

# Part I

# Overview of Accounting Information Systems

## **CHAPTER 1**

The Information System: An  
Accountant's Perspective

## **CHAPTER 2**

Introduction to Transaction  
Processing

## **CHAPTER 3**

Ethics, Fraud, and Internal  
Control

## The Information System: An Accountant's Perspective

### LEARNING OBJECTIVES

*After studying this chapter, you should:*

- Understand the primary information flows within the business environment.
- Understand the difference between accounting information systems and management information systems.
- Understand the difference between a financial transaction and a nonfinancial transaction.
- Know the principal features of the general model for information systems.
- Be familiar with the functional areas of a business and their principal activities.
- Understand the stages in the evolution of information systems.
- Understand the relationship between external auditing, internal auditing, and IT auditing.

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

The purpose of this chapter is to place the subject of accounting information systems in perspective for accountants. Toward this end, the chapter is divided into four major sections, each dealing with a different aspect of information systems. The first section explores the information environment of the firm. It introduces basic systems concepts, identifies the types of information used in business, and describes the flows of information through an organization. This section also presents a framework for viewing accounting information systems in relation to other information systems components. The second section of the chapter deals with the impact of organizational structure on AIS. Here we examine the business organization as a system of functional areas. The accounting function plays an important role as the purveyor of financial information for the rest of the organization.

The third section reviews the evolution of information systems. Over the years, AIS has been represented by a number of different approaches or models. Five AIS models are examined. The final section discusses the role of accountants as users, designers, and auditors of AIS.

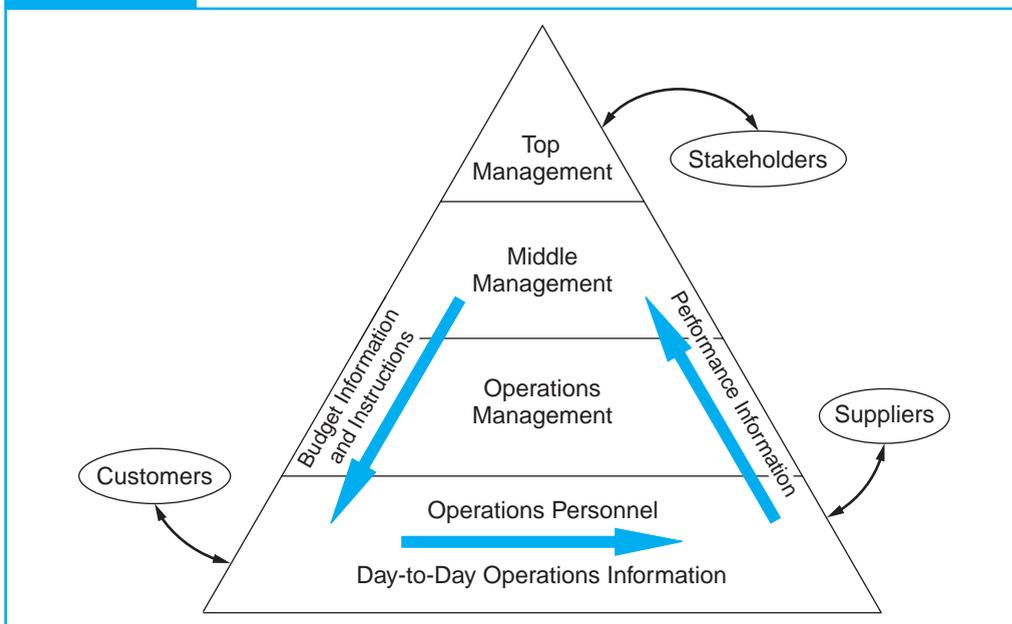
## The Information Environment

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

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

Notice in Figure 1-1 how information flows in two directions within the organization: horizontally and vertically. The horizontal flow supports operations-level tasks with highly detailed information about the many business transactions affecting the firm.

**FIGURE 1-1** Internal and External Flows of Information



This includes information on events such as the sale and shipment of goods, the use of labor and materials in the production process, and internal transfers of resources from one department to another. The vertical flow distributes summarized information about operations and other activities upward to managers at all levels. Management uses this information to support its various planning and control functions. Information also flows downward from senior managers to junior managers and operations personnel in the form of instructions, quotas, and budgets.

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

All user groups have unique information requirements. The level of detail and the nature of the information they receive differ considerably. For example, managers cannot use the highly detailed information needed by operations personnel. Management information is thus more summarized and oriented toward reporting on overall performance and problems rather than routine operations. The information must identify potential problems in time for management to take corrective action. External stakeholders, on the other hand, require information very different from that of management and operations users. Their financial statement information, based on generally accepted accounting principles (GAAP), is accrual based and far too aggregated for most internal uses.

## What Is a System?

For many, the term **system** generates mental images of computers and programming. In fact, the term has much broader applicability. Some systems are naturally occurring, whereas others are artificial. Natural systems range from the atom—a system of electrons, protons, and neutrons—to the universe—a system of galaxies, stars, and planets. All life forms, plant and animal, are examples of natural systems. Artificial systems are man-made. These systems include everything from clocks to submarines and social systems to information systems.

### *Elements of a System*

Regardless of their origin, all systems possess some common elements. To specify:

A system is a group of two or more interrelated components or subsystems that serve a common purpose.

Let's analyze the general definition to gain an understanding of how it applies to businesses and information systems.

**Multiple Components.** A system must contain more than one part. For example, a yo-yo carved from a single piece of wood and attached to a string is a system. Without the string, it is not a system.

**Relatedness.** A common purpose relates the multiple parts of the system. Although each part functions independently of the others, all parts serve a common objective. If a particular

component does not contribute to the common goal, then it is not part of the system. For instance, a pair of ice skates and a volleyball net are both components. They lack a common purpose, however, and thus do not form a system.

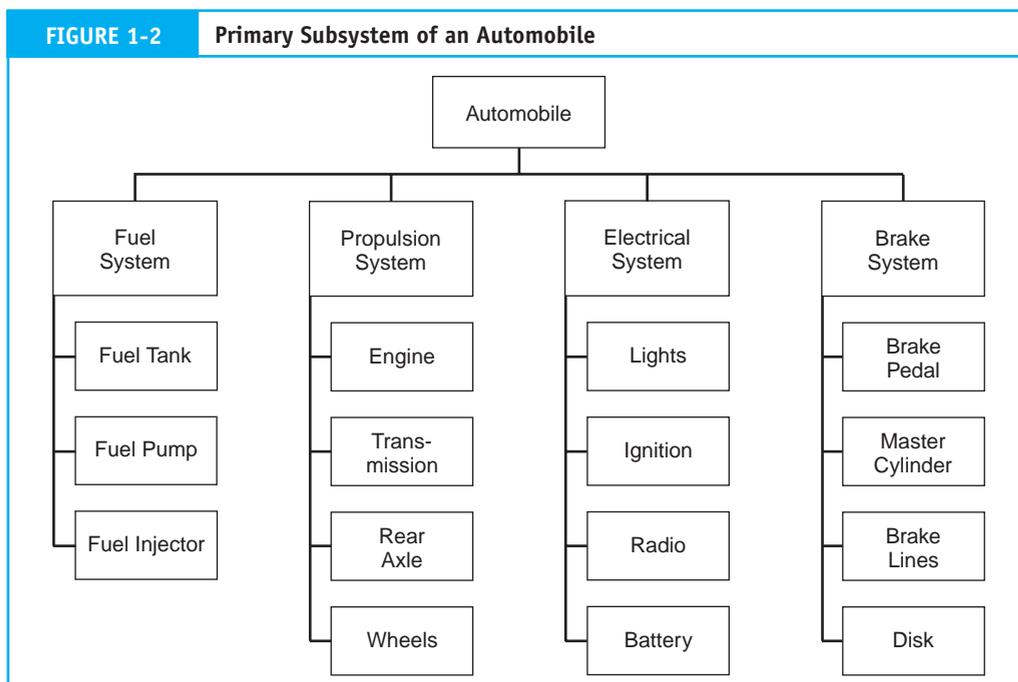
**System versus Subsystem.** The distinction between the terms *system* and *subsystem* is a matter of perspective. For our purposes, these terms are interchangeable. A system is called a **subsystem** when it is viewed in relation to the larger system of which it is a part. Likewise, a subsystem is called a system when it is the focus of attention. Animals, plants, and other life forms are systems. They are also subsystems of the ecosystem in which they exist. From a different perspective, animals are systems composed of many smaller subsystems, such as the circulatory subsystem and the respiratory subsystem.

**Purpose.** A system must serve at least one purpose, but it may serve several. Whether a system provides a measure of time, electrical power, or information, serving a purpose is its fundamental justification. When a system ceases to serve a purpose, it should be replaced.

### An Example of an Artificial System

An automobile is an example of an artificial system that is familiar to most of us and that satisfies the definition of a system provided previously. To simplify matters, let's assume that the automobile system serves only one purpose: providing conveyance. To do so requires the harmonious interaction of hundreds or even thousands of subsystems. For simplicity, Figure 1-2 depicts only a few of these.

In the figure, two points are illustrated of particular importance to the study of information systems: system decomposition and subsystem interdependency.



**System Decomposition.** Decomposition is the process of dividing the system into smaller subsystem parts. This is a convenient way of representing, viewing, and understanding the relationships among subsystems. By decomposing a system, we can present the overall system as a hierarchy and view the relationships between subordinate and higher-level subsystems. Each subordinate subsystem performs one or more specific functions to help achieve the overall objective of the higher-level system. Figure 1-2 shows an automobile decomposed into four primary subsystems: the fuel subsystem, the propulsion subsystem, the electrical subsystem, and the braking subsystem. Each contributes in a unique way to the system's objective, conveyance. These second-level subsystems are decomposed further into two or more subordinate subsystems at a third level. Each third-level subsystem performs a task in direct support of its second-level system.

**Subsystem Interdependency.** A system's ability to achieve its goal depends on the effective functioning and harmonious interaction of its subsystems. If a vital subsystem fails or becomes defective and can no longer meet its specific objective, the overall system will fail to meet its objective. For example, if the fuel pump (a vital subsystem of the fuel system) fails, then the fuel system fails. With the failure of the fuel system (a vital subsystem of the automobile), the entire system fails. On the other hand, when a nonvital subsystem fails, the primary objective of the overall system can still be met. For instance, if the radio (a subsystem of the electrical system) fails, the automobile can still convey passengers.

Designers of all types of systems need to recognize the consequences of subsystem failure and provide the appropriate level of control. For example, a systems designer may provide control by designing a backup (redundant) subsystem that comes into play when the primary subsystem fails. Control should be provided on a cost-benefit basis. It is neither economical nor necessary to back up every subsystem. Backup is essential, however, when excessive negative consequences result from a subsystem failure. Hence, virtually every modern automobile has a backup braking system, whereas very few have backup stereo systems.

Like automobile designers, information system designers need to identify critical subsystems, anticipate the risk of their failure, and design cost-effective control procedures to mitigate that risk. As we shall see in subsequent chapters, accountants feature prominently in this activity.

## An Information Systems Framework

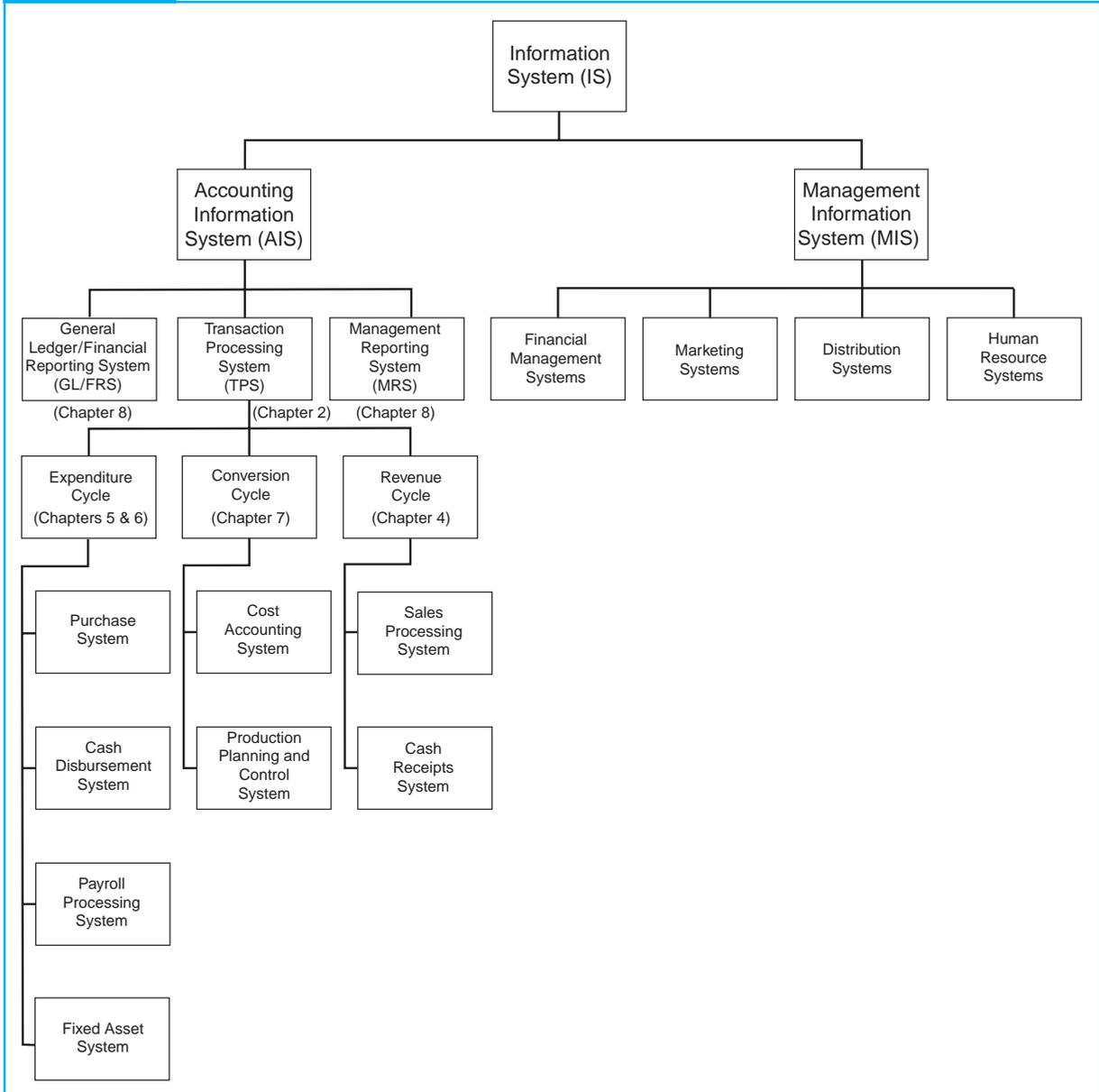
The **information system** is the set of formal procedures by which data are collected, processed into information, and distributed to users.

Figure 1-3 shows the information system of a hypothetical manufacturing firm decomposed into its elemental subsystems. Notice that two broad classes of systems emerge from the decomposition: the accounting information system (AIS) and the management information system (MIS). We will use this framework to identify the domain of AIS and distinguish it from MIS. Keep in mind that Figure 1-3 is a conceptual view; physical information systems are not typically organized into such discrete packages. More often, MIS and AIS functions are integrated to achieve operational efficiency.

The distinction between AIS and MIS centers on the concept of a transaction, as illustrated by Figure 1-4. The information system accepts input, called transactions, which are converted through various processes into output information that goes to users. Transactions fall into two classes: financial transactions and nonfinancial transactions. Before exploring this distinction, let's first broadly define:

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

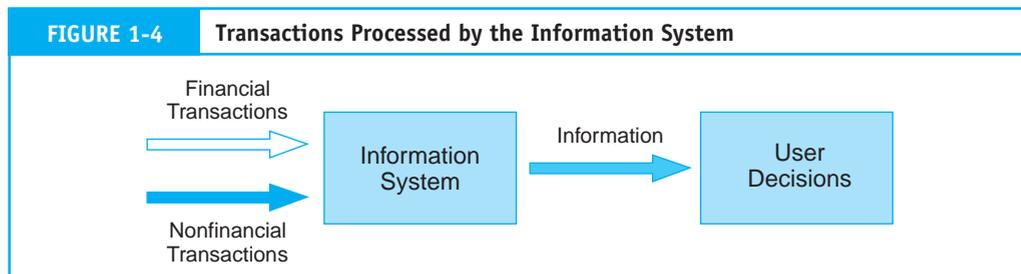
FIGURE 1-3 A Framework for Information Systems



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

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

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



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

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

### *The Accounting Information System*

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

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

### *The Management Information System*

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

**TABLE 1-1** Examples of MIS Applications in Functional Areas

Function	Examples of MIS Applications
Finance	Portfolio Management Systems Capital Budgeting Systems
Marketing	Market Analysis New Product Development Product Analysis
Distribution	Warehouse Organization and Scheduling Delivery Scheduling Vehicle Loading and Allocation Models
Personnel	Human Resource Management Systems <ul style="list-style-type: none"> <li>• Job skill tracking system</li> <li>• Employee benefits system</li> </ul>

### *Why Is it Important to Distinguish between AIS and MIS?*

SOX legislation requires that management design and implement internal controls over the entire financial reporting process. This includes the financial reporting system, the general ledger system, and the transaction processing systems that supply the data for financial reporting. SOX further requires that management certify these controls and that the external auditors express an opinion on control effectiveness. Because of the highly integrative nature of modern information systems, management and auditors need a conceptual view of the information system that distinguishes key processes and areas of risk and legal responsibility from the other (nonlegally binding) aspects of the system. Without such a model, critical management and audit responsibilities under SOX may not be met.

### **AIS Subsystems**

We devote separate chapters to an in-depth study of each AIS subsystem depicted in Figure 1-3. At this point, we briefly outline the role of each subsystem.

#### *Transaction Processing System*

The transaction processing system (TPS) is central to the overall function of the information system by converting economic events into financial transactions; recording financial transactions in the accounting records (journals and ledgers); and distributing essential financial information to operations personnel to support their daily operations.

The transaction processing system deals with business events that occur frequently. In a given day, a firm may process thousands of transactions. To deal efficiently with such volume, similar types of transactions are grouped together into transaction cycles. The TPS consists of three transaction cycles: the revenue cycle, the expenditure cycle, and the conversion cycle. Each cycle captures and processes different types of financial transactions.

Chapter 2 provides an overview of transaction processing. Chapters 4, 5, 6, and 7 examine in detail the revenue, expenditure, and conversion cycles.

### *General Ledger/Financial Reporting Systems*

The general ledger system (GLS) and the financial reporting system (FRS) are two closely related subsystems. However, because of their operational interdependency, they are generally viewed as a single integrated system—the GL/FRS. The bulk of the input to the GL portion of the system comes from the transaction cycles. Summaries of transaction cycle activity are processed by the GLS to update the general ledger control accounts. Other, less frequent events, such as stock transactions, mergers, and lawsuit settlements, for which there may be no formal processing cycle in place, also enter the GLS through alternate sources.

The financial reporting system measures and reports the status of financial resources and the changes in those resources. The FRS communicates this information primarily to external users. This type of reporting is called nondiscretionary because the organization has few or no choices in the information it provides. Much of this information consists of traditional financial statements, tax returns, and other legal documents.

### *Management Reporting System*

The management reporting system (MRS) provides the internal financial information needed to manage a business. Managers must deal immediately with many day-to-day business problems, as well as plan and control their operations. Managers require different information for the various kinds of decisions they must make. Typical reports produced by the MRS include budgets, variance reports, cost-volume-profit analyses, and reports using current (rather than historical) cost data. This type of reporting is called discretionary reporting because the organization can choose what information to report and how to present it.

## **A General Model for AIS**

Figure 1-5 presents the **general model for viewing AIS applications**. This is a general model because it describes all information systems, regardless of their technological architecture. The elements of the general model are **end users**, data sources, data collection, data processing, database management, information generation, and feedback.

### *End Users*

**End users** fall into two general groups: external and internal. External users include creditors, stockholders, potential investors, regulatory agencies, tax authorities, suppliers, and customers. Institutional users such as banks, the SEC, and the Internal Revenue Service (IRS) receive information in the form of financial statements, tax returns, and other reports that the firm has a legal obligation to produce. Trading partners (customers and suppliers) receive transaction-oriented information, including purchase orders, billing statements, and shipping documents.

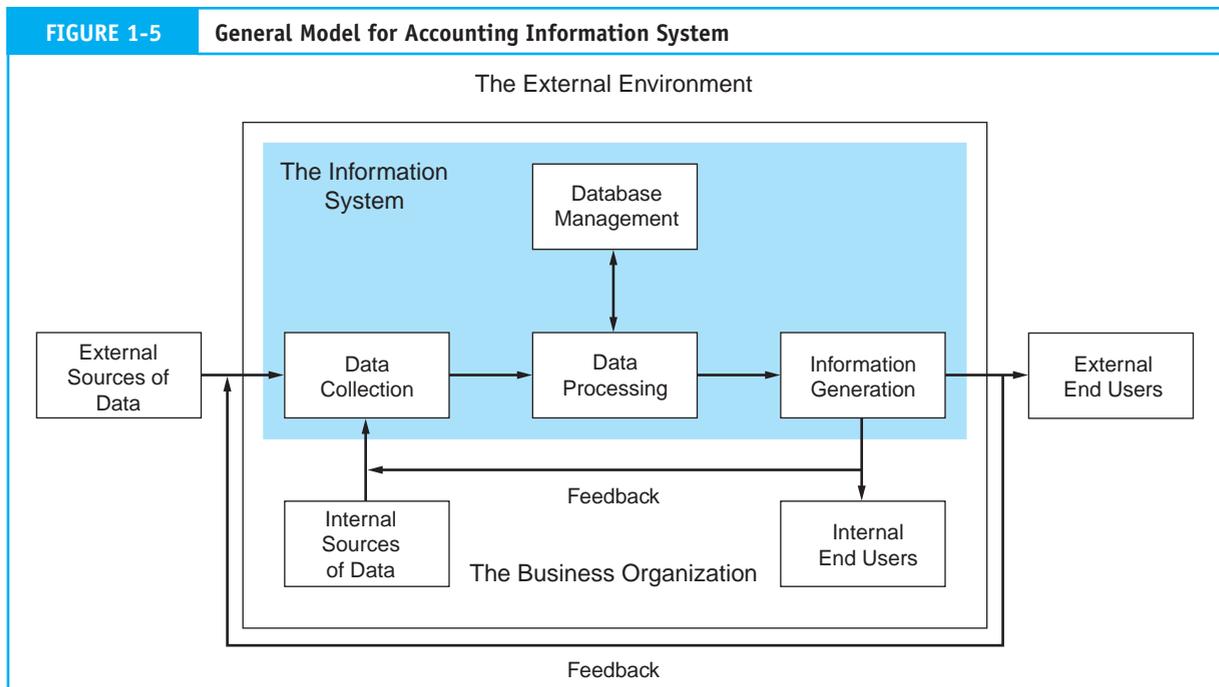
Internal users include management at every level of the organization, as well as operations personnel. In contrast to external reporting, the organization has a great deal of latitude in the way it meets the needs of internal users. Although there are some well-accepted conventions and practices, internal reporting is governed primarily by what gets the job done. System designers, including accountants, must balance the desires of internal users against legal and economic concerns such as adequate control and security, proper accountability, and the cost of providing alternative forms of information.

Thus internal reporting poses a less structured and generally more difficult challenge than external reporting.

**Data versus Information.** Before discussing the data sources portion of Figure 1-5, we must make an important distinction between the terms *data* and *information*. **Data** are facts, which may or may not be processed (edited, summarized, or refined) and have no direct effect on the user. By contrast, **information** causes the user to take an action that he or she otherwise could not, or would not, have taken. Information is often defined simply as processed data. This is an inadequate definition. Information is determined by the effect it has on the user, not by its physical form. For example, a purchasing agent receives a daily report listing raw material inventory items that are at low levels. This report causes the agent to place orders for more inventory. The facts in this report have information content for the purchasing agent. However, this same report in the hands of the personnel manager is a mere collection of facts, or data, causing no action and having no information content.

We can see from this example that one person's information is another person's data. Thus, information is not just a set of processed facts arranged in a formal report. Information allows users to take action to resolve conflicts, reduce uncertainty, and make decisions. We should note that action does not necessarily mean a physical act. For instance, a purchasing agent who receives a report showing that inventory levels are adequate will respond by ordering nothing. The agent's action to do nothing is a conscious decision, triggered by information and different from doing nothing because of being uninformed.

The distinction between data and information has pervasive implications for the study of information systems. If output from the information system fails to cause users to act, the system serves no purpose and has failed in its primary objective.



### Data Sources

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

### Data Collection

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

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

Efficient data collection procedures are designed to collect data only once. These data can then be made available to multiple users. Capturing the same data more than once leads to data redundancy and inconsistency. Information systems have limited collection, processing, and data storage capacity. Data redundancy overloads facilities and reduces the overall efficiency of the system. Inconsistency among redundant data elements can result in inappropriate actions and bad decisions.

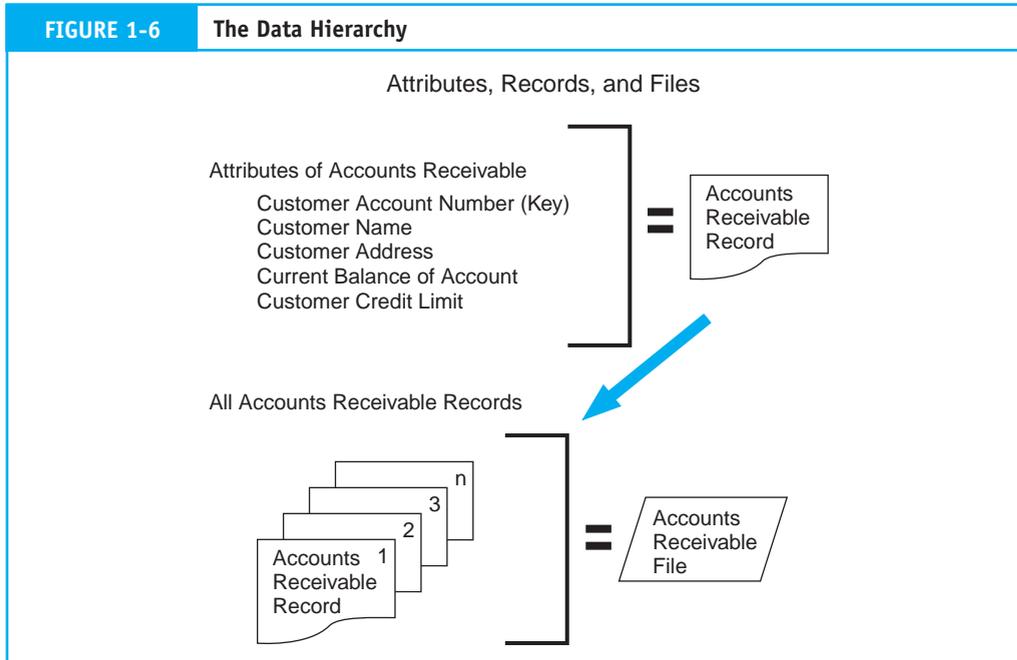
### Data Processing

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

### Database Management

The organization's **database** is its physical repository for financial and nonfinancial data. We use the term *database* in the generic sense. It can be a filing cabinet or a computer disk. Regardless of the database's physical form, we can represent its contents in a logical hierarchy. The levels in the data hierarchy—attribute, record, and file—are illustrated in Figure 1-6.

**Data Attribute.** The data attribute is the most elemental piece of potentially useful data in the database. An attribute is a logical and relevant characteristic of an entity about which the firm captures data. The attributes shown in Figure 1-6 are logical because they all relate sensibly to a common entity—accounts receivable (AR). Each attribute is also



relevant because it contributes to the information content of the entire set. As proof of this, the absence of any single relevant attribute diminishes or destroys the information content of the set. The addition of irrelevant or illogical data would not enhance the information content of the set.

**Record.** A record is a complete set of attributes for a single occurrence within an entity class. For example, a particular customer's name, address, and account balance is one occurrence (or record) within the AR class. To find a particular record within the database, we must be able to identify it uniquely. Therefore, every record in the database must be unique in at least one attribute.<sup>1</sup> This unique identifier attribute is the primary key. Because no natural attribute (such as customer name) can guarantee uniqueness, we typically assign artificial keys to records. The key for the AR records in Figure 1-6 is the customer account number. This is the only unique identifier in this record class. The other attributes possess values that may also exist in other records. For instance, multiple customers may have the same name, sales amounts, credit limits, and balances. Using any one of these as a key to find a record in a large database would be a difficult task. These nonunique attributes are, however, often used as secondary keys for categorizing data. For example, the account balance attribute can be used to prepare a list of customers with balances greater than \$10,000.

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

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

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

### *Information Generation*

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

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

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

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

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

**Summarization.** Information should be aggregated in accordance with the user's needs. Lower-level managers tend to need information that is highly detailed. As information flows upward through the organization to top management, it becomes more summarized. We shall look more closely at the effects that organizational structure and managerial level have on information reporting later in this chapter.

### *Feedback*

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

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

### Information System Objectives

Each organization must tailor its information system to the needs of its users. Therefore, specific information system objectives may differ from firm to firm. Three fundamental objectives are, however, common to all systems:

1. *To support the stewardship function of management.* Stewardship refers to management's responsibility to properly manage the resources of the firm. The information system provides information about resource utilization to external users via traditional financial statements and other mandated reports. Internally, management receives stewardship information from various responsibility reports.
2. *To support management decision making.* The information system supplies managers with the information they need to carry out their decision-making responsibilities.
3. *To support the firm's day-to-day operations.* The information system provides information to operations personnel to assist them in the efficient and effective discharge of their daily tasks.

### Acquisition of Information Systems

We conclude this section with a brief discussion of how organizations obtain information systems. Usually, they do so in two ways: (1) they develop customized systems from scratch through in-house systems development activities and (2) they purchase preprogrammed commercial systems from software vendors. Larger organizations with unique and frequently changing needs engage in in-house development. The formal process by which this is accomplished is called the **system development life cycle**. Smaller companies and larger firms that have standardized information needs are the primary market for commercial software. Three basic types of commercial software are turnkey systems, backbone systems, and vendor-supported systems.

**Turnkey systems** are completely finished and tested systems that are ready for implementation. Typically, they are general-purpose systems or systems customized to a specific industry. In either case, the end user must have standard business practices that permit the use of canned or off-the-shelf systems. The better turnkey systems, however, have built-in software options that allow the user to customize input, output, and processing through menu choices. However, configuring the systems to meet user needs can be a formidable task. Enterprise resource planning (ERP) systems such as Oracle and SAP are examples of this approach to systems implementation. ERP systems are discussed later in this chapter.

**Backbone systems** consist of a basic system structure on which to build. The primary processing logic is preprogrammed, and the vendor then designs the user interfaces to suit the client's unique needs. A backbone system is a compromise between a custom system and a turnkey system. This approach can produce satisfactory results, but customizing the system is costly.

**Vendor-supported systems** are custom (or customized) systems that client organizations purchase commercially rather than develop in-house. Under this approach, the software vendor designs, implements, and maintains the system for its client. This is a popular option with healthcare and legal services organizations that have complex systems

requirements but are not of sufficient magnitude to justify retaining an in-house systems development staff. Indeed, this has become a popular option for many organizations that traditionally have relied on in-house development but have chosen to outsource these activities. In recent years, public accounting firms have expanded their involvement in the vendor-supported market.

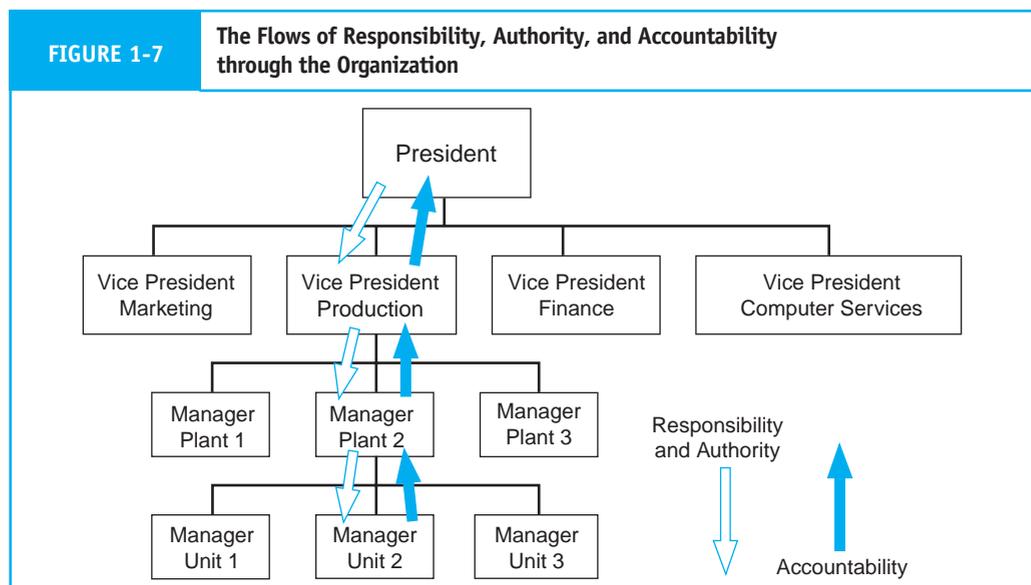
## Organizational Structure

The structure of an organization reflects the distribution of responsibility, authority, and accountability throughout the organization. These flows are illustrated in Figure 1-7. Firms achieve their overall objectives by establishing measurable financial goals for their operational units. For example, budget information flows downward. This is the mechanism by which senior management conveys to their subordinates the standards against which they will be measured for the coming period. The results of the subordinates' actions, in the form of performance information, flow upward to senior management. Understanding the distribution pattern of responsibility, authority, and accountability is essential for assessing user information needs.

### Business Segments

Business organizations consist of functional units or **segments**. Firms organize into segments to promote internal efficiencies through the specialization of labor and cost-effective resource allocations. Managers within a segment can focus their attention on narrow areas of responsibility to achieve higher levels of operating efficiency. Three of the most common approaches include segmentation by:

1. *Geographic Location*. Many organizations have operations dispersed across the country and around the world. They do this to gain access to resources, markets, or lines of



distribution. A convenient way to manage such operations is to organize the management of the firm around each geographic segment as a quasi-autonomous entity.

2. *Product Line.* Companies that produce highly diversified products often organize around product lines, creating separate divisions for each. Product segmentation allows the organization to devote specialized management, labor, and resources to segments separately, almost as if they were separate firms.
3. *Business Function.* Functional segmentation divides the organization into areas of specialized responsibility based on tasks. The functional areas are determined according to the flow of primary resources through the firm. Examples of business function segments are marketing, production, finance, and accounting.

Some firms use more than one method of segmentation. For instance, an international conglomerate may segment its operations first geographically, then by product within each geographic region, and then functionally within each product segment.

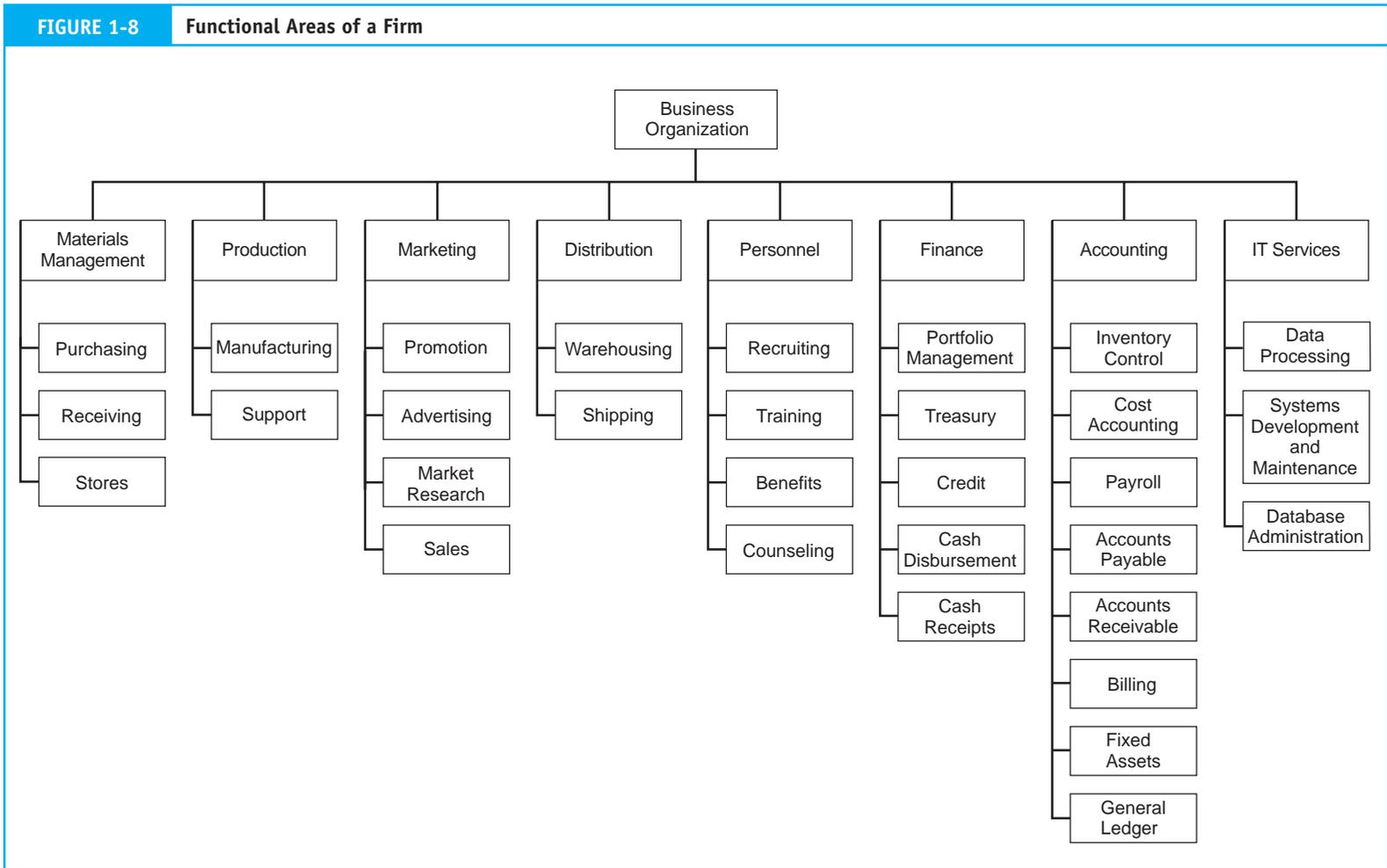
## Functional Segmentation

Segmentation by business function is the most common method of organizing. To illustrate it, we will assume a manufacturing firm that uses these resources: materials, labor, financial capital, and information. Table 1-2 shows the relationship between functional segments and these resources.

The titles of functions and even the functions themselves will vary greatly among organizations, depending on their size and line of business. A public utility may have little in the way of a marketing function compared to an automobile manufacturer. A service organization may have no formal production function and little in the way of inventory to manage. One firm may call its labor resource *personnel*, whereas another uses the term *human resources*. Keeping in mind these variations, we will briefly discuss the functional areas of the hypothetical firm shown in Figure 1-8. Because of their special importance to the study of information systems, the accounting and information technology (IT) functions are given separate and more detailed treatment.

**TABLE 1-2** Functions from Resources

Resource	Business Function
Materials	Inventory Management Production Marketing Distribution
Labor	Personnel
Financial Capital	Finance
Information	Accounting Information Technology



## Materials Management

The objective of materials management is to plan and control the materials inventory of the company. A manufacturing firm must have sufficient inventories on hand to meet its production needs and yet avoid excessive inventory levels. Every dollar invested in inventory is a dollar that is not earning a return. Furthermore, idle inventory can become obsolete, lost, or stolen. Ideally, a firm would coordinate inventory arrivals from suppliers such that they move directly into the production process. As a practical matter, however, most organizations maintain safety stocks to carry them through the lead time between placing the order for inventory and its arrival. We see from Figure 1-8 that materials management has three subfunctions:

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

## Production

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

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

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

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

## Marketing

The marketplace needs to know about, and have access to, a firm's products. The marketing function deals with the strategic problems of product promotion, advertising, and

market research. On an operational level, marketing performs such daily activities as sales order entry.

### *Distribution*

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

### *Personnel*

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

### *Finance*

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

## The Accounting Function

The accounting function manages the financial information resource of the firm. In this regard, it plays two important roles in transaction processing. First, accounting captures and records the financial effects of the firm's transactions. These include events such as the movement of raw materials from the warehouse into production, shipments of the finished products to customers, cash flows into the firm and deposits in the bank, the acquisition of inventory, and the discharge of financial obligations.

Second, the accounting function distributes transaction information to operations personnel to coordinate many of their key tasks. Accounting activities that contribute directly to business operations include inventory control, cost accounting, payroll, accounts payable, accounts receivable, billing, fixed asset accounting, and the general ledger. We deal with each of these specifically in later chapters. For the moment, however, we need to maintain a broad view of accounting to understand its functional role in the organization.

### *The Value of Information*

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

A marketing manager signed a contract with a customer to supply a large quantity of product by a certain deadline. He made this decision based on information about finished

goods inventory levels. However, because of faulty record keeping, the information was incorrect. The actual inventory levels of the product were insufficient to meet the order, and the necessary quantities could not be manufactured by the deadline. Failure to comply with the terms of the contract may result in litigation.

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

### *Accounting Independence*

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

## The Information Technology Function

Returning to Figure 1-8, the final area to be discussed is the IT function. Like accounting, the IT function is associated with the information resource. Its activities can be organized in a number of different ways. One extreme structure is the centralized data processing approach; at the other extreme is the distributed data processing approach. Most organizational structures fall somewhere between these extremes and embody elements of both.

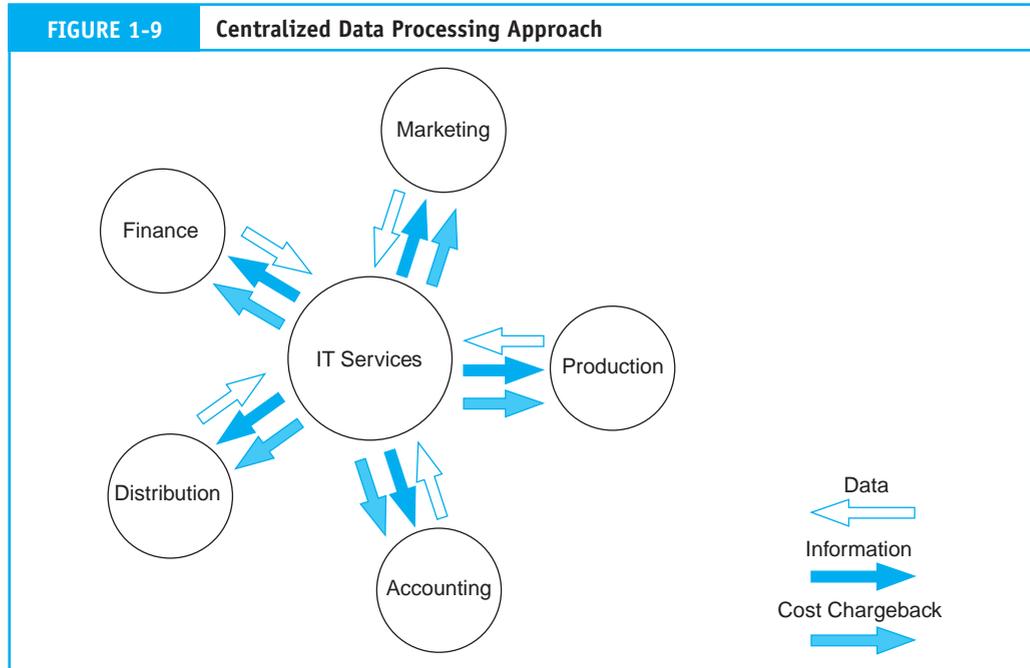
### *Centralized Data Processing*

Under the **centralized data processing** model, all data processing is performed by one or more large computers housed at a central site that serve users throughout the organization. Figure 1-9 illustrates this approach in which IT activities are consolidated and managed as a shared organization resource. End users compete for these resources on the basis of need. The IT function is usually treated as a cost center whose operating costs are charged back to the end users. Figure 1-10 shows the IT areas of operation in more detail. These include database administration, data processing, and systems development and maintenance. The key functions of each of these areas are described next.

**Database Administration.** Centrally organized companies maintain their data resources in a central location that is shared by all end users. In this shared data arrangement, a special independent group—database administration—headed by the database administrator is responsible for the security and integrity of the database. We explore the database concept and the role of the database administrator in Chapter 9.

**Data Processing.** The data processing group manages the computer resources used to perform the day-to-day processing of transactions. It may consist of the following functions: data control, data conversion, computer operations, and the data library.

Data control groups have all but disappeared from modern organizations. Traditionally, this function was responsible for receiving batches of transaction documents for processing from end users and then distributing computer output (documents and reports) back to the users. Today this function is usually automated and distributed back to the end users. Some organizations with older legacy systems, however, may still use a data



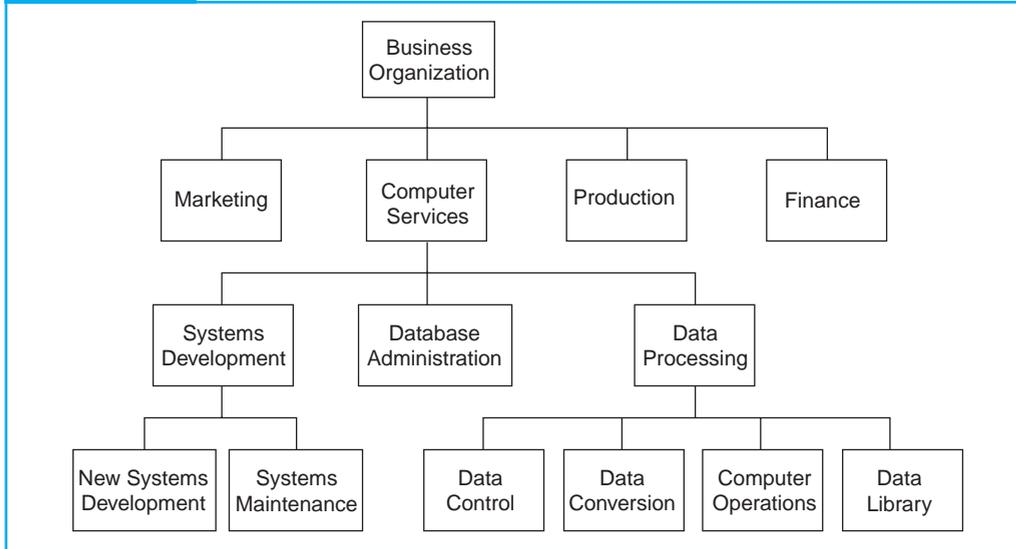
control group as a liaison between the end user and data processing. The data conversion function transcribes transaction data from source (paper) documents to digital media (tape or disk) suitable for computer processing by the central computer, which is managed by the computer operations group. Accounting applications are usually run according to a strict schedule that is controlled by the central computer.

The data library is a room often adjacent to the computer center that provides safe storage for the offline data files, such as magnetic tapes and removable disk packs. A data librarian who is responsible for the receipt, storage, retrieval, and custody of data files controls access to the library. The librarian issues tapes to computer operators and takes custody of files when processing is completed. The move to real-time processing and direct access files (discussed in Chapter 2) has reduced or eliminated the role of the data librarian in most organizations.

**Systems Development and Maintenance.** The information needs of users are met by two related functions: systems development and systems maintenance. The former group is responsible for analyzing user needs and for designing new systems to satisfy those needs. The participants in system development include systems professionals, end users, and stakeholders.

*Systems professionals* include systems analysts, database designers, and programmers who design and build the system. Systems professionals gather facts about the user's problem, analyze the facts, and formulate a solution. The product of their efforts is a new information system.

*End users* are those for whom the system is built. They are the managers who receive reports from the system and the operations personnel who work directly with the system as part of their daily responsibilities.

**FIGURE 1-10 Organization of IT Function in a Centralized System**


*Stakeholders* are individuals inside or outside the firm who have an interest in the system but are not end users. They include management, internal auditors, and consultants who oversee systems development.

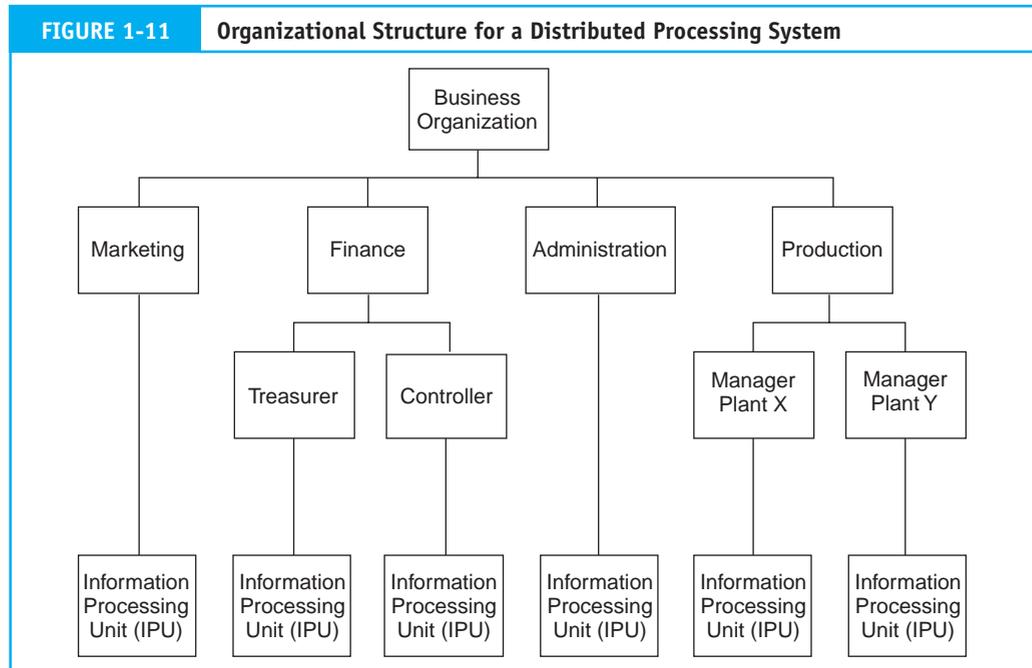
Once a new system has been designed and implemented, the systems maintenance group assumes responsibility for keeping it current with user needs. Over the course of the system's life (often several years), between 80 and 90 percent of its total cost will be attributable to maintenance activities.

### *Distributed Data Processing*

An alternative to the centralized model is the concept of **distributed data processing (DDP)**. The topic of DDP is quite broad, touching on such related topics as end-user computing, commercial software, networking, and office automation. Simply stated, DDP involves reorganizing the IT function into small information processing units (IPUs) that are distributed to end users and placed under their control. IPUs may be distributed according to business function, geographic location, or both. Any or all of the IT activities represented in Figure 1-10 may be distributed. Figure 1-11 shows a possible new organizational structure following the distribution of all data processing tasks to the end-user areas.

Notice that the central IT function has been eliminated from the organization structure. Individual operational areas now perform this role. In recent years, DDP has become an economic and operational feasibility that has revolutionized business operations. DDP is, however, a mixed bag of advantages and disadvantages.

**Disadvantages of DDP.** We should bear in mind that the disadvantages of DDP might also be described as the advantages of a centralized approach. The discussion focuses on important issues that carry control implications that accountants should recognize. The loss of control is one of the most serious disadvantages of DDP. Other potential problems include the inefficient use of resources, the destruction of audit trails, inadequate segregation



of duties, an increased potential for programming errors and systems failures, and the lack of standards. Specific problems are examined in the following section.

*Mismanagement of organization-wide resources.* Some argue that when organization-wide resources exceed a threshold amount, say 5 percent of the total operations budget, they should be controlled and monitored centrally. Information processing services (such as computer operations, programming, data conversion, and database management) represent a significant expenditure for many organizations. Those opposed to DDP argue that distributing responsibility for these resources will inevitably lead to their mismanagement and suboptimal utilization.

*Hardware and software incompatibility.* Distributing the responsibility for hardware and software purchases to user management can result in uncoordinated and poorly conceived decisions. Working independently, decision makers may settle on dissimilar and incompatible operating systems, technology platforms, spreadsheet programs, word processors, and database packages. Such hardware and software incompatibilities can degrade and disrupt communications between organizational units.

*Redundant tasks.* Autonomous systems development activities distributed throughout the firm can result in each user area reinventing the wheel. For example, application programs created by one user, which could be used with little or no change by others, will be redesigned from scratch rather than shared. Likewise, data common to many users may be recreated for each IPU, resulting in a high level of data redundancy.

*Consolidating incompatible activities.* The distribution of the IT function to individual user areas results in the creation of many very small units that may not permit the necessary separation of incompatible functions. For example, within a single IPU, the same person may program applications, perform program maintenance, enter transaction data into the

computer, and operate the computer equipment. This situation represents a fundamental violation of internal control.

*Hiring qualified professionals.* End-user managers may lack the knowledge to evaluate the technical credentials and relevant experience of candidates applying for a position as a computer professional. Also, if the organizational unit into which a new employee is entering is small, the opportunity for personal growth, continuing education, and promotion may be limited. For these reasons, IPU managers sometimes experience difficulty attracting highly qualified personnel, which increases the risk of programming errors and systems failures.

*Lack of standards.* Because of the distribution of responsibility in the DDP environment, standards for developing and documenting systems, choosing programming languages, acquiring hardware and software, and evaluating performance may be unevenly applied or nonexistent. Opponents of DDP argue that the risks associated with the design and operation of a data processing system are made tolerable only if such standards are consistently applied. This requires that standards be imposed centrally.

**Advantages of DDP.** The most commonly cited advantages of DDP are related to cost savings, increased user satisfaction, and improved operational efficiency. Specific issues are discussed in the following section.

*Cost reductions.* In the past, achieving economies of scale was the principal justification for the centralized approach. The economics of data processing favored large, expensive, powerful computers. The wide variety of needs that such centralized systems had to satisfy called for computers that were highly generalized and employed complex operating systems.

Powerful yet inexpensive small scale, which can cost-effectively perform specialized functions, have changed the economics of data processing dramatically. In addition, the unit cost of data storage, which was once the justification for consolidating data in a central location, is no longer the prime consideration. Moreover, the move to DDP can reduce costs in two other areas: (1) data can be entered and edited at the IPU, thus eliminating the centralized tasks of data conversion and data control; and (2) application complexity can be reduced, which in turn reduces development and maintenance costs.

*Improved cost control responsibility.* Managers assume the responsibility for the financial success of their operations. This requires that they be properly empowered with the authority to make decisions about resources that influence their overall success. Therefore, if information-processing capability is critical to the success of a business operation, then should not management be given control over these resources? This argument counters the argument presented earlier favoring the centralization of organization-wide resources. Proponents of DDP argue that the benefits from improved management attitudes outweigh the additional costs incurred from distributing these resources.

*Improved user satisfaction.* Perhaps the most often cited benefit of DDP is improved user satisfaction. This derives from three areas of need that too often go unsatisfied in the centralized approach: (1) as previously stated, users desire to control the resources that influence their profitability; (2) users want systems professionals (analysts, programmers, and computer operators) who are responsive to their specific situation; and (3) users want to become more actively involved in developing and implementing their own systems. Proponents of DDP argue that providing more customized support—feasible only in a distributed environment—has direct benefits for user morale and productivity.

*Backup.* The final argument in favor of DDP is the ability to back up computing facilities to protect against potential disasters such as fires, floods, sabotage, and earthquakes. One solution is to build excess capacity into each IPU. If a disaster destroys a single site, its transactions can be processed by the other IPUs. This requires close coordination between decision makers to ensure that they do not implement incompatible hardware and software at their sites.

### *The Need for Careful Analysis*

DDP carries a certain leading-edge prestige value that, during an analysis of its pros and cons, may overwhelm important considerations of economic benefit and operational feasibility. Some organizations have made the move to DDP without fully considering whether the distributed organizational structure will better achieve their business objectives. Some DDP initiatives have proven ineffective, and even counterproductive, because decision makers saw in these systems virtues that were more symbolic than real. Before taking such an aggressive step, decision makers should assess the true merits of DDP for their organization. Accountants have an opportunity and an obligation to play an important role in this analysis.

## The Evolution of Information System Models

Over the past 50 years, a number of different approaches or models have represented accounting information systems. Each new model evolved because of the shortcomings and limitations of its predecessor. An interesting feature in this evolution is that the newest technique does not immediately replace older models. Thus, at any point in time, various generations of systems exist across different organizations and may even coexist within a single enterprise. The modern auditor needs to be familiar with the operational features of all AIS approaches that he or she is likely to encounter. This book deals extensively with five such models: manual processes, flat-file systems, the database approach, the REA (resources, events, and agents) model, and ERP (enterprise resource planning) systems. Each of these is briefly outlined in the following section.

### **The Manual Process Model**

The manual process model is the oldest and most traditional form of accounting systems. Manual systems constitute the physical events, resources, and personnel that characterize many business processes. This includes such tasks as order-taking, warehousing materials, manufacturing goods for sale, shipping goods to customers, and placing orders with vendors. Traditionally, this model also includes the physical task of record keeping. Often, manual record keeping is used to teach the principles of accounting to business students. This approach, however, is simply a training aid. These days, manual records are never used in practice.

Nevertheless, there is merit in studying the manual process model before mastering computer-based systems. First, learning manual systems helps establish an important link between the AIS course and other accounting courses. The AIS course is often the only accounting course in which students see where data originate, how they are collected, and how and where information is used to support day-to-day operations. By examining information flows, key tasks, and the use of traditional accounting records in transaction processing, the students' bookkeeping focus is transformed into a business processes perspective.

Second, the logic of a business process is more easily understood when it is not shrouded by technology. The information needed to trigger and support events such as selling, warehousing, and shipping is fundamental and independent of the technology that underlies the information system. For example, a shipping notice informing the billing process that a product has been shipped serves this purpose whether it is produced and processed manually or digitally. Once students understand what tasks need to be performed, they are better equipped to explore different and better ways of performing these tasks through technology.

Finally, manual procedures facilitate understanding internal control activities, including segregation of functions, supervision, independent verification, audit trails, and access controls. Because human nature lies at the heart of many internal control issues, we should not overlook the importance of this aspect of the information system.

## The Flat-File Model

The flat-file approach is most often associated with so-called **legacy systems**. These are large mainframe systems that were implemented in the late 1960s through the 1980s. Organizations today still use these systems extensively. Eventually, modern database management systems will replace them, but in the meantime accountants must continue to deal with legacy system technologies.

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

When multiple users need the same data for different purposes, they must obtain separate data sets structured to their specific needs. Figure 1-12 illustrates how customer sales data might be presented to three different users in a durable goods retailing organization. The accounting function needs customer sales data organized by account number and structured to show outstanding balances. This is used for customer billing, AR maintenance, and financial statement preparation. Marketing needs customer sales history data organized by demographic keys. They use this for targeting new product promotions and for selling product upgrades. The product services group needs customer sales data organized by products and structured to show scheduled service dates. Such information is used for making after-sales contacts with customers to schedule preventive maintenance and to solicit sales of service agreements.

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

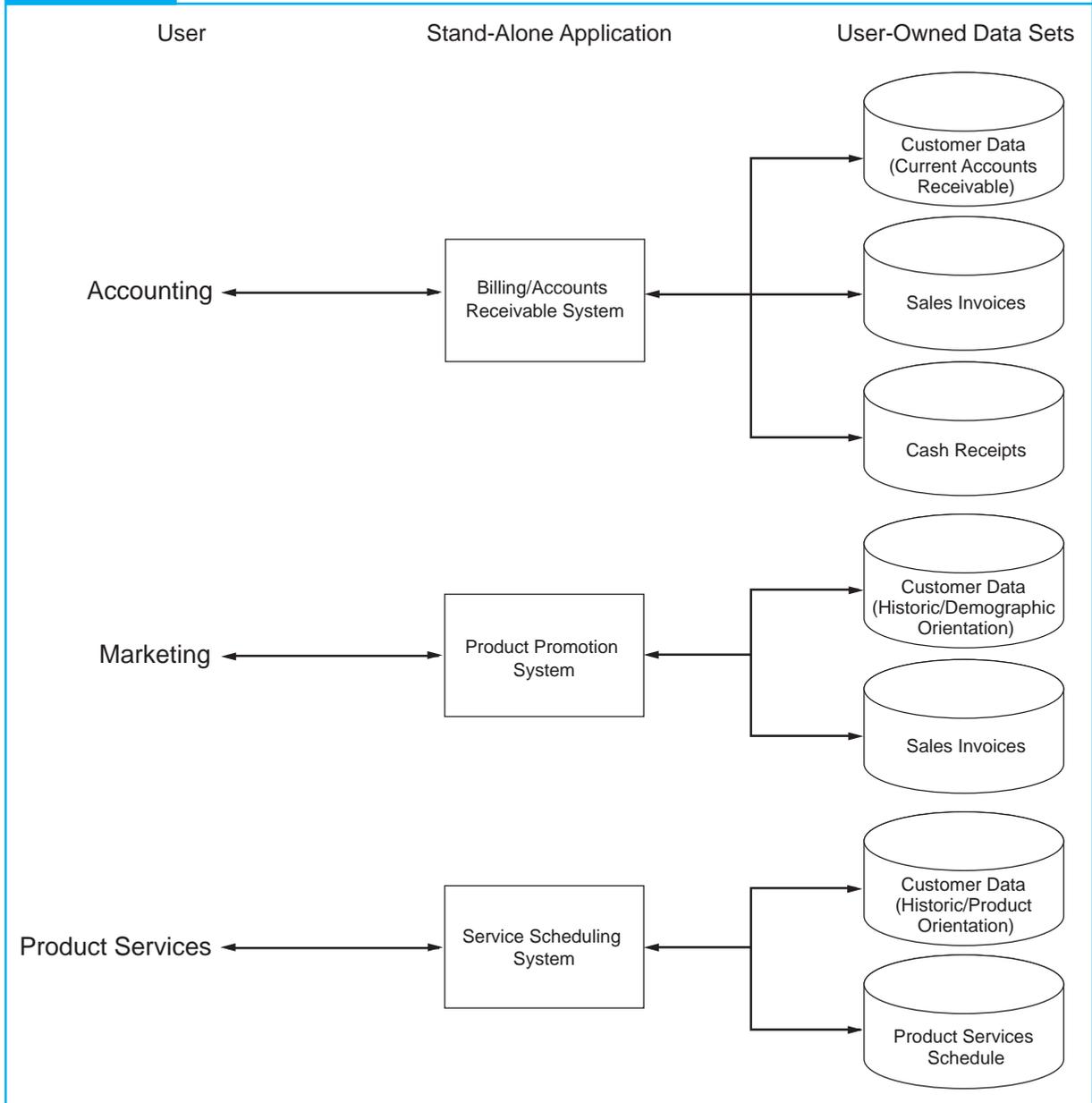
### *Data Storage*

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

### *Data Updating*

Organizations have a great deal of data stored in files that require periodic updating to reflect changes. For example, a change to a customer's name or address must be reflected in

FIGURE 1-12 Flat-File Model



the appropriate master files. When users keep separate files, all changes must be made separately for each user. This adds significantly to the task and the cost of data management.

### *Currency of Information*

In contrast to the problem of performing multiple updates is the problem of failing to update all the user files affected by a change in status. If update information is not

properly disseminated, the change will not be reflected in some users' data, resulting in decisions based on outdated information.

### *Task-Data Dependency*

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

### *Flat Files Limit Data Integration*

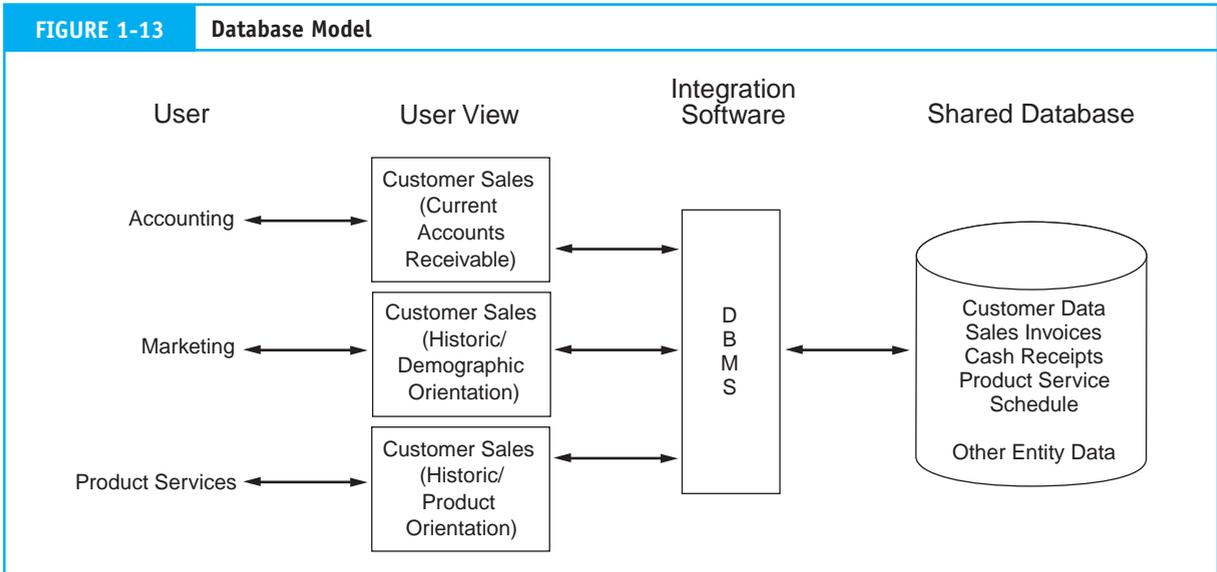
The flat-file approach is a single-view model. Files are structured, formatted, and arranged to suit the specific needs of the owner or primary user of the data. Such structuring, however, may exclude data attributes that are useful to other users, thus preventing successful integration of data across the organization. For example, because the accounting function is the primary user of accounting data, these data are often captured, formatted, and stored to accommodate financial reporting and GAAP. This structure, however, may be useless to the organization's other (nonaccounting) users of accounting data, such as the marketing, finance, production, and engineering functions. These users are presented with three options: (1) do not use accounting data to support decisions; (2) manipulate and massage the existing data structure to suit their unique needs; or (3) obtain additional private sets of the data and incur the costs and operational problems associated with data redundancy.

In spite of these inherent limitations, many large organizations still use flat files for their general ledger and other financial systems. Most members of the data processing community assumed that the end of the century would see the end of legacy systems. Instead, corporate America invested billions of dollars making these systems year-2000 (Y2K) compliant. Legacy systems continue to exist because they add value for their users, and they will not be replaced until they cease to add value. Students who may have to work with these systems in practice should be aware of their key features.

## **The Database Model**

An organization can overcome the problems associated with flat files by implementing the **database model** to data management. Figure 1-13 illustrates how this approach centralizes the organization's data into a common database that is shared by other users. With the organization's data in a central location, all users have access to the data they need to achieve their respective objectives. Access to the data resource is controlled by a **database management system (DBMS)**. The DBMS is a special software system that is programmed to know which data elements each user is authorized to access. The user's program sends requests for data to the DBMS, which validates and authorizes access to the database in accordance with the user's level of authority. If the user requests data that he or she is not authorized to access, the request is denied. Clearly, the organization's procedures for assigning user authority are an important control issue for auditors to consider.

The most striking difference between the database model and the flat-file model is the pooling of data into a common database that all organizational users share. With access to the full domain of entity data, changes in user information needs can be satisfied without



obtaining additional private data sets. Users are constrained only by the limitations of the data available to the entity and the legitimacy of their need to access it. Through data sharing, the following traditional problems associated with the flat-file approach may be overcome:

*Elimination of data redundancy.* Each data element is stored only once, thereby eliminating data redundancy and reducing data collection and storage costs. For example, customer data exists only once, but is shared by accounting, marketing, and product services users. To accomplish this, the data are stored in a generic format that supports multiple users.

*Single update.* Because each data element exists in only one place, it requires only a single update procedure. This reduces the time and cost of keeping the database current.

*Current values.* A single change to a database attribute is automatically made available to all users of the attribute. For example, a customer address change is immediately reflected in the marketing and product services views when the billing clerk enters it.

Flat-file and early database systems are called **traditional systems**. Within this context, the term *traditional* means that the organization's information systems applications (its programs) function independently of each other rather than as an integrated whole. Early database management systems were designed to interface directly with existing flat-file programs. Thus when an organization replaced its flat files with a database, it did not have to spend millions of dollars rewriting its existing programs. Indeed, early database applications performed essentially the same independent functions as their flat-file counterparts.

Another factor that limited integration was the structured database models of the era. These models were inflexible and did not permit the degree of data sharing that is found in modern database systems. Whereas some degree of integration was achieved with this type of database, the primary and immediate advantage to the organization was the reduction in data redundancy.

True integration, however, would not be possible until the arrival of the **relational database model**. This flexible database approach permits the design of integrated systems applications capable of supporting the information needs of multiple users from a common set of integrated **database tables**. We should note, however, that the relational

database model merely permits integration to occur; integration is not guaranteed. Poor systems design can occur under any model. In fact, most organizations today that employ a relational database run applications that are traditional in design and do not make full use of relational technology. The two remaining models to be discussed (REA and ERP) employ relational database technology more effectively.

## The REA Model

**REA** is an accounting framework for modeling an organization's critical resources, events, and agents (REA) and the relationships between them. Once specified, both accounting and nonaccounting data about these phenomena can be identified, captured, and stored in a relational database. From this repository, user views can be constructed that meet the needs of all users in the organization. The availability of multiple views allows flexible use of transaction data and permits the development of accounting information systems that promote, rather than inhibit, integration.

The REA model was proposed in 1982 as a theoretical model for accounting.<sup>2</sup> Advances in database technology have focused renewed attention on REA as a practical alternative to the classical accounting framework. The following summarizes the key elements of the REA models.

### Resources

Economic **resources** are the assets of the organization. They are defined as objects that are both scarce and under the control of the enterprise. This definition departs from the traditional model because it does not include AR. An account receivable is an artifact record used simply to store and transmit data. Because it is not an essential element of the system, it need not be included in the database. Instead, AR values are derived from the difference between sales to customers and the cash received in payment of sales.

### Events

Economic **events** are phenomena that affect changes in resources. They can result from activities such as production, exchange, consumption, and distribution. Economic events are the critical information elements of the accounting system and should be captured in a highly detailed form to provide a rich database.

### Agents

Economic **agents** are individuals and departments that participate in an economic event. They are parties both inside and outside the organization with discretionary power to use or dispose of economic resources. Examples of agents include sales clerks, production workers, shipping clerks, customers, and vendors.

The REA model requires that accounting phenomena be characterized in a manner consistent with the development of multiple user views. Business data must not be preformatted or artificially constrained and should reflect all relevant aspects of the underlying economic events. As such, REA procedures and databases are structured around events rather than accounting artifacts such as journals, ledgers, charts of accounts, and double-entry accounting. Under the REA model, business organizations prepare financial statements directly from the event database. The following sales and cash receipts events for

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2 W. E. McCarthy, "The REA Accounting Model: A Generalized Framework for Accounting Systems in a Shared Data Environment." *The Accounting Review* (July 1982): 554–57.

a hypothetical retailer can be used to illustrate the inherent differences between classical and REA accounting:

Sept. 1: Sold 5 units of product X21 @ \$30 per unit and 10 units of product Y33 @ \$20 per unit to customer Smith (Total sale = \$350). The unit cost of the inventory is \$16 and \$12, respectively (Total CGS = \$200).

Sept. 30: Received \$200 cash from customer Smith on account, check number 451.

In flat-file or non-REA database systems, the two events would be recorded in a set of classical accounts like those shown in Figure 1-14. This involves summarizing the events to accommodate the account structure. The details of the transactions however, are not captured under this approach.

An REA accounting system would capture these transactions in a series of relational database tables that emphasize events rather than accounts. This is illustrated in Figure 1-15. Each table deals with a separate aspect of the transaction. Data pertaining to the customer, the invoice, specific items sold, and so on, can thus be captured for multiple uses and users. The tables of the database are linked via common attributes called primary keys (PK) and embedded foreign keys (FK) that permit integration. In contrast, the files in the traditional system are independent of each other and thus cannot accommodate such detailed data gathering. As a result, traditional systems must summarize event data at the loss of potentially important facts.

Traditional accounting records including journals, ledgers, and charts of accounts do not exist as physical files or tables under the REA model. For financial reporting purposes, views or images of traditional accounting records are constructed from the event tables. For example, the amount of Smith's account receivable balance is derived from {total sales (Quant sold \* Sale price) less cash received (Amount) = 350 - 200 = 150}.

**FIGURE 1-14** Classical Accounting Records in a Non-REA System

**Accounts Receivable File**

Customer Number	Customer Name	Debit	Credit	Balance
23456	Smith	350	200	150

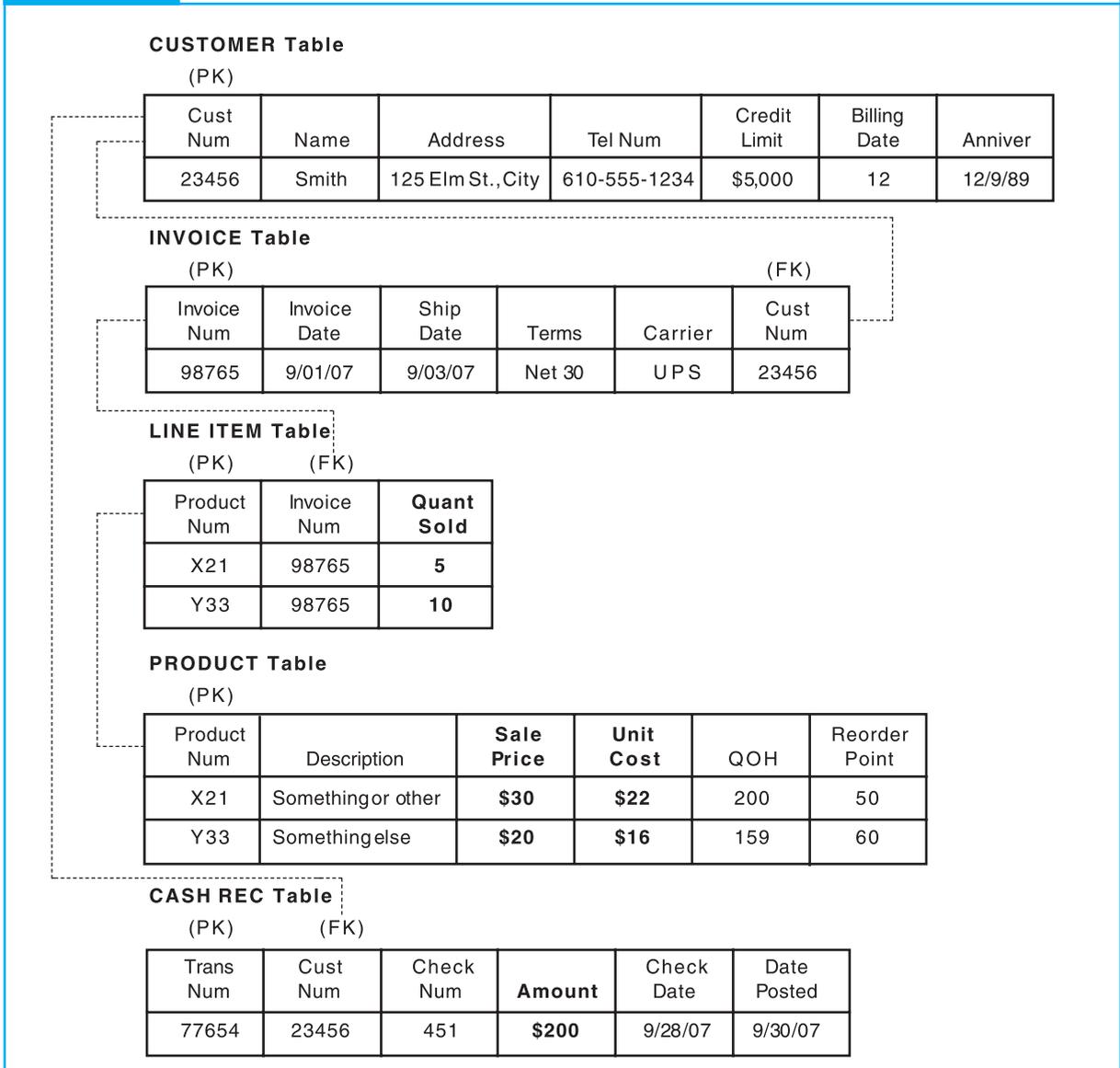
**Cost of Goods Sold File**

Acct Number	Debit	Credit
5734	270	

**Sales File**

Acct Number	Credit
4975	350

FIGURE 1-15 Event Database in an REA System



If necessary or desired, journal entries and general ledger amounts can also be derived from these event tables. For example, the cost of goods sold control account balance is (Quant sold \* Unit cost) summed for all transactions for the period.

REA is a conceptual model, not a physical system. Many of its tenets, however, are found within advanced database systems. The most notable application of REA philosophy is seen in the proliferation of ERP systems, which are discussed in the following section.

## Enterprise Resource Planning Systems

**Enterprise resource planning (ERP)** is an information system model that enables an organization to automate and integrate its key business processes. ERP breaks down traditional functional barriers by facilitating data sharing, information flows, and the introduction of common business practices among all organizational users. The implementation of an ERP system can be a massive undertaking that can span several years. Because of the complexity and size of ERPs, few organizations are willing or able to commit the necessary financial and physical resources and incur the risk of developing an ERP system in-house. Hence, virtually all ERPs are commercial products. The recognized leaders in the market are SAP, Oracle, Baan, J.D. Edwards & Co., and PeopleSoft Inc.

ERP packages are sold to client organizations in modules that support standard processes. Some common ERP modules include:

- Asset Management
- Financial Accounting
- Human Resources
- Industry-Specific Solutions
- Plant Maintenance
- Production Planning
- Quality Management
- Sales and Distribution
- Inventory Management

One of the problems with standardized modules is that they may not always meet the organization's exact needs. For example, a textile manufacturer in India implemented an ERP package only to discover that extensive, unexpected, and expensive modifications had to be made to the system. The ERP would not allow the user to assign two different prices to the same bolt of cloth. The manufacturer charged one price for domestic consumption, but another (four times higher) for exported products. That particular ERP system, however, provided no way to assign two prices to the same item while maintaining an accurate inventory count.

Organizations that hope to successfully implement an ERP will need to modify their business processes to suit the ERP, modify the ERP to suit their business, or, more likely, modify both. Often, additional software applications need to be connected to the ERP to handle unique business functions, particularly industry-specific tasks. These applications, often called bolt-ons, are not always designed to communicate with ERP packages. The process of creating a harmonious whole can be quite complex and sometimes fails, resulting in significant losses to the organization. ERP packages are enormously expensive, but the savings in efficiencies should be significant. Organization management should exercise great care in deciding which, if any, ERP is best for them.

The evolution of information systems models outlined in this section provides a framework for much of the material contained in this book. Chapters 2 through 8 deal with business processes, security, fraud, controls, and a variety of other issues related to traditional (manual, flat-file, and early database) systems. Chapters 9 through 12 examine advanced database systems, the REA model, ERP, and other emerging technologies.

## The Role of the Accountant

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The final section of this chapter deals with the accountant's relationship to the information system. Accountants are primarily involved in three ways: as system users, designers, and auditors.

## Accountants as Users

In most organizations, the accounting function is the single largest user of IT. All systems that process financial transactions impact the accounting function in some way. As end users, accountants must provide a clear picture of their needs to the professionals who design their systems. For example, the accountant must specify accounting rules and techniques to be used, internal control requirements, and special algorithms such as depreciation models. The accountant's participation in systems development should be active rather than passive. The principal cause of design errors that result in system failure is the absence of user involvement.

## Accountants as System Designers

An appreciation of the accountant's responsibility for system design requires a historic perspective that predates the computer as a business information tool. Traditionally, accountants have been responsible for key aspects of the information system, including assessing the information needs of users, defining the content and format of output reports, specifying sources of data, selecting the appropriate accounting rules, and determining the controls necessary to preserve the integrity and efficiency of the information system.

These traditional systems were physical, observable, and unambiguous. The procedures for processing information were manual, and the medium for transmitting and storing data was paper. With the arrival of the computer, computer programs replaced manual procedures, and paper records were stored digitally. The role accountants would play in this new era became the subject of much controversy. Lacking computer skills, accountants were generally uncertain about their status and unwilling to explore this emerging technology.

Many accountants relinquished their traditional responsibilities to the new generation of computer professionals who were emerging in their organizations. Computer programmers, often with no accounting or business training, assumed full responsibility for the design of accounting information systems. As a result, many systems violated accounting principles and lacked necessary controls. Large system failures and computer frauds marked this period in accounting history. By the mid-1970s, in response to these problems, the accounting profession began to reassess the accountant's professional and legal responsibilities for computer-based systems.

Today, we recognize that the responsibility for systems design is divided between accountants and IT professionals as follows: the accounting function is responsible for the conceptual system, and the IT function is responsible for the physical system. To illustrate the distinction between conceptual and physical systems, consider the following example:

The credit department of a retail business requires information about delinquent accounts from the AR department. This information supports decisions made by the credit manager regarding the creditworthiness of customers.

The design of the **conceptual system** involves specifying the criteria for identifying delinquent customers and the information that needs to be reported. The accountant determines the nature of the information required, its sources, its destination, and the accounting rules that need to be applied. The **physical system** is the medium and method for capturing and presenting the information. The computer professionals determine the most economical and effective technology for accomplishing the task. Hence, systems design should be a collaborative effort. Because of the uniqueness of each system and the susceptibility of systems to serious error and even fraud, the accountant's involvement in systems design should be pervasive. In later chapters, we shall see that the active participation of accountants is critical to the system's success.

## Accountants as System Auditors

**Auditing** is a form of independent attestation performed by an expert—the auditor—who expresses an opinion about the fairness of a company's financial statements. Public confidence in the reliability of internally produced financial statements rests directly on their being validated by an independent expert auditor. This service is often referred to as the **attest function**. Auditors form their opinions based on a systematic process that will be explained in Chapter 15.

Both internal and external auditors conduct audits. External auditing is often called independent auditing because certified public accounting (CPA) firms that are independent of the client organization's management perform them. External auditors represent the interests of third-party stakeholders in the organization, such as stockholders, creditors, and government agencies.

### External Auditing

Historically, the external accountant's responsibility as a systems **auditor** was limited to the attest function described previously. In recent years this role has been expanded by the broader concept of assurance. The Big Four public accounting firms have now renamed their traditional audit functions *assurance services*.

**Assurance.** **Assurance services** are professional services, including the attest function, that are designed to improve the quality of information, both financial and nonfinancial, used by decision makers. For example, a client may contract assurance services to obtain an opinion as to the quality or marketability of a product. Alternatively, a client may need information about the efficiency of a production process or the effectiveness of their network security system. A gray area of overlap exists between assurance and consulting services, which auditors must avoid. They were once allowed to provide consulting services to audit clients. This is now prohibited under SOX legislation. These issues are discussed in later chapters.

**IT Auditing.** **IT auditing** is usually performed as part of a broader financial audit. The organizational unit responsible for conducting IT audits may fall under the assurance services group or be independent. Typically they carry a name such as *IT Risk Management*, *Information Systems Risk Management*, or *Global Risk Management*. The IT auditor attests to the effectiveness of a client's IT controls to establish their degree of compliance with prescribed standards. Because many of the modern organization's internal controls are computerized, the IT audit may be a large portion of the overall audit. We examine IT controls, risks, and auditing issues in Chapters 15, 16, and 17.

### Internal Auditing

**Internal auditing** is an appraisal function housed within the organization. Internal auditors perform a wide range of activities on behalf of the organization, including conducting financial statement audits, examining an operation's compliance with organizational policies, reviewing the organization's compliance with legal obligations, evaluating operational efficiency, detecting and pursuing fraud within the firm, and conducting IT audits. As you can see, the tasks external and internal auditors perform are similar. The feature that most clearly distinguishes the two groups is their respective constituencies. External auditors represent third-party outsiders, whereas internal auditors represent the interests of management.

## Summary

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

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

The third section reviewed the evolution of AIS models. Each new model evolved because of the shortcomings and limitations of its predecessor. As new approaches evolved, however, the predecessor or legacy systems often remained in service. Thus, at any point in time, various generations of systems coexist across different organizations and even within a single enterprise. Five AIS models were examined.

The final section of the chapter examined three roles of accountant as (1) users of AIS, (2) designers of AIS, and (3) auditors of AIS. In most organizations, the accounting function is the single largest user of the AIS. The IT function is responsible for designing the physical system, and the accounting function is responsible for specifying the conceptual system. Auditing is an independent attestation performed by the auditor, who expresses an opinion about the fairness of a company's financial statements. Both external and internal auditors conduct IT audits. The IT auditor attests to the effectiveness of a client's IT controls to establish their degree of compliance with prescribed standards.

## Key Terms

- accounting information systems (AIS) (2)
- agents (31)
- assurance services (36)
- attest function (36)
- auditing (36)
- auditor (36)
- backbone systems (15)
- centralized data processing (21)
- conceptual system (35)
- currency of information (27)
- data (11)
- data collection (12)
- data processing (12)
- data sources (12)
- data storage (27)
- data updating (27)
- database (12)
- database management (14)
- database management system (DBMS) (29)
- database model (29)
- database tables (30)
- distributed data processing (DDP) (23)
- end users (10)
- enterprise resource planning (ERP) (34)
- events (31)
- feedback (14)
- financial transaction (7)
- flat-file model (27)
- general ledger/financial reporting system (GL/FRS) (8)
- general model for viewing AIS applications (10)
- independence (21)
- information (11)
- information flows (3)
- information generation (14)
- information system (6)
- internal auditing (36)
- IT auditing (36)
- legacy systems (27)
- management information system (MIS) (8)
- management reporting system (MRS) (8)
- nonfinancial transactions (8)
- physical system (35)
- REA (31)
- relational database model (30)
- reliability (20)
- resources (31)
- segments (16)
- stakeholders (4)
- subsystem (5)
- system (4)
- system development life cycle (15)
- task-data dependency (29)
- trading partners (4)
- traditional systems (30)
- transaction (6)
- transaction processing system (TPS) (8)
- turnkey systems (15)
- vendor-supported systems (15)

## Review Questions

1. What are the four levels of activity in the pyramid representing the business organization? Distinguish between horizontal and vertical flows of information.
2. Distinguish between natural and artificial systems.
3. What are the elements of a system?
4. What is system decomposition and subsystem interdependency? How are they related?
5. What is the relationship among data, information, and an information system?
6. Distinguish between AIS and MIS.
7. What are the three cycles of transaction processing systems?
8. What is discretionary reporting?
9. What are the characteristics of good or useful information?
10. What rules govern data collection?
11. What are the levels of data hierarchy?
12. What are the three fundamental tasks of database management?
13. What is feedback and how is it useful in an information system?
14. What are the fundamental objectives of all information systems?
15. What does stewardship mean and what is its role in an information system?

16. Distinguish between responsibility, authority, and accountability. Which flow upward and which flow downward?
17. Distinguish between turnkey, backbone, and vendor-supported systems.
18. List each of the functional areas and their subfunctions.
19. What are the roles of internal and external auditors?
20. What is the role of a database administrator?
21. Name the three most common ways to segment an organization.
22. What is the role of the accounting function in an organization?
23. Distinguish between the centralized and distributed approaches to organizing the IT function.
24. What is the role of the data control group?
25. What is distributed data processing?
26. What are the advantages and disadvantages of distributed data processing?
27. What types of tasks become redundant in a distributed data processing system?
28. What is a flat-file system?
29. What are the three general problems associated with data redundancy?
30. Define the key elements of the REA model.
31. What is an ERP system?
32. What three roles are played by accountants with respect to the information system?
33. Define the term *attest function*.
34. Define the term *assurance*.
35. What is IT auditing?
36. Distinguish between conceptual and physical systems.

## Discussion Questions

1. Discuss the differences between internal and external users of information and their needs and demands on an information system. Historically, which type of user has the firm catered to most?
2. Comment on the level of detail necessary for operations management, middle management, and stockholders.
3. Distinguish between financial and nonfinancial transactions. Give three examples of each.
4. Why have reengineering efforts been made to integrate AIS and MIS?
5. Do you think transaction processing systems differ significantly between service and manufacturing industries? Are they equally important to both sectors?
6. Discuss the difference between the financial reporting system and general ledger system.
7. Examine Figure 1-5 and discuss where and how problems can arise that can cause the resulting information to be bad or ineffective.
8. Discuss how the elements of efficiency, effectiveness, and flexibility are crucial to the design of an information system.
9. Discuss what is meant by the statement, “The accounting system is a conceptual flow of information that represents the physical flows of personnel, raw materials, machinery, and cash through the organization.”
10. Discuss the importance of accounting independence in accounting information systems. Give an example of where this concept is important (use an example other than inventory control).
11. Discuss why it is crucial that internal auditors report solely to the uppermost level of management (either to the chief executive officer or the audit committee of the board of directors) and answer to no other group.
12. Contrast centralized data processing with distributed data processing. How do the roles of systems professionals and end users change? What do you think the trend is today?
13. Discuss how conceptual and physical systems differ and which functions are responsible for each of these systems.
14. If accountants are viewed as providers of information, then why are they consulted as system users in the systems development process?

15. Do you agree with the statement, “The term *IT auditor* should be considered obsolete because it implies a distinction between regular auditors and auditors who examine computerized AIS”? Why or why not?
16. What are the primary reasons for segmenting organizations?
17. Why is it important to organizationally separate the accounting function from other functions of the organization?
18. What is the most likely system acquisition method—in-house, turnkey, backbone, or vendor-supported—for each of the following situations?
  - A plumbing supply company with 12 employees that sells standard products to wholesale customers in a local community needs a system to manage its affairs.
  - A major oil company with diverse holdings, complex oil leases, and esoteric accounting practices needs a system that can coordinate its many enterprises.
  - A municipal government needs a system that complies with standard government accounting practices but can be integrated with other existing systems.
19. The REA model is based on the premise that “business data must not be preformatted or artificially constrained and must reflect all relevant aspects of the underlying economic events.” What does this mean and how is it applied?
20. ERP systems are composed of a highly integrated set of standardized modules. Discuss the advantages and potential disadvantages of this approach.

### Multiple-Choice Questions

1. Which of the following is NOT a financial transaction?
  - a. purchase of products
  - b. cash receipts
  - c. update valid vendor file
  - d. sale of inventory
2. The following are subsystems of the Accounting Information System, EXCEPT
  - a. Transaction Processing System.
  - b. Human Resources System.
  - c. General Ledger/Financial Reporting System.
  - d. Management Reporting System.
3. Which of the following is NOT a purpose of the Transaction Processing System?
  - a. managing and reporting on the status of financial investments
  - b. converting economic events into financial transactions
  - c. distributing essential information to operations personnel to support their daily operations
  - d. recording financial transactions in the accounting records
4. The objectives of the data collection activity of the general model for AIS are to collect data that are
  - a. relevant and redundant.
  - b. efficient and objective.
  - c. efficient and redundant.
  - d. efficient and relevant.
5. Which of the following is NOT a characteristic of effective information?
  - a. relevance
  - b. accuracy
  - c. summarization
  - d. precision
6. Which of the following is NOT a database management task?
  - a. retrieval
  - b. storage
  - c. summarization
  - d. deletion

7. When viewed from the highest to most elemental level, the data hierarchy is
  - a. attribute, record, file.
  - b. record, attribute, key.
  - c. file, record, attribute.
  - d. file, record, key.
  - e. key, record, file.
8. Which is NOT an accountant's primary role in information systems?
  - a. system user
  - b. system auditor
  - c. system designer
  - d. system programmer
9. Which of the following is NOT an objective of all information systems?
  - a. support for the stewardship function of management
  - b. support for management decision making
  - c. support for the day-to-day operations of the firm
  - d. all of the above are objectives
10. Which of the following best describes the activities of the materials management function?
  - a. purchasing, receiving, and inventory control
  - b. receiving, sales, distribution, and purchasing
  - c. receiving, storage, purchasing, and accounts payable
  - d. purchasing, receiving, and storage
  - e. purchasing, storage, and distribution
11. Which of the following best describes the activities of the production function?
  - a. maintenance, inventory control, and production planning
  - b. production planning, quality control, manufacturing, and cost accounting
  - c. quality control, production planning, manufacturing, and payroll
  - d. maintenance, production planning, storage, and quality control
  - e. manufacturing, quality control, and maintenance
12. Which of the following best describes the activities of the accounting function?
  - a. inventory control, accounts payable, fixed assets, and payroll
  - b. fixed assets, accounts payable, cash disbursements, and cost accounting
  - c. purchasing, cash receipts, accounts payable, cash disbursements, and payroll
  - d. inventory control, cash receipts, accounts payable, cash disbursements, and payroll
  - e. inventory control, cost accounting, accounts payable, cash disbursements, and payroll
13. Which statement best describes the issue of distributed data processing (DDP)?
  - a. The centralized and DDP approaches are mutually exclusive; an organization must choose one approach or the other.
  - b. The philosophy and objective of the organization's management will determine the extent of DDP in the firm.
  - c. In a minimum DDP arrangement, only data input and output are distributed, leaving the tasks of data control, data conversion, database management, and data processing to be centrally managed.
  - d. The greatest disadvantage of a totally distributed environment is that the distributed IPU locations are unable to communicate and coordinate their activities.
  - e. Although hardware (such as computers, database storage, and input/output terminals) can be effectively distributed, the systems development and maintenance tasks must remain centralized for better control and efficiency.
14. Which of the following is a disadvantage of distributed data processing?
  - a. End-user involvement in systems operation is decreased.
  - b. Disruptions due to mainframe failures are increased.
  - c. The potential for hardware and software incompatibility across the organization is increased.
  - d. The time between project request and completion is increased.
  - e. All of the above are disadvantages.

## Problems

### 1. Users of Information

Classify the following users of information as either:

I—internal user

T—external user: trading partner

S—external user: stakeholder

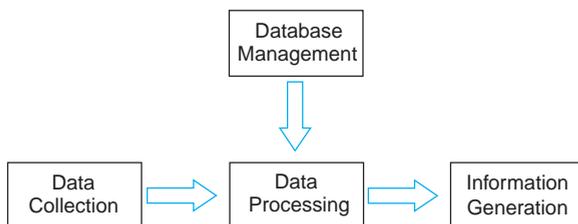
- Internal Revenue Service
- Inventory control manager
- Board of directors
- Customers
- Lending institutions
- Securities and Exchange Commission
- Stockholders
- Chief executive officer
- Suppliers
- Bondholders

### 2. Subsystems

Use the human body system to illustrate the concepts of system decomposition and subsystem interdependency. Draw a hierarchical chart similar to the one in Figure 1-2 and discuss the interdependencies.

### 3. AIS Model

Examine the diagram below and determine what essential mechanism is missing. Once you have identified the missing element, discuss its importance.



### 4. AIS & MIS Features

List some AIS and MIS information from which salespeople may benefit. Clearly indicate whether the information item would be an output of a traditional AIS or MIS system. Finally, discuss the benefits of integrating this information.

### 5. Information System Categorization

Classify the following items as either:

TPS—transaction processing system

FRS—financial reporting system

MRS—management reporting system

- Variance reports
- Sales order capture
- Balance sheet
- Budgets
- Purchase order preparation
- Tax returns
- Sales summary by product line
- Cash disbursements preparation
- Annual report preparation
- Invoice preparation
- Cost-volume-profit analysis

### 6. Flat-File versus Database Model

Outline the traditional problems associated with the flat-file model that are resolved by the database model.

### 7. Organization Functions

Based on Figure 1-8, draw a diagram of functional segments for an oil company that has the following operations:

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

### 8. Organization Functions

Based on Figure 1-8, draw a diagram of functional segments for a manufacturer of diversified products. The general characteristics of the firm are as follows:

- The organization produces three unrelated products: lawn and garden furniture for sale in home improvement centers and

department stores; plastic packaging products for the electronics and medical supply industries; and paper products (for example, plates, cups, and napkins) for the fast food industry.

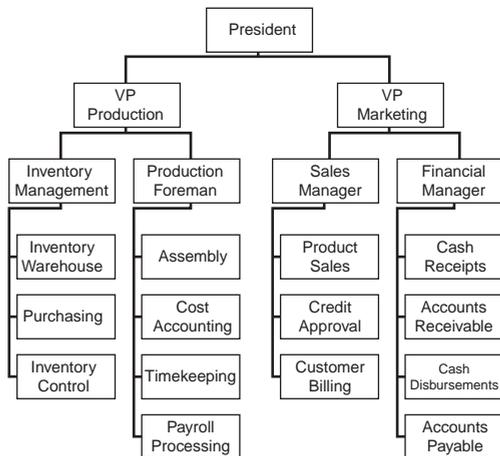
- b. Although the manufacturing facilities are located within a single complex, none of the three products share the same suppliers, customers, or physical production lines.
- c. The organization’s functional activities include design, production, distribution, marketing, finance, human resources, and accounting.

### 9. Functional Segmentation

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

**Required:**

- a. What operational problems (inefficiency, errors, fraud, etc.) do you think Blue Sky could experience because of this structure?
- b. Draw a new diagram reflecting an improved structure that solves the problems you identified. If necessary, you may add up to two new positions.



### 10. Communications

Before the mid-1970s, systems programmers and businesspeople (including accountants) did not communicate well with one another.

The programmers were criticized for using too much jargon, and the businesspeople were criticized for not adequately expressing their needs. Efforts have been made to overcome this communication gap, but room for improvement still exists. What problems do you think resulted from this communication gap? What do you think you can do to help close the gap even more when you enter the workforce?

### 11. Characteristics of Useful Information

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

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

### 12. Data Attributes

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

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

### 13. Distributed Data Processing

Explain why an organization would choose to install a distributed instead of a centralized computer environment.