaiser Kidney Transplant Center from developing good policies and procedures. As a result, hundreds of patients did not receive life-saving transplant surgeries, and the transplant center was forced to close two years after opening. Inadequate controls at Heartland Payment Systems, a credit card processor, allowed hackers to steal sensitive information from more than 100 million credit card accounts.

A ***physical systems design report*** summarizes what was accomplished and serves as the basis for management's decision whether or not to proceed to the implementation phase. Table 22-8 shows a table of contents for the report prepared at Shoppers Mart.

Systems Implementation

Systems implementation is the process of installing hardware and software and getting the AIS up and running. Implementation processes are shown in Figure 22-3 and described below. Focus 22-2 describes the improvements the state of Virginia made to its AIS.

Implementation Planning and Site Preparation

An ***implementation plan*** consists of implementation tasks, expected completion dates, cost estimates, and who is responsible for each task. The plan specifies when the project should be complete and when the AIS is operational. The implementation team identifies factors that decrease the likelihood of successful implementation, and the plan contains a strategy for coping with each factor.

AIS changes may require adjustments to a company's existing organizational structure. New departments may be created, existing ones may be eliminated or downsized, or the IS department itself may change. Technical staff at Blue Cross and Blue Shield of Wisconsin who did not understand the company's business or vision contracted for a $200 million system that did not work properly. It sent checks to a nonexistent town, made $60 million in overpayments, and resulted in the loss of 35,000 clients. One reason the system failed was that its implementation should have included an organizational restructuring.

Site preparation is a lengthy process and should begin well in advance of the installation date. A large computer may require extensive changes, such as additional electrical outlets, data communications facilities, raised floors, humidity controls, special lighting, air conditioning, fire protection, and an emergency power supply. Space is needed for equipment, storage, and offices.

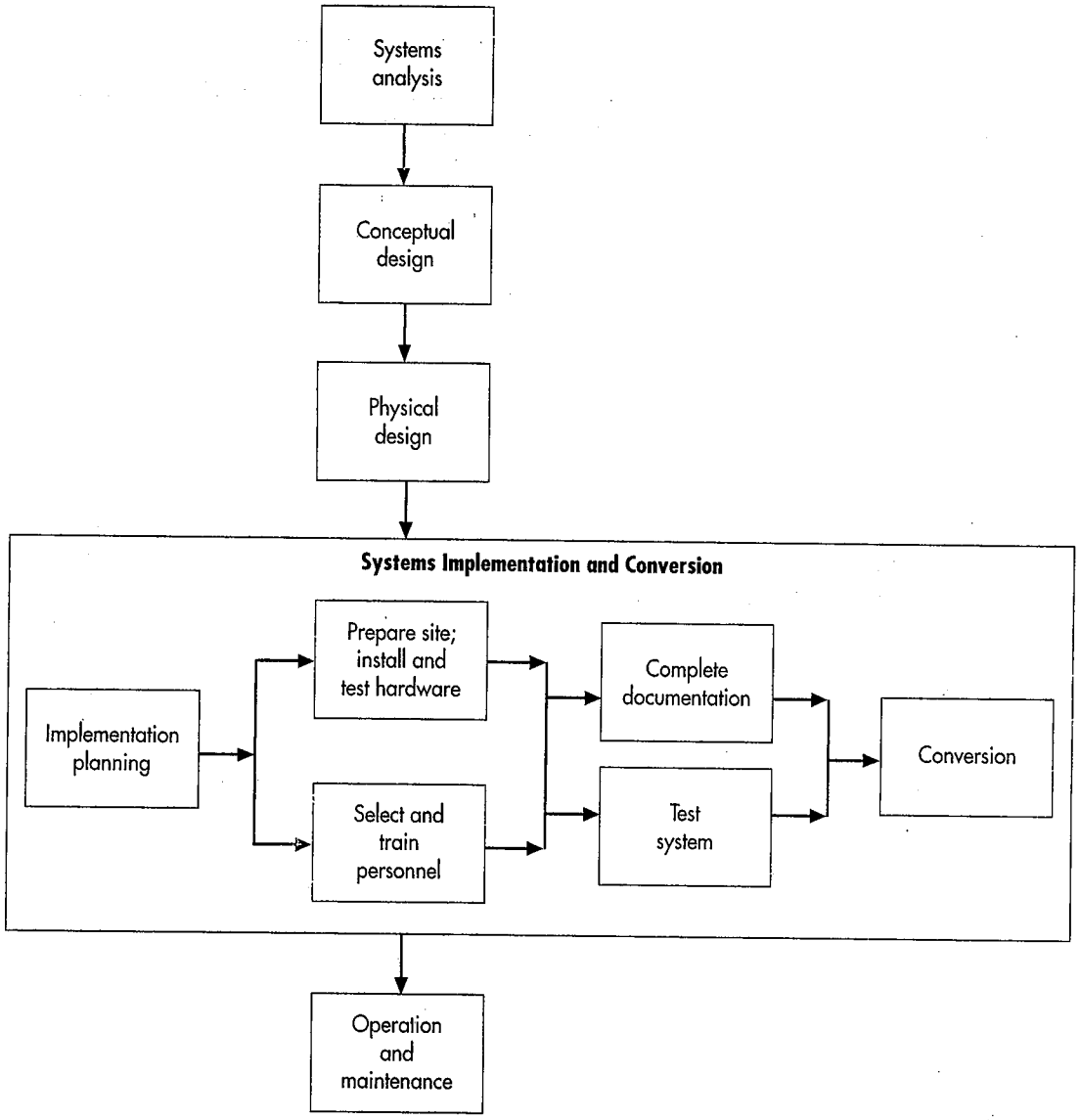


FIGURE 22-3
Systems Implementation Activities

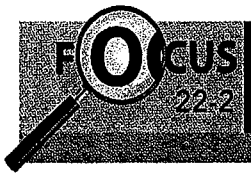
Selecting and Training Personnel

Employees are hired from outside the company or transferred internally, which often is the less costly alternative because they already understand the firm's business and operations. Transferring employees who are displaced because of the new system could boost employee loyalty and morale.

When users are not adequately trained, the company will not achieve the expected benefits and return on its investment. Companies provide insufficient training because it is time-consuming and expensive. The hidden cost of inadequate training is that users turn for help to coworkers who have mastered the system, decreasing the productivity of coworkers and increasing company costs.

Employees must be trained on the hardware, software, and any new policies and procedures. Training should be scheduled for just before systems testing and conversion. Many training options are available, such as vendor training, self-study manuals, computer-assisted instruction, videotape presentations, role-playing, case studies, and experimenting with the system under the guidance of experienced users.

Boots the Chemists, a British pharmacy chain with over 1,000 stores, developed a novel approach to training employees nervous about a forthcoming system. They were invited to a party at a store where a new POS system had been installed. They were invited to try to harm the system by pushing the wrong buttons or fouling up a transaction. Employees quickly found they could not harm the system and that it was easy to use.



STARS Saves Virginia $80 Million

Most Virginia taxpayers receive tax refunds within a week of filing instead of the usual two to three months thanks to Jane Bailey, director of AIS at the Department of Taxation. Bailey managed the development of the State Tax Accounting and Reporting System (STARS), a multisystem project that took nine years to complete. STARS was so successful that the IRS, 27 states, and a Canadian province sent teams to Richmond to see whether STARS could improve their systems development and implementation efforts.

The state's IT group had strongly recommended outside contractors for the job, saying Bailey's six-person staff was far too small and unsophisticated to overhaul the state's disjointed manual and batch systems. Bailey insisted on going with an inside job. She was able to convince management by stating that she would maintain the system and respond quickly to tax law changes.

Bailey insisted on hiring first-rate people, and her staff eventually swelled to 45 employees. If she could not hire the experts and specialists she needed, she retained them as consultants and used them to train her staff. She recruited five management analysts to redesign business processes, write user documentation, and train users. Ten people from her staff are management analysts who work full-time on user procedures and issues. Seeing user involvement as crucial, Bailey succeeded in getting six managers from user areas assigned full-time to the project.

Over the years, STARS expanded to encompass more functions and more users, and its budget climbed from $3 million to $11 million. A new piece of software was installed every three to six months. Users had to adapt, often getting 15 new screens at a time. The megaproject eventually involved putting together 1,500 programs, 40 IBM databases, and 350 online screens in 25 applications for 1,800 users.

The state asked for a Chevrolet and got a Cadillac; the payoff has been impressive. STARS users estimate that it saved the state $80 million over five years, most of it from added collections from would-be tax cheats.

Complete Documentation

Three types of documentation must be prepared for new systems:

1. *Development documentation* describes the new AIS. It includes a system description; copies of output, input, and file and database layouts; program flowcharts; test results; and user acceptance forms.
2. *Operations documentation* includes operating schedules; files and databases accessed; and equipment, security, and file-retention requirements.
3. *User documentation* teaches users how to operate the AIS. It includes a procedures manual and training materials.

Testing the System

Inadequate system testing was another reason for the Blue Cross and Blue Shield system failure. The developers underestimated system complexity and promised an unrealistic delivery time of 18 months. One shortcut they took to meet the deadline was to deliver an untested system. Documents and reports, user input, controls, operating and processing procedures, capacity limits, recovery procedures, and computer programs should all be tested in realistic circumstances. Following are three common forms of testing:

1. *Walk-throughs* are step-by-step reviews of procedures or program logic to find incorrect logic, errors, omissions, or other problems. The development team and system users attend walk-throughs early in system design. The focus is on the input, files, outputs, and data flows of the organization. Subsequent walk-throughs, attended by programmers, address logical and structural aspects of program code.
2. *Processing test data*, including all valid transactions and all possible error conditions, is performed to determine whether a program operates as designed; that is, valid transactions are handled properly and errors are detected and dealt with appropriately. To evaluate test results, the correct system response for each test transaction must be specified in advance.
3. *Acceptance tests* use copies of real transactions and files rather than hypothetical ones. Users develop the acceptance criteria and make the final decision whether to accept the AIS.

Chemical Bank did not adequately test an ATM upgrade, and customers who withdrew cash had their accounts debited twice. Over 150,000 withdrawals with a total value of $8 million were posted twice. Thousands of small accounts were overdrawn or emptied, which annoyed and angered customers. Chemical Bank lost a great deal of customer credibility because of the glitch.

Even software purchased from an outside vendor must be tested thoroughly before being installed. As soon as Kane Carpets installed an AIS custom tailored to the floor-covering industry, its inventory control system told salespeople that orders could not be filled when the product was available, and vice versa. As a result, Kane lost many of its customers.

Systems Conversion

Conversion is changing from the old to the new AIS. Many elements must be converted: hardware, software, data files, and procedures. The process is complete when the new AIS is a routine, ongoing part of the system. Four conversion approaches are used:

- *Direct conversion* terminates the old AIS when the new one is introduced. For example, Shoppers Mart could discontinue its old system on Saturday night and use its new AIS on Monday morning. Direct conversion is appropriate when a new system is so different that comparisons between the two are meaningless. The approach is inexpensive, but it provides no backup AIS. Unless a system has been carefully developed and tested, direct conversion carries a high risk of failure. Focus 22-3 discusses the problems at an Egyptian University, caused in part by attempting a direct conversion.
- *Parallel conversion* operates the old and new systems simultaneously for a period. For example, Shoppers Mart could process transactions with both systems, compare the output, reconcile the differences, correct problems, and discontinue the old system after the new system proves itself. Parallel processing protects companies from errors, but it is costly and stressful to process transactions twice. Because companies often experience problems during conversion, parallel processing has gained widespread popularity.

FOCUS 22-3 Dangers of Direct Conversion to an ERP SAP Implementation

In 2004, a not-for-profit university in Egypt that follows the American accreditation system decided to upgrade its aging financial system by implementing an advanced integrated financial system. The project steering committee (ST) selected the SAP finance module. Egypt's IBM branch was selected as the implementer. The ST was made up of representatives from IBM, the university's finance department, the university IT unit, and senior administrators. The SAP project was viewed by the top administrators as a business project, being directly linked to the finance operations. The end users thus had a key role in deciding the project outcomes, being the stakeholders in accepting or rejecting the new SAP operational processes. The ST considered two alternative conversion approaches to the new system: direct or parallel conversion. The finance end users adamantly supported direct conversion against the recommendation of the senior administrators, the IT unit, and IBM representatives.

Despite the opposition, the direct approach prevailed. The IT unit and IBM representatives warned that thorough and meticulous testing plans, using synthetic and/or historical data, should be developed before the conversion. However, these warnings were not heeded because of time and cost pressures. As a consequence, the old system was plugged off, and transactions subsequent to the kick-off date were to be posted to the new system.

The university experienced serious problems from day one of the conversion. A defective process workflow led to transaction entry errors to the General Ledger, Accounts Payable, and Accounts Receivable modules, and missing financial reporting forced the university to revert to manual operation. With no rollback plan to the old system, financial reporting and payroll had to be prepared hastily using Excel spreadsheets. After spending more than $20 million on the system, the university had to bring in another implementer to fix the dysfunctional finance system. A new steering committee was formed, with more power given to the IT organization to challenge any flawed technical decisions.

This case highlights how strategic decisions can determine the success or failure of the implementation process. It also highlights the need for testing before conversion.

- *Phase-in conversion* gradually replaces elements of the old AIS with the new one. For example, Shoppers Mart could implement its inventory system, then disbursements, then sales collection, and so forth, until the whole system is functional. Gradual changes allow data processing resources to be acquired over time. The disadvantages are the cost of creating the temporary interfaces between the old and the new AIS and the time required to make the gradual changeover.
- *Pilot conversion* implements a system in one part of the organization, such as a branch location. For example, Shoppers Mart could install its new POS system at one of its stores using a direct, parallel, or phase-in approach. When problems with the system are resolved, the new system could be implemented at the remaining locations. This localizes conversion problems and allows training in a live environment. The disadvantages are the long conversion time and the need for interfaces between the old and the new systems, which coexist until all locations have been converted. Owens-Corning Fiberglass implemented its accounts payable, travel expense, and payroll systems by getting the system up and running in one plant and then moving it to all the others.

Data conversion can be time-consuming, tedious, and expensive; its difficulty and magnitude are easily underestimated. Data files may need to be modified in three ways. First, files may be moved to a different storage medium—for example, from tapes to disks. Second, data content may be changed—for example, fields and records may be added or deleted. Third, file or database format may be changed.

The first step in data conversion is to decide which data files need to be converted. Then the data are checked for completeness and errors, and inconsistencies are removed. Following data conversion, the new files are validated to ensure data were not lost during conversion. If data conversion is lengthy, the new files must be updated with the transactions that occurred during data conversion. Once the files and databases have been converted and tested for accuracy, the new system is functional. The system should be monitored for a time to make sure it runs smoothly and accurately. The final activity is to document the conversion activities.

Operation and Maintenance

The final SDLC step is to operate and maintain the new system. A *post-implementation review* is conducted to determine whether the system meets its planned objectives. Important review considerations are listed in Table 22-7. Problems uncovered during the review are brought to

TABLE 22-7 Factors to Investigate During Post-Implementation Review

Factors	Questions
Goals and objectives	Does the system help the organization meet its goals, objectives, and overall mission?
Satisfaction	Are users satisfied? What would they like changed or improved?
Benefits	How have users benefited? Were the expected benefits achieved?
Costs	Are actual costs in line with expected costs?
Reliability	Is the system reliable? Has it failed? If so, what caused its failure?
Accuracy	Does the system produce accurate and complete data?
Timeliness	Does the system produce information on a timely basis?
Compatibility	Are hardware, software, data, and procedures compatible with existing systems?
Controls and security	Is the system safeguarded against errors, fraud, and intrusion?
Errors	Do adequate error-handling procedures exist?
Training	Are systems personnel and users trained to support and use the system?
Communications	Is the communications system adequate?
Organizational changes	Are organizational changes beneficial or harmful? If harmful, how can they be resolved?
Documentation	Is system documentation complete and accurate?

TABLE 22-8 Table of Contents for Shoppers Mart Reports

Conceptual Systems Design Report	Physical Systems Design Report	Postimplementation Review Report
Table of Contents	Table of Contents	Table of Contents
I. Executive Summary of Conceptual Systems Design	I. Executive Summary of Physical Systems Design	I. Executive Summary of Postimplementation Review
II. Overview of Project Purpose and Summary of Findings to Date	II. Overview of Project Purpose and Summary of Findings to Date	II. Overview of Development Project
III. Recommended Conceptual Design(s)	III. Physical Design Recommendations	III. Evaluation of the Development
A. Overview of Recommended Design(s)	A. Output Design	A. Degree to Which System Objectives Were Met
B. Objectives to Be Achieved by Design(s)	B. Input Design	B. Analysis of Actual Versus Expected Costs and Benefits
C. Impact of Design(s) on Information System and Organization	C. Database Design	C. User Reactions and Satisfaction
D. Expected Costs and Benefits of Design(s)	D. Software Design	IV. Evaluation of Project Development Team
E. Audit, Control, and Security Processes and Procedures	E. Hardware Design	V. Recommendations
F. Hardware, Software, and Other Resource Requirements	F. Controls Design	A. Recommendations for Improving the New System
G. Processing Flows: Relationships of Programs, Databases, Inputs, and Outputs	G. Procedures Design	B. Recommendations for Improving the System Development Process
H. Description of System Components (Programs, Databases, Inputs, and Outputs)	IV. Assumptions and Unresolved Problems	VI. Summary
IV. Assumptions and Unresolved Problems	V. Summary	
V. Summary	VI. Appendixes, Glossary	
VI. Appendixes, Glossary		

management's attention, and the necessary adjustments are made. Table 22-8 illustrates what the ***post-implementation review report*** should contain. User acceptance of the report is the final activity in the systems development process.

Control of the AIS is passed to the data processing department, but work on the new system is not finished. Over the life of a typical system, 30% of the work takes place during development, and 70% is spent on software modifications and updates. At Hartford Insurance Group, 70% of its personnel resources are devoted to maintaining an inventory of 34,000 program modules containing 24 million lines of code. The job is even more difficult because changes in insurance regulations and business strategies reduced the structure of the code and increased its complexity.

Summary and Case Conclusion

Ann Christy tackles the sales processing system first. She gives the project development team her systems analysis report and accompanying data. During conceptual systems design, the team visits stores with similar operations and identifies ways to meet AIS requirements. Alternative approaches are discussed with users, management, and the steering committee. They are narrowed down to Ann's original approach. Ann has considered buying software but does not find a package that accomplishes what she and the company want. The team develops conceptual design specifications for the output, input, processing, and data storage elements.

The company decides to use screen-based output and to capture data electronically using point-of-sale (POS) devices. Data that cannot be captured electronically will be entered using PCs. Each store will have a network that connects its PCs and POS devices to a local database. The POS cash registers will capture and feed sales data electronically to this database. Each store will be linked to the central office using a wide area network. All sales data, store orders, and other summary-level information will be uploaded to the corporate database daily. The corporate database will download the information needed to manage the store. The central office will use electronic data interchange to order goods and pay suppliers.

During physical design, the development team designs each report identified during conceptual design. Users and designers rework the reports until everyone is satisfied. The team

designs all files, databases, and input screens. Then they design the software programs that collect and process data and produce the output. The team develops new procedures for handling data and operating the AIS. The accountants and the internal audit staff are especially helpful during the design of the controls needed to protect the system against errors and fraud.

Implementation planning starts early. A location for the new mainframe is identified, and site preparation begins during the design phase. The hardware and software are installed and tested and then the entire AIS is tested. The new AIS is staffed with existing employees that are trained as the system is tested. System documentation is completed before data from the old AIS are converted to the new one.

For the corporate system, the new and old systems are operated in parallel for a month, and the results compared. The bugs are ironed out, and the old AIS is discontinued. For the store systems, a pilot approach is used. The AIS is installed at three stores, and all problems are resolved before the system is implemented at the remaining stores. Conversion requires a fair amount of overtime and duplicate processing. After a few months, Ann and her staff conduct a post-implementation review and make some adjustments to enhance the high user acceptance of the new AIS.

Ann makes a final presentation to top management after the AIS is installed and operating. She is widely congratulated and even hears the president mention that she "is worth keeping an eye on" for even more responsibility in the firm. Table 22-8 is a summary of the contents of the conceptual, physical, and post-implementation reports.

Key Terms

conceptual systems design 661
conceptual design specifications 663
conceptual systems design report 663
physical systems design 663
scheduled report 664
special-purpose analysis report 664
triggered exception report 664
demand report 664
structured programming 666
debugging 666
program maintenance 667
physical systems design report 668
systems implementation 668
implementation plan 668
walk-through 670
processing test data 670
acceptance test 670
conversion 671
direct conversion 671
parallel conversion 671
phase-in conversion 672
pilot conversion 672
post-implementation review 672
post-implementation review report 673

AIS IN ACTION

Chapter Quiz

1. The developers of your new system have proposed two different AIS designs and have asked you to evaluate them. This evaluation process is most likely to be a part of which SDLC step?
   a. systems analysis
   b. conceptual design
   c. physical design
   d. implementation and conversion
   e. operation and maintenance

2. What is the purpose of the conceptual systems design report?
   a. to guide physical systems design activities
   b. to communicate how management and user information needs are met
   c. to help the steering committee assess system feasibility
   d. a and b
   e. a, b, and c

3. Which of the following is the correct order of the steps in physical systems design?
   a. input, file and database, output, controls, procedures, program
   b. file and database, output, input, procedures, program, controls
   c. output, input, file and database, procedures, program, controls
   d. output, file and database, input, program, procedures, controls

4. A monthly payroll register showing all hourly employees, the number of hours they worked, their deductions, and their net pay is most likely which of the following?
   a. scheduled report
   b. special-purpose analysis
   c. triggered exception report
   d. demand report

5. Which of the following is NOT a consideration in input design?
   a. Which errors are possible, and how can they be detected and corrected?
   b. How can data be entered (keyboards, OCR, or POS terminal)?
   c. Which format efficiently captures the input data with the least effort and cost?
   d. How often should the system produce reports?

6. Which of the following is most likely to help improve program development?
   a. physical model
   b. IT strategic plan
   c. walk-through
   d. record layout

7. Which of the following statements is true?
   a. The Gartner Group estimates that programming bugs not found until later in the SDLC cost 25% to 30% more to correct than if they had been found earlier in the SDLC.
   b. Direct system conversion is the least risky of the system conversion methods.
   c. Many software developers state that 5% to 10% of software development costs should be allocated to testing, debugging, and rewriting software.
   d. Over the life of a system, only 30% of information systems work takes place during development; the remaining 70% is spent maintaining the system.

8. Which of the following describes the systems testing approach that uses real transactions and files rather than hypothetical ones?
   a. walk-through
   b. processing of test transactions
   c. acceptance test
   d. parallel conversion test

9. What is the process of discontinuing an old system as soon as a new one is introduced?
   a. direct conversion
   b. parallel conversion
   c. phase-in conversion
   d. pilot conversion

10. Which of the following describes designing a program from the top down to more detailed levels?
    a. hierarchical program design
    b. top-down program design
    c. parallel program design
    d. unstructured program design

Case 22-1 Hershey's Big Bang ERP

Halloween is the biggest candy season of them all, with $1.8 billion in sales. For Hershey's, Halloween 1999 was the scariest of all time. Hershey's had planned to implement a $112 million ERP system in 48 months. Instead, it was implemented in an accelerated 30-month time frame. Hershey's "flipped the switch" in July 1999, right during its busiest ordering season. Issues with inventory and ordering processes promptly gummed up the order-distribution system. By August 1999, Hershey's was 15 days behind in shipping orders. Many distributors who placed orders in September were still waiting for their shipment at Halloween. Hershey had plenty of candy in inventory; it just could not move the candy from its warehouses to its customers. The implementation problem contributed to a 19% drop in revenue. It took a full year for the company to bounce back.

The new ERP system employed over 5,000 PCs, network hubs, and servers. The ERP software was supplied by three firms and implemented by a large consulting firm. Despite the system's size and complexity, Hershey chose to implement most of it in one step called the "big bang."

Required

What could Hershey have done to properly design, implement, and operate this new ERP?

Discussion Questions

22.1. Prism Glass is converting to a new information system. To expedite and speed up implementation, the CEO asked your consulting team to postpone establishing standards and controls until after the system is fully operational. How should you respond to the CEO's request?

22.2. When a company converts from one system to another, many areas within the organization are affected. Explain how conversion to a new system will affect the following groups, both individually and collectively.

a. Personnel
b. Data storage
c. Operations
d. Policies and procedures
e. Physical facilities

22.3. The following notice was posted in the employee cafeteria on Monday morning:

To: All Accounting and Clerical Employees
From: I.M. Krewel, President
Subject: Termination of Employee Positions

Effective this Friday, all accounting and clerical employees not otherwise contacted will be terminated. Our new computer system eliminates the need for most of these jobs. We're grateful for the loyal service you've rendered as employees and wish you success. You may wish to pick up your final checks on Friday before you go.

Discuss the president's approach to human resource management. What are the possible repercussions of this episode? Assuming that job termination is the best alternative available, how should management approach the situation?

22.4. In which phase of the systems development cycle would each of the following positions be most actively involved? Justify your answers.

a. Managerial accountant
b. Programmer
c. Systems analyst
d. Financial vice president
e. Information systems manager
f. Internal auditor

22.5. During which of the five SDLC stages is each task, labeled (a) through (m), performed? More than one answer may apply for each activity.

—— 1. Systems analysis
—— 2. Conceptual (general) systems design
—— 3. Physical (detailed) systems design
—— 4. Implementation and conversion
—— 5. Operation and maintenance

a. Writing operating procedures manuals
b. Developing program and process controls
c. Identifying alternative systems designs
d. Developing a logical model of the system
e. Identifying external and administrative controls
f. Testing the system
g. Training personnel
h. Evaluating the existing system

i. Analyzing the achievement of systems benefits
j. Modifying and altering programs
k. Analyzing total quality management (TQM) performance measures
l. Conducting a feasibility analysis
m. Aligning AIS development plans with business objectives

Problems

22.1. You were hired to manage the accounting and control functions at the Glass Jewelry Company. During your introductory meeting, the president asked you to design and implement a new AIS within six months. Company sales for the past year were $10 million, and they are expected to double in the next 18 months.

Required

a. Outline the procedures you would follow to complete the assigned project. Include a description of the following:
   1. Sources of information
   2. Methods of documenting information collected
   3. Methods of verifying the information collected
b. The accounts payable system will contain a number of programs, including Enter Invoices and Print Payable Checks. For each program, describe its purpose, and outline application control considerations. *(SMAC Examination, adapted)*

22.2. Wang Lab's tremendous growth left the company with a serious problem. Customers would often wait months for Wang to fill orders and process invoices. Repeated attempts by Wang's understaffed IS department to solve these problems met with failure. Finally, Wang hired a consulting firm to solve its revenue tracking problems and expedite prompt receipt of payments. The 18-month project turned into a doubly long nightmare. After three years and $10 million, the consultants were dismissed from the unfinished project.

The project failed for many reasons. The systems development process was so dynamic that the failure to complete the project quickly became self-defeating as modifications took over the original design. Second, management did not have a clear vision of the new AIS and lacked a strong support staff. As a result, a number of incompatible tracking systems sprang from the company's distributed computer system. Third, the project was too large and complex for the consulting firm, who had little experience with the complex database at the heart of the new system. Finally, the project had too many applications. Interdependencies among subprograms left consultants with few completed programs. Every program was linked to several subprograms, which in turn were linked to several other programs. Programmers eventually found themselves lost in a morass of subroutines with no completed program.

The IS department finally developed a system to solve the problem, but their revenue tracking system suffered quality problems for years.

Required

Wang asked you to write a memo explaining the failure of the systems development project.

a. Why did the development project fail? What role did the consultants play in the failure?
b. Identify the organizational issues that management must address in the future.
c. Recommend steps the company could take to guarantee consulting service quality.

22.3. Tiny Toddlers, a manufacturer of children's toys and furniture, is designing and implementing a distributed system to assist its sales force. Each of the 10 sales offices in Canada and 20 in the United States maintains its own customers and is responsible for granting credit and collecting receivables. Reports used by each sales office to maintain the customer master file and to enter the daily sales orders are shown in Figures 22-4 and 22-5.

Required

Evaluate the reports shown in Figures 22-4 and 22-5 using the following format:

Weakness	Explanation	Recommendation(s)

(SMAC Examination, adapted)

22.4. Mickie Louderman is the new assistant controller of Pickens Publishers. She was the controller of a company in a similar industry, where she was in charge of accounting and had considerable influence over computer center operations. Pickens wants to revamp its information system, placing increased emphasis on decentralized data access and online systems. John Richards, the controller, is near retirement. He has put Mickie in charge of developing a new system that integrates the company's accounting-related functions. Her promotion to controller will depend on the success of the new AIS.

Mickie uses the same design characteristics and reporting format she used at her former company. She sends details of the new AIS to the departments that interface with accounting, including inventory control, purchasing, human resources, production control, and marketing. If they do not respond with suggestions by a prescribed date, she will continue the development process. Mickie and John have established a new schedule for many of the reports, changing the frequency from weekly to monthly. After a meeting with the director of IS, Mickie selects a programmer to help her with the details of the new reporting formats.

Most control features of the old system are maintained to decrease the installation time, with a few new ones added for unusual situations. The procedures for maintaining the controls are substantially changed. Mickie makes all the AIS control change and program-testing decisions, including screening the control features related to payroll, inventory control, accounts receivable, cash deposits, and accounts payable.

FIGURE 22-4
Customer Maintenance Form for Tiny Toddlers

CUSTOMER MAINTENANCE FORM

New Customer?	☐ Yes _____
	☑ No 24671
Name	The Little Ones Furniture Store
New Address	5 St. Antoine Street N. Quebec City
Old Address	305 St. Antoine Street S. Quebec City
Salesperson #	02
Requested Credit Limit	50,000
Sales Office	Eastern Canada
Pricing Code	25
Estimated Sales	300,000
Credit Limit	10,000
Currency	U.S.A. ☐, Canada ☐
Bank	Canadian Credit Bank 50 St. Antoine Street Quebec City
Bank Line	
Rating	Satisfactory

_____
Sales Manager

_____
Credit Manager

SALES ORDER FORM

Customer: 24671 Date: _____
The Little Ones Furniture Store
5 St. Antoine Street N.
Quebec City

Product Code	Description	Quantity
24571	Crib	4
M0002	Mattress	102
HG730	High chair—white	32
HG223	High chair—natural wood	22
CT200	Changing table	300
D0025	Desk—modern design	2
C9925	Chair—modern design	5
BP809	Bumper pads	1200

Salesperson No.: _____

Entered by: _____

FIGURE 22-5
Sales Order Form for Tiny Toddlers

As each module is completed, Mickie has the corresponding department implement the change immediately to take advantage of the labor savings. Incomplete instructions accompany these changes, and specific implementation responsibility is not assigned to departmental personnel. Mickie believes operations people should learn as they go, reporting errors as they occur.

Accounts payable and inventory control are implemented first, and several problems arise. The semimonthly payroll runs, which had been weekly under the old system, have abundant errors, requiring numerous manual paychecks. Payroll run control totals take hours to reconcile with the computer printout. To expedite matters, Mickie authorizes the payroll clerk to prepare payroll journal entries.

The new inventory control system fails to improve the carrying level of many stock items. This causes critical stock outs of raw material that result in expensive rush orders. The new system's primary control procedure is the availability of ordering and user information. The information is available to both inventory control and purchasing personnel so that both departments can issue timely purchase orders. Because the inventory levels are updated daily, Mickie discontinues the previous weekly report.

Because of these problems, system documentation is behind schedule, and proper backup procedures have not been implemented. Mickie has requested budget approval to hire two systems analysts, an accountant, and an administrative assistant to help her implement the new system. John is disturbed by her request because her predecessor had only one part-time assistant.

Required

a. List the steps Mickie should have taken while designing the AIS to ensure that end-user needs were satisfied.
b. Identify and describe three ways Mickie violated internal control principles during the AIS implementation.
c. Identify and describe the weaknesses in Mickie's approach to implementing the new AIS. How could you improve the development process for the remaining parts of the AIS? *(CMA Examination, adapted)*

22.5. Ryon Pulsipher, manager of Columbia's property accounting division, has had difficulty responding to the following departmental requests for information about fixed assets.

1. The controller has requested individual fixed assets schedules to support the general ledger balance. Although Ryon has furnished the information, it is late. The way the records are organized makes it difficult to obtain information easily.

2. The maintenance manager wants to verify the existence of a punch press that he thinks was repaired twice. He has asked Ryon to confirm the asset number and the location of the press.
3. The insurance department wants data on the cost and book values of assets to include in its review of current insurance coverage.
4. The tax department has requested data to determine whether Columbia should switch depreciation methods for tax purposes.
5. The internal auditors have spent significant time in the property accounting division to confirm the annual depreciation expense.

Ryon's property account records, kept in an Excel spreadsheet, show the asset acquisition date, its account number, the dollar amount capitalized, and its estimated useful life for depreciation purposes. After many frustrations, Ryon realizes his records are inadequate and that he cannot supply data easily when requested. He discusses his problems with the controller, Gig Griffith.

RYON: Gig, something has to give. My people are working overtime and can't keep up. You worked in property accounting before you became controller. You know I can't tell the tax, insurance, and maintenance people everything they need to know from my records. Internal auditing is living in my area, and that slows down the work. The requests of these people are reasonable, and we should be able to answer their questions and provide the needed data. I think we need an automated property accounting system. I want to talk with the AIS people to see if they can help me.

GIG: I think that's a great idea. Just be sure you are personally involved in the design of any system so you get all the info you need. Keep me posted on the project's progress.

Required

a. Identify and justify four major objectives Columbia's automated property accounting system should possess to respond to departmental requests for information.
b. Identify the data that should be included in the database for each asset. *(CMA Examination, adapted)*

22.6. A credit union is developing a new AIS. The internal auditors suggest planning the systems development process in accordance with the SDLC concept. The following nine items are identified as major systems development activities that will have to be completed.

1. System test
2. User specifications
3. Conversion
4. Systems survey
5. Technical specifications
6. Post-implementation planning
7. Implementation planning
8. User procedures and training
9. Programming

Required

a. Arrange the nine items in the sequence in which they should logically occur.
b. One major activity is to convert data files from the old system to the new one. List three types of file conversion documentation that would be of particular interest to an auditor. *(CMA Examination, adapted)*



22.7. MetLife, an insurance company, spent $11 billion to acquire Travelers Life and Annuity from Citicorp in one of the largest insurance company acquisitions of all time. The Metlife CIO estimated it would take three years to integrate the two systems. Because the integration project was especially critical, he figured he could

accomplish the integration in 18 months if he pulled out all the stops. The MetLife CEO gave him nine months to complete the task. To pull off the integration in nine months, he had to:

- Integrate over 600 IS applications, all with their own infrastructure and business processes. The new systems had to comply with "One MetLife," a company policy that all information systems had to have a common look and feel companywide and be able to function seamlessly with other MetLife systems.
- Work with over 4,000 employees located in 88 offices scattered all over the globe.
- Supervise an oversight team and 50 integration teams in seven project management offices.
- Work with hostile, uncooperative Travelers employees for the six months it took to get regulatory approval and close the deal. The systems had to be integrated three months after the deal closed.
- Identify integration deliverables (144 in total) and manage the process to deliver them.
- Negotiate with Citicorp for hundreds of transition services that would not be immediately converted to MetLife's systems

Required

a. What tasks would MetLife have to perform to integrate the Traveler systems into MetLife's?
b. Search the Internet for articles that describe the integration process. Write a two-page summary of the problems and successes that MetLife experienced while integrating the two systems.

22.8. During final testing, just before launching a new payroll system, the project manager at Reutzel Legal Services found that the purchased payroll system was doing the following:

- Writing checks for negative amounts
- Printing checks with names and employee numbers that did not match
- Making errors; for example, $8 per hour became $800 per hour if a decimal point was not entered
- Writing checks for amounts greater than a full year's salary

Fortunately, payroll was still installed on time, and only 1.5% of the checks had to be manually reissued every payday until the problem was solved.

Other problems were that no one had made sure the new system was compatible with the existing payroll database, and there appeared to be no formal transition between the development of the project and the implementation of the project. The system was never run in parallel.

Although the programming manager lost his job, the payroll problems helped raise awareness of the company's growing dependence on IT. Lacking a major problem, there was a perception that the information system did not affect operations.

Required

a. What does "the system was never run in parallel" mean?
b. If the company had run the system in parallel, what should have occurred?
c. What other testing methodologies could have been used by the firm?
d. What other types of problems are evident from reading the case?

22.9. A new program at Jones and Carter Corporation (JCC) was supposed to track customer calls. Unfortunately, the program took 20 minutes to load on a PC, and it crashed frequently. The project did not have a traditional reporting structure, and it appeared that no one was actually in charge. The lead project manager quit halfway through the

project, the in-house programmers were reassigned to other projects or let go, and two layers of management loosely supervised the systems analyst.

Management hired consultants to fix the application, but after three months and $200,000, the project was discontinued. JCC did not check the references of the consulting firm it hired to create the new system. The consultants, who were located two states away, made many programming errors. Although the systems analyst caught some of the consultant's mistakes, they grew increasingly distant and difficult to work with. They would not even furnish the source code to the project managers, most likely because they were afraid of revealing their incompetence.

Required

a. Identify potential causes for the system implementation failure.
b. What steps should JCC have taken to successfully design and implement the call tracking system?

Case 22-2 Citizen's Gas Company

Citizen's Gas Company (CGC) provides natural gas service to 200,000 customers. The customer base is divided into the following three revenue classes:

Class	Customers	Sales in Cubic Feet	Revenues
Residential	160,000	80 billion	$160 million
Commercial	38,000	15 billion	$ 25 million
Industrial	2,000	50 billion	$ 65 million
Totals		145 billion	$250 million

Residential customer gas usage is highly correlated with the weather. Commercial customer usage is partially weather dependent. Industrial customer usage is governed almost entirely by business factors.

The company buys natural gas from 10 pipeline companies in the amounts specified in contracts that run for 5 to 15 years. For some contracts, the supply is in equal monthly increments; for other contracts, the supply varies according to the heating season. Supply over the contract amounts is not available, and some contracts contain take-or-pay clauses. That is, the company must pay for the gas volume specified in the contract, regardless of the amount used.

To match customer demand with supply, gas is pumped into a storage field when supply exceeds customer demand. Gas is withdrawn when demand exceeds supply. There are no restrictions on the gas storage field except that the field must be full at the beginning of each gas year (September 1). Consequently, when the contractual supply for the remainder of the gas year is less than that required to satisfy projected demand and fill the storage field, CGC curtails service to industrial customers (except for heating quantities). The curtailments must be carefully controlled to prevent either an oversupply at year-end or a curtailing of commercial or residential customers so the storage field can be filled at year-end.

In recent years, CGC's planning efforts have not been able to control the supply during the gas year or provide the information needed to establish long-term contracts. Customer demand has been projected only as a function of the total number of customers. Commercial and industrial customers' demand for gas has been curtailed. This has resulted in lost sales and caused an excess of supply at the end of the gas year.

To correct the problems, CGC has hired a director of corporate planning. She is presented with a conceptual design for an information system that will help analyze gas supply and demand. The system will provide a monthly gas plan for the next five years, with particular emphasis on the first year. The plan will provide detailed reports that assist in the decision-making process. The system will use actual data during the year to project demand for the year. The president has indicated that she will base her decisions on the effect alternative plans have on operating income.

Required

1. Discuss the criteria to consider in specifying the structure and features of CGC's new system.
2. Identify the data that should be incorporated into CGC's new system to provide adequate planning capability. Explain why each data item is important and the level of detail needed for the data to be useful. *(CMA Examination, adapted)*

AIS IN ACTION SOLUTIONS

Quiz Key

1. The developers of your new system have proposed two different AIS designs and have asked you to evaluate them. This evaluation process is most likely to be a part of which SDLC step?
   a. systems analysis [Incorrect. During systems analysis, analysts identify user requirements and establish objectives and specifications for the design phases of the SDLC.]
   ▶ b. conceptual design [Correct. During conceptual design, users develop and evaluate appropriate design alternatives.]
   c. physical design [Incorrect. During physical design, the company translates the broad, user-oriented requirements of the conceptual design into detailed specifications that are used to develop and test computer programs.]
   d. implementation and conversion [Incorrect. During implementation and conversion, the company installs and tests hardware, software, and procedures, as well as converts from the old system to the new system.]
   e. operation and maintenance [Incorrect. During operation and maintenance, the company runs the system and performs ongoing maintenance and minor modifications.]

2. What is the purpose of the conceptual systems design report?
   a. to guide physical systems design activities [Incorrect. The conceptual design report also includes communicating how management and users' needs are met and helping the steering committee assess system feasibility.]
   b. to communicate how management and user information needs are met [Incorrect. The conceptual design report also includes guiding physical systems design activities and helping the steering committee assess system feasibility.]
   c. to help the steering committee assess system feasibility [Incorrect. The conceptual design report also includes communicating how management and users' needs are met and guiding physical systems design activities.]
   d. a and b [Incorrect. The conceptual design report also includes helping the steering committee assess system feasibility.]
   ▶ e. a, b, and c [Correct. The conceptual design report guides physical systems design activities, communicates how management and users' needs are met, and helps the steering committee assess system feasibility.]

3. Which of the following is the correct order of the steps in physical systems design?
   a. input, file and database, output, controls, procedures, program [Incorrect. See Figure 22-2.]
   b. file and database, output, input, procedures, program, controls [Incorrect. See Figure 22-2.]
   c. output, input, file and database, procedures, program, controls [Incorrect. See Figure 22-2.]
   ▶ d. output, file and database, input, program, procedures, controls [Correct. See Figure 22-2.]

4. A monthly payroll register showing all hourly employees, the number of hours they worked, their deductions, and their net pay is most likely which of the following?
   ▶ a. scheduled report [Correct. Scheduled reports have a specified content, format, and delivery time. A monthly payroll register exhibits these characteristics.]
   b. special-purpose analysis [Incorrect. A special-purpose analysis has no specified content, format, or delivery schedule.]
   c. triggered exception report [Incorrect. A triggered exception report has specified content and format, but it is generated only if a certain event occurs.]
   d. demand report [Incorrect. A demand report has specified content and format, but it is generated only on request.]

5. Which of the following is NOT a consideration in input design?
   a. Which errors are possible, and how can they be detected and corrected? [Incorrect. Error identification and correction should be considered during input design. See Table 22-4.]

b. How can data be entered (keyboards, OCR, or POS terminal)? [Incorrect. Data entry methods should be considered during input design. See Table 22-4.]
c. Which format efficiently captures the input data with the least effort and cost? [Incorrect. Data format should be considered during input design. See Table 22-4.]
▶ d. How often should the system produce reports? [Correct. Report generation frequency is not normally considered during input design. See Table 22-4.]

6. Which of the following is most likely to help improve program development?
a. physical model [Incorrect. A physical model is most commonly used to describe the physical characteristics of a database.]
b. IT strategic plan [Incorrect. An entity's strategic plan provides a roadmap for achieving long-range goals.]
▶ c. walk-through [Correct. During walk-throughs, people associated with designing the project review it step by step so any problems can be identified and corrected.]
d. record layout [Incorrect. A record layout illustrates how data items are stored in a file.]

7. Which of the following statements is true?
a. The Gartner Group estimates that programming bugs not found until later in the SDLC cost 25% to 30% more to correct than if they had been found earlier in the SDLC. [Incorrect. The correct estimate is 80% to 1,000% more.]
b. Direct system conversion is the least risky of the system conversion methods. [Incorrect. Direct conversion is the most risky rather than the least risky method for converting from an old system to a new system.]
c. Many software developers state that 5% to 10% of software development costs should be allocated to testing, debugging, and rewriting software. [Incorrect. Software developers recommend that 20% to 30% of software development costs be allocated to testing, debugging, and rewriting software.]
▶ d. Over the life of a system, only 30% of information systems work takes place during development; the remaining 70% is spent maintaining the system. [Correct.]

8. Which of the following describes the systems testing approach that uses real transactions and files rather than hypothetical ones?
a. walk-through [Incorrect. Walk-throughs are step-by-step reviews of procedures or programs so any problems can be identified and corrected.]
b. processing of test transactions [Incorrect. Processing of test transactions uses valid and erroneous data to test for the proper handling of transactions, as well as the proper detection and handling of errors.]
▶ c. acceptance test [Correct. An acceptance test uses real transaction data to test a new system.]
d. parallel conversion test [Incorrect. Parallel conversion is a system conversion method, not a testing method.]

9. What is the process of discontinuing an old system as soon as a new one is introduced?
▶ a. direct conversion [Correct. In direct conversion, the old system is discontinued as soon as the new one is activated.]
b. parallel conversion [Incorrect. A parallel conversion involves operating both the old and the new system in parallel until the users accept the new system.]
c. phase-in conversion [Incorrect. Phase-in conversion gradually replaces elements of the old system with the new one.]
d. pilot conversion [Incorrect. A pilot conversion activates and tests the new system in one or a few locations.]

10. Which of the following describes designing a program from the top down to more detailed levels?
▶ a. hierarchical program design [Correct. Hierarchical program design is the process of programming from the general level to the detailed level.]
b. top-down program design [Incorrect. This is not a program design method described in the text.]
c. parallel program design [Incorrect. This is not a program design method described in the text.]
d. unstructured program design [Incorrect. This is not a program design method described in the text.]

Case 22-1 Solution

To properly design, implement, and operate this new ERP system, Hershey could have taken the following steps.

Conceptual Design

In designing its new ERP system, Hershey should have looked at all possible designs, evaluated their strengths and weaknesses, and selected the best one. Once the system was selected, Hershey needed to address the design specifications, such as what distribution output is needed to meet customer demands, how to store order and shipping data, how to input order and shipping data, and how to process the inputs and data to produce the outputs. Hershey should have prepared a detailed report to guide the physical design phase and communicate with management and the steering committee the project's progress, requirements, and feasibility.

Physical Design

Once the conceptual design was approved, physical design should have been planned. During this design phase, the following should have been created: order and shipment output documents, reports, files and databases; and the input forms and computer screens needed to capture order and shipment data. Hershey needed to choose which ERP modules to implement and to decide how to structure and modify those modules to meet its needs. Hershey also needed to decide how employees will interact with the system and to develop policies and procedures to formalize that interaction. Controls should have been designed to make sure those procedures and the system in general perform as intended and to prevent fraud and abuse. All of the physical design elements also should have been put into a report to guide Hershey in the actual implementation of the system.

Systems Implementation

Once the new ERP system had been designed and created, the actual hardware, software, procedures, and controls should have been implemented. An installation plan includes all tasks needed to prepare the physical location of the new ERP system, train managers and users to operate the ERP system, document the system, and test it. Based on the information in the case, it appears that Hershey failed to test its new ERP system adequately before converting from the old system.

System Conversion

Of the four primary system conversion approaches, Hershey chose direct conversion—the highest-risk approach. Hershey called the approach the "big bang"—and the big bang that was heard was a drop in market capitalization (stock price) and a damaged reputation due to the loss of orders and the loss of supplier confidence. In hindsight, Hershey should have used one of the other three approaches—parallel, phase-in, or pilot—with the parallel approach probably being the most effective. If Hershey had been able to convert to the new ERP system more successfully, it could have then focused on operating and maintaining the new system and making improvements to make it more effective and efficient.

Glossary

A

acceptance tests Tests of new systems using specially developed transactions and acceptance criteria. The test results are evaluated to determine whether the system is acceptable.

access control list (ACL) A set of rules that determines which packets of information transmitted over a network are allowed entry and which are dropped.

access control matrix An internally maintained table specifying which portions of the system users are permitted to access and what actions they can perform. The matrix contains a list of user codes, a list of all files and programs maintained on the system, and a list of the accesses each user is authorized to make.

accounting information system (AIS) A system that collects, records, stores, and processes data to produce information for decision makers. AIS components include: people, procedures and instructions, data, software, information technology infrastructure, and internal controls and security measures.

accounts receivable aging schedule A report listing customer account balances by length of time outstanding. The report provides useful information for evaluating current credit policies, for estimating bad debts, and for deciding whether to increase the credit limit for specific customers.

activity-based costing (ABC) A cost system designed to trace costs to the activities that create them. Once costs are traced to their specific activities, they are allocated to their corresponding products or departments.

Address Resolution Protocol (ARP) spoofing Sending fake ARP messages to an Ethernet LAN. ARP is a computer networking protocol for determining a network host's hardware address when only its IP or network address is known.

ad hoc queries Nonrepetitive requests for reports or answers to specific questions about the contents of the system's data files.

adware Spyware that (1) causes banner ads to pop up on a monitor as a user surfs the Internet; and (2) collects information about the user's Web-surfing and spending habits and forwards it to the company gathering the data, often an advertising or media organization. Adware usually comes bundled with freeware and shareware downloaded from the Internet.

agents In the REA data model, the people and organizations w participate in events and about whom information is desired.

aggression Resistance to change intended to destroy, cripple, or lessen the effectiveness of a system. It may take the form of increased error rates, disruptions, or deliberate sabotage.

analytical review The examination of the relationships between different sets of data.

application The data processing task to which a computer's processing power is applied.

application controls Controls that prevent, detect, and correct transaction errors and fraud in application programs. They are concerned with the accuracy, completeness, validity, and authorization of the data captured, entered into the system, processed, stored, transmitted to other systems, and reported. Contrast with *general controls.*

application programmer A person who uses a programming language to write an application program.

application service provider (ASP) A company that provides access to and use of application programs via the Internet. The ASP owns and hosts the software; the contracting organization accesses the software remotely via the Internet.

application software The programs that perform data or information processing tasks, such as accounts receivable and payable, inventory control, and payroll.

archive A copy of a database, master file, or software that is retained indefinitely as a historical record, usually to satisfy legal and regulatory requirements.

asymmetric encryption systems *See public key infrastructure (PKI).*

asynchronous transmission Data transmission in which each character is transmitted separately. A start bit is required before the character and a stop bit after it because the interval of time between transmission of characters can vary. Contrast with *synchronous transmission.*

attributes Characteristics of interest in a file or database; the different individual properties of an entity. Examples of attributes are employee number, pay rate, name, and address.

audit committee The committee responsible for overseeing a corporation's internal control structure, financial reporting process, and compliance with related laws and regulations. It is usually made up of outside members of the board of directors.

audit hooks A concurrent audit technique that embeds audit routines into application software to flag transactions that might indicate an error or fraud.

audit log A log of all transactions that have audit significance.

audit trail A path that allows a transaction to be traced through a data processing system from point of origin (whether paper or electronic) to final output or backwards from from final output to point of origin. It is used to check the accuracy and validity of ledger postings and to trace changes in general ledger accounts from their beginning balance to their ending balance.

auditing A systematic process of (1) objectively obtaining and evaluating evidence regarding assertions about economic actions and events to ascertain the degree of correspondence between those assertions and established criteria; and (2) communicating the results to interested parties.

authentication Verifying the identity of the person or device attempting to access the system.

authorization Granting an employee power to perform certain organizational functions, such as purchasing or selling on behalf of the company. Employees who are allowed to handle routine transactions without special approval have *general* authorization. An employee needing approval to handle a transaction receives *specific* authorization.

automated decision table programs Programs that generate a decision table representing the program's logic.

automated flowcharting program A program that interprets the source code of a program and generates a flowchart of the logic used by the program.

avoidance A way of resisting change by not using the new system.

B

back door See *trap door.*

back order A document authorizing the purchase or production of items that is created when there is insufficient inventory to meet customer orders.

background check An investigation conducted by a potential or current employer regarding a prospective or current employee. A background check often involves verifying the educational and work experience data on the person's resume, talking to references, checking for a criminal record, checking credit records, and checking other publicly available information about the individual.

backup A copy of a database, file, or software program.

balance-forward method Method of maintaining accounts receivable in which customers typically pay according to the amount shown on a monthly statement, rather than by individual invoices. Remittances are applied against the total account balance, rather than specific invoices.

balanced scorecard A management report that measures four dimensions of performance: financial, internal operations, innovation and learning, and customer perspectives of the organization.

bandwidth The difference between the highest and the lowest frequencies of a communications channel. Usually expressed in cycles per second (hertz).

bar code An identification label found on most merchandise with vertical lines of differing widths that represent binary information that is read by an optical scanner.

batch processing Accumulating transaction records into groups or batches for processing at a regular interval such as daily or weekly. The records are usually sorted into some sequence (such as numerically or alphabetically) before processing.

batch total The sum of a numerical item for a batch of documents. These totals are calculated prior to processing the batch and are compared with machine-generated totals at each subsequent processing step to verify that the data was processed correctly.

behavioral aspects of change New systems can change organizations, which may result in people changing their behavior. Organizations must be sensitive to and consider the feelings and reactions of persons affected by such changes.

belief system A corporate attitude enstilled by upper management that communicates company core values to employees and inspires them to live by these values. A belief system should draw attention to how the organization creates values and help employees understand the direction management wants the company to take.

benchmark problem A data processing task executed by different computer systems. The results are used to measure systems performance and to make comparative evaluations among systems.

bill of lading A legal contract that defines responsibility for goods while they are in transit. It identifies the carrier, source, destination, shipping instructions, and the party (customer or vendor) that must pay the carrier.

bill of materials A document that specifies the part number, description, and quantity of each component used in a product.

biometric identification Using unique physical characteristics such as fingerprints, voice patterns, retina prints, and signature dynamics to identify people.

bits Binary digits are the smallest storage location in a computer. A bit may be either "on" or "off," or "magnetized" or "nonmagnetized." A combination of bits (usually eight) is used to represent a single character of data.

bits per second (BPS) A unit of measurement describing the number of bits of data transmitted electronically in one second.

blanket purchase order or **blanket order** A commitment to purchase specified items at designated prices from a particular supplier for a set time period, often one year.

block code Blocks of numbers within a numerical sequence that are reserved for categories having meaning to the user.

border router A device that connects an organization's information system to the Internet.

boundary system An established system that helps employees act ethically by setting limits beyond which an employee must not pass. Employees can solve problems and meet customer needs as long as they operate within certain limits, such as meeting minimum standards of performance, shunning activities that are off limits, and avoiding courses of action that would damage the company's reputation.

broadband lines Communications channels capable of handling high-speed data transmissions.

budget The formal expression of goals in financial terms. Budgets are financial planning tools. Contrast with *performance report.*

buffer overflow attack When an attacker sends a program more data than it can handle. Buffer overflows may cause the system to crash or may provide a command prompt that gives the attacker full administrative privileges and control of the device.

business continuity plan (BCP) A plan that specifies how to resume all business processes in the event of a major calamity.

business cycle A group of related business processes. The major business cycles are sales and cash receipts, purchasing and cash disbursements, production and inventory control, human resources and payroll, and finance.

business process A set of related, coordinated, and structured activities and tasks that help accomplish a specific organizational goal.

business intelligence Accessing and using data for strategic decision making. There are two main business intelligence techniques: online analytical processing (OLAP) and data mining.

business process management (BPM) Managing the process of improving business processes. Software has been developed to automate business process improvement tasks.

business process management system (BPMS) System that automates and facilitates business process improvements throughout the SDLC. It can improve communication and collaboration, automate activities, and integrate with other systems and with other partners in the value chain.

business process reengineering (BPR) The thorough analysis and redesign of business processes and information systems to achieve dramatic performance improvements.

byte A group of adjacent bits (usually eight) used to represent an alphabetic, numeric, or special character, or even two numeric characters "packed" into a single eight-bit byte.

C

callback system A routing verification procedure. After the user dials in and is authenticated, the computer disconnects and calls the user back as an additional security precaution.

Caller ID spoofing Displaying an incorrect number on the recipient's caller ID display to hide the identity of the caller.

canned software Programs for sale on the open market to a broad range of users with similar needs.

capital budgeting model An estimate of funds to be appropriated for the acquisition of major capital assets and for investment in long-term projects. The estimated benefits are compared with the costs to determine if the system is cost beneficial.

cardinality A property of a database relationship indicating the number of occurrences of one entity that may be associated with a single occurrence of the other entity. Three types of cardinalities are one-to-one, one-to-many, and many-to-many.

cash flow budget A budget that shows projected cash inflows and outflows for a specified period so that an organization can anticipate the need for short-term borrowing.

centralized system or **network** A system where user terminals are linked to the centralized host computer so that users can send data to the host computer for processing and access data as needed. It provides an "economy of scale" advantage in data processing operations.

central processing unit (CPU) The hardware that contains the circuits that control the interpretation and execution of instructions and that serves as the principal data processing device. Its major components are the arithmetic-logic unit, the memory, and the control unit.

certificate authority An independent organization that issues public and private keys and records the public key in a digital certificate.

change control The process that ensures that hardware, software, or process modifications do not reduce systems reliability. Careful testing prior to implementing changes reduces the likelihood of changes that cause system downtime. Companies with a good change control process are less likely to suffer financial or reputational harm from security incidents.

change management Making sure that system changes minimize negative effects on users and do not negatively affect systems reliability, security, confidentiality, integrity, and availability.

character A letter, numeric digit, or symbol that is entered into a computer system.

chart of accounts A listing of all balance sheet and income statement account number codes.

check digit ID numbers (such as employee number) can contain a **check digit** computed from the other digits. For example, the system could assign employees a nine-digit number, calculate a tenth digit from the nine, and append it to form a ten-digit ID number.

check digit verification Recalculating a check digit to verify that an error has not been made. This calculation can be made only on a data item that has a check digit.

checkpoint The point(s) during a long processing run where a copy of all data values and status indicators of a program are captured. If a system failure occurs, the system is backed up to the most recent checkpoint and processing restarts at the checkpoint rather than at the beginning of the program.

ciphertext Plaintext that was transformed into unreadable gibberish using encryption.

client/server system A system where information requested by a user is processed as much as possible by the server and then transmitted to the user.

closed-loop verification An input validation method that uses data entered into the system to retrieve and display other related information so the accuracy of the input data can be verified.

cloud computing Purchasing software, storage, infrastructure, or platforms from a third-party (referred to as the cloud provider) on a pay-for-use or subscription basis. Cloud providers use virtualization technology to economically provide shared access simultaneously to multiple customers. The resulting economies of scale mean that organizations can often cut their total costs for IT with cloud computing and transforms IT into a utility.

coding (1) The systematic assignment of numbers or letters to items to classify and organize them. (2) Writing program instructions that direct a computer to perform specific data processing tasks.

cold site A location that provides everything necessary to quickly install computer equipment in the event of a disaster.

collusion Cooperation between two or more people in an effort to thwart internal controls.

Committee of Sponsoring Organizations (COSO) A private-sector group consisting of the American Accounting Association, the AICPA, the Institute of Internal Auditors, the Institute of Management Accountants, and the Financial Executives Institute.

compatibility check (or **test**) Determining whether a person attempting to access an information system resource is authorized to do so. The computer matches the user's authentication credentials against the access control matrix to determine whether the employee is allowed access to that resource or to perform the requested operation.

compensating controls Control procedures that compensate for the deficiency in other controls.

completeness test (or **check**) An online data entry control in which the computer determines whether all data required for a particular transaction have been entered.

compliance audit Determines compliance with applicable laws, regulations, policies, and procedures. These audits often result in

recommendations to improve processes and controls that ensure compliance with regulations.

compliance objectives Objectives to help the company comply with applicable laws and regulations.

computer-assisted audit techniques (CAATS) Audit software, often referred to as generalized audit software (GAS) or computer audit software (CAS), that uses auditor-supplied specifications to generate a program that performs audit functions, thereby automating or simplifying the audit process.

computer crime Any illegal act for which knowledge of a computer is essential for the crime's perpetration, investigation, or prosecution.

computer forensics specialists Computer experts whose job entails discovering, extracting, safeguarding, and documenting computer evidence so that its authenticity, accuracy, and integrity will not succumb to legal challenges.

computer fraud See *computer crime.*

computer incident response team (CIRT) A team that is responsible for dealing with major security incidents. The CIRT should include technical specialists as well as senior operations management, because some security incident responses may have significant economic consequences.

computer-integrated manufacturing (CIM) A manufacturing approach in which much of the manufacturing process is performed and monitored by computerized equipment, in part through the use of robotics and real-time data collection of manufacturing activities.

computer operators People who operate the company's computers. They ensure that data are properly input to the computer and processed correctly, and needed output is produced.

computer programmers Persons who develop, code, and test computer programs.

computer security The policies, procedures, tools, and other means of safeguarding information systems from unauthorized access or alteration, intentional or unintentional damage, or theft.

computer security officer An employee independent of the information system function who monitors the system and disseminates information about improper system uses and their consequences.

concatenated key Two or more primary keys of other database tables that, together, become a unique identifier or primary key of another table. A multiple-attribute primary key.

conceptual design specifications System requirement specifications for systems output, data storage, input, processing procedures, and operations.

conceptual-level schema The organization-wide view of the entire database. It lists all data elements and the relationships between them. Contrast with *external-level schema* and *internal-level schema.*

conceptual systems design The systems development life cycle phase in which a general framework is created to implement user requirements and solve problems identified in the analysis phase.

conceptual systems design report A document specifying the findings and results of conceptual systems design. The report is used in physical systems design to identify the hardware, software, and procedures necessary to deliver the system.

concurrent audit techniques Software that continuously monitors an information system as it processes live data in order to collect, evaluate, and report information about system reliability.

concurrent update controls Controls that lock out users to protect individual records from errors that could occur if multiple users attempted to update the same record simultaneously.

context diagram The highest data flow diagram level. It provides a summary-level view of a system. It shows the data processing system, system input(s) and output(s), and the external entities that are the sources and destinations of the input(s) and output(s).

continuous and intermittent simulation (CIS) A concurrent audit technique that embeds an audit module into a database management system, rather than the application software.

control account A general ledger account that summarizes the total amounts recorded in a subsidiary ledger. The accounts payable control account in the general ledger represents the total amount owed to all vendors. The balances in the subsidiary accounts payable ledger indicate the amount owed to each specific vendor.

control activities Policies, procedures, and rules that provide reasonable assurance that control objectives are met and their risk responses are carried out.

control environment The organization's environment relating to controls, including management's philosophy, the audit committee, and the organizational structure.

Control OBjectives for Information and related Technology (COBIT) An information systems security and control framework that allows (1) management to benchmark the security and control practices of IT environments, (2) users of IT services to be assured that adequate security and control exist, and (3) auditors to substantiate their internal control opinions and advise on IT security and control matters.

control risk The risk that a significant control problem will not be prevented or detected by the internal control system.

control totals Batch totals used to ensure that all data are processed correctly. Examples are the number of transactions processed and the dollar amount of all updates.

conversion The process of changing from one computer format to another.

cookie A text file created by a Web site and stored on a visitor's hard drive. Cookies store information about who the user is and what the user has done on the site.

corrective controls Procedures that remedy problems that occur.

cost driver Anything that has a cause-and-effect relationship to costs. For example, the number of purchase orders processed is a purchasing department cost driver.

cracking See *hacking.*

credit limit The maximum allowable credit account balance for each customer, based on past credit history and ability to pay.

credit memo A document authorizing the billing department to credit a customer's account. Usually issued for sales returns, for allowances granted for damaged goods kept by the customer, or to write off uncollectible accounts. Approved by the credit manager.

critical path The path requiring the greatest amount of time to complete a project. If an activity on the critical path is delayed, the whole project is delayed. If possible, resources are shifted to critical path activities to reduce project completion time.

cross-footing balance test A procedure in which worksheet data are totaled both across and down. Then, the total of the horizontal totals is compared to the total of the vertical totals to ensure that the worksheet balances.

cross site scripting (XSS) Exploits Web page security vulnerabilities to bypass browser security mechanisms and create a malicious link that injects unwanted code into a Web site.

cryptography See *data encryption.*

customer relationship management (CRM) systems Software that organizes information about customers in a manner that facilitates efficient and personalized service.

custom software Software developed and written in-house to meet the unique needs of a particular company.

cyber-bullying Using computer technology to harm another person.

cycle billing Producing monthly statements for subsets of customers at different times. For example, each week monthly statements would be prepared for one-fourth of the customers.

D

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

data administrator (DA) The person responsible for developing general policies and procedures governing all organizational data, not just what is stored in the database. The DA is responsible for understanding the organization's information needs and deciding what should be included in the database.

database A set of interrelated, centrally controlled data files that are stored with as little data redundancy as possible. A database consolidates records previously stored in separate files into a common pool and serves a variety of users and data processing applications.

database administrator The person responsible for coordinating, controlling, and managing the database.

database management system (DBMS) The program that manages and controls the data and the interfaces between the data and the application programs.

database query language An easy-to-use DBMS language that lets users ask questions about the data stored in a database.

database system The combination of the database, the database management system, and the application programs that access the database through the database management system.

data communications The transmission of data from a point of origin to a point of destination.

data communications network A communication system that bridges geographical distances, giving users immediate access to a company's computerized data. It allows multiple companies or computer services to be linked to information.

data control group The group charged with ensuring that source data have been properly approved, monitoring the flow of work through the computer, reconciling input and output, maintaining a record of input errors to ensure their correction and resubmission, and distributing systems output.

data definition language (DDL) A DBMS language that ties the logical and physical views of data together. It is used to build the data dictionary, initialize or create the database, describe the logical views for each individual user or programmer, and specify any limitations or constraints on security imposed on database records or fields.

data destination An entity outside the system that receives data produced by the system. A component of a data flow diagram.

data dictionary A description of each data element that is stored in the database. For example, customer numbers are stored in the database and there is a record in the data dictionary describing that data element.

data diddling Changing data before, during, or after it is entered into the system. The change can be made to add, delete, or alter system data.

data flow The data flow diagram component that represents data flowing into or out of a process.

data flow diagram (DFD) A graphical description of the flow of data within an organization. It is used to document existing systems and to plan and design new ones.

data independence Storing data such that the data and the application programs that use it are independent. This means that one may be changed without affecting the other.

data leakage The unauthorized copying of company data, often without leaving any indication that it was copied.

data loss prevention (DLP) Software which works like antivirus programs in reverse, blocking outgoing messages (e-mail, instant messages, etc.) that contain key words or phrases associated with intellectual property or other sensitive data the organization wants to protect.

data maintenance The periodic processing of transactions to update stored data. The four types of data maintenance are create, read, update, and delete (often referred to as CRUD).

data manipulation language (DML) A DBMS language used create, read, update, and delete items in the database.

data mart A smaller data warehouse for functions such as finance and human resources.

data masking A program that protects privacy by replacing customers' personal information with fake values before sending that data to the program development and testing system. For example, a real Social Security number might be replaced with a different set of numbers that have the same characteristics, such as 123-45-6789.

data mining Accessing information stored in a data warehouse through statistical analysis or artificial intelligence techniques to "discover" unhypothesized relationships in the data.

data model An abstract representation of the contents of a database.

data modeling Defining a database so that it faithfully represents all key components of an organization's environment. The objective is to explicitly capture and store data about every business activity the organization wishes to plan, control, or evaluate.

data processing center The room that houses the hardware, software, data, and people who operate a computer system.

data processing cycle The operations performed on data to generate meaningful and relevant information. It has four stages: data input, data storage, data processing, and information output.

data processing schedule A schedule of data processing tasks designed to maximize the use of scarce computer resources.

data query language (DQL) A high-level, English-like, DBMS language that retrieves, sorts, orders, and presents subsets of the database in response to user queries.

data redundancy The storage of the same data item in two or more files within an organization.

data source The entity that produces or sends the data that is entered into the system. A component of a data flow diagram.

data store The place or medium where system data is stored. A component of a data flow diagram.

data transmission controls Methods of monitoring the network to detect weak points, maintain backup components, and ensure that the system can still communicate if one of the communications paths fails.

data value The actual value stored in a field. It describes a particular attribute of an entity.

data warehouses Very large databases that contain detailed and summarized data for a number of years and that are used for analysis rather than transaction processing.

debit memo A document used to record a reduction to the balance due to a vendor.

debugging The process of checking for and correcting the errors found in a computer program.

decentralized system An information system that has an independent CPU and data processing manager at each location.

decision support system (DSS) An interactive computer system designed to help with the decision-making process by providing access to a database or decision-making model.

decryption Transforming ciphertext back into plaintext.

deduction register A report listing the miscellaneous voluntary deductions for each employee.

deep packet inspection When the firewall examines the data in the body of an IP packet rather than looking only at the information in the IP header.

default value A control that helps preserve the integrity of data processing and stored data by leaving a field blank if a standard value is to be used.

defense-in-depth Employing multiple layers of controls to avoid a single point-of-failure. Overlapping, complementary, and redundant controls buy time for the organization to detect and react to attacks. It also increases effectiveness because if one procedure fails or is circumvented, another may function as planned.

delete anomaly When deleting a row from a table results in the loss of all information about an entity. For example, if customer addresses are stored only in the sales invoice table, then deleting the row representing the only sale to a particular customer results in the loss of all information about that customer.

demand reports Reports that have a prespecified content and format but are prepared only in response to a request from a manager or other employee.

demilitarized zone (DMZ) Placing the organization's Web servers and e-mail servers in a separate network that sits outside the corporate network but is accessible from the Internet.

denial-of-service attack A computer attack in which the attacker sends so many e-mail bombs (thousands per second), often from randomly generated false addresses, that the Internet service provider's e-mail server is overloaded and shuts down. Another denial-of-service attack involves sending so many requests for Web pages that the Web server crashes.

detection risk The risk that auditors and their procedures will not detect a material misstatement.

detective controls Controls designed to discover control problems when they arise.

diagnostic control system A performance measurement system that compares actual performance to planned performance.

dictionary attack Using special software to guess company addresses and send them blank e-mail messages. Unreturned messages are usually valid e-mail addresses that can be added to spammer e-mail lists.

differential backup Copying all changes made since the last full backup. Thus, each new differential backup file contains the cumulative effects of all activity since the last full backup.

digital certificate An electronic document, created and digitally signed by a trusted third party, that certifies the identity of the owner of a particular public key. The digital certificate contains that party's public key. Thus, digital certificates provide an automated method for obtaining an organization's or an individual's public key.

digital fingerprint A hash number that identifies and validates a digital certificate.

digital signature (1) A piece of data signed on a document by a computer. A digital signature cannot be forged and is useful in tracing authorization. (2) Information encrypted with the creator's private key.

digital watermark Code embedded in documents that enables an organization to identify confidential information that has been disclosed. A digital watermark is a detective control and organizations should investigate how a compromise occurred and take appropriate corrective action.

direct access An access method that allows the computer to access a particular record without reading other records. Because each storage location on a direct access storage device has a unique address, the computer can find the record needed as long as it has the record's address.

direct access storage device (DASD) A storage device (such as a disk drive) that can directly access individual storage locations to store or retrieve data.

direct conversion An approach to converting from one system to another in which the old system is discontinued, after which the new system is started (also known as "burning the bridges" or "crash conversion").

disaster recovery plan A plan to recover data processing capacity as smoothly and quickly as possible in the event of an emergency that disables the computer system.

disbursement voucher A document that identifies the vendor, lists the outstanding invoices, and indicates the net amount to be paid after deducting any applicable discounts and allowances.

distributed data processing (DDP) A system in which computers are set up at remote locations and then linked to a centralized mainframe computer.

DNS spoofing Sniffing the ID of a Domain Name System (server that converts a Web site name to an IP address) request and replying before the real DNS server.

documentation The narratives, flowcharts, diagrams, and other written materials that explain how a system works. It covers the who, what, when, where, why, and how of data entry, processing, storage, information output, and system controls.

document flowchart Flowchart that traces a document from its cradle to its grave. They show where each document originates, its distribution, the purposes for which it is used, its ultimate disposition, and everything that happens as it flows through the system. They illustrate the flow of documents and information among areas of responsibility within an organization.

documents Records of transaction or other company data such as checks, invoices, receiving reports, and purchase requisitions.

dumpster diving See *scavenging*.

E

earnings statement A report listing the amount of gross pay, deductions, and net pay for the current period and the year-to-date totals for each category.

eavesdropping Observing data transmissions intended for someone else. One way unauthorized individuals can intercept signals is by setting up a wiretap.

e-business All uses of advances in information technology, particularly networking and communications technology, to improve the ways an organization performs its business processes.

echo check A hardware control that verifies transmitted data by having the receiving device send the message back to the sending device so that the message received can be compared with the message sent.

economic espionage The theft of information and intellectual property.

economic exchange An event in which one agent gives a resource to another agent in exchange for some other resource.

economic feasibility The dimension of feasibility concerned with whether the benefits of a proposed system will exceed the costs.

economic order quantity (EOQ) The optimal order size to minimize the sum of ordering, carrying, and stockout costs. Ordering costs are expenses associated with processing purchase transactions. Carrying costs are the costs associated with holding inventory. Stockout costs, such as lost sales or production delays, result from inventory shortages.

edit checks Accuracy checks performed by an edit program.

edit programs Computer programs that verify the validity and accuracy of input data.

electronic data interchange (EDI) The use of computerized communications and a standard coding scheme to submit business documents electronically in a format that can be automatically processed by the recipient's information system.

electronic data processing (EDP) Processing data utilizing a computer system.

electronic funds transfer (EFT) The transfer of funds between two or more organizations or individuals using computers and other automated technology. This eliminates the delay associated with the time the remittance is in the mail.

electronic lockbox A lockbox arrangement (see *lockbox*) in which the bank electronically sends the company information about the customer account number and the amount remitted as soon as it receives payments. This enables the company to begin applying remittances to customer accounts before the photocopies of the checks arrive.

electronic vaulting Electronically transmitting backup copies of data to a physically different location. Electronic vaulting permits online access to backup data when necessary.

element A specific data item in an XBRL instance document, such as a financial statement line item.

e-mail bomb A denial-of-service attack in which the receiver's e-mail server is bombarded with hundreds of e-mail messages per second.

e-mail spoofing (forgery) Making a sender address and other parts of an e-mail header appear as though the e-mail originated from a different source.

e-mail threats Threats sent to victims by e-mail. The threats usually require some follow-up action, often at great expense to the victim.

embedded audit modules Special portions of application programs that track items of interest to auditors, such as unauthorized attempts to access the data files.

embezzlement The fraudulent appropriation of business property by an employee to whom it has been entrusted. It is often accompanied by falsification of records.

encryption The process of transforming normal text, called *plaintext*, into unreadable gibberish, called *ciphertext*. Encryption is particularly important when confidential data is being transmitted from remote terminals because data transmission lines can be electronically monitored without the user's knowledge.

endpoints Collective term for the workstations, servers, printers, and other devices that comprise an organization's network. Supplementing preventive controls on the network perimeter with additional preventive controls on the endpoints enhances the security of information systems.

end-user computing (EUC) The creation, control, and implementation by end users of their own information system.

end-user system (EUS) A system developed by users, rather than information systems professionals, to meet their information needs. An EUS often draws upon the information in existing corporate databases to meet users' information needs.

enterprise resource planning (ERP) system A system that integrates all aspects of an organization's activities into one accounting information system.

Enterprise Risk Management—Integrated Framework (ERM) A COSO-developed internal framework that expands on the elements of COSO's Internal Control Integrated Framework and provides an all-encompassing focus on the broader subject of enterprise risk management.

entity The item about which information is stored in a record. Examples include an employee, an inventory item, and a customer.

entity integrity rule A design constraint in a relational database, requiring that the primary key have a non-null value. This ensures that a specific object exists in the world and can be identified by reference to its primary key value.

entity-relationship (E-R) diagram A graphical depiction of a database's contents showing the various entities being modeled and the important relationships among them. An entity is any class of objects about which data are collected, such as the resources, events, and agents that comprise the REA data model. An E-R diagram represents entities as rectangles; lines and diamonds represent relationships between entities.

error log The record of data input and data processing errors.

error message A message indicating that the computer encountered a mistake or malfunction.

error report A report summarizing errors by record type, error type, and cause.

evaluated receipt settlement (ERS) An invoiceless approach to accounts payable that replaces the three-way matching process (vendor invoice, receiving report, and purchase order) with a two-way match of the purchase order and receiving report. ERS saves time and money by reducing the number of mismatches and the time and expense of generating and tracking invoices.

event (1) In the REA data model, a business activity about which management wants to collect information for planning or control purposes. (2) An incident or occurrence from internal or external sources that affects the implementation of strategy or the achievement of objectives.

expected loss The mathematical product of the potential dollar loss that would occur should a threat become a reality (called *exposure*) and the risk or probability that the threat will occur (called *likelihood*).

expenditure cycle A recurring set of business activities and related data processing operations associated with the purchase of and payment for goods and services.

exploit The set of instructions for taking advantage of a vulnerability.

exposure The potential dollar loss should a particular threat become a reality.

extension taxonomy A set of custom XBRL tags to define elements unique to the reporting organization that are not part of the standard generally accepted taxonomies for that industry.

external label A label on the outside of a storage medium that identifies the data it contains.

external-level schema An individual user's or application program's view of a subset of the organization's database. Each of these individual user views is also referred to as a subschema. Contrast with *conceptual-level schema* and *internal-level schema.*

F

fault tolerance The capability of a system to continue performing when there is a hardware failure.

feasibility study An investigation to determine whether the development of a new application or system is practical. One of the first steps in the systems evaluation and selection process.

field The part of a data record that contains the data value for a particular attribute. For example, fields in all accounts receivable records would include customer account number, customer address, and balance due.

field check An edit check in which the characters in a field are examined to ensure they are of the correct field type (e.g., numeric data in numeric fields).

file A set of logically related records, such as the payroll records of all employees.

file maintenance The periodic processing of transaction data, which is the most common task in data processing systems. It includes creating, reading, updating, and deleting records. After file maintenance, the master file will contain all current information.

file organization The way data are stored on physical storage media. File organization may be either sequential or direct (random) access.

financial audit A review of the reliability and integrity of financial and operating information and the means used to identify, measure, classify, and report such information.

financial electronic data interchange (FEDI) The combination of EFT and EDI that enables both remittance data and funds transfer instructions to be included in one electronic package.

financial total The total of a dollar field, such as total sales, in a set of records. It is usually generated manually from source documents prior to input and compared with machine-generated totals at each subsequent processing step. A discrepancy may indicate a loss of records or errors in data transcription or processing.

financial value-added network (FVAN) An independent organization that offers specialized hardware and software to link various EDI networks with the banking system for EFT.

financing cycle The business activities and data processing operations associated with obtaining funds to operate, repay creditors, and distribute profits to investors.

firewall A combination of security algorithms and router communications protocols that prevent outsiders from tapping into corporate databases and e-mail systems.

flexible benefits plan A plan under which each employee receives some minimum coverage in medical insurance and pension contributions, plus additional benefit "credits" that can be used to acquire extra vacation time or additional health insurance. These plans are sometimes called *cafeteria-style benefit plans* because they offer a menu of options.

flexible budget A budget in which the amounts are stated in terms of formulas based upon actual level of activity.

flowchart An analytical technique used to describe some aspect of an information system in a clear, concise, and logical manner. Flowcharts use a standard set of symbols to describe pictorially transaction processing procedures and the flow of data through a system.

flowcharting symbols A set of objects that are used in flowcharts to show how and where data move. Each symbol has a special meaning that is easily conveyed by its shape.

flowcharting template A piece of hard, flexible plastic on which the shapes of flowcharting symbols have been die cut.

Foreign Corrupt Practices Act (1977) Legislation that, among other things, requires all publicly owned corporations subject to the Securities Exchange Act of 1934 to keep reasonably detailed records and maintain a system of internal accounting controls.

foreign key An attribute appearing in one table that is itself the primary key of another table. Foreign keys are used to link tables.

forensic accountants Accountants who specialize in fraud auditing and investigation. Upon qualification, forensic accountants may receive a Certified Fraud Examiner (CFE) certificate.

fraud Any and all means a person uses to gain an unfair advantage over another person.

fraud hot line A phone number employees can call to anonymously report fraud and abuse.

fraudulent financial reporting Intentional or reckless conduct, whether by act or omission, that results in materially misleading financial statements.

G

Gantt chart A bar graph used for project planning and control. Project activities are shown on the left and units of time across the top. The time period each activity is expected to take is represented with a horizontal bar on the graph.

general authorization The authorization given to regular employees to handle routine transactions without special approval.

general controls Controls designed to make sure an organization's information system and control environment is stable and well managed. Contrast with *application controls.*

generalized audit software (GAS) A software package that can be used to perform audit tests on the data files of a company.

general journal A journal used to record infrequent or nonroutine transactions, such as loan payments and end-of-period adjusting and closing entries.

general journal listing A report showing the details (account number, source reference code, description, and amount debited or credited) of each entry posted to the general ledger. This report

indicates whether the total debits equal the total credits posted to the general ledger.

general ledger Ledger that contains summary-level data for every asset, liability, equity, revenue, and expense account of the organization.

general ledger and reporting system The information-processing operations involved in updating the general ledger and preparing reports that summarize organizational activities.

give-get exchange An event in which two entities exchange items, such as cash for goods or services.

goal conflict Occurs when a decision or action of a subsystem is inconsistent with another subsystem or the system as a whole.

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

grandfather-father-son concept Retaining the three most current copies of the master files (the son is the most recent) and transaction files. If a master file is destroyed, it can be recreated using a prior master file and the appropriate transaction file.

group codes Two or more subgroups of digits that are used to code an item. A group code is often used in conjunction with a block code.

H

hacking Unauthorized access and use of computer systems, usually by means of a personal computer and telecommunications networks.

hardening The process of turning off unnecessary program features.

hash Plaintext that has been transformed into short code.

hashing Transforming plaintext of any length into a short code called a hash.

hash total A total generated from values for a field that would not usually be totaled, such as customer account numbers. It is usually generated manually from source documents prior to input and compared with machine-generated totals at each subsequent processing step. Any discrepancy may indicate a loss of records or errors in data transcription or processing.

header label/record Type of internal label that appears at the beginning of each file and contains the file name, expiration date, and other file identification information.

help desk An in-house group of analysts and technicians who answer employees' questions with the purpose of encouraging, supporting, coordinating, and controlling end-user activity.

hijacking Gaining control of someone else's computer to carry out illicit activities, such as sending spam without the computer user's knowledge.

home page A "storefront" or site on the Internet set up by individuals and firms to provide useful and interesting information.

hot site Completely operational data processing facility configured to meet the user's requirement that can be made available to a disaster-stricken organization on short notice.

human resources management (HRM)/payroll cycle The recurring set of business activities and data processing operations associated with effectively managing the employee workforce.

I

identity theft Assuming someone's identity, usually for economic gain, by illegally obtaining confidential information such as a social security number.

impact See *exposure.*

impersonation See *masquerading.*

implementation The process of installing a computer system. It includes selecting and installing equipment, training personnel, establishing operating and control policies and procedures, testing and documenting the system, installing software, and getting the system to function properly.

implementation and conversion phase The capstone phase in the systems development life cycle where the elements and activities of the system come together.

implementation plan A written plan that outlines how the new system will be implemented. The plan includes a timetable for completion, the employee who is responsible for each activity, cost estimates, and task milestones.

imprest fund A cash account with two characteristics: (1) It is set at a fixed amount, such as $100; and (2) vouchers are required for every disbursement. At all times, the sum of cash plus vouchers should equal the preset fund balance.

incremental backup Copying data items that have changed since the last backup. This produces a set of incremental backup files, each containing the results of one day's transactions.

information Data that have been organized and processed to provide meaning to a user.

information overload The state in which additional information cannot be used efficiently and has no marginal value.

information processing The process of turning data into information. This process has four stages: data input, data processing, data storage, and information output.

information rights management (IRM) Software that offers the capability not only to limit access to specific files or documents, but also to specify the actions (read, copy, print, download, etc.) that individuals who are granted access to that resource can perform. Some IRM software even has the capability to limit access privileges to a specific period of time and to remotely erase protected files.

information system An organized way of collecting, processing, managing, and reporting information so that an organization can achieve its objectives and goals. Formal information systems have an explicit responsibility to produce information. An informal information system meets a need that is not satisfied by a formal channel and operates without formal designation of responsibility.

information system library A collection of corporate databases, files, and programs stored in a separate storage area.

information systems audit Reviews the general and application controls of an AIS to assess its compliance with internal control policies and procedures and its effectiveness in safeguarding assets.

information systems steering committee Plans and oversees the information systems function. The committee often consists of high-level management people, such as the controller and systems and user-department management. The steering committee sets policies that govern the AIS and ensures top-management participation, guidance, and control.

inherent risk The susceptibility of a set of accounts or transactions to significant control problems in the absence of internal control.

initial investigation A preliminary investigation to determine whether a proposed new system is both needed and possible.

input Data entered into the computer system either from an external storage device or from the keyboard of the computer.

input controls Controls that ensure that only accurate, valid, and authorized data are entered into the system.

input controls matrix A matrix that shows the control procedures applied to each field of an input record.

input validation routines Computer programs or routines designed to check the validity or accuracy of input data.

inquiry processing Processing user information queries by searching databases for the desired information and then organizing the information into an appropriate response.

insert anomaly A problem that arises when attributes that are not characteristics of the primary key are stored in a table. The problem arises because new information about those attributes cannot be entered in the database without violating integrity rules. For example, assume that information about vendors is stored only as part of the purchases table. Data about potential new vendors, or about alternative suppliers, could not be added until a purchase from them was made. Otherwise, the purchase order number column, the primary key of the purchases table, would have a null value, violating the entity integrity rule.

instance document An XBRL report that contains tagged data.

integrated test facility A testing technique in which a dummy company or division is introduced into the company's computer system. Test transactions may then be conducted on these fictitious records without affecting the real records. Test transactions may be processed along with real transactions, and the employees of the computer facility need not be aware that testing is being done.

integration Eliminating duplicate recording, storage, reporting, and other processing activities in an organization. For example, companies that used to have separate programs to prepare customer statements, collect cash, and maintain accounts receivable records now combine these functions into a single application.

integrity Protecting data from unauthorized tampering.

interactive control system Helps top-level managers with high-level activities that demand frequent and regular attention, such as developing company strategy, setting company objectives, understanding and assessing threats and risks, monitoring changes in competitive conditions and emerging technologies, and developing responses and action plans to proactively deal with these high-level issues.

internal auditing An independent, objective assurance and consulting activity designed to add value and improve organizational effectiveness and efficiency. Internal auditing helps an organization accomplish its objectives by using a systematic, disciplined approach to evaluate and improve the effectiveness of the risk management, control, and governance processes.

internal control flowchart A document flowchart that describes and evaluates internal controls. Often used by auditors in the planning stage of an audit.

Internal Control Integrated Framework A framework developed by COSO to define internal controls as well as to provide guidance for evaluating and enhancing internal control systems. It is widely accepted as the authority on internal controls.

internal controls Controls within a business organization that ensure information is processed correctly.

internal control system The plan of organization and the methods and measures adopted within a business to safeguard its assets, maintain records that accurately and fairly reflect company assets, check the accuracy and reliability of its accounting data, provide assurance that financial reporting is prepared in accordance with GAAP, promote operational efficiency, comply with applicable laws and regulations, and encourage adherence to prescribed managerial policies.

internal environment The tone or culture of a company that helps determine the risk consciousness of employees. It is the foundation for all other ERM components, providing discipline and structure. It is essentially the same thing as the control environment in the internal control framework.

internal labels Labels written in machine-readable form on a magnetic storage medium that identify the data contained on the storage medium. Internal labels include volume, header, and trailer labels.

internal-level schema A low-level view of the entire database describing how the data are actually stored and accessed. It includes information about record layouts, definitions, addresses, indexes, and so forth. Contrast with *external-level schemas* and *conceptual-level schemas.*

internal rate of return (IRR) The effective interest rate that equates the present value of total costs to the present value of total savings.

Internet auction fraud Using an Internet auction site to defraud another.

Internet misinformation Using the Internet to spread false or misleading information. This can be done in a number of ways, including inflammatory messages in online chats, setting up Web sites, and spreading urban legends.

Internet Protocol (IP) Protocol that specifies the structure of the TCP packets and how to route them to the proper destination.

Internet pump-and-dump fraud Using the Internet to pump up the price of a stock and then sell it.

Internet service providers (ISPs) Companies that provide connections to the Internet for individuals and other companies.

Internet terrorism Hackers using the Internet to disrupt electronic commerce and destroy company or individual communications.

intranet An internal network that can connect to the main Internet and be navigated with browser software. It is usually closed off from the general public.

intrusion detection systems (IDS) A system that creates logs of all network traffic that was permitted to pass the firewall and then analyzes those logs for signs of attempted or successful intrusions.

intrusion prevention systems (IPS) A new type of filter designed to identify and drop packets that are part of an attack.

inventory control The function of determining what, when, and how much inventory to purchase.

investigative audit Examines incidents of possible fraud, misappropriation of assets, waste and abuse, or improper governmental activities, looking for evidence of impropriety.

IP address spoofing Creating Internet Protocol packets with a forged IP address to hide the sender's identity or to impersonate another computing system.

J

job-order costing A cost system that assigns costs to specific production batches or jobs; it is used when the product or service being produced can be distinctly identified.

job-time ticket A document used to collect data about labor activity by recording the amount of time a worker spent on each specific job task.

journal voucher A form used to document one or more journal entries such as those made to update the general ledger.

journal voucher file A file that stores all journal entries used to update the general ledger.

just-in-time (JIT) inventory system A system that minimizes or virtually eliminates manufacturing inventories by scheduling inventory deliveries at the precise times and locations needed. Instead of making infrequent bulk deliveries to a central receiving and storage facility, suppliers deliver materials in small lots at frequent intervals to the specific locations that require them.

just-in-time (JIT) manufacturing Manufacturing systems with short planning horizons whose goal is to minimize or eliminate inventories of raw materials, work in process, and finished goods. JIT is often referred to as *pull manufacturing* because goods are produced in response to customer demand. Theoretically, JIT manufacturing systems produce only in response to customer orders. In practice, however, most JIT manufacturing systems develop short-run production plans.

K

key A unique identification code assigned to each data record within a system.

key escrow The process of storing a copy of an encryption key in a secure location.

key logger Spyware that records a user's keystokes, e-mails sent and received, Web sites visited, and chat session participation.

key-to-disk encoder Several keying stations linked to a computer. Data may be entered simultaneously from each of the key stations and pooled on a disk file.

key-to-tape encoder A device for keying in data and recording the data on magnetic tape.

key verification Checking the accuracy of data entry by having two people enter the same data using a key-operated device. The computer then compares the two sets of keystrokes to determine whether the data were entered correctly.

kickbacks Gifts given by vendors to purchasing agents for the purpose of influencing their choice of suppliers.

kiting A fraud scheme where the perpetrator conceals a theft of cash by creating cash through the transfer of money between banks. For example, suppose a fraud perpetrator opens checking accounts in banks A, B, and C. Then the perpetrator "creates" cash by depositing a $1,000 check from bank A into bank B and then withdraws the $1,000 from bank B. Since there are insufficient funds in bank A to cover the $1,000 check, the perpetrator deposits a $1,000 check from bank C to bank A before his check to bank B clears bank A. Since bank C also has insufficient funds, $1,000 must be deposited to bank C before the check to bank A clears. The check to bank C is written from bank B, which also has insufficient funds. The scheme continues, with checks and deposits occurring as needed to keep the checks from bouncing.

L

LAN See *local area network.*

lapping Concealing the theft of cash by means of a series of delays in posting collections to accounts. For example, a perpetrator steals customer A's accounts receivable payment. Funds received at a later date from customer B are used to pay off customer A's balance. Funds from customer C are used to pay off B's balance, and so forth.

lean manufacturing The goal of lean manufacturing is to minimize or eliminate inventories of raw materials, work in process, and finished goods. Lean manufacturing is often referred to as *pull manufacturing* because goods are produced in response to customer demand.

Lebanese looping Inserting a sleeve into an ATM that will not eject a card, pretending help for the purpose of obtaining a PIN, and then using the card and PIN to drain the account.

legal feasibility The dimension of feasibility that determines whether there will be any conflicts between the system under consideration and the organization's ability to discharge its legal obligations.

likelihood The probability that a threat to an AIS will come to pass.

limit check An edit check to ensure that a numerical amount in a record does not exceed some predetermined limit.

line count Total number of lines entered during a data processing session.

Linkbases One or more XBRL files that define the relationships among elements found in a specific instance document.

local area network (LAN) A network that links computers, printers, and other electronic equipment located within a limited geographical area, such as a single building.

lockbox A postal address to which customers send their remittances. This Post Office box is maintained by the participating bank, which picks up the checks each day and deposits them to the company's account. The bank sends the remittance advices, an electronic list of all remittances, and digital copies of all checks to the company.

log analysis The process of examining logs to monitor security.

logical access The ability to use computer equipment to access company data.

logical models Descriptions of a system that focus on the essential activities and flow of information in the system irrespective of how the flow is actually accomplished.

logical view The manner in which a user or programmer conceptually organizes, views, and understands the relationships among data items. Contrast with *physical view.*

logic errors Errors that occur when the instructions given to the computer do not accomplish the desired objective. Contrast with *syntax errors.*

logic time bomb A program that lies idle until some specified circumstance or a particular time triggers it. Once triggered, the program sabotages the system by destroying programs or data.

M

MAC address A Media Access Control address is a hardware address that uniquely identifies each node on a network.

magnetic disks Magnetic storage media consisting of one or more flat, round disks with a magnetic surface on which data can be written.

magnetic ink character recognition (MICR) The recognition of characters printed by a machine that uses special magnetic ink.

magnetic tape A secondary storage medium that is about 1/2 inch in width and that has a magnetic surface on which data can be stored. The most popular types are seven-track and nine-track tapes.

mainframe computers Large digital computers, typically with a separate stand-alone CPU.

management audit A review of how well management is utilizing company resources and how well company operations and programs follow established objectives.

management by exception A method for interpreting variances displayed on performance reports. If the performance report shows actual performance to be at or near budgeted figures, a manager can assume that the item is under control and that no action needs to be taken. Significant deviations from budgeted amounts, in *either* direction, signal the need to investigate the cause of the discrepancy and take appropriate action to correct the problem.

management information system The set of human and capital resources that are dedicated to collecting and processing data so that all levels of management have the information they need to plan and control the activities of the organization.

man-in-the-middle (MITM) attack A hacker placing himself between a client and a host to intercept network traffic; also called *session hijacking*.

manual information system Information system in which most data processing is completed by people without the use of computers.

manufacturing overhead All manufacturing costs that are not economically feasible to trace directly to specific jobs or processes.

manufacturing resource planning (MRP-II) An extension of materials resource planning that seeks to balance existing production capacity and raw materials needs to meet forecasted sales demands. Also referred to as *push manufacturing* because goods are produced in expectation of customer demand.

many-to-many (M:N) relationship A relationship between two entities where each entity can be associated with many instances of the other entity. For example, each inventory item can be sold to many different customers and each customer can order many different inventory items.

mapping programs Programs that provide information as to which portions of an application program are not executed.

masquerading Gaining access to a system by pretending to be an authorized user. This approach requires that the perpetrator know the legitimate user's identification numbers and passwords.

master file A permanent file of records that stores cumulative information about an organization's resources and the agents with whom it interacts. As transactions take place, individual records within a master file are updated to keep them current.

master plan A long-range planning document that specifies the overall information system plan of an organization. It shows what the system will consist of, how it will be developed, who will develop it, how needed resources will be acquired, and where the AIS is headed.

master production schedule (MPS) Specifies how much of each product is to be produced during the planning period and when that production should occur.

materiality The concept that an auditor should focus on detecting and reporting only those errors, deficiencies, and omissions that could possibly have a significant impact on decisions.

materials requirements planning (MRP) An approach to inventory management that seeks to reduce required inventory levels by improving the accuracy of forecasting techniques to better schedule purchases to satisfy production needs.

materials requisition Authorizes the removal of the necessary quantity of raw materials from the storeroom to the factory location where production operations are to begin.

maximum cardinality The maximum number of instances that an entity can be linked to the other entity in the relationship.

message The data transmitted over a data communication system.

message acknowledgment techniques Techniques that let the sender of an electronic message know that a message was received. They include echo checks, trailer records, and numbered batches.

minimum cardinality The minimum number of instances that an entity can be linked to the other entity in the relationship.

misappropriation of assets See *employee fraud.*

mnemonic code Letters and numbers that are interspersed to identify an item. The mnemonic code is derived from the description of the item and is usually easy to memorize. For example, Dry300W05 could represent a low end (300), white (W) dryer (Dry) made by Whirlpool (05).

modular conversion An approach for converting from an old system to a new system in which parts of the old system are gradually replaced by the new until the old system has been entirely replaced.

monthly statement A document summarizing all transactions that occurred during the past month and informing customers of their current account balance.

move tickets Documents that identify the internal transfer of parts, the location to which they are transferred, and the time of the transfer.

multifactor authentication The use of two or more authentication methods (passwords, ID badges, biometrics, etc.) in conjunction to achieve a greater level of security.

multimodal authentication The use of multiple authentication credentials of the same type to achieve a greater level of security.

mutual authentication scheme A routing verification procedure that requires both computers to exchange their passwords before communication takes place.

N

narrative description Written, step-by-step explanation of system components and how the components interact.

net present value (NPV) A value determined by discounting all estimated future cash flows back to the present, using a discount rate that reflects the time value of money.

network A group of interconnected computers and terminals; a series of locations tied together by communications channels.

network administrator One who installs, manages, and supports a network. The network administrator also controls access to the network and maintains the shared software and data.

network interface card (NIC) The device needed to connect a computer or peripheral to a data communications network.

network managers The people responsible for ensuring that all applicable devices are linked to the organization's internal and external networks and that the networks operate continuously and properly.

neural networks Computing systems that imitate the brain's learning process by using a network of interconnected processors that perform multiple operations simultaneously and interact dynamically. Neural networks recognize and understand voice, face, and word patterns much more successfully than do regular computers and humans.

nonoperational (or throwaway) prototypes Prototypes that are discarded, but the system requirements identified from the prototypes are used to develop a new system.

nonrepudiation Creating legally binding agreements that cannot be unilaterally repudiated by either party. This is done by signing

documents and giving both parties copies. In today's digital world, the same level of nonrepudiation is accomplished by using hashing and asymmetric encryption to create a digital signature.

nonvoucher system A method for processing accounts payable in which each approved invoice is posted to individual vendor records in the accounts payable file and is then stored in an open invoice file. When a check is written to pay for an invoice, the invoice is removed from the open invoice file, marked paid, and stored in the paid invoice file. Contrast with *voucher system.*

normalization The process of following the guidelines for properly designing a relational database that is free from delete, insert, and update anomalies.

O

off-line devices Devices that are not connected to or controlled by a computer or network. Off-line devices are used to prepare data for entry into the computer system (e.g., key-to-tape encoder, key-punch/verification equipment). Contrast with *online devices.*

one-to-many (1:N) relationship A relationship between two entities where one entity in the relationship can be associated with many instances of the other entity in that relationship.

one-to-one (1:1) relationship A relationship between two entities where one entity in the relationship is associated with only one instance of the other entity in the relationship.

online analytical processing (OLAP) Tools that provide access to information stored in a data warehouse by using queries to investigate hypothesized relationships.

online batch processing Processing in which the computer captures data electronically and stores it so that it can be processed later.

online devices Hardware devices that are connected directly to the CPU by a cable or telephone line.

online processing Processing individual transactions as they occur and from their point of origin rather than accumulating them to be processed in batches. Online processing requires the use of online data entry devices and direct access file storage media so that each master record can be accessed directly.

online, real-time processing The computer system processes data immediately after capture and provides updated information to the user on a timely basis.

open-invoice method Method for maintaining accounts receivable in which customers typically pay according to each invoice. Usually, two copies of the invoice are mailed to the customer, who is requested to return one copy with the payment.

operating budget A report that projects an organization's revenues and expenses for a given time period, usually a month or a year.

operating system A software program that controls the overall operation of a computer system. Its functions include controlling the execution of computer programs, scheduling, debugging, assigning storage areas, managing data, and controlling input and output.

operational audit See *management audit.*

operational feasibility The dimension of feasibility concerned with whether a proposed system will be used by the people in an organization. It also is concerned with how useful the system will be within the operating environment of the organization.

operational prototypes Prototypes that are further developed into fully functional systems.

operations and maintenance The last phase of the system development life cycle where follow-up studies are conducted to detect and correct design deficiencies. Minor modifications will be made as problems arise in the new system.

operations list A document that specifies the labor and machine requirements needed to manufacture a product. It indicates how a product moves through the factory, specifying what is done at each step and how much time each operation should take.

operations objectives Objectives that deal with the effectiveness and efficiency of company operations, such as performance and profitability goals and safeguarding assets.

opportunity The condition or situation that allows a person or organization to commit and conceal a dishonest act and convert it to personal gain.

Optical Character Recognition (OCR) The use of light-sensitive hardware devices to convert characters readable by humans into computer input. Because OCR readers can read only certain items, a special machine-readable font must be used.

ordering costs All expenses associated with processing purchase transactions.

output The information produced by a system. Output is typically produced for the use of a particular individual or group of users.

output controls Controls that regulate system output.

outsourcing Hiring an outside company to handle all or part of the data processing activities.

P

packet sniffers Programs that capture data from information packets as they travel over the Internet or company networks. Captured data is sifted to find confidential or proprietary information that can be sold or otherwise used.

packing slip A document listing the quantity and description of each item included in a shipment.

parallel conversion A systems conversion approach in which the new and old systems are run simultaneously until the organization is assured that the new system is functioning correctly.

parallel simulation An approach auditors use to detect unauthorized program changes and data processing accuracy. The auditor writes his or her own version of a program and then reprocesses data. The output of the auditor's program and the client's program are compared to verify that they are the same.

parity bit An extra bit added to a byte and magnetized as needed to ensure that there is always an odd (or even) number of magnetized bits. The computer uses the odd (or even) parity scheme to check the accuracy of each item of data.

parity checking Process in which a computer, as it reads or receives a set of characters, verifies that the proper number of magnetized bits is in each character received. If not, the corresponding character may contain an error.

password A series of letters, numbers, or both that must be entered to access and use system resources. Password use helps prevent unauthorized tampering with hardware, software, and the organization's data.

password cracking Occurs when an intruder penetrates a system's defenses, steals the file containing valid passwords, decrypts them, and uses them to gain access to system resources such as programs, files, and data.

patch Code released by software developers that fixes a particular vulnerability.

patch management The process of regularly applying patches and updates to software.

payback period The number of years required for the net savings to equal the initial cost of an investment.

payroll clearing account A general ledger account used to check the accuracy and completeness of recording payroll costs and their subsequent allocation to appropriate cost centers.

payroll register A listing of payroll data for each employee for a payroll period.

payroll service bureau An organization that maintains the payroll master file for each of its clients and performs their payroll processing activities for a fee.

penetration test An authorized attempt to break into the organization's information system.

performance evaluations A project development control that requires evaluating each module or task as it is completed.

performance objectives The overall performance goals that an entity wishes to achieve.

performance report A report that compares standard, or expected, performances with actual performance and also shows the variances, or differences, between the two. Used for financial control. Contrast with *budget.*

peripherals The hardware devices (input, output, processing, and data communications) that are connected to a CPU.

personal identification number (PIN) A confidential code that allows an individual to gain access to a system and the data or resources stored in that system.

phase-in conversion See *modular conversion.*

phishing Sending an e-mail pretending to be a legitimate company, usually a financial institution, and requesting information. The recipient is asked to either respond to the e-mail request or visit a Web page and submit data. The request is bogus, and the information gathered is used to commit identity theft or to steal funds from the victim's account.

phreaker A hacker who attacks phone systems.

physical access Ability to physically use computer equipment.

physical design A phase of the system development life cycle where the broad, user-oriented requirements of the conceptual design are implemented by creating a detailed set of specifications that are used to code and test the computer programs.

physical model The description of how a system functions by describing the flow of documents, the computer processes performed and the people performing them, the equipment used, and other physical elements of the system.

physical systems design The phase of the systems development life cycle in which the designer specifies the hardware, software, and procedures for delivering the conceptual systems design.

physical systems design report A report prepared at the end of the physical design phase that describes the system and summarizes what was accomplished. Management uses this report to decide whether or not to proceed to the implementation phase.

physical view The way data are physically arranged and stored in the computer system. Contrast with *logical view.*

picking ticket A document authorizing the inventory control function to release merchandise to the shipping department. The picking ticket is often printed so that the item numbers and quantities are listed in the sequence in which they can be most efficiently retrieved from the warehouse.

piggybacking When a perpetrator latches onto a user who is logging in to a system. The legitimate user unknowingly carries the perpetrator with him into the system.

pilot conversion The implementation of a system in part of the organization, such as a branch location. This localizes conversion problems and allows training in a live environment. Disadvantages are the long conversion times and the need to interface the old system with the new system.

plaintext Normal text that has not been encrypted.

podslurping Using a small device with storage capacity (iPod, flash drive) to download unauthorized data from a computer.

point-of-sale (POS) devices Electronic devices used to record sales information at the time of the sale and to perform other data processing functions.

point scoring An objective procedure in which weighted selection criteria are used to evaluate the overall merits of vendor proposals.

policies The rules that provide a formal direction for achieving performance objectives and that enable performance.

policy and procedures manual A management tool for assigning authority and responsibility. It explains proper business practices, describes the knowledge and experience needed by key personnel, spells out management policy for handling specific transactions, and documents the systems and procedures employed to process those transactions.

post-implementation review Review made after a new system has been operating for a brief period. The purpose is to ensure that the new system is meeting its planned objectives, to identify the adequacy of system standards, and to review system controls.

post-implementation review report A report that analyzes a newly delivered system to determine if the system achieved its intended purpose and was completed within budget.

preformatting An online data entry control in which the computer displays a form on the screen and the user fills in the blanks on the form as needed.

pressure A person's incentive or motivation for committing fraud.

preventive controls Controls that deter problems before they arise. Effective preventive controls include hiring qualified accounting personnel; appropriately segregating employee duties; and effectively controlling physical access to assets, facilities, and information.

preventive maintenance A program of regularly examining the hardware components of a computer and replacing any that are found to be weak.

primary activities Activities in the value chain that are performed to create, market, and deliver products and services to customers and provide post-delivery service and support. Primary activities include production, shipping and receiving, and marketing.

primary key The attribute, or combination of attributes, that uniquely identifies a row in a database table. The primary key is used to distinguish, order, and reference records in a database.

private key system An encryption system in which both the sender and the receiver have access to the key but do not allow others access to the same key.

process A set of actions, automated or manual, that transform data into other data or information.

process costing A cost system that assigns costs to each process, or work center, in the production cycle, and then calculates the average cost for all units produced. Process costing is used when masses of similar goods or services are produced or sold.

processing controls Controls that ensure that all transactions are processed accurately and completely and that all files and records are properly updated.

processing test transactions Running hypothetical transactions through a new system to test for processing errors.

procurement card A corporate credit card that employees can use to purchase specific kinds of items.

production cycle The recurring set of business activities and related data processing operations associated with the manufacture of products.

production order A document authorizing the manufacture of a specified quantity of a particular product. It lists the operations to be performed, the quantity to be produced, and the location to which the finished product is to be delivered.

professional employer organization (PEO) An organization that processes payroll and also provides human resource management services such as employee benefit design and administration.

program A set of instructions that can be executed by a computer.

program evaluation and review technique (PERT) A commonly used technique for planning, coordinating, controlling, and scheduling complex projects such as systems implementation.

program flowchart A diagrammatical representation of the sequence of logical operations performed by a computer in executing a program. A program flowchart describes the specific logic to perform a process shown on a system flowchart.

program maintenance The revision of a computer program to meet new program instructions, satisfy system demands such as the need for a new report, correct an error, or make changes in file content.

programmer The person who takes the design provided by systems analysts and creates an information system by writing the computer programs.

programming The process of writing software programs to accomplish a specific task or set of tasks.

program tracing A technique used to obtain detailed knowledge of the logic of an application program as well as to test the program's compliance with its control specifications.

project development plan A document that shows how a project will be completed, including the modules or tasks to be performed and who will perform them, the dates they should be completed, and project costs.

project development team A group of people consisting of specialists, management, and users that develop a project's plan and direct the steps of the systems development life cycle. The team monitors costs, progress, and employees, and also gives status reports to top management and to the steering committee.

projection A way of resisting change by blaming anything and everything on the new system. The system becomes the scapegoat for all real and imagined problems and errors.

project milestones Significant points in a development effort where a formal review of progress is made.

prompting An online data entry control that uses the computer to control the data entry process. The system requests each required item of input data and then waits for an acceptable response before requesting the next required item.

proposal to conduct systems analysis A document calling for the analysis of either an existing or a proposed system. This document is prepared by a user or department and requests the information systems function to analyze the feasibility of developing a system to perform a specific function.

protocol The set of rules governing the exchange of data between two systems or components of a system.

prototype A simplified working model of an information system.

prototyping An approach to systems design in which a simplified-working model, or prototype, of an information system is developed. The users experiment with the prototype to determine what they like and do not like about the system. The developers make modifications until the users are satisfied with the system.

Public Company Accounting Oversight Board (PCAOB) A five-member board that regulates the auditing profession. The PCAOB was created as part of the Sarbanes–Oxley Act, and its members are appointed and overseen by the SEC.

public key infrastructure (PKI) An approach to encryption that uses two keys: a public key that is publicly available and a private key that is kept secret and known only by the owner of that pair of keys. With PKI, either key (the public or private) can be used to encode a message, but only the other key in that public-private pair can be used to decode that message.

purchase order A document that formally requests a vendor to sell and deliver specified products at designated prices. It is also a promise to pay and becomes a contract once the vendor accepts it.

purchase requisition A document or electronic form that identifies the requisitioner; specifies the delivery location and date needed; identifies the item numbers, descriptions, quantity, and price of each item requested; and may suggest a vendor.

Q

query A request for specific information from a computer. When the information is found, it is retrieved, displayed, or analyzed as requested. Queries are often used with a database management system to extract data from the database.

query-by-example (QBE) languages Graphical query languages for retrieving information from a relational database.

query languages Languages used to process data files and to obtain quick responses to questions about those files.

R

random access memory (RAM) A temporary storage location for computer instructions and data.

range check An edit check designed to verify that a data item falls within a certain predetermined range of acceptable values.

ransomware Software that encrypts programs and data until a ransom is paid to remove it.

rationalization The excuse that fraud perpetrators use to justify their illegal behavior.

REA data model A data model used to design AIS databases. It contains information about three fundamental objects: resources, events, and agents. Resources represent identifiable objects that have economic value to the organization. Events represent an organization's business activities. Agents represent the people or organizations about which data are collected.

real-time notification A variation of the embedded audit module in which the auditor is notified of each transaction as it occurs by means of a message printed on the auditor's terminal.

real-time system A system that is able to respond to an inquiry or provide data fast enough to make the information meaningful to the user. Real-time systems are usually designed for very fast response.

reasonable assurance The concept that an auditor cannot obtain complete assurance that information is correct, because to do so would be prohibitively expensive. Instead, the auditor accepts a reasonable degree of risk that the audit conclusion is incorrect.

reasonableness test An edit check of the logical correctness of relationships among data items. For example, a journal entry that debits inventory and credits wages payable is not reasonable.

receiving report A document that records details about each delivery, including the date received, shipper, vendor, quantity received.

record A set of logically related data items that describe specific attributes of an entity, such as all payroll data relating to a single employee.

record count A total of the number of input documents in a process or the number of records processed at a given time.

record layout A document that illustrates the arrangement of items of data in input, output, and file records.

recovery point objective (RPO) The length of time between the last backup and the time that an incident occurred. The RPO represents the period of time for which management is willing to have to reenter, data about past transactions.

recovery procedures A set of procedures that is followed if the computer quits during data processing. The procedures allow the user to recover from hardware or software failures.

recovery time objective (RTO) The time by which the organization's information system must be available again following a disaster.

redundant arrays of independent drives (RAID) Writing data to multiple disk drives simultaneously so that if one disk drive fails the data can be readily accessed from another.

redundant data check An edit check that requires the inclusion of two identifiers in each input record (e.g., the customer's account number and the first five letters of the customer's name). If these input values do not match those on the record, the record will not be updated.

reengineering See *business process reengineering.*

referential integrity rule A constraint in relational database design requiring that any non-null value of a foreign key must correspond to a primary key in the referenced table. For example, if vendor number is a foreign key in the inventory table, to indicate the preferred source of that item, then any vendor number appearing in that table must appear as a primary key value in the vendor table. This constraint ensures consistency in the database. Note, however, that the foreign key can be null, if there is no existing relationship between the two tables. For example, a null value for vendor number in any row in the inventory table would indicate that there is no preferred vendor for that inventory item.

relational data model A database model in which all data elements are logically viewed as being stored in two-dimensional tables called *relations*. In these tables each row represents a unique entity or record. Each column represents a field where the record's attributes are stored. The tables serve as the building blocks from which data relationships can be created.

relational database A database management system that uses the relational data model developed by Dr. E. F. Codd in 1970.

remittance advice An enclosure included with a customer's payment that indicates the invoices, statements, or other items paid.

remittance list A document listing all checks received in the mail.

Remote Authentication Dial-In User Service (RADIUS) A standard method for verifying the identity of users attempting to connect via dial-in access. Users connect to a remote access server and submit their login credentials. The remote access server passes those credentials to the RADIUS server, which performs compatibility tests to authenticate the identity of that user.

remote batch processing Accumulating transaction records in batches at some remote location and then transmitting them electronically to a central location for processing.

reorder point The level to which the inventory balance of an item must fall before an order to replenish stock is initiated.

report System output organized in a meaningful fashion. Used by employees to control operational activities, by managers to make decisions and design strategies, and by investors and creditors to gather information about a company's business activities. Prepared for both internal and external use.

reporting objectives Objectives to help ensure the accuracy, completeness, and reliability of internal and external company reports, of both a financial and nonfinancial nature. They also improve decision making and monitor company activities and performance more efficiently.

report writers A language that simplifies report creation. Typically, users need specify only which data elements they want printed and how the report should be formatted. The report writer searches the database, extracts the specified data items, and prints them according to the user-specified format.

reprocessing An approach auditors use to detect unauthorized program changes. The auditor verifies the integrity of an application program and then saves it for future use. At subsequent intervals, and on a surprise basis, the auditor uses the previously verified version of the program to reprocess transaction data. The output of the two runs is compared and discrepancies are investigated.

request for proposal (RFP) A request by an organization or department for vendors to bid on hardware, software, or services.

request for systems development A written request for a new or improved system. The request describes the current system's problems, why the change is needed, and the proposed system's goals and objectives as well as its anticipated benefits and costs.

requirements costing A system evaluation method in which a list is made of all required features. If a proposed system does not have a desired feature, the cost of developing or purchasing that feature is added to the basic cost of the system. This method allows different systems to be compared and evaluated based on the costs of providing the required features.

residual risk The risk that remains after management implements internal controls or some other form of response to risk.

resources Those things that have economic value to an organization such as cash, inventory, supplies, factories, and land.

response time The amount of time that elapses between making a query and receiving a response.

responsibility accounting A system of reporting financial results on the basis of managerial responsibilities within an organization.

restoration The process of installing the backup copy of a database or file for use in data processing.

revenue cycle The recurring set of business activities and data processing operations associated with providing goods and services to customers and collecting cash in payment for those sales.

risk The likelihood that a threat or hazard will actually come to pass.

risk appetite The amount of risk a company is willing to accept to achieve its goals and objectives.

rollback A process whereby a log of all pre-update values is prepared for each record that is updated within a particular interval. If there is a system failure, the records can be restored to the pre-update values and the processing restarted.

round-down technique A fraud technique used in financial institutions that pay interest. The programmer instructs the computer to round down all interest calculations to two decimal places. The fraction of a cent rounded down on each calculation is put into the programmer's own account.

routers Special purpose devices that are designed to read the destination address fields in IP packet headers to decide where to send (route) the packet next.

routing verification procedures Controls to ensure that messages are not routed to the wrong system address. Examples are header labels, mutual authentication schemes, and dial-back.

run-to-run totals Comparison of the new balance of an updated general ledger account to its prior balance plus the sum of all current period debits and credits.

S

sabotage An intentional act where the intent is to destroy a system or some of its components.

salami technique A fraud technique in which tiny slices of money are stolen from many different accounts.

sales invoice A document notifying customers of the amount of a sale and where to send payment.

sales order The document created during sales order entry listing the item numbers, quantities, prices, and terms of the sale.

Sarbanes–Oxley Act (SOX) A law passed by Congress in 2002. SOX applies to publicly held companies and their auditors and is intended to prevent financial statement fraud, make financial reports more transparent, provide protection to investors, strengthen the internal controls at public companies, and punish executives who perpetrate fraud.

scanning routines Software routines that search a program for the occurrence of a particular variable name or other combinations of characters.

scareware Malicious software of no benefit that is sold using scare tactics.

scavenging Searching for corporate or personal records to gain unauthorized access to confidential information. Scavenging methods include searching garbage cans, communal trash bins, and city dumps to find documents with confidential information.

scheduled reports Reports that are generated by a system at specified time intervals.

scheduling feasibility The dimension of feasibility that determines if the system being developed can be implemented in the time allotted.

schema (1) A description of the data elements in a database, the relationships among the data elements, and the structure or overall logical model used to organize and describe the data. (2) An XBRL file that defines every element that appears in a specific instance document.

secondary key A field that can be used to identify records in a file. Unlike the primary key, it does not provide a unique identification.

security management Ensures that all aspects of the system are secure and protected from all internal and external threats.

segregation of accounting duties Separating the accounting functions of authorization, custody, and recording so as to minimize an employee's ability to comitt fraud.

segregation of duties The separation of assigned duties and responsibilities in such a way that no single employee can both perpetrate and conceal errors or irregularities.

segregation of systems duties Implementing control procedures to clearly divide authority and responsibility within the information system function to prevent employees from perpetrating and concealing fraud.

sequence check An edit check that determines if a batch of input data is in the proper numerical or alphabetical sequence.

sequence codes Documents are numbered consecutively to account for them. Gaps in the sequence code indicate missing documents that should be investigated. Examples of documents that are given sequence codes include prenumbered checks, invoices, and purchase orders.

sequential access An access method that requires data items to be accessed in the same order in which they were written.

sequential file A way of storing numeric or alphabetical records according to a key (e.g., customer numbers from 00001 to 99999). To access a sequential file record, the system starts at the beginning of the file and reads each record until the desired record is located.

sequential file processing Processing a master file sequentially from beginning to end. The master and transaction files are processed in the same predetermined order, such as alphabetically.

server High-capacity computer that contains the network software to handle communications, storage, and resource-sharing needs of other computers in the network. The server also contains the application software and data common to all users.

sexting Exchanging sexually explicit text messages and pictures with other people by means of a phone.

shoulder surfing Watching people enter telephone calling card or credit card numbers or listening as they give credit card numbers over the telephone or to a clerk.

sign check An edit check that verifies that the data in a field have the appropriate arithmetic sign.

size check An edit check that ensures the input data will fit into the assigned field.

smart cards Plastic cards containing a microprocessor, memory chips, and software that can store up to three pages of text. Used in Europe as a credit or ATM card.

SMS spoofing Using short message service (SMS) to change the name or number a text message appears to come from.

snapshot technique An audit technique that records the content of both a transaction record and a related master file record before and after each processing step.

social engineering Using deception to obtain unauthorized access to information resources. Access is usually obtained by fooling an employee.

software agents Computer programs that learn how to do often-performed, tedious, time consuming, or complex tasks.

software piracy The unauthorized copying of software.

source code (or **source program**) A computer program written in a programming language that is translated into the object (machine language) program by a translation program such as a compiler or assembler.

source code comparison program Compares the current version of a program with the source code of the program. If no changes were authorized, the two versions should be identical and any differences should be investigated. If the difference is an authorized change, auditors examine program change specifications to ensure that the changes were authorized and correctly incorporated.

source data automation (SDA) The collection of transaction data in machine-readable form at the time and place of origin. Examples of SDA devices are optical scanners and ATMs.

source documents Contain the initial record of a transaction that takes place. Examples of source documents, which are usually recorded on preprinted forms, include sales invoices, purchase orders, and employee time cards. Contrast with *operational document.*

spamming Simultaneously e-mailing the same unsolicited message to many people, often in an attempt to sell them some product.

special-purpose analysis reports Reports that have no prespecified content or format and are not prepared according to any regular schedule; rather, they are generally prepared in response to a management request to investigate a specific problem or opportunity.

specialized journals Journals where large numbers of repetitive transactions—such as credit sales, cash receipts, purchases on account, and cash disbursements—are recorded.

specific authorization Special approval an employee needs in order to be allowed to handle a transaction.

spoofing Altering something, such as an e-mail message, to make it look as if someone else sent it.

spyware Software that monitors computing habits and sends the data to someone else, often without the computer user's permission.

SQL injection (insertion) Inserting a malicious SQL query in input in such a way that it is passed to and executed by an application program.

standards The required procedures implemented to meet the policies.

stateful packet filtering A technique employed by firewalls in which a table is maintained that lists all established connections between the organization's computers and the Internet. The firewall consults this table to determine whether an incoming packet is part of an ongoing communication initiated by an internal computer.

static packet filtering A process that screens individual IP packets based solely on the contents of the source and/or destination fields in the IP packet header.

steering committee An executive-level committee to plan and oversee the information systems function. The committee typically consists of management from the systems department, the controller, and other management affected by the information systems function.

strategic master plan An organization's multiple-year plan that serves as a technological road map and lays out the projects the company must complete to achieve its long-range goals.

strategic objectives High-level goals that are aligned with and support the company's mission.

strategic planning Decisions that establish the organization's objectives and policies for accomplishing those objectives.

structured programming A modular approach to programming in which each module performs a specific function and is coordinated by a control module.

structured query language (SQL) A text-based query language provided by most relational database management systems. Powerful queries can be built using basic keywords such as: SELECT, FROM, and WHERE.

structured relationships Relationships in program design in which every event entity is linked to a resource entity and two agent entities.

structured walkthrough A formal program design review process. One or more programmers walk through another programmer's logic and code to detect weaknesses and errors in program design.

style sheet An XBRL file that provides instructions on how to display (render) an instance document on either a computer screen or printed report.

subschema (1) A subset of the schema that includes only those data items used in a particular application program or by a particular user. (2) The way the user defines the data and the data relationships.

subsidiary ledgers Ledgers used to record the detailed data for any general ledger account that has many individual subaccounts. Subsidiary ledgers are commonly used for accounts receivable, inventory, fixed assets, and accounts payable.

subsystems Smaller systems that are a part of the entire information system. Each subsystem performs a specific function that is important to and that supports the system of which it is a part.

superzapping The unauthorized use of a special system program to bypass regular system controls and perform illegal acts. The superzap utility was originally written to handle emergencies, such as restoring a system that had crashed.

supply chain An extended system that includes an organization's value chain as well as its suppliers, distributors, and customers.

support activities Activities in the value chain that enable the primary activities to be performed efficiently and effectively. Examples include administration, purchasing, and human resources.

symmetric encryption systems Encryption systems that use the same key both to encrypt and to decrypt.

synchronous transmission Data transmission in which start and stop bits are required only at the beginning and end of a block of characters. Contrast with *asynchronous transmission.*

syntax errors Errors that result from using the programming language improperly or from incorrectly typing the source program.

system (1) An entity consisting of two or more components or subsystems that interact to achieve a goal. (2) The equipment and programs that comprise a complete computer installation. (3) The programs and related procedures that perform a single task on a computer.

system control audit review file (SCARF) A concurrent audit technique that embeds audit modules into application software to continuously monitor all transaction activity and collect data on transactions having special audit significance.

system flowchart A diagrammatical representation that shows the flow of data through a series of operations in an automated data processing system. It shows how data are captured and put into the system, the processes that operate on the data, and system outputs.

system performance measurements Measurements used to evaluate and assess a system. Common measurements include throughput (output per unit of time), utilization (percentage of time the system is being productively used), and response time (how long it takes the system to respond).

system review A step in internal control evaluation in which it is determined if the necessary control procedures have been prescribed.

systems administrator Ensures that an information system operates smoothly and efficiently.

systems analysis (1) A rigorous and systematic approach to decision making, characterized by a comprehensive definition of available alternatives and an exhaustive analysis of the merits of each alternative as a basis for choosing the best alternative. (2) Examination of user information requirements in an organization to establish objectives and specifications for the design of an information system.

systems analysis report Comprehensive report prepared at the end of the systems analysis and design phase that summarizes and documents the findings of analysis activities.

systems analysts The people who help users determine their information needs and then design an information system to meet those needs.

systems design The process of preparing detailed specifications for the development of a new information system.

systems development life cycle (SDLC) Five processes a company goes through when it decides to design and implement a new system. The five steps are systems analysis, conceptual design, physical design, implementation and conversion, and operation and maintenance.

systems documentation A complete description of all aspects of each systems application, including narrative material, charts, and program listings.

systems implementation The task of delivering a completed system to an organization for use in day-to-day operations.

systems integrator A vendor who uses common standards and manages a cooperative systems development effort involving its own development personnel and those of the client and other vendors.

systems software Software that interfaces between the hardware and the application program. Systems software includes operating systems, database management systems, utility programs, language translators, and communications software.

systems survey The systematic gathering of facts relating to the existing information system. A systems analyst generally carries out this task.

systems survey report The culmination of the systems survey. It contains documentation such as memos; interview and observation notes; questionnaire data; file and record layouts and descriptions; input and output descriptions; and copies of documents, flowcharts, and data flow diagrams.

T

tagging An audit procedure in which certain records are marked with a special code before processing. During processing, all data relating to the marked records are captured and saved so that the auditors can verify them later.

taxonomy A set of XBRL files that defines elements and the relationships among them.

technical feasibility The dimension of feasibility concerned with whether a proposed system can be developed given the available technology.

terminal An input/output device for entering or receiving data directly from the computer.

test data Data that have been specially developed to test the accuracy and completeness of a computer program. The results from the test data are compared with hand-calculated results to verify that the program operates properly.

test data generator program A program that takes the specifications describing the logic characteristics of the program to be tested and automatically generates a set of test data that can be used to check the logic of the program.

test of control A test whose objective it is to determine whether control procedures are being followed correctly.

threats Any potential adverse occurrence or unwanted event that could be injurious to either the AIS or the organization. Also referred to as an *event.*

throughput (1) The total amount of useful work performed by a computer system during a given period of time. (2) A measure of production efficiency representing the number of "good" units produced in a given period of time.

time-based model of security Implementing a set of preventive, detective, and corrective controls that enable an organization to recognize that an attack is occurring and take steps to thwart it before any assets have been compromised.

time card A document that records the employee's arrival and departure times for each work shift. The time card records the total hours worked by an employee during a pay period.

time sheet A data entry screen (or paper document) used by salaried professionals to record how much time was spent performing various tasks for specific clients.

trailer label (record) Type of internal label that appears at the end of each file and serves as an indicator that the end of the file has been reached. The trailer label contains the batch totals calculated during input.

transaction An agreement between two entities to exchange goods or services. Any exchange that can be measured in economic terms by an organization.

transaction cycles A group of related business activities (e.g., sales order entry, shipping, billing, and cash receipts constitutes the revenue cycle). The four transaction cycles covered in the text are revenue, expenditure, production, and human resource management/payroll.

transaction file File that contains the individual business transactions that occur during a specific fiscal period. A transaction file is conceptually similar to a journal in a manual AIS.

transaction log A detailed record of every transaction entered in a system.

transaction processing A process that begins with capturing transaction data and ends with an informational output.

transcription error An error in which a digit of a number is written incorrectly (e.g., a 4 in the tens position transcribed as a 9, which would cause an error of 50 in the value of the number).

Transmission Control Protocol/Internet Protocol (TCP/IP) The protocol enabling communications on the Internet. It creates what

is called a packet-switching network. When a message is ready to be sent over the Internet, the TCP breaks it up into small packets. Each packet is then given a header, which contains the destination address, and the packets are then sent individually over the Internet. The IP uses the information in the packet header to guide the packets so that they arrive at the proper destination. Once there, the TCP reassembles the packets into the original message.

transposition error An error that results when numbers in two adjacent columns are inadvertently exchanged (for example, 64 is written as 46).

trap door A set of computer instructions that allows a user to bypass the system's normal controls.

trial balance A report listing the balances of all general ledger accounts. It is so named because one of its purposes is to allow the accountant to verify that the total debit balances in various accounts equal the total credit balances in other accounts.

triggered exception reports Preformatted reports generated only when certain conditions exist (e.g., the amount of raw materials on hand falls below the safety stock amount). The reports bring the information about the existing conditions to the attention of a decision maker.

Trojan horse A set of unauthorized computer instructions in an authorized and otherwise properly functioning program. It performs some illegal act at a preappointed time or under a predetermined set of conditions.

tuple (rhymes with *couple*). A row in a relation. A tuple contains data about a specific occurrence in a database table. For example, each row in the inventory table contains all the pertinent data about a particular inventory item.

turnaround document Records of company data sent to an external party and then returned to the system as input. Turnaround documents are prepared in machine-readable form to facilitate their subsequent processing as input records. An example is a utility bill.

turnkey system A system that is delivered to customers ready (theoretically) to be turned on. A turnkey system supplier buys hardware, writes application software that is tailored both to that equipment and to the specific needs of its customers, and then markets the entire system.

U

uninterruptible power supply (UPS) An alternative power supply device that protects against the loss of power and fluctuations in the power level by using battery power to enable the system to operate long enough to back up critical data and safely shut down.

Universal Product Code (UPC) A machine-readable code that is read by optical scanners. The code consists of a series of bar codes and is printed on most products sold in grocery stores.

UNIX A flexible and widely used operating system for 16-bit machines.

update anomaly If attributes that are not characteristics of the primary key of a relation are stored in that table, then that data item is stored in many different rows. For example, if customer addresses are stored in the sales invoice table, then the address for a given customer is stored many times (once for each sale). Consequently, if the value of that data item is not changed in every row in which it is stored, inconsistencies in the database will result.

updating Changing stored data to reflect more recent events (e.g., changing the accounts receivable balance because of a recent sale or collection).

user ID A knowledge identifier, such as an employee number or account number, that users enter to identify themselves when signing on to a system.

user identification (ID) and authentication system A system that requires users to identify themselves by entering a unique user ID when they sign on to the system.

users People who interact with the system. Users are those who record data, manage the system, and control the system's security. Those who use information from the system are end users.

utility programs A set of prewritten programs that perform a variety of file and data-handling tasks (e.g., sorting or merging files) and other housekeeping chores.

utilization The percentage of time a system is being productively used.

V

validity check An edit test in which an identification number or transaction code is compared with a table of valid identification numbers or codes maintained in computer memory.

value-added network (VAN) A public network that adds value to the data communications process by handling the difficult task of interfacing with the multiple types of hardware and software used by different companies.

value chain The linking together of all the primary and support activities in a business. Value is added as a product passes through the chain.

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

value system The combination of several value chains into one system. A value system includes the value chains of a company, its suppliers, its distributors, and its customers.

vendor-managed inventory (VMI) Practice in which manufacturers and distributors manage a retail customer's inventory using EDI. The supplier accesses its customer's point-of-sale system in order to monitor inventory and automatically replenish products when they fall to agreed-upon levels.

virtualization Taking advantage of the power and speed of modern computers to run multiple systems simultaneously on one physical computer. This reduces the number of servers needed and thereby reduces hardware, maintenance, and data center costs.

virtual private network (VPN) A network that controls access to an extranet using encryption and authentication technology.

virus A segment of executable code that attaches itself to an application program or some other executable system component. When the hidden program is triggered, it makes unauthorized alterations to the way a system operates.

voucher A document that summarizes the data relating to a disbursement and represents final authorization of payment.

voucher package The set of documents used to authorize payment to a vendor. It consists of a purchase order, receiving report, and vendor invoice.

voucher system A method for processing accounts payable in which a disbursement voucher is prepared instead of posting invoices directly to vendor records in the accounts payable subsidiary ledger. The disbursement voucher identifies the vendor, lists the outstanding invoices, and indicates the net amount to be paid after

deducting any applicable discounts and allowances. Contrast with *nonvoucher system.*

vulnerabilities Flaws in programs that can be exploited to either crash the system or take control of it.

vulnerability scans Automated tools designed to identify whether a given system possesses any well-known vulnerabilities. The scanning tool can also identify unused and unnecessary programs that represent potential security threats. The process of identifying and turning off unnecessary programs is called *hardening.*

W

walk-throughs Meetings, attended by those associated with a project, in which a detailed review of systems procedures and/or program logic is carried out in a step-by-step manner.

war dialing Searching for an idle modem by programming a computer to dial thousands of phone lines. Finding an idle modem often enables a hacker to gain access to the network to which it is connected.

war driving The practice of looking for unprotected home or corporate wireless networks.

Web cramming Developing a free and worthless trial-version Web site and charging the phone bill of the consumer for months even if the consumer cancels.

Web-page spoofing See *phishing.*

white-collar criminals Typically, businesspeople who commit fraud. White-collar criminals usually resort to trickery or cunning, and their crimes usually involve a violation of trust or confidence.

wide area network (WAN) A telecommunications network that covers a large geographic area anywhere in size from a few cities to the whole globe. A WAN uses telephone lines, cables, microwaves, or satellites to connect a wide variety of hardware devices in many different locations.

wiretap To listen in (eavesdrop) on an unprotected communications line.

worm Similar to a virus, except that it is a program rather than a code segment hidden in a host program. A worm also copies itself automatically and actively transmits itself directly to other systems.

X

XBRL eXtensible Business Reporting Language is a variant of XML (eXtensible Markup Language) specifically designed for use in communicating the content of financial data. It does this by creating tags for each data item that look much like the tags used by HTML.

Z

zero-balance check An internal check that requires the balance of an account to be zero after all entries to it have been made.

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