WOLLO UNIVERSITY

COLLAGE OF BUSINESS AND ECONOMICS
DEPARTMENT OF ACCOUNTING AND FINANCE

DISTANCE MODULE FOR DEGREE PROGRAM

ACCOUNTING INFORMATION SYSTEMS

(ACFN3181)

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Contents

CHAPTER ONE

ACCOUNTING INFORMATION SYSTEMS: AN OVERVIEW

Chapter objectives

Up on the completion of this chapter, you should be able to:

- ✓ 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 uses of AIS in corporate strategy and in the value chain.
- ✓ Understand the role of the accountant in AIS.

Introduction

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

1.1.The Information Environment

Like other business resources (e.g. raw materials, capital, and labor), information is vital for the survival of a business organization. In this regard, we have to recognize information as a business resource. 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 presents an overview of these internal and external **information flows.**

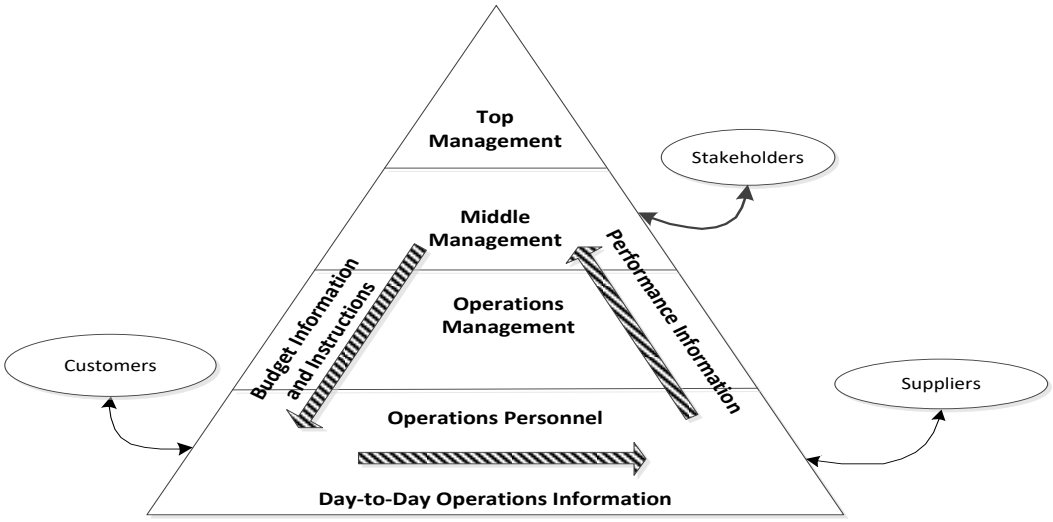


Figure 1: Internal and External Flows of Information

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.

1.1.1. What is System?

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

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

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 manmade. 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.

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.

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.

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.

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. 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.

Self-test 1.1. *Dear learners, check your progress!*

1. Explain why information is recognized as a business resource?
2. Differentiate between goal conflict and goal congruence?
3. Define system decomposition?

1.1.2. 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 2 shows the information system of a hypothetical manufacturing firm decomposed into its elemental subsystems.

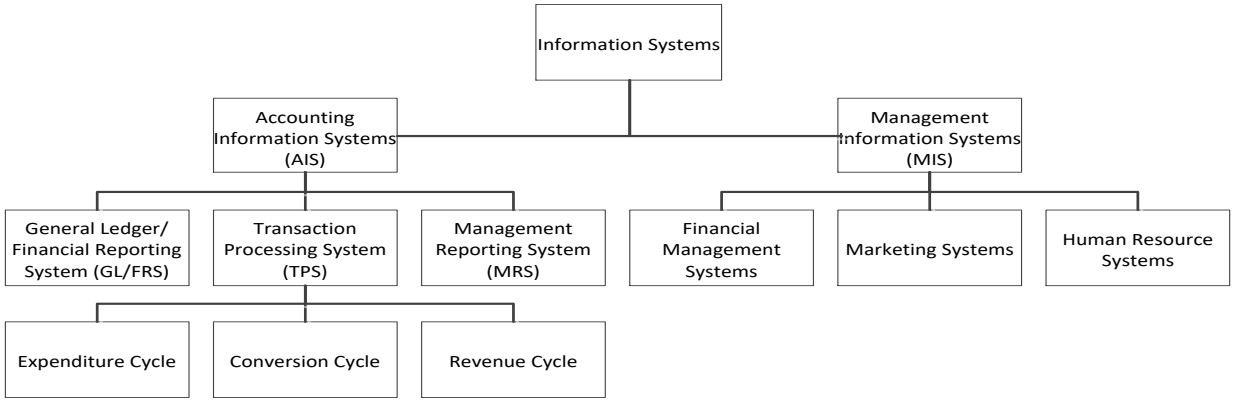


Figure 2: A Framework for Information Systems of a hypothetical manufacturing firm

Notice that two broad classes of systems emerge from the decomposition: the accounting information system (AIS) and the management information system (MIS). The distinction between AIS and MIS centers on the concept of a transaction, as illustrated by Figure 3. The information system accepts input, called transactions, which are converted through various processes into output information that goes to users. Transactions fall into two classes: financial transactions and nonfinancial transactions. Hence, **transaction is** an event that affects or is of interest to the organization and is processed by its information system as a unit of work.

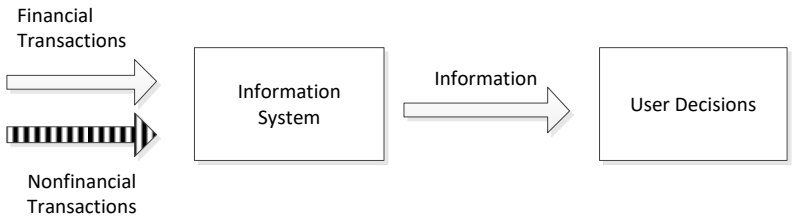


Figure 3: Transactions Processed by the Information System

The above definition of transaction encompasses both financial and nonfinancial events. 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.

A. The Accounting Information System (AIS)

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.

B. The Management Information System (MIS)

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 **MIS** processes nonfinancial transactions that are not normally processed by AIS.

1.1.3. AIS Subsystems

As previously indicated, AIS has three major subsystems. At this point, we briefly outline the role of each subsystem and we devote separate chapters to an in-depth study of each AIS subsystem.

A. 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.

B. 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 financial statements, tax returns, and other legal documents.

C. 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.

Self-test 1.2. *Dear learners, check your progress!*

1. What is an information system?
2. What is the center of the difference between AIS and MIS?
3. List the three sub system of AIS?

1.1.4. A General Model for AIS

Accounting is a data identification, collection, and storage process as well as an information development, measurement, and communication process. By definition, accounting is an information system, since an AIS collects, records, stores, and processes accounting and other data to produce information for decision makers. This is illustrated in Figure 4.

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

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

Figure 4 presents the **general model for viewing AIS applications.** This is a general model because it describes all information systems, regardless of their technological design. The elements of the general model are (a) end users, (b) data sources, (c) data collection, (d) data processing, (e) database management, (f) information generation, and (g) feedback.

(a) 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. External users receive information in the form of financial statements, tax returns, and other reports that the firm has a legal obligation to produce. Specifically, 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. 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.

Data versus Information: Before discussing the data sources portion of Figure 4, 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. 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.

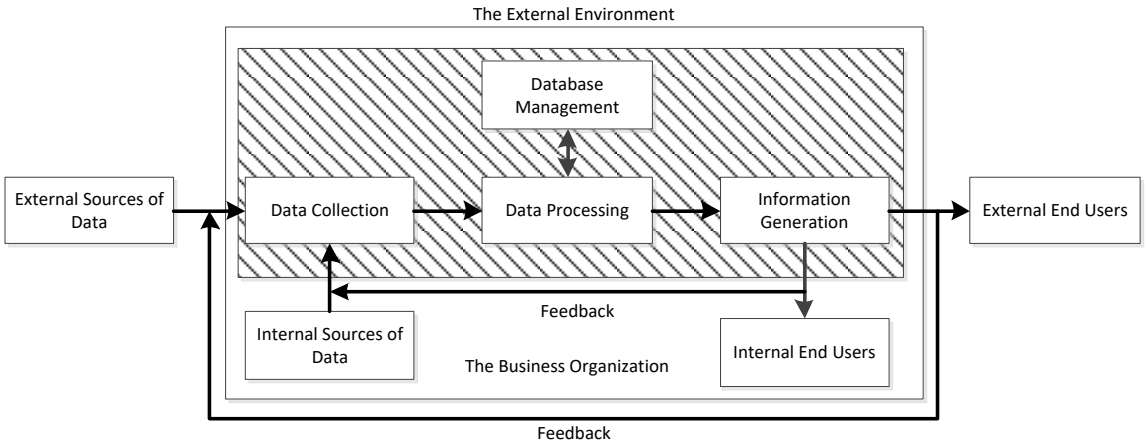


Figure 4: General Model for Accounting Information System

(b) 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.

(c) Data Collection

Data collection is the first operational stage in the information system. The objective is to ensure the event of data entering in to the system is valid, complete, and free from material errors. In many respects, this is the most important stage in the system. If transaction errors undetected and pass through data collection, 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.

(d) Data Processing

Once collected, data usually require processing to produce information. Tasks in the **data processing** stage range from simple to complex. Examples include: statistical techniques for sales forecasting, and posting and summarizing procedures used for accounting applications.

(e) Database Management

The organization's **database** is its physical repository for financial and nonfinancial data. Database 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 are—attribute, record, and file.

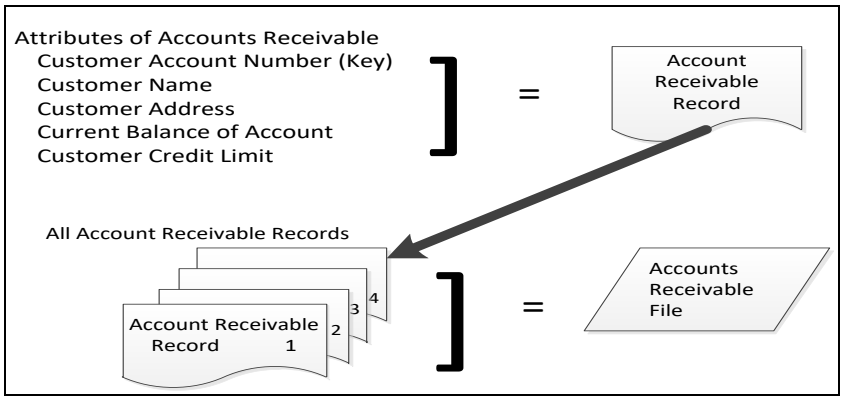


Figure 5: The Data Hierarchy

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 5 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.

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. 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 5 is the customer account number.

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.

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.

(f) 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.

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.

*Generally, t*he value of information to a user is determined by its reliability. Because, the purpose of information is to lead the user to a desired action. For this to happen, information must possess the above mentioned five characteristics. 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 faulty information. Effective decisions require information that has a high degree of reliability.

(g) 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, minimum allowable levels. Internal feedback from this information will initiate the inventory ordering process to replenish the inventories.

Self-test 1.3. *Dear learners, check your progress!*

1. Explain why accounting is called an information system?
2. Differentiate between data and information?
3. _____is a complete set of records of an identical class?

1.1.5. 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.

1.1.6. Acquisition of Information Systems

Organizations obtain information systems usually 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 difficult task. **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.

1.2. Business process and information needs

Organizations must understand how their business functions before they can identify the information they need to manage their business effectively. Then they can determine the types of data and procedures they will need to collect and produce that information. Organizations should identify the basic business processes, key decisions that need to be made for each process, and information they need to make the decisions. They also recognize that not all the information needs will be produced internally. Information about payment terms for merchandise purchases, for example, will be provided by vendors. Thus, they must effectively integrate external data with internally generated data so that they can use both types of information to run their business. organizations will interact with many external parties, such as customers, vendors, and governmental agencies, as well as with internal parties such as management and employees. To get a better handle on the more important interactions with these parties, they should identify their information needs and business process.

Organizations must reorganize their business processes into groups of related transactions. A *transaction* is an agreement between two entities to exchange goods or services or any other event that can be measured in economic terms by an organization. Examples include selling goods to customers, buying inventory from suppliers, and paying employees. The process that begins with capturing transaction data and ends with informational output, such as the financial statements, is

called ***transaction processing.*** Many business activities are pairs of events involved in a ***give-get exchange***. Most organizations engage in a small number of give-get exchanges, but each type of exchange happens many times.

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

 The *revenue cycle,* where goods and services are sold for cash or a future promise to receive cash.

The ***expenditure cycle***, where companies purchase inventory for resale or raw materials to use in producing products in exchange for cash or a future promise to pay cash.

 The ***production* or *conversion cycle***, where raw materials are transformed into finished goods.

 The ***human resources/payroll cycle***, where employees are hired, trained, compensated, evaluated, promoted, and terminated.

 The ***financing cycle***, where companies sell shares in the company to investors and borrow money and where investors are paid dividends and interest is paid on loans.

These cycles process a few related transactions repeatedly. For example, most revenue cycle transactions are either selling goods or services to customers or collecting cash for those sales.

Self-test 1.4. *Dear learners, check your progress!*

1. List the three fundamental objectives of an information system?
2. _____systems are completely finished and tested systems that are ready for implementation.
3. _____is where companies purchase inventory for resale or raw materials to use in producing products in exchange for cash or a future promise to pay cash.

1.3. Uses of AIS

How an AIS Can Add Value to an Organization

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

1) ***Improving the quality and reducing the costs of products or services.*** For example, an AIS can monitor machinery so operators are notified immediately when performance falls outside acceptable quality limits. This helps maintain product quality, reduces waste, and lowers costs.

2) ***Improving efficiency***. For example, timely information makes a just-in-time manufacturing approach possible, as it requires constant, accurate, up-to-date information about raw materials inventories and their locations.

3) ***Sharing knowledge***. Sharing knowledge and expertise can improve operations and provide a competitive advantage. For example, CPA firms use their information systems to share best practices and to support communication between offices. Employees can search the corporate

database to identify experts to provide assistance for a particular client; thus, a CPA firm's international expertise can be made available to any local client.

4) ***Improving the efficiency and effectiveness of its supply chain***. For example, allowing customers to directly access inventory and sales order entry systems can reduce sales and marketing costs, thereby increasing customer retention rates.

5) ***Improving the internal control structure.*** An AIS with the proper internal control structure can protect systems from fraud, errors, system failures, and disasters.

6) ***Improving decision making***. Improved decision making is vitally important and is discussed below in more detail.

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

An AIS can help improve decision making in several ways:

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

The AIS and Corporate Strategy

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

recognize that the design of the AIS can also influence the organization's culture by controlling the flow of information within the organization. For example, an AIS that makes information easily accessible and widely available is likely to increase pressures for more decentralization and autonomy. IT developments can affect business strategy. For example, the Internet has profoundly affected the way many activities are performed, significantly affecting both strategy and strategic positioning.

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

The Role of the AIS in the Value Chain

To provide value to their customers, most organizations perform a number of different activities.

1) **Inbound logistics**, consists of receiving, storing, and distributing the materials an organization uses to create the services and products it sells. For example, an automobile manufacturer receives, handles, and stores steel, glass, and rubber.

2) **Operations** activities transform inputs into final products or services. For example, assembly line activities convert raw materials into a finished car.

3) ***Outbound logistics*** activities distribute finished products or services to customers. An example is shipping automobiles to car dealers.

4) ***Marketing and sales*** activities help customers buy the organization's products or services. Advertising is an example of a marketing and sales activity.

5) ***Service*** activities provide post-sale support to customers. Examples include repair and maintenance services.

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

1) ***Firm infrastructure****:* is the accounting, finance, legal, and general administration activities that allow an organization to function. The AIS is part of the firm infrastructure.

2) ***Human resources***: activities include recruiting, hiring, training, and compensating employees.

3) ***Technology:*** activities improve a product or service. Examples include research and development, investments in IT, and product design.

4) ***Purchasing*** activities procure raw materials, supplies, machinery, and the buildings used to carry out the primary activities.

An organization's value chain is a part of a larger system called a ***supply chain***. Organizations interacts with its suppliers and distributors. By paying attention to its supply chain, a company can improve its performance by helping the others in the supply chain to improve their performance.

1.4. The Role of the Accountant

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

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.** 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.

Self-test 1.5. *Dear learners, check your progress!*

1. Explain how IAS benefit a company in its value chain?
2. _____ is the medium and method for capturing and presenting the information?
3. List the three ways by which accountants can engage in AIS?

Chapter Summary

Like other business resources (e.g. raw materials, capital, and labor), information is vital for the survival of a business organization. In this regard, we have to recognize information as a business resource.

A system is a set of two or more interrelated components that interact to achieve a goal. Most systems are composed of smaller subsystems that support the larger system. Multiple components, relatedness, system versus subsystem, purpose, system decomposition are the elements of a system. The information system is the set of formal procedures by which data are collected, processed into information, and distributed to users.

AIS subsystems process financial transactions and nonfinancial transactions that directly affect the processing of financial transactions. The AIS is composed of three major subsystems: the transaction processing system, the general ledger/financial reporting system, and the management reporting system. The distinction between AIS and MIS centers on the concept of a transaction. Management often requires information that goes beyond the capability of AIS. The MIS processes nonfinancial transactions that are not normally processed by AIS. The general model of AIS describes all information systems, regardless of their technological design. The elements of the general model are end users, data sources, data collection, data processing, database management, information generation, and feedback.

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.

The three primary objectives of an information system are to support the stewardship function of management, to support management decision making and to support the firm's day-to-day operations. Organizations must understand how their business functions before they can identify the information they need to manage their business effectively. Then they can determine the types of data and procedures they will need to collect and produce that information. Organizations should identify the basic business processes, key decisions that need to be made for each process, and information they need to make the decisions.

Many business activities are pairs of events involved in a give-get exchange. Most organizations engage in a small number of give-get exchanges, but each type of exchange happens many times. These exchanges can be grouped into five major business processes or transaction cycles: This are the revenue cycle, the expenditure cycle, the production or conversion cycle, the human resources/payroll cycle, and the financing cycle.

AIS can add value to the organization. its corporate strategy and in the value chain. Since accounting data comes from an AIS, AIS knowledge and skills are critical to an accountant's career

success. Interacting with an AIS is one of the most important activities that accountants perform. Other important AIS-related activities include designing internal control systems and business process improvements. Accountants are primarily involved in three ways: as system users, designers, and auditors.

Chapter Review Questions

Part I: True or false: Write true if the statement is correct or false if it is incorrect.

1. A system is a set of two or more interrelated components that interact to achieve a goal.
2. Goal conflict occurs when a subsystem achieves its goals while contributing to the organization's overall goal.
3. The larger the organization and the more complicated the system, the more difficult it is to achieve goal congruence.
4. A system must serve at most one purpose, but it may serve several.
5. The physical system is the medium and method for capturing and presenting the information.

Part II: Multiple choices

Choices the best answer for the following questions.

1. Which of the following is not elements of a system?
   A. Multiple Components
   B. Un relatedness
   C. Purpose
   D. System Decomposition:
   E. Subsystem Interdependency
2. _____is an economic event that affects the assets and equities of the organization, is reflected in its accounts, and is measured in monetary terms.
   A. Financial transaction
   B. Nonfinancial transaction
   C. Business process
   D. Information needs
   E. All
   F. None
3. Which of the following is not a financial transaction?
   A. Sales of products to customers
   B. Purchases of inventory from vendors
   C. Adding a new supplier of raw materials to the list of valid suppliers
   D. Cash disbursements and receipts
4. Which of the following deals with business events that occur frequently?
   A. General Ledger/Financial Reporting Systems
   B. Management Reporting System
   C. The transaction processing system
   D. All
   E. None
5. _____is the first operational stage in the information system?

A. Data sources
B. Data collection
C. Data processing

Part III: Fill the blank

1. _____is the set of formal procedures by which data are collected, processed into information, and distributed to users.
2. **_____is** an event that affects or is of interest to the organization and is processed by its information system as a unit of work.
3. _____is its physical repository for financial and nonfinancial data.
4. _____is a logical and relevant characteristic of an entity about which the firm captures data.
5. _____is the process of compiling, arranging, formatting, and presenting information to users.

Answer for self-tests

Self-test 1.1.

1. Every individual in the organization, from business operations to top management, needs information to accomplish his or her tasks.
2. ***Goal conflict:*** occurs when a subsystem is inconsistent with the goals of another subsystem or with the system as a whole. Whereas, ***Goal congruence:*** occurs when a subsystem achieves its goals while contributing to the organization's overall goal.
3. ***System Decomposition:*** Decomposition is the process of dividing the system into smaller subsystem parts.

Self-test 1.2.

1. The information system is the set of formal procedures by which data are collected, processed into information, and distributed to users.
2. The distinction between AIS and MIS centers on the concept of a transaction.
   Management often requires information that goes beyond the capability of AIS.
   The MIS processes nonfinancial transactions that are not normally processed by AIS.
3. Transaction Processing System
   General Ledger/Financial Reporting Systems
   Management Reporting System

Self-test 1.3.

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

2. **Data** are facts, which may or may not be processed (edited, summarized, or refined) and have no direct effect on the user.
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.

3. File

Self-test 1.4.

1. To support the stewardship function of management
   To support management decision making
   To support the firm’s day-to-day operations
2. Turnkey systems
3. Expenditure cycle

Self-test 1.5.

1. An organization's value chain is a part of a larger system called a *supply chain.* Organizations interacts with its suppliers and distributors. By paying attention to its supply chain, a company can improve its performance by helping the others in the supply chain to improve their performance.
2. physical system
3. Accountants are primarily involved in three ways
    a. as system users
    b. as system designers, and
    c. as system auditors.

CHAPTER TWO

OVERVIEW OF BUSINESS PROCESSES

Chapter objectives

Dear students, at the end of this chapter, you are expected to;

- ✓ Understand the business process and events
- ✓ Identify the events in a business process
- ✓ Understand the transaction processing cycle
- ✓ Identify the types of files and data used in the transaction processing cycle both in manual and computer based processing models.
- ✓ Explain the advantages and disadvantages of Enterprise Resource Planning (ERP) system.

Introduction

Dear students, the first chapter introduced the overview of the information system from the accountants' perspective. This chapter is organized into five major sections. The first is an overview of the business process and events. This section describes the five major business process common to all types of organizations. The second section describes the in each business process. The third section presents the transaction processing cycle. The fourth section of this chapter addresses the types of files and data used in the transaction processing cycle both in manual and computer based processing models. Finally, it describes the Enterprise Resource Planning (ERP) systems including its advantages and dis advantages.

2.1. Business Processes and Events

It is explained in the previous chapter that organizations must reorganize their business processes into groups of related transactions. A transaction is an agreement between two entities to exchange goods or services or any other event that can be measured in economic terms by an organization. Examples include selling goods to customers, buying inventory from suppliers, and paying employees. Many business activities are pairs of events involved in a give-get exchange. These exchanges can be grouped into five major *business processes or transaction cycles:*

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

These cycles process a few related transactions repeatedly. For example, most revenue cycle transactions are either selling goods or services to customers or collecting cash for those sales.

2.2. Identifying events in business process

A financial transaction is an economic event that affects the assets and equities of the firm, is reflected in its accounts, and is measured in monetary terms. The most common financial transactions are economic exchanges with external parties. These include the sale of goods or services, the purchase of inventory, the discharge of financial obligations, and the receipt of cash on account from customers. Financial transactions also include certain internal events such as the depreciation of fixed assets; the application of labor, raw materials, and overhead to the production process; and the transfer of inventory from one department to another. These three cycles exist in all types of businesses both profit-seeking and not-for-profit. For instance, every business (1) incurs expenditures in exchange for resources (expenditure cycle), (2) provides value added through its products or services (conversion cycle), and (3) receives revenue (grant) from outside sources (revenue cycle).

2.2.1. The Expenditure Cycle

Business activities begin with the acquisition of materials, property, and labor in exchange for cash in the expenditure cycle. **Figure 2.1.** shows the flow of cash from the organization to the various providers of these resources. Most expenditure transactions are based on a credit relationship between the trading parties. The actual disbursement of cash takes place at some point after the receipt of the goods or services. Thus, from a systems perspective, this transaction has two parts: a physical component (the acquisition of the goods) and a financial component (the cash disbursement to the supplier). A separate subsystem of the cycle processes each component. The major subsystems of the expenditure cycle are outlined below.

- **Purchases/accounts payable system:** This system recognizes the need to acquire physical inventory (such as raw materials) and places an order with the vendor. When the goods are received, the purchases system records the event by increasing inventory and establishing an account payable to be paid at a later date.
- **Cash disbursements system:** When the obligation created in the purchases system is due, the cash disbursements system authorizes the payment, disburses the funds to the vendor, and records the transaction by reducing the cash and accounts payable accounts.
- **Payroll system**: The payroll system collects labor usage data for each employee, computes the payroll, and disburses paychecks to the employees.
- **Fixed asset system:** A firm's fixed asset system processes transactions pertaining to the acquisition, maintenance, and disposal of its fixed assets.

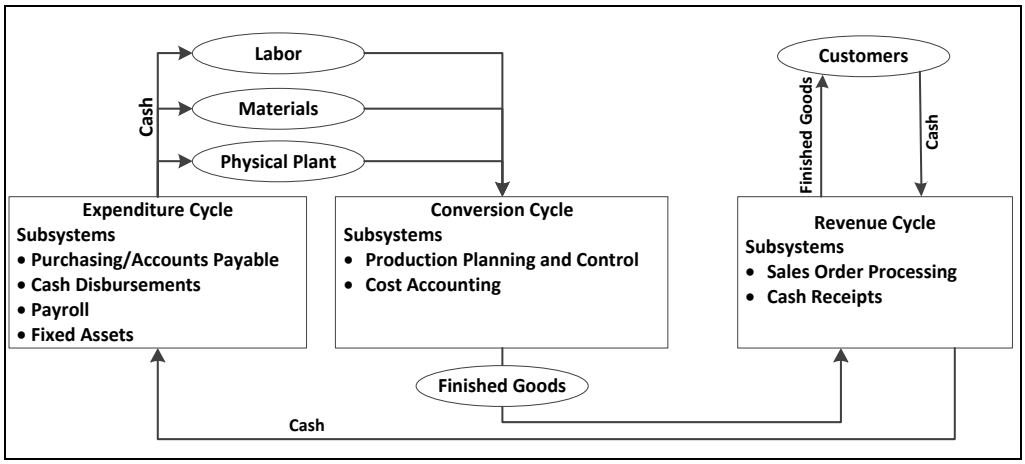


Figure 2.1. Relationship between Transaction Cycles

2.2.2. The Conversion Cycle

The conversion cycle is composed of two major subsystems: the production system and the cost accounting system.

- ✓ **The production system:** involves the planning, scheduling, and control of the physical product through the manufacturing process. This includes determining raw material requirements, authorizing the work to be performed and the release of raw materials into production, and directing the movement of the work-in process through its various stages of manufacturing.
- ✓ **The cost accounting system:** monitors the flow of cost information related to production. The information this system produces is used for inventory valuation, budgeting, cost control, performance reporting, and management decisions, such as make-or-buy decisions.

Manufacturing firms convert raw materials into finished products through formal conversion cycle operations. However, the conversion cycle is not usually formal and observable in service and retail enterprises.

2.2.3. The Revenue Cycle

Firms sell their finished goods to customers through the revenue cycle, which involves processing cash sales, credit sales, and the receipt of cash following a credit sale. Revenue cycle transactions also have a physical and a financial component, which are processed separately. The primary subsystems of the revenue cycle are:

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

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

Self-test 2.1. *Dear learners, check your progress!*

1. What are the three major business process
2. List the major subsystems of the expenditure cycle?

2.3. Organizing data in AIS: The data (transaction) processing cycle

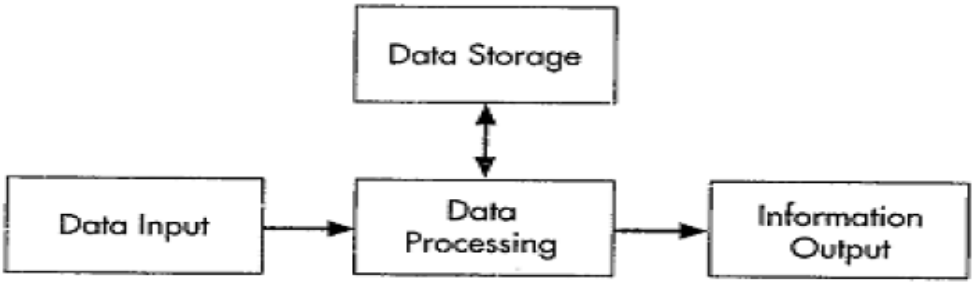
Accountants and other system users play a significant role in the data processing cycle. For example, they interact with systems analysts to help answer questions such as these:

- What data should be entered and stored by the organization, and who should have access to them?
- How should data be organized, updated, stored, accessed, and retrieved?
- How can scheduled and unanticipated information needs be met?

To answer these and related questions, the data processing concepts explained in this chapter must be understood.

One important AIS function is to process company transactions efficiently and effectively. In manual (non-computer-based) systems, data are entered into journals and ledgers maintained on paper. In computer-based systems, data are entered into computers and stored in files and data bases. The operations performed on data to generate meaningful and relevant information are referred to collectively as the **data processing cycle**. In other words, the process that begins with capturing transaction data and ends with informational output, such as the financial statements, is called transaction processing. As shown in Figure 2.2., this process consists of four steps: data input, data storage, data processing, and information output.

Figure 2.2. The data processing cycle



2.3.1. Data input

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

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

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

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

Historically, most businesses used **paper source documents** to collect data about their business activities. They later transferred that data into the computer. When the data is entered using computer screens, they often retain the same name and basic format as the paper source document it replaced. Table 2.1. lists some common transaction cycle activities and the source document or form used to capture data about that event.

Turn around documents are company output sent to an external party, who often adds data to the document, and then are returned to the company as an input document. They are in machine-readable form to facilitate their subsequent processing as input records. An example is a utility bill that is sent to the customer, returned with the customer's payment, and read by a special scanning device when it is returned. **Source data automation** devices capture transaction data in machine-readable form at the time and place of their origin. Examples include ATMs used by banks, point-of-sale (POS) scanners used in retail stores, and bar code scanners used in warehouses.

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

Users can improve control either by purchasing pre-numbered source documents or by having the system automatically assign a sequential number to each new transaction. Pre-numbering

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

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

TABLE 2-1 Common Business Activities and Source Documents

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

2.3.2. Data storage

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

Imagine how difficult it would be to read a textbook if it were not organized into chapters, sections, paragraphs, and sentences. Now imagine how hard it would be for a company to find an invoice if all documents were randomly dumped into file cabinets. Fortunately, information in an AIS is organized for easy and efficient access.

Transaction data are often recorded in a journal before they are entered into a ledger. Cumulative accounting information is stored in general and subsidiary ledgers.

Coding techniques

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

i. With **sequence codes**, items are numbered consecutively to account for all items. Any missing items cause a gap in the numerical sequence. Examples include pre-numbered checks, invoices, and purchase orders.

ii. With a **block code**, blocks of numbers are reserved for specific categories of data. For example, business reserved the following numbers for major product categories:

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

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

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

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

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

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

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

✓ Be consistent with its intended use, which requires that the code designer determine desired system outputs prior to selecting the code.

- ✓ Allow for growth. For example, don't use a three-digit employee code for a fast-growing company with 950 employees.
- ✓ Be as simple as possible to minimize costs, facilitate memorization and interpretation, and ensure employee acceptance.
- ✓ Be consistent with the company's organizational structure and across the company's divisions.

Chart of accounts

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

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

For example, in the chart of accounts in which each account number is three digits long. The **first digit** represents the major account category and indicates where it appears on a company's financial statements. Thus, all current assets are numbered in the 100s; noncurrent assets are numbered in the 200s, and so on.

The **second digit** represents the primary financial subaccounts within each category. Again, the accounts are assigned numbers to match the order of their appearance in financial statements (in order of decreasing liquidity). Thus, account 120 represents accounts receivable, and account150 represents inventory.

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

A chart of accounts is tailored to the nature and purpose of an organization. For example, the chart of accounts for a corporation include equity accounts of common stock and retained earnings . In contrast, a partnership would include separate capital and drawing accounts for each partner, instead of common stock and retained earnings. Likewise, if a business is a retail organization, it has only one type of general ledger inventory account. A manufacturing company, in contrast, would have separate general ledger accounts for raw materials, work in process, and finished goods inventories.

Audit trail

An **audit trail** is a traceable path of a transaction through a data processing system from point of origin to final output, or backwards from final output to point of origin. It is used to check the accuracy and validity of ledger postings.

Self-test 2.2. *Dear learners, check your progress!*

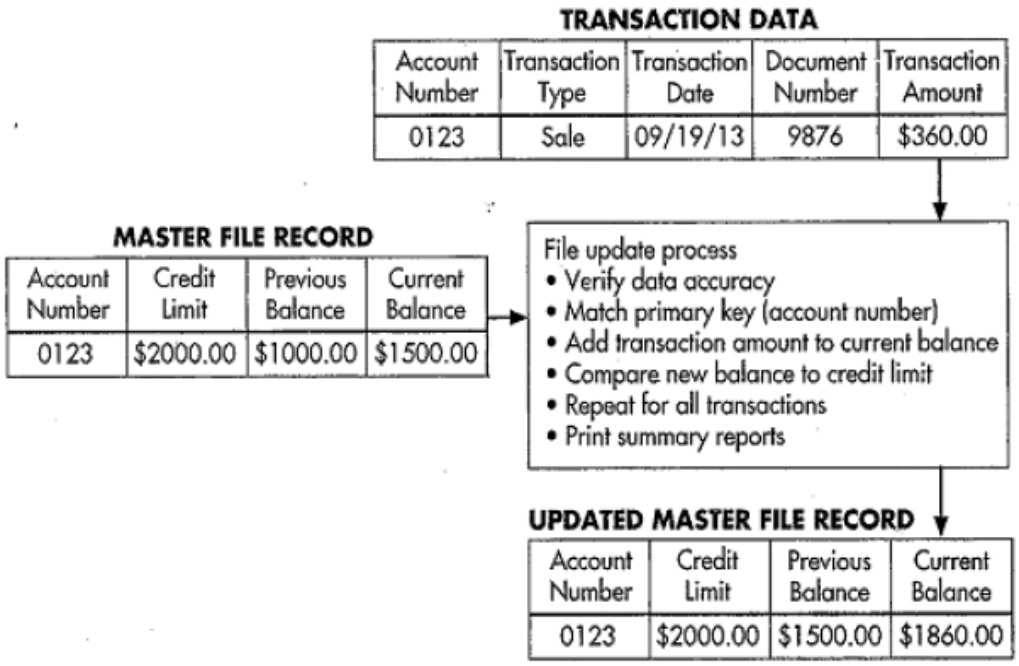
1. What are the three steps in processing data input?
2. What is audit trial?

2.3.3. Data processing

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

1. ***Creating*** new data records, such as adding a newly hired employee to the payroll database.
2. ***Reading***, retrieving, or viewing existing data.
3. ***Updating,*** previously stored data. Figure 2.3. depicts the steps required to update an accounts receivable record with a sales transaction. The two records are matched using the account number. The sale amount ($360) is added to the account balance ($1,500) to get a new current balance ($1,860).
4. ***Deleting*** data, such as purging the vendor master file of all vendors the company no longer does business with.

Figure 2.3. The accounts receivable file update process



Batch vs. Real-Time Processing

There are two ways to process transactions: using batches and in real time. Updating done periodically, such as daily, is referred to as ***batch processing***. In a **batch processing system**, transactions are accumulated over a period of time and processed as a single unit, or batch.

Although batch processing is cheaper and more efficient, the data are current and accurate only immediately after processing. For that reason, batch processing is used only for applications, such as payroll, that do not need frequent updating and those naturally occurs or are processed at fixed time periods. For example, a store may update its sales records every day after the store closes. Or, a payroll system may process all the time cards every two weeks to determine employee earnings and produce paychecks. Whatever the time period in a batch system, there is some time delay between the actual event and the processing of the transaction to update the records of the organization.

Most companies update each transaction as it occurs, referred to as ***real-time processing*** because it ensures that stored information is always current, thereby increasing its decision making usefulness. It is also more accurate because data input errors can be corrected in real time or refused. It also provides significant competitive advantages.

In a **real-time processing system**, transactions are processed immediately as they occur without any delay to accumulate transactions. Real-time processing is also referred to as **online transaction processing**, or **OLTP**. In this case, the records in the system always reflect the current status.

A good example of a real-time processing system would be airline ticket reservations. When you book a ticket, and select a seat, that booking is made right away, and nobody else can get that same seat even a second later. Any changes you make to your reservation are also updated in real time.

Another example is the stock market. When you submit an order to buy a stock, that order is processed immediately and not at the end of the day.
While real-time processing is often more efficient and in some cases, necessary, batch processing may be more effective. In the case of a payroll system, there is really no need to keep track of how much an employee has earned every minute of the day and doing every two weeks is likely sufficient.

2.3.4. Information output

The final step in the data processing cycle is information output. When displayed on a monitor, output is referred to as ***soft copy***. When printed on paper, it is referred to as ***hard copy***. Information is usually presented in one of three forms: a document, a report, or a query response.
Document*s* are records of transaction or other company data. Some, such as checks and invoices, are transmitted to external parties. Others, such as receiving reports and purchase requisitions, are used internally. Documents can be printed out, or they can be stored as electronic images in a computer. For example, Toys 'R' Us uses electronic data interchange to communicate with its suppliers. Every year it processes over half a million invoices electronically, thereby eliminating paper documents and dramatically reducing costs and errors. This has resulted in higher profits and more accurate information.
Reports are used by employees to control operational activities and by managers to make decisions and to formulate business strategies. External users need reports to evaluate company profitability, judge creditworthiness, or comply with regulatory requirements. Some reports, such as financial statements and sales analyses, are produced on a regular basis. Others are produced on an exception basis to call attention to unusual conditions. For example, a company could have its system produce a report to indicate when product returns exceed a certain percentage of sales. Reports can also be produced on demand. For example, Susan could produce a report to identify the salesperson who sold the most items during a specific promotional period.
The need for reports should be periodically assessed, because they are often prepared long after they are needed, wasting time, money, and resources. For example, NCR Corporation reduced the number of reports from 1,200 to just over 100. Another company eliminated 6 million pages of reports, a stack four times higher than its 41-story headquarters building. One 25- page report took five days to prepare and sat unread.
A database ***query*** is used to provide the information needed to deal with problems and questions that need rapid action or answers. A user enters a request for a specific piece of information; it is retrieved, displayed, or analyzed as requested. Repetitive queries are often developed by information systems specialists. One-time queries are often developed by users. Some companies, such as Wal-Mart, allow suppliers to access their databases to help them better serve Wal-Mart's needs. Suppliers can gauge how well a product is selling in every Wal-Mart store in the world and maximize sales by stocking and promoting items that are selling well.

Self-test 2.3. *Dear learners, check your progress!*

1. What are the four different types of data processing activities?
2. _____is used to provide the information needed to deal with problems and questions that need rapid action or answers.

2.4. Types of Files and Data

This section presents the different types of files and data used in the data processing cycle described in the above section both in the manual and computer systems. We begin with traditional records used in manual systems (documents, journals, and ledgers) and then examine their magnetic counterparts in computer-based systems.

2.4.1. 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. The following are the files and data used in the manual process model.

A. Documents

A document provides evidence of an economic event and may be used to initiate transaction processing. Some documents are a result of transaction processing. There are three types of documents: source documents, product documents, and turnaround documents.

Source Documents: Economic events result in some documents being created at the beginning (the source) of the transaction. These are called source documents. Source documents are used to capture and formalize transaction data that the transaction cycle needs for processing.

Product Documents: Product documents are the result of transaction processing rather than the triggering mechanism for the process. For example, a payroll check to an employee is a product document of the payroll system.

Turnaround Documents: Turnaround documents are product documents of one system that become source documents for another system.

B. Journals

A journal is a record of a chronological entry. At some point in the transaction process, when all relevant facts about the transaction are known, the event is recorded in a journal in chronological order. Documents are the primary source of data for journals. The journal holds a complete record of transactions and thus provides a means for posting to accounts. There are two primary types of journals: special journals and general journals.

- ✓ **Special journals** are used to record specific classes of transactions that occur in high volume. Such transactions can be grouped together in a special journal and processed more efficiently than a general journal permits. Most organizations use several special journals, including the cash receipts journal, cash disbursements journal, purchases journal, and the payroll journal.
- ✓ **General Journals** are used to record nonrecurring, infrequent, and dissimilar transactions. For example, we usually record periodic depreciation and closing entries in the general journal.

Journal vouchers are used to record summaries of routine transactions, no routine transactions, adjusting entries, and closing entries.

C. Ledgers

A ledger is a book of accounts that reflects the financial effects of the firm's transactions after they are posted from the various journals. Whereas journals show the chronological effect of business activity, ledgers show activity by account type. A ledger indicates the increases, decreases, and current balance of each account. Organizations use this information to prepare financial statements, support daily operations, and prepare internal reports. There are two basic types of ledgers: (1) general ledgers, which contain the firm's account information in the form of highly summarized control accounts, and (2) subsidiary ledgers, which contain the details of the individual accounts that constitute a particular control account.

- ✓ **The general ledger** summarizes the activity for each of the organization's accounts. The general ledger department updates these records from journal vouchers prepared from special journals and other sources located throughout the organization. The general ledger provides a single value for each control account, such as accounts payable, accounts receivable, and inventory. This highly summarized information is sufficient for financial reporting, but it is not useful for supporting daily business operations.

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

Generally, the accounting records described previously provide an audit trail for tracing transactions from source documents to the financial statements. Of the many purposes of the audit trail, most important to accountants is the year-end audit.

2.4.2. Computer-Based Systems

Accounting records in computer-based systems are represented by four different types of magnetic files: master files, transaction files, reference files, and archive files.

A. Master File.

A master file generally contains account data. The general ledger and subsidiary ledgers are examples of master files. Data values in master files are updated from transactions.

B. **Transaction File**

A transaction file is a temporary file of transaction records used to change or update data in a master file. Sales orders, inventory receipts, and cash receipts are examples of transaction files.

C. **Reference File**

A reference file stores data that are used as standards for processing transactions. For example, the payroll program may refer to a tax table to calculate the proper amount of employment tax. Other reference files include price lists used for preparing customer invoices, lists of authorized suppliers and customer credit files for approving credit sales.

D. **Archive File.**

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

Self-test 2.4. *Dear learners, check your progress!*

1. What are the three types of documents used in manual processing model?
2. _____ is a temporary file of transaction records used to change or update data in a master file.

2.5. Enterprise resource planning (ERP) systems

Traditionally, the AIS has been referred to as a transaction processing system because its only concern was financial data and accounting transactions. For example, when a sale took place, the AIS would record a journal entry showing only the date of the sale, a debit to either cash or accounts receivable, and a credit to sales. Other potentially useful nonfinancial information about the sale, such as the time of day that it occurred, would traditionally be collected and processed outside the AIS. Consequently, many organizations developed additional information systems to collect, process, store, and report information not contained in the AIS. Unfortunately, the existence of multiple systems creates numerous problems and inefficiencies. Often the same data must be captured and stored by more than one system, which not only results in redundancy across systems but also can lead to discrepancies if data are changed in one system but not in others. In addition, it is difficult to integrate data from the various systems.

Enterprise resource planning (ERP) systems overcome these problems as they integrate all aspects of a company's operations with a traditional AIS. **ERP** is a set of integrated programs to manage critical operations for an entire organization. At the center of the ERP system is a database that is shared by all users. This makes it possible for all units in the organization to have access to current data to support operations and planning. ERP has emerged as an important tool in controlling costs and product flows through a complex enterprise. One of the defining characteristics of ERP is that it integrates real-time information from across the entire enterprise.

Most large and many medium-sized organizations use ERP systems to coordinate and manage their data, business processes, and resources. The ERP system collects, processes, and stores data and provides the information managers and external parties need to assess the company.

As shown in Figure 2.4., a properly configured ERP system uses a centralized database to share information across business processes and coordinate activities. This is important because an activity that is part of one business process often triggers a complex series of activities throughout many different parts of the organization. For example, a customer order may necessitate scheduling additional production to meet the increased demand. This may trigger an order to purchase more raw materials. It may also be necessary to schedule overtime or hire temporary help. Well-designed ERP systems provide management with easy access to up-to-date information about all of these activities in order to plan, control, and evaluate the organization's business processes more effectively.

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

➢ Financial (general ledger and reporting system)-general ledger, accounts receivable, accounts payable, fixed assets, budgeting, cash management, and preparation of managerial reports and financial statements

➢ Human resources and payroll-human resources, payroll, employee benefits, training, time and attendance, benefits, and government reporting ·

➢ Order to cash (revenue cycle)-sales order entry, shipping, inventory, cash receipts, commission calculation

➢ Purchase to pay (disbursement cycle)-purchasing, receipt and inspection of inventory, inventory and warehouse management, and cash disbursements.

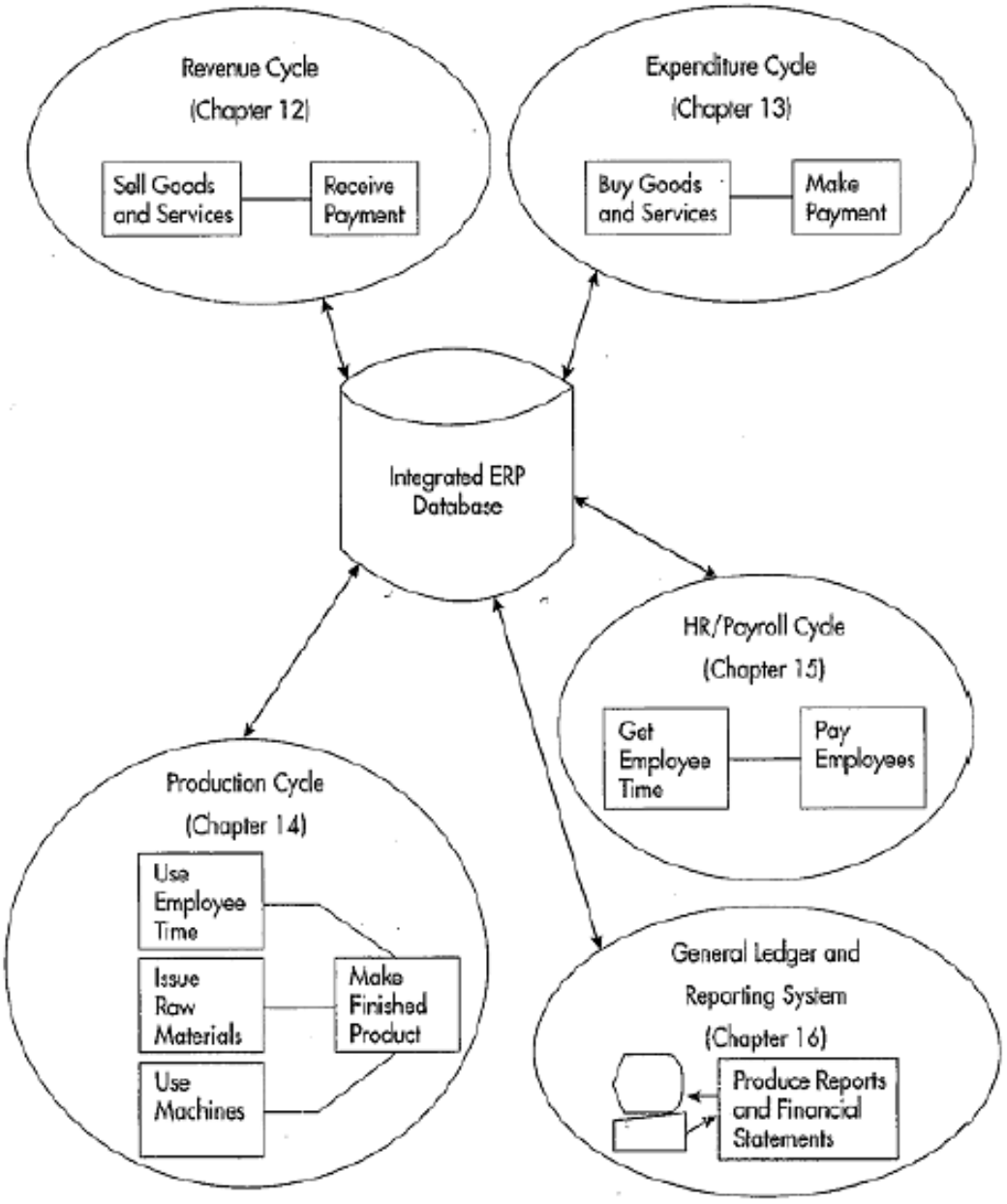
➢ Manufacturing (production cycle)- engineering, production scheduling, bill of materials, work-in-process, workflow management, quality control, cost management, and manufacturing processes and projects

➢ Project management-costing, billing, time and expense, performance units, activity management

➢ Customer relationship management-sales and marketing, commissions, service, customer contact, and call center support

➢ System tools-tools for establishing master file data, specifying flow of information, access controls, and so on

Figure 2.4. Integrated ERP system



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

➢ An ERP provides an integrated, enterprise-wide, single view of the organization's data and financial situation. Storing all corporate information in a single database breaks down barriers between departments and streamlines the flow of information.

➢ Data input is captured or keyed once, rather than multiple times, as it is entered into different systems. Downloading data from one system to another is no longer needed.

➢ Management gains greater visibility into every area of the enterprise and greater monitoring capabilities. Employees are more productive and efficient because they can quickly gather data from both inside and outside their own department.

➢ The organization gains better access control. An ERP can consolidate multiple permissions and security models into a single data access structure.

➢ Procedures and reports are standardized across business units. This standardization can be especially valuable with mergers and acquisitions because an ERP system can replace the different systems with a single, unified system.

➢ Customer service improves because employees can quickly access orders, available inventory, shipping information, and past customer transaction details.

➢ Manufacturing plants receive new orders in real time, and the automation of manufacturing processes leads to increased productivity.

ERP systems also have significant disadvantages:

➢ Cost. ERP hardware, software, and consulting costs range from $50 to $500 million for a Fortune 500 company and upgrades can cost $50 million to $100 million. Midsized companies spend between $10 and $20 million.

➢ Amount of time required. It can take years to select and fully implement an ERP system, depending on business size, number of modules to be implemented, degree of customization, the scope of the change, and how well the customer takes ownership of the project. As a result, ERP implementations have a very high risk of project failure.

Changes to business processes. Unless a company wants to spend time and money customizing modules, they must adapt to standardized business processes as opposed to adapting the ERP package to existing company processes. The failure to map current business processes to existing ERP software is a main cause of ERP project failures.

➢ Complexity. This comes from integrating many different business activities and systems, each having different processes, business rules, data semantics, authorization hierarchies, and decision centers.

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

Self-test 2.5. *Dear learners, check your progress!*

1. What is ERP system?
2. What are the disadvantages of ERP system?

Chapter summary

Many business activities are pairs of events involved in a give-get exchange. These exchanges can be grouped into five major business processes. Namely, the revenue cycle, expenditure cycle, production (conversion) cycle, human resource cycle, and financing cycle. The revenue cycle consists of sales order processing and cash receipts systems. The major subsystems of the expenditure cycle are purchases/accounts payable system, cash disbursements system, payroll system, and fixed asset system. The conversion cycle is composed of the production system and the cost accounting system.

The process that begins with capturing transaction data and ends with informational output, such as the financial statements, is called transaction processing. Accountants and other system users play a significant role in the data processing cycle. The data processing cycle consist four steps, data input, data storage, data processing, and information output.

The first step in processing input is to capture transaction data and enter them into the system. Data must be collected about each activity of interest, the resources affected by each activity and the people who participate in each activity of each business activity. The second step in processing input is to make sure captured data are accurate and complete. The final step in processing input is to make sure company policies are followed.

After data is collected it should be organized and stored in an AIS and to make it accessible. Transaction data are often recorded in a journal before they are entered into a ledger. Cumulative accounting information is stored in general and subsidiary ledgers. Coding is the systematic assignment of numbers or letters to items to classify and organize them. The most common coding techniques includes chart of accounts, sequence codes, block codes, group code, and mnemonic codes. An audit trail is a traceable path of a transaction through a data processing system from point of origin to final output, or backwards from final output to point of origin. It is used to check the accuracy and validity of ledger postings.

Once business activity data have been entered into the system, they must be processed to keep the databases current. The four different types of data processing activities, referred to as CRUD, are Creating, Reading, Updating, Deleting data. There are two ways to process transactions: using batches and in real time. In a batch processing system, transactions are accumulated over a period of time and processed as a single unit, or batch. On the other hand, In a real-time processing system, transactions are processed immediately as they occur without any delay to accumulate transactions.

The final step in the data processing cycle is information output. When displayed on a monitor, output is referred to as soft copy. When printed on paper, it is referred to as hard copy. Documents are records of transaction or other company data. Some, such as checks and invoices, are transmitted to external parties. Reports are used by employees to control operational activities and by managers to make decisions and to formulate business strategies. A database query is used to

provide the information needed to deal with problems and questions that need rapid action or answers.

Documents, journals and ledgers are the files and data used in the manual transaction processing model. Whereas, master file, transaction file, reference file and archive file are the files used in the computer based process model.

Traditionally, the AIS has been referred to as a transaction processing system because its only concern was financial data and accounting transactions. Other potentially useful nonfinancial information about the sale, such as the time of day that it occurred, would traditionally be collected and processed outside the AIS. Consequently, many organizations developed additional information systems to collect, process, store, and report information not contained in the AIS. Enterprise resource planning (ERP) systems is a set of integrated programs to manage critical operations for an entire organization. At the center of the ERP system is a database that is shared by all users. This makes it possible for all units in the organization to have access to current data to support operations and planning.

Chapter Review Questions

Part I: True or false: Write true if the statement is correct or false if it is incorrect.

1. The first step in processing input is to capture transaction data and enter them into the system.
2. Source data automation are company output sent to an external party, who often adds data to the document, and then are returned to the company as an input document.
3. In a batch processing system transactions are accumulated over a period of time and processed as a single unit.
4. Documents are used by employees to control operational activities and by managers to make decisions and to formulate business strategies.
5. Source documents are used to capture and formalize transaction data that the transaction cycle needs for processing.

Part II: Multiple choices

Choices the best answer for the following questions.

1. Which of the following system collects labor usage data for each employee, computes the payroll, and disburses paychecks to the employees?
   A. Purchases system
   B. Cash disbursements system
   C. Payroll system
   D. Fixed asset system
2. Which of the following is not the subsystems of the expenditure cycle?
   A. Accounts payable system
   B. Cash disbursements system
   C. Payroll system
   D. Production system
   E. Fixed asset system
3. _____involves the planning, scheduling, and control of the physical product through the manufacturing process.
   A. Production system
   B. Cost accounting system
   C. Sales order processing
   D. Cash receipts
4. Which of the following is /are example of source data automation?
   A. ATMs used by banks
   B. Point-of-sale (POS)
   C. Scanners used in retail stores
   D. Bar code scanners used in warehouses
   E. All
   F. None
5. Which of the following involves retrieving, or viewing existing data?

A. Creating
B. Reading
C. Updating
D. Deleting
A.

Part III: Fill the blank

1. _____is the process that begins with capturing transaction data and ends with informational output, such as the financial statements.
2. _____is devices capture transaction data in machine-readable form at the time and place of their origin.
3. _____is the systematic assignment of numbers or letters to items to classify and organize them.
4. _____is a traceable path of a transaction through a data processing system from point of origin to final output, or backwards from final output to point of origin.
5. _____are records of transaction or other company data.

Answer for self-tests

Self-test 2.1.

1. The revenue cycle, where goods and services are sold for cash or a future promise to receive cash.
   The expenditure cycle, where companies purchase inventory for resale or raw materials to use in producing products in exchange for cash or a future promise to pay cash.
   The production or conversion cycle, where raw materials are transformed into finished goods.
   The human resources/payroll cycle, where employees are hired, trained, compensated, evaluated, promoted, and terminated.
   The financing cycle, where companies sell shares in the company to investors and borrow money and where investors are paid dividends and interest is paid on loans.
2. Purchases/accounts payable system
   Cash disbursements system
   Payroll system
   Fixed asset system

Self-test 2.2.

1. The first step in processing input is to capture transaction data and enter them into the system.

The second step in processing input is to make sure captured data are accurate and complete.

The third step in processing input is to make sure company policies are followed.

2. An audit trail is a traceable path of a transaction through a data processing system from point of origin to final output, or backwards from final output to point of origin.

Self-test 2.3.

1. Creating
Reading
Updating,
Deleting

2. A database query

Self-test 2.4.

1. **Source Documents:** Economic events result in some documents being created at the beginning (the source) of the transaction. These are called source documents. Source documents are used to capture and formalize transaction data that the transaction cycle needs for processing.
   Product Documents: Product documents are the result of transaction processing rather than the triggering mechanism for the process. For example, a payroll check to an employee is a product document of the payroll system.

Turnaround Documents: Turnaround documents are product documents of one system that become source documents for another system.

2. A transaction file

Self-test 2.5.

1. **ERP** is a set of integrated programs to manage critical operations for an entire organization.
2. Cost
   Amount of time required.
   Complexity.
   Resistance.

CHAPTER THREE

THE SYSTEM DEVELOPMENT PROCESS

Chapter objectives

Dear students, *after reading this chapter, you will:*

- Understand why documenting an AIS is important.
- Be able to draw simple document flowcharts and explain how they describe the flow of data in AISs.
- Be able to draw simple document flowcharts, system flowcharts, process maps, and data flow diagrams.
- Know how program flowcharts and decision tables help document AISs.
- Understand the system development process
- Identify the phases in the system development life cycle (SDLC)
- Understand the role of accountants in the system development life cycle (SDLC)

Introduction

Dear students, chapter two presents the major business process, the transaction processing cycle and the enterprise resource planning system. The purpose of this chapter is to describe the system documentation and the process of developing a system. The chapter is composed of two major sections. Accordingly, the first section presents the system documentation tools, techniques and symbols. The second section of the chapter introduce you with the system development process including the phases involved in the system development life cycle (SDLC), and the role of accountants in the system development life cycle (SDLC).

3.1. System Development and Documentation: Tools and Techniques

Documentation explains how AISs operate and is therefore a vital part of any accounting system. For example, documentation describes the tasks for recording accounting data, the procedures that users must perform to operate computer applications, the processing steps that AISs follow, and the logical and physical flows of accounting data through the system. Accountants use many different types of diagrams to trace the flow of accounting data through an AIS. For example, document flowcharts describe the physical flow of order forms, requisition slips, and similar hard-copy documents through an AIS. These flowcharts pictorially represent data paths in compact formats and therefore save pages of narrative description. System flowcharts are similar to document flowcharts, except that system flowcharts usually focus on the electronic flows of data in computerized AISs. Other examples of documentation aids include process maps, data flow diagrams, program flowcharts, and decision tables. A wide variety of software is available for documenting AISs. Documentation includes the following types of tools:

- ✓ The narratives (written descriptions),
- ✓ Flowcharts,
- ✓ Diagrams, and

- ✓ Other written material that explain how the system works

This information covers the who, what, when, where, why, and how of data entry, processing, storage, information output and system controls. One popular means of documenting a system is to develop diagrams, flowcharts, tables, and other graphical representations of information. These are then supplemented by a narrative description of the system, which is a written step-by step explanation of system components and interactions. The two most common tools of system documentation- dataflow diagrams and flowcharts will be discussed in this part.

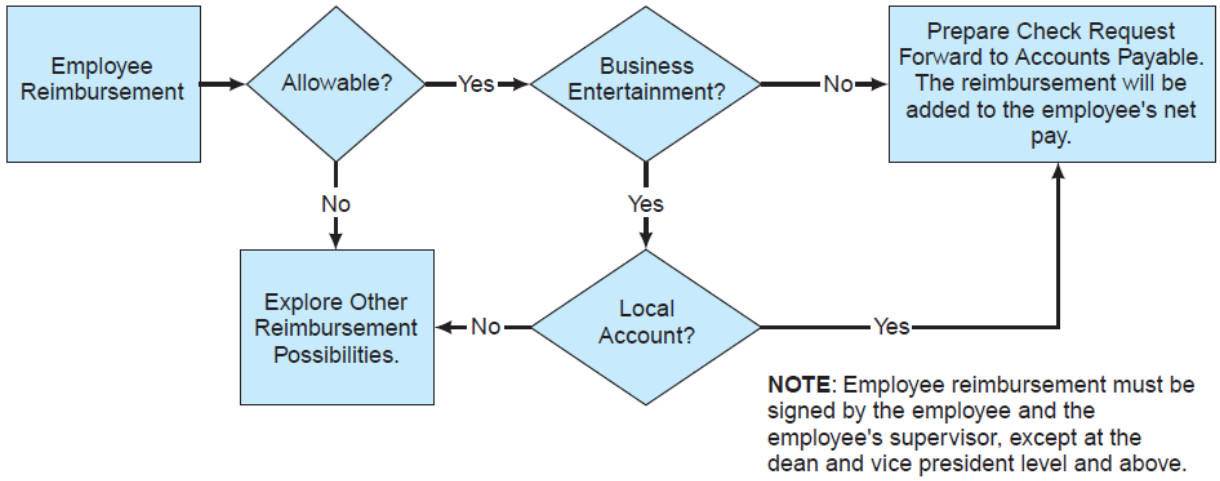
Importance of documentation in System Development

Accountants do not need to understand exactly how computers process the data of a particular accounting application, but it is important for them to understand the documentation that describes how this processing takes place. Documentation also describes the logical flow of data within a computer system and the procedures that employees must follow to accomplish application tasks. The following are nine reasons why documentation is important to AISs.

1. **Depicting how the system works:** Documentation helps employees understand how a system works, assists accountants in designing controls for it, and gives managers confidence that it will meet their information needs. The Internet contains many examples of flowcharts or logic diagrams that help individuals understand unfamiliar tasks or processes. For example, some universities use them to show students what classes to take and when they should take them to complete their majors in a timely manner. The University of Washington has flowcharts that show how to obtain grants and other types of funding. The University of Illinois at Urbana-Champaign uses elaborate diagrams to depict what happens when a faculty member's employment terminates. **Figure 3.1.** is a logic diagram from the University of Arizona website that shows employees how to file a claim for reimbursement? If the employee would like additional information for any step in the process, a click of the mouse on the appropriate flowchart symbol reveals additional information.
2. **Training users:** Documentation also includes the user guides, manuals, and similar operating instructions that help people learn how an AIS operates. Employees usually do not like to read the user manuals that typically accompany application software, but these instructional materials are invaluable reference aids when they are needed. Whether distributed manually in hard-copy format or electronically in the familiar Help files or ''get-started tours'' of microcomputer applications, these documentation aids help train users to operate AIS hardware and software, solve operational problems, and perform their jobs better.

Figure 3.1. Example of a flowchart used at the University of Arizona to help employees file a reimbursement claim. For additional information, individuals simply click on the appropriate

symbol.



3. **Designing new systems:** Documentation helps system designers develop new systems in much the same way that blueprints help architects design buildings. For example, professional IT personnel commonly hold structured walkthroughs in which they review system documentation to ensure the integrity and completeness of their designs, and to identify design flaws. Well-written documentation, along with other systems-design methodologies, often plays a key role in reducing systems failures and decreasing the time spent correcting ‘‘emergency errors’’ in computer systems. Conversely, poorly-designed systems usually lead to critical mistakes and expensive write-offs.
4. **Controlling system development and maintenance costs:** Personal computer applications typically employ prewritten, off-the-shelf software that is relatively reliable and inexpensive. In contrast, custom-developed business systems often cost millions of dollars and can be less reliable. Good documentation helps system designers develop **object-oriented software**, that is, programs that contain modular, reusable code. This object-orientation helps programmers avoid writing duplicate programs and facilitates changes when programs must be modified later. If you have ever replaced a specialized part in your car, you have some idea of how frustrating, time-consuming, and expensive ‘‘non-standardization’’ can be, and therefore how useful object-oriented programming might be to business organizations.
5. **Standardizing communications with others:** The usefulness of narrative descriptions can vary significantly, and a reader can interpret such descriptions differently from what the writer intended. Documentation aids such as system flowcharts or data flow diagrams are standard industry tools, and they are more likely to be interpreted the same way by all parties viewing them. Thus, documentation tools are important because they help describe an existing or proposed system in a ‘‘common language’’ and help users communicate with one another about these systems.
6. **Auditing AISs:** Documentation helps depict audit trails. When investigating an AIS, for example, the auditors typically focus on internal controls. In such circumstances, documentation helps auditors determine the strengths and weaknesses of a system’s controls,

and therefore the scope and complexity of the audit. Similarly, the auditors will want to trace sample outputs to the original transactions that created them (e.g., tracing inventory assets back to original purchases). System documentation helps auditors perform these tasks.

7. **Documenting business processes:** Accounting systems automatically create a record of some organization's processes because they capture financial data as they occur. A study of these processes can lead to better systems. Thus, in mapping these processes, documentation can help managers better understand the ways in which their businesses operate, what controls are involved or missing from critical organizational activities, and how to improve core business processes.
8. **Complying with the Sarbanes-Oxley Act:** Section 404 of the Sarbanes-Oxley Act of 2002 (SOX) requires publicly-traded companies to identify the major sources of business risks, *document their internal control procedures*, and hire external auditors to evaluate the validity and effectiveness of such procedures. Documentation is therefore crucial for analyzing the risks of errors, frauds, omissions, and similar mistakes in important business processes, as well as helping auditors evaluate the controls used to mitigate such risks. i.e., some of the major tasks required by SOX. Almost everyone acknowledges that the costs of complying with SOX are enormous, and many also believe that SOX gave documentation ''a new life.'' To save money, many companies now use software packages to help them automate SOX documentation tasks.
9. **Establishing accountability:** Manual signatures on business and government documents allow employees and government agents to execute their responsibilities, create audit trails, and establish accountability for their actions. An example is a signed checklist that outlines the month-end journal entries an accountant must perform. Such checklists verify that the accountant performed these tasks, that a reviewer approved them, and that both individuals are accountable for the accuracy of the work. Similar comments apply to the checklists for preparing financial statements, tax returns, auditing papers, budgets, and similar accounting documents. Including such checklists with the statements themselves both documents the work that the employees performed as well as the procedures and controls *involved* in the work.

Self-test 3.1. *Dear learners, check your progress!*

1. What is documentation?
2. Why documentation is important?

3.1.1. Basic Documentation Tools

As both systems designers and auditors, accountants use system documentation routinely. The ability to document systems in graphic form is thus an important skill for accountants to master.

The two of the most common and basic documentation tools are:

1. Data Flow Diagrams (DFDs): are graphical descriptions of the sources and destinations of data. They show data flow within an organization i.e. where data comes from and where it goes, how it flows, the processes performed on it, and how data are stored

2. Flow Charts: There are three types of flow charts

i. **Document Flow Chart:** a graphical description of the flow of documents and information between departments or areas of responsibility within an organization. It traces the physical flow of documents through an organization.

ii. **System Flowchart:** a graphical description of the relationship among the input, processing, and output in an information system. It shows the electronic flow of data and processing steps in an AIS.

iii. **Program Flowchart:** a graphical description of the sequence of logical operations that a computer performs as it executes a program.

These tools are used extensively in the **System Development Process**. Systems development is a complex process and these tools are used to create order from chaos and complexity. In addition, the team members who develop information systems projects often change and these documentation tools help the new team members get up to speed quickly. Both DFDs and Flowcharts are easy to prepare and revise when one of the recently developed DFDs or Flowcharting Software packages is used.

3.1.1.1. Data Flow Diagrams (DFDs)

A data flow diagram (DFD) graphically describes the flow of data within an organization. DFDs are primarily used in the systems development process as a tool for analyzing an existing system. It is also used to plan and design new ones. DFDs uses symbols to represent the entities, processes, data flows, and data stores that pertain to a system.

Symbols used in a Data Flow Diagram

A DFD is composed of four basic symbols: data sources and destinations, data flows, transformation processes, and data stores. Each is represented in a DFD by a unique symbol.

Figure 3.2. presents the symbol set most commonly used. DFDs are used to represent systems at different levels of detail from very general to highly detailed.

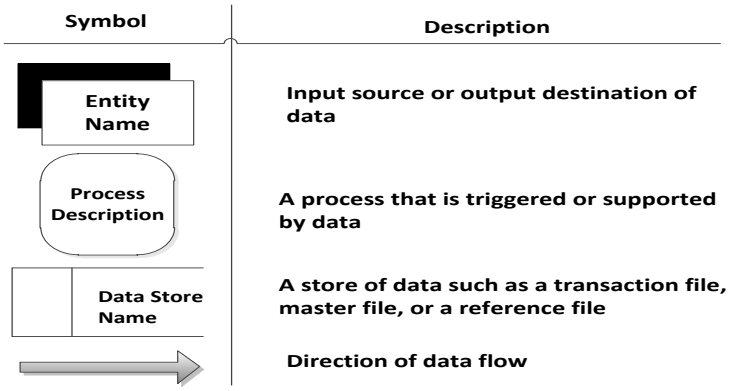
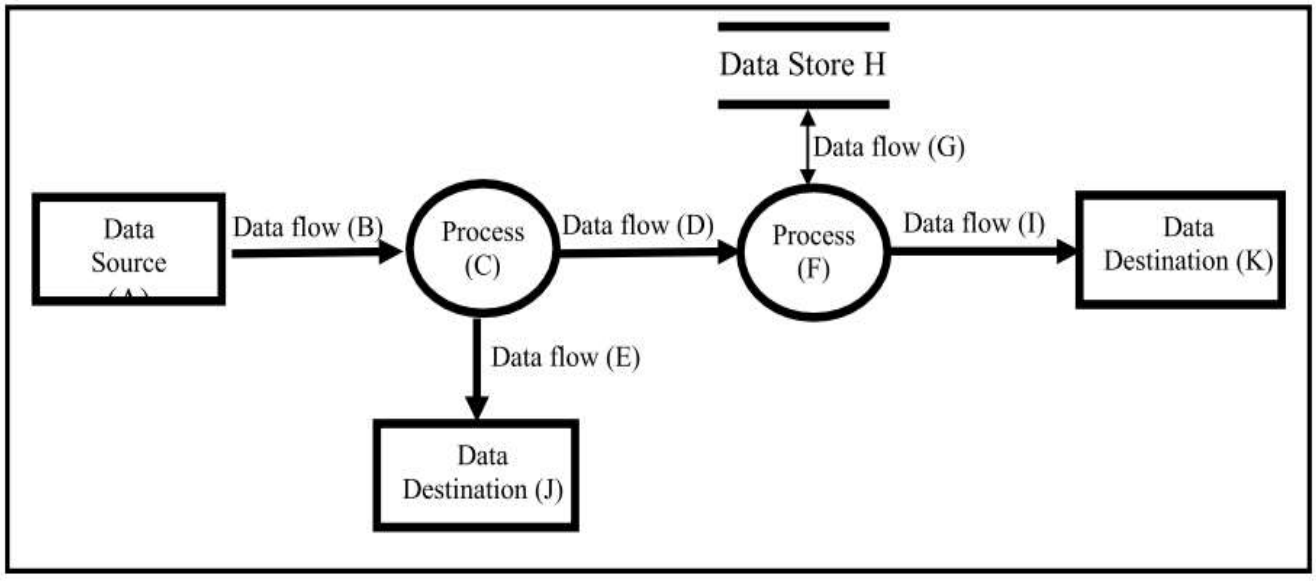


Figure 3.2. : Data Flow Diagram Symbols

These four symbols are combined to show how data are processed. For example, in the diagram below, the input to Process C is data flow B, which comes from data source A. The outputs of process C, are data flows D and E. Data flow E is sent to data destination J. Process F uses data flows D and G, as input and produces data flows I and G, as output. Data flow G comes from and returns to data store h. Data flow I is sent to data destination K.



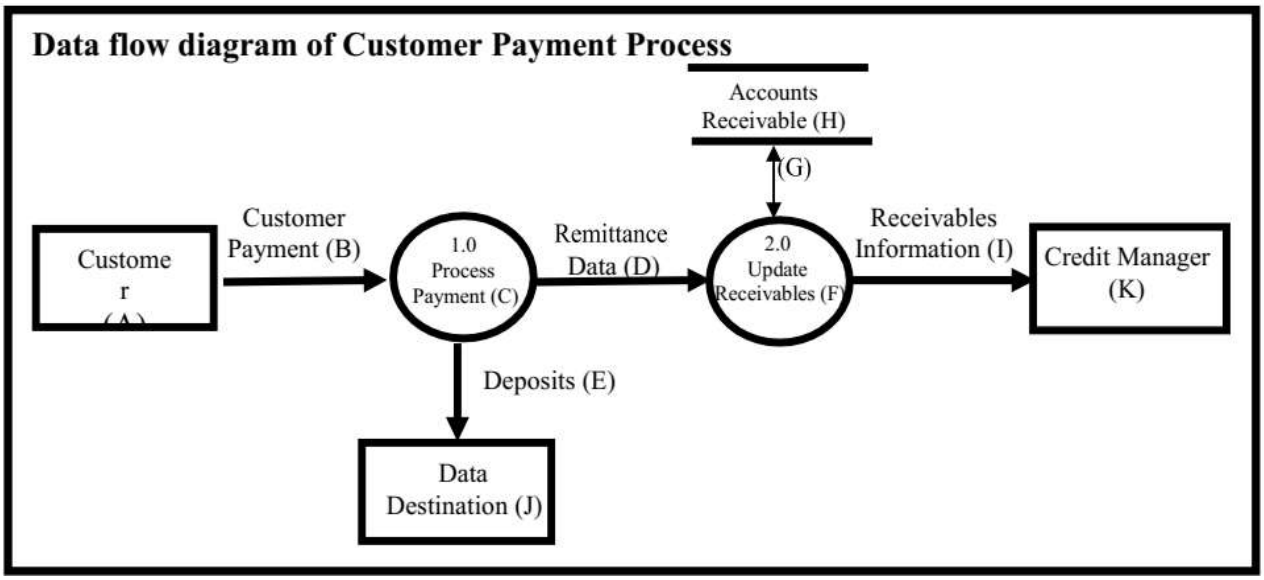
1. Entity: Data Sources and Destinations

A data source **or** ***data destination*** symbol on the DFD represents an organization or individual that sends or receives data that they system uses or produces. An entity can be both a source and a destination. Data sources or destinations are represented by a square.

2. Data flows

Data flows appear as arrows. A data flow represents the flow of data between processes, data stores and data sources and destinations. Data that passes between data stores and either a data source or a destination must go through some form of data processing (transformation process). Data flow

arrows are labeled to indicate the type of data being passed. Thus, the reader knows exactly what information is flowing; no inferences are required. In the diagram below data flow B is labeled Customer Payment; Item D (remittance data); E (deposit); G (unlabeled; represents information entered into or retrieved from an accounts receivable data file), and I (receivable information) A data flow can consist of one or more pieces of datum. For example, data flow B (customer payment) in the diagram below consists of two parts: **a payment and remittance data**. Process 1.0 (process payment) splits these two data elements and sends them in different directions. The remittance data (D) flows to another process, where it is used to update accounts receivable records, and the payment (E) is sent to the bank with a deposit slip. Because data flows may consist of more than one data element, the designer must determine the number of lines to show. The determining factor is if the data elements always flow together. For example, customers may send inquiries about the processing of their payments with payments or separately.



3. Transformation Process

A transformation process represents the transformations of data. The diagram above shows that process payment (C) takes customer payment and splits into the remittance data and the deposit (which includes the checks and deposit slip created within process payment). The updating receivables (F) process takes the remittance data (D) and the accounts receivables (H) data, producing updated receivables record and sending receivables information to the credit manager.

4. Data Stores

A data store is a temporary or permanent repository of data. DFDs do not show the physical storage medium such as disks, and paper, used to store data. As with other DFD elements, data store names should be descriptive. Data stores are represented by horizontal lines, with respective name recorded inside.

Data Dictionary

*A **data dictionary*** contains description of all the elements, stores, and flows in a system. Data flows and data stores are typically collections of data elements. Typically, a master copy of the data dictionary is maintained to ensure consistency and accuracy throughout the development process.

Types of DFDs

1. Physical Data Flow Diagrams

A Physical DFD documents the physical structure of an existing system. It answers questions such as **where** an entity works, **how** an entity works, the work is done by **whom**, etc. Given the very "physical" focus of a physical DFD, it changes whenever the entities, technology used to implement the system, etc. changes. Physical DFDs have no lower levels. Physical DFD focuses on physical entities as well as the tangible documents, reports, and similar hard-copy inputs and outputs that flow through the system. Physical DFD lists the job title of one typical employee and it is simple, more readable, and therefore more easily understood. **Figure 3.3.** presents an example of physical DFDs.

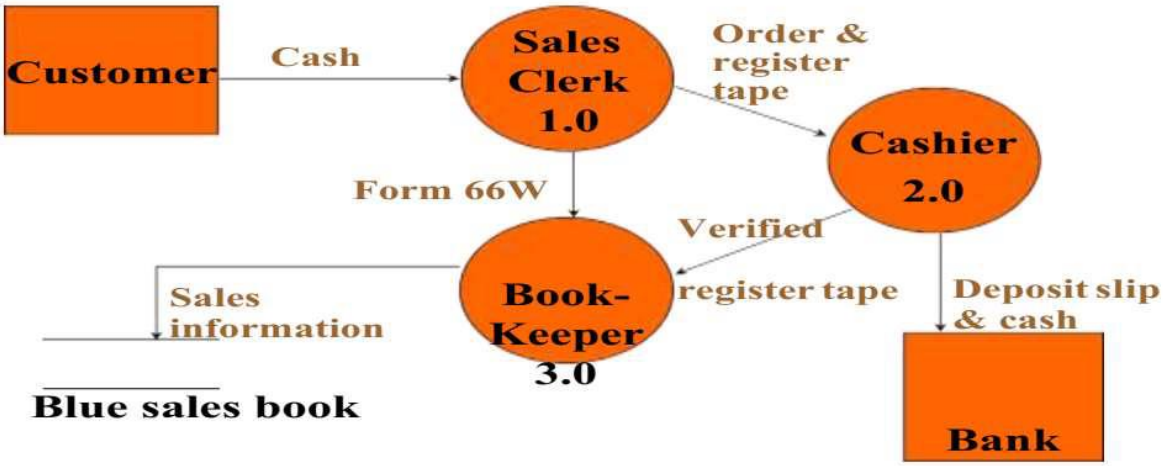


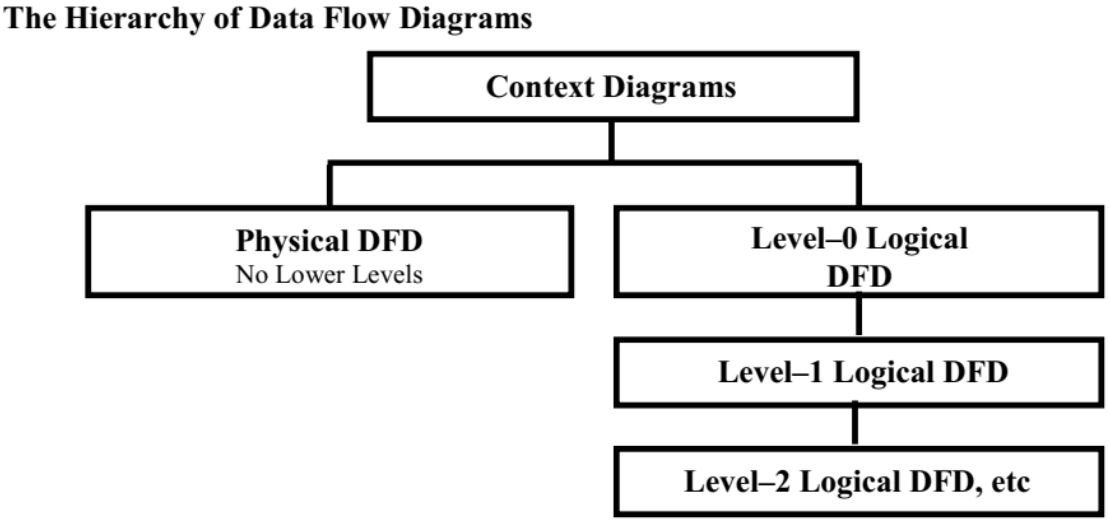
Figure: Physical Data Flow Diagram

2. Logical Data Flow Diagrams

Logical Data Flow Diagrams document the processes in an existing or proposed system. It used to document what tasks the system performs. The logical DFD focuses on the logical flow of data. Because the logic of a system changes infrequently, relative to its physical nature, a logical DFD will remain relatively constant over time. Logical Data Flow Diagrams are usually drawn in levels that include increasing amounts of detail. Logical Data flow diagrams typically have levels below the level-0 diagram.

Context Diagram

A top level (**High-Level**) **Logical DFD** that provides an overall picture of an application or system is called a **Context Diagram**. A context diagram provides the reader with a summary level view of the system. It depicts a **data processing system** and **the external entities** that are the sources and destinations of the system's **inputs** and **outputs**. It does focus either on the tasks or the physical entities. It shows the overall picture of the system. The following diagram shows the hierarchy of DFDs.



Guideline for Drawing DFDs

There is no ideal way to develop a DFD, because different problems call for different methods. However, some general guidelines for developing DFDs can be used by system analysts. The following are the guidelines for drawing DFDs.

1. *Understand the system*: involves observing the flow of information through an organization and interviewing the individuals who use and process the data.

2. *Ignore certain aspects of the system*: as DFD diagrams the origin, flow, transformation, storage and destinations of data, all control actions and processes should be ignored.

3. *Determine system boundaries*: is determining what to include in and exclude form the system. All relevant data elements shall be included in the DFD because excluded items will not be considered during systems development. When in doubt about an element's importance, include it until a definitive decision can be made to discard it.

***4. Develop a context diagram*:** a context diagram is a good way of depicting system boundaries. In the diagram's center is a circle; inside of it is displayed the system of concern. The outside entities, with which the system interacts directly, are in boxes on either side, connected by data flows depicting the data passed between them. DFDs are prepared, in successively more detail, to depict data flows in the system.

5. *Identify data flows*: all data flows shall be identified entering or leaving the system's boundary, including where the data originate and the final destination. Any significant movement of information is usually a data flow. All data flows come from and go to either a transformation

process, a data store (file), or a data source or destination. As each of this is identified, it should be connected to the appropriate data flow. Data flows can move in two directions, shown as a line with arrows on both ends.

6. *Group data flows*: a data flow consists of one or more pieces of datum. Data elements that always flow together should be grouped together and shown as one data flow until they are separated. If the data elements do not always flow together, then they should be shown as two separate data flows.

***7. Identify transformation processes*:** this is by placing a circle wherever work is required to transform one data flow into another. All transformation processes should have one or more incoming or outgoing data flows.

8. *Group transformation processes*: transformation processes that are logically related or occur at the same time and place should be grouped together. Unrelated items shall never be combined into a single transformation process. If data are not processed together, or are sometimes processed differently, then, they shall be separate.

9. *Identify all files or data stores*: data are stored temporarily or permanently in most systems. Each data repository, and each data flow into and out of it, should be identified.

10. *Identify all data sources and destinations*: all sources and destinations of data should be identified and included on the DFD.

11. ***Name all DFD elements***: except for data flows into or out of data stores (data store is sufficient to identify the data flow), data elements should be given unique and descriptive names representing what is known about them. This makes DFD easier to read and understand as it provides the reader with key information. Naming data flows first forces the developer to concentrate on the all important data flows, rather than on the processes or stores. Once data flows have been labeled, naming the process and data stores is usually easy, because they typically take their names from the data inflows or outflows. Choosing active and descriptive names such as daily inventory update and validate transaction, rather than input data or update process. Process names should include action verbs such as update, edit, prepare, and record.

12. *Subdivide the DFD*: a cluttered DFD is hard to read and understand. If there are more than five to seven processes on a single page, then, higher level and lower level DFDs shall be used. The context diagram shall be decomposed into high level processes, and then exploded into successively lower level processes.

13. *Give each process a sequential number*: in completed DFD, each process is given a sequential number that helps readers move back and forth between different DFD levels. Data flows should only go from lower numbered to higher numbered processes.

14. *Repeat the process*: DFD developers must work through organization data flows several times. Each subsequent pass helps refine the diagram and identify the fine points. When refining, the DFD shall be organized to flow from top to bottom and from left to right.

***15. Prepare a final copy*-** the final copy of the DFD shall be drawn. Data flow lines shall be allowed to cross over each other, if necessary, a data store or destination may be repeated. The name of the DFD, the data prepared, and the preparer shall be placed on each page.

Self-test 3.2. *Dear learners, check your progress!*

1. List and explain the four symbols used in DFD.
2. What are the two types of DFDs?

3.1.1.2. Flowcharts

A flowchart is an analytical technique used to describe some aspect of an information system in a clear, concise, and logical manner. Flowcharts use a standard set of symbols to pictorially describe transaction processing procedures. Flowcharts can be used to represent manual activities, computer processing activities, or both. There are three types of flow charts. 1) Document flow chart, 2) System flow chart and 3) Program flow chart

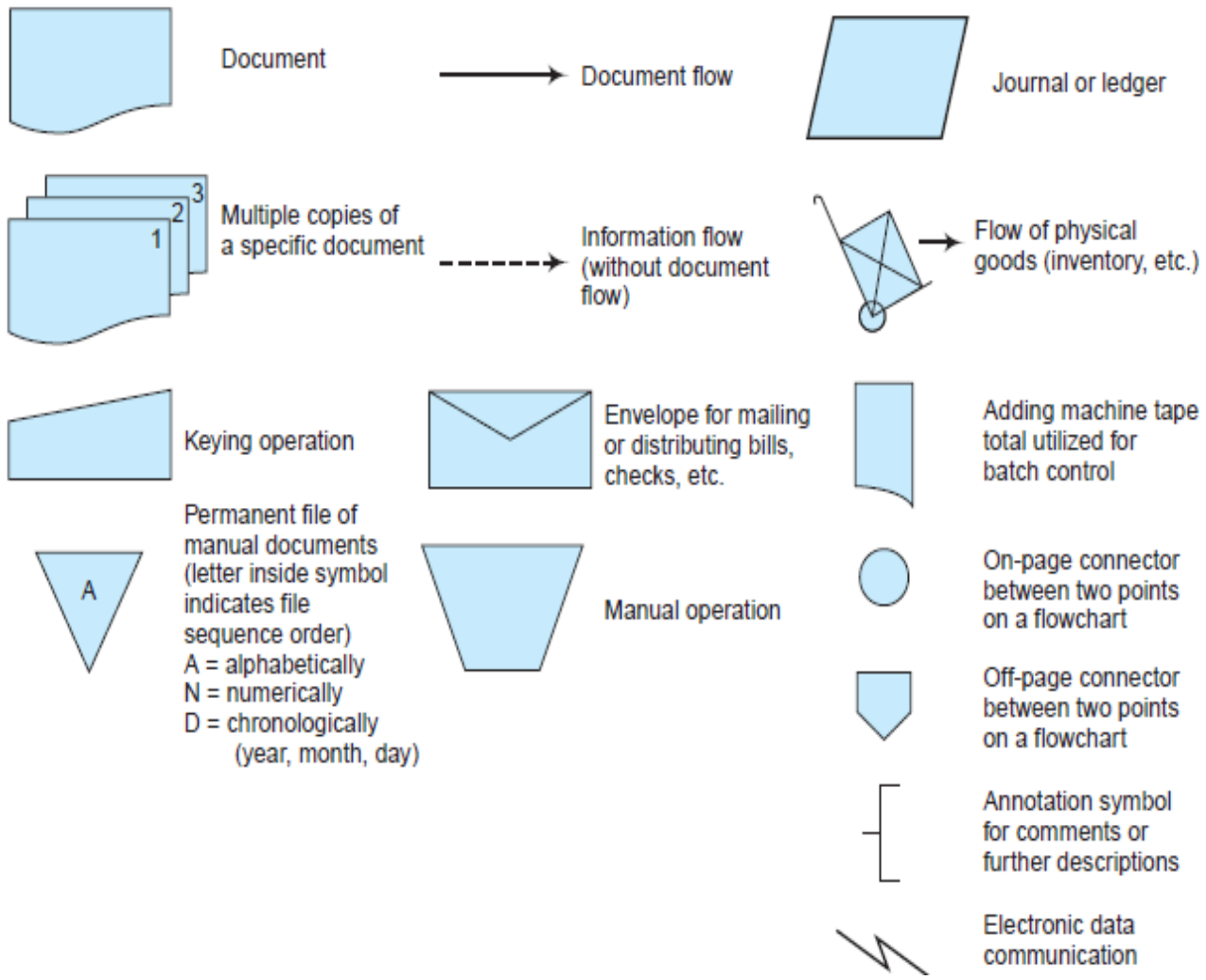
1.Document flow chart

A **document flowchart** traces the physical flow of documents through an organization- i.e., from the departments, groups, or individuals who first create them to their final dispositions. **Figure 3.4**. to presents the common document flowcharting symbols, and the examples below illustrate how to use them to create simple document flowcharts. Constructing a document flowchart begins by identifying the different departments or groups that handle the documents of a particular system. The flow charter then uses the symbols in Figure 3.4. to illustrate the document flows.

Example. Let us consider the task of hiring a new employee at your company. The process begins when a department develops a vacancy. The Human Resources (HR) director explains the process as follows:

"The department that develops a vacancy must first complete a job vacancy form, which it forwards to my department. We then advertise for the position and, with the help of the requesting department, interview applicants. When the vacancy is filled, the HR Department prepares a position hiring form (PHF) in triplicate. We file the first copy in a manual file, which is organized by employee Social Security number. We staple the third copy to the job vacancy form and return it to the Requesting Department, where clerks file it alphabetically by employee last name. The HR Department forwards the second copy of the PHF to the Payroll Department. The Payroll Department uses the form as an authorization document to create a payroll record for the new employee. Thus, the information on the form is keyed directly into the company's computer system using an online terminal located in the payroll office. This copy of the PHF is then filed numerically for reference and also as evidence that the form has been processed."

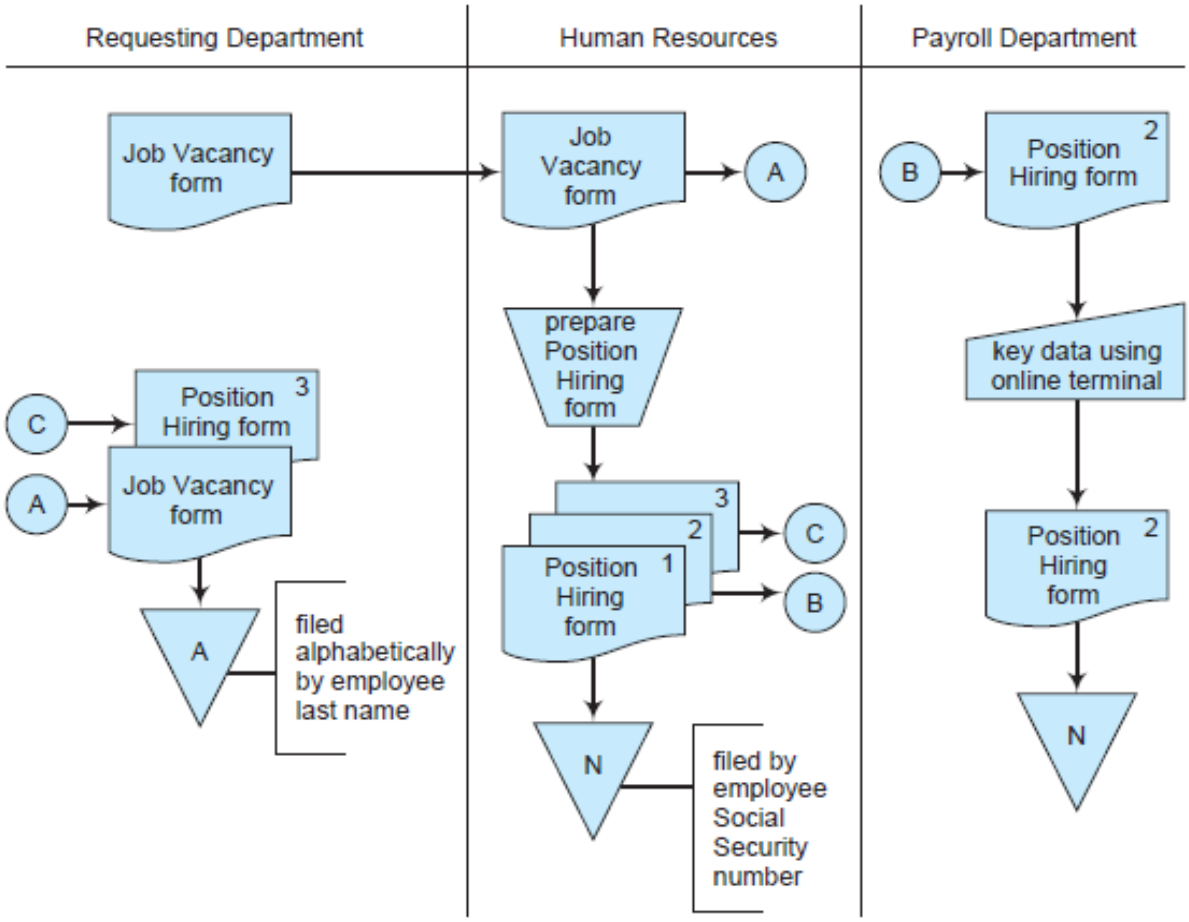
Figure 3.5. is a document flowchart for this example. To draw it, the first step is to identify the participants. In this case there are three of them: (1) the department with the job vacancy (i.e., the Requesting Department in Figure 3.5), (2) the Human Resources Department, and (3) the Payroll Department. You identify each of these departments in separate columns at the top of the document **Figure 3.4** Common document flowcharting symbols.



flowchart. Your next step is to identify the documents involved. There are two major ones: (1) the Job Vacancy form, which we presume is prepared as a single copy, and (2) the Position Hiring form, which we are told is prepared in triplicate. In practice, multiple-copy forms are usually color-coded. However, in document flowcharts, usually these are simply numbered and a separate page is attached to explain the color-number equivalencies. Your third step is to indicate where the documents are created, processed, and used. This is probably the most

difficult task, and a document flowchart designer must often use considerable ingenuity to represent data flows and processing activities accurately. Figure 3.5. illustrates these flows for the hiring procedures just described. Where there are a large number of document transmittals, you can use on-page connectors (circles) to connect document flows from one place on a page to another and avoid complicated flow lines. Thus, Figure 3.5. uses several on-page connectors (with letters A, B, and C) to avoid cluttering the drawing and shows the completed document flowchart. You should use a unique identifier in each connector (such as a letter) for identification purposes. You can also use off-page connectors (to connect data flows to other pages) if necessary.

Figure 3.5. A document flowchart illustrating the flow of documents involved in the hiring of a new employee.



Guidelines for Drawing Document Flowcharts

Document flowcharts concentrate on the physical flow of reports and similar documents. When constructing them, some analysts also include any movement of physical goods in their document flowcharts e.g., moving inventory from a receiving department to an inventory storeroom. (Document flowcharts typically use hand-truck symbols for this task.) Some document flowcharts also illustrate information flows that do not involve documents (for example, a sales clerk

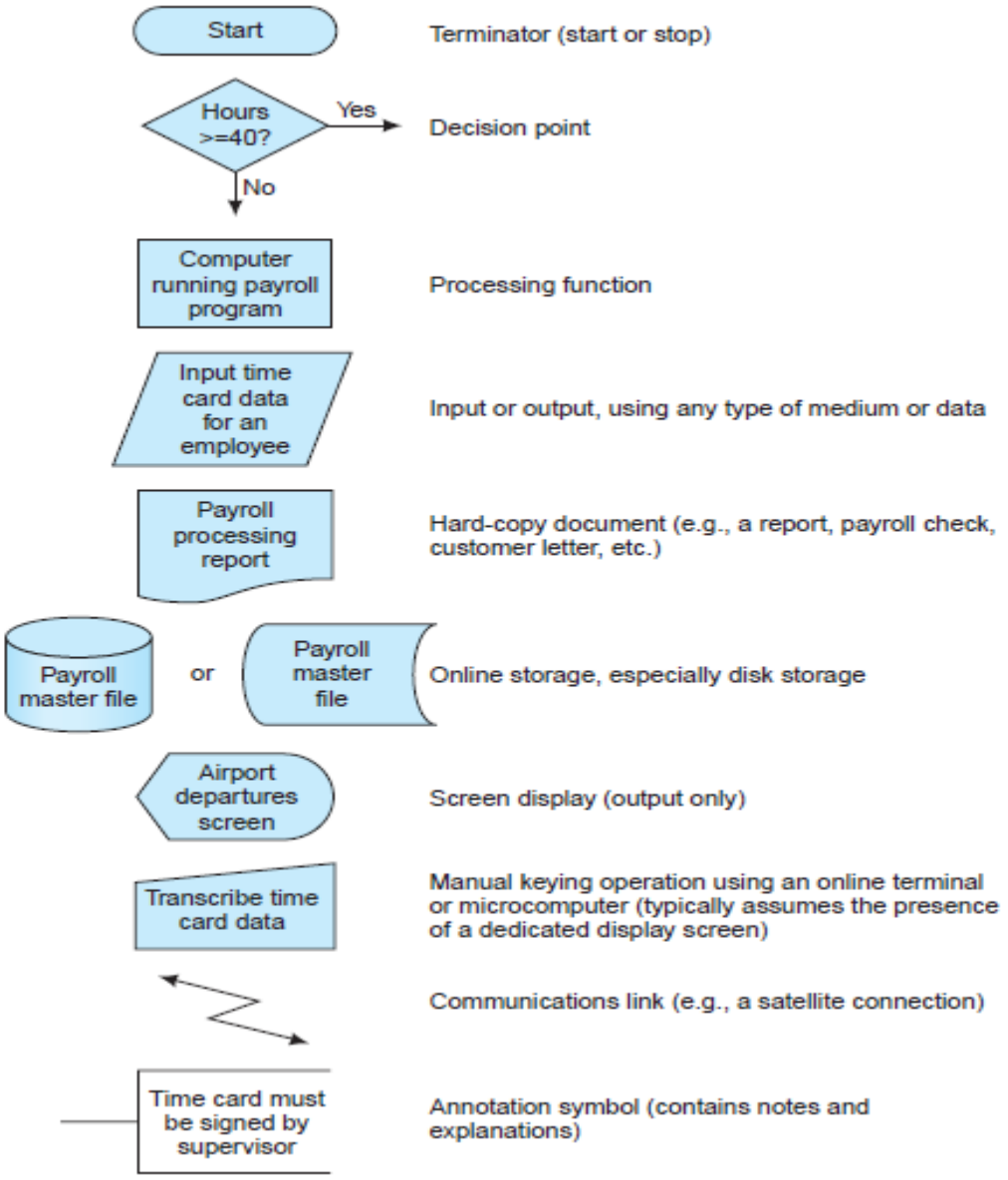
telephoning to check a customer's account balance before approving a credit sale). Thus, the term ''document'' broadly includes all types of organizational communications and data flows. Unlike other types of symbols—for example, the system and program flowcharting symbols discussed later in this chapter—document flowcharting symbols are not standardized. But even though creating document flowcharts is more an art than a science, you can use the following guidelines to make these flowcharts clearer.

1. Identify all the departments that create or receive the documents involved in the system. Use vertical lines to create ''swim lanes'' to separate each department from the others.
2. Carefully classify the documents and activities of each department, and draw them under their corresponding department headings.
3. Identify each copy of an accounting document with a number. If multiple-copy documents are color-coded, use a table to identify the number-color associations.
4. Account for the distribution of each copy of a document. In general, it is better t over-document a complicated process than to under-document it.
5. Use on-page and off-page connectors to avoid diagrams with lines that cross one another.
6. Each pair of connectors (a ''from'' and a ''to'' connector in each pair) should use the same letter or number.
7. Use annotations if necessary to explain activities or symbols that may be unclear. These are little notes to the reader that help clarify your documentation.
8. If the sequence of records in a file is important, include the letter ''A'' for alphabetical, ''N'' for numeric, or ''C'' for chronological in the file symbol. As indicated in guideline 7, you can also include a note in the flowchart to make things clearer.
9. Most employees reference forms with acronyms (e.g., GRF or PHF in the preceding examples). To avoid confusion, use full names (possibly with acronyms in parentheses) or create a table of equivalents to ensure accuracy in identifying such forms.
10. Consider using automated flowcharting tools. See the section of this chapter on CASE tools.

2. System Flowcharts

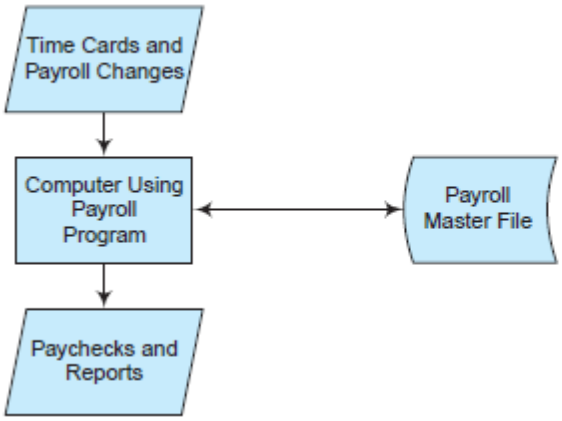
Whereas document flowcharts focus on tangible documents, **system flowcharts** concentrate on the computerized data flows of AISs. Thus, a system flowchart typically depicts the electronic flow of data and processing steps in an AIS. System flowcharts are similar to document flowcharts, except that system flowcharts usually focus on the electronic flows of data in computerized AISs. **Figure 3.6.** presents some common system flowcharting symbols.

Figure 3.6. Some common system and programming flowcharting symbols.



Some system flowcharts are general in nature and merely provide an overview of the system. These *are high-level system flowcharts*. **Figure 3.7.** is an example. The inputs and outputs of the system are specified by the general input and output symbol, a parallelogram. In more detailed system flowcharts, the specific form of these inputs and outputs would be indicated for example, by magnetic disk symbols. Figure 3.7. refers to only one process preparing a payroll. A more detailed system flowchart would describe all the processes performed by the payroll program and the specific inputs and outputs of each process. At the lowest, most-detailed level of such documentation are program flowcharts that describe the processing logic of each application program.

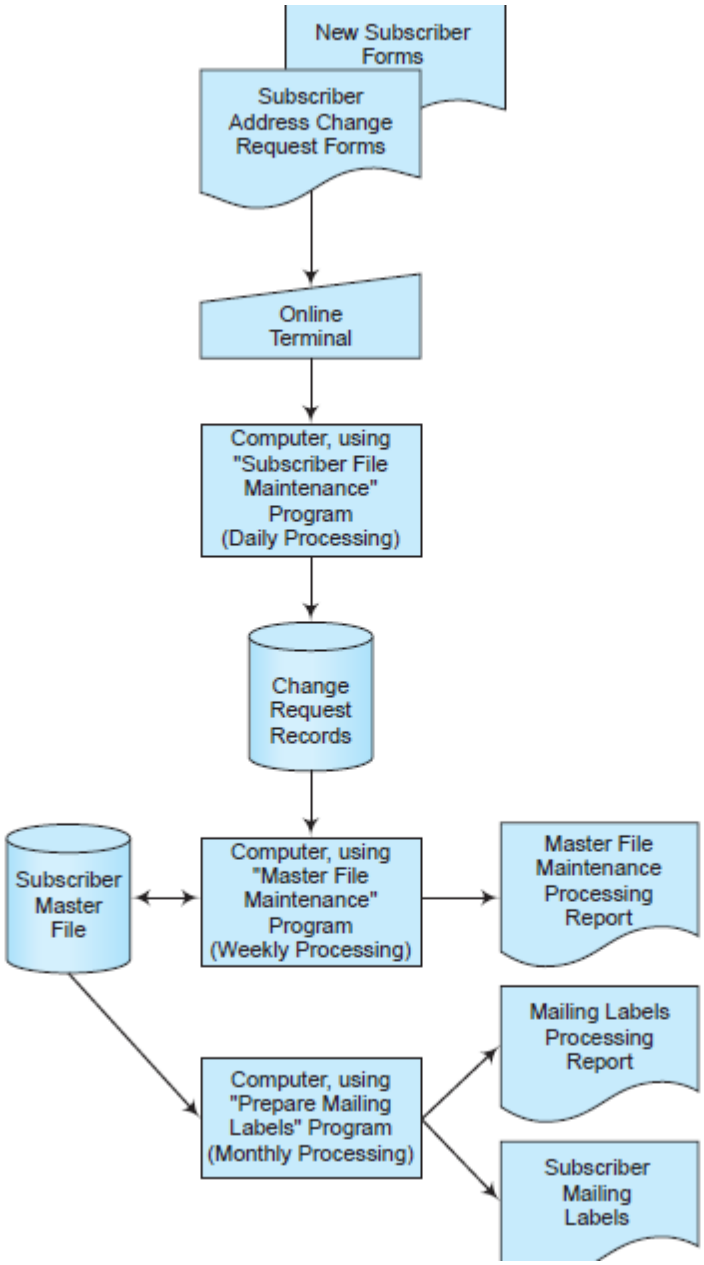
Figure 3.7. A high-level system flowchart for payroll processing.



Like document flowcharts, the process of drawing system flowcharts is probably best understood by studying an illustration. **Figure 3.8.** is a system flowchart for the following example.

"The Sarah Stanton Company is a magazine distributor that maintains a file of magazine subscribers for creating monthly mailing labels. Magazine subscribers mail change-of-address forms or new-subscription forms directly to the company, where input personnel key the information into the system through online terminals. The computer system temporarily stores this information as a file of address-change or new-subscription requests. Clerical staff keys these data into computer files continuously, so we may characterize it as ''daily processing.'' Once a week, the system uses the information in the daily processing file to update the subscriber master file. At this time, new subscriber names and addresses are added to the file, and the addresses of existing subscribers who have moved are changed. The system also prepares a Master File Maintenance Processing Report to indicate what additions and modifications were made to the file. Once a month, the company prepares postal labels for the magazine's mailing. The subscriber master file serves as the chief input for this computer program. The two major outputs are the labels themselves and a Mailing Labels Processing Report that documents this run and indicates any problems."

Figure 3.8. A system flowchart illustrating the computer steps involved in maintaining a subscriber master file and creating monthly mailing labels.



The system flowchart in Figure 3.8. documents the flow of data through the company's computerized system. Thus, it identifies sources of data, the places where data are temporarily stored, and the outputs on which processed data appear. In Figure 3.8., for example, the system flowchart begins with the subscriber request forms and documents the flow of data on these forms through the keying phase, master-file-maintenance phase, and finally, the monthly mailing phase. Indirectly, system flowcharts also indicate processing cycles (daily, weekly, or monthly), hardware needs (e.g., disk drives and printers), areas of weak or missing application controls, and potential

bottlenecks in processing (e.g., manual data entry). In Figure 3.8., we can also identify the major files of the system (a temporary log file of change-request records and a subscriber master file) and the major reports of the system. Finally, note that each processing phase of a system flowchart usually involves preparing one or more control reports. These reports provide processing-control information (e.g., counts of transactions processed) for control purposes and exceptions information (e.g., the identity of unprocessed transactions) that helps employees correct the errors detected by the system.

Guidelines for Drawing System Flowcharts

System flowcharts depict an electronic job stream of data through the various processing phases of an AIS, and therefore also illustrate audit trails. Each time the records of a file are sorted or updated, for example, a system flowchart should show this in a separate processing step. Generally speaking, this is the way processing proceeds in almost all AISs, one step at a time, and is therefore the way system flowcharts must portray processing phases. In recognizing the usefulness of system flowcharts, both the American Institute of Certified Public Accountants (AICPA) and the Institute of Management Accountants (IMA) consistently include test questions in their professional examinations, which require a working knowledge of system flowcharts. Although no strict rules govern exactly how to construct a system flowchart, the 1following list provides some guidelines.

1. System flowcharts should read from top to bottom and from left to right. In drawing or reading such flowcharts, you should begin in the upper-left corner.
2. Because system flowcharting symbols are standardized, you should use these symbols when drawing your flowcharts—do not make up your own.
3. A processing symbol should always be found between an input symbol and an output symbol. This is called the **sandwich rule**.
4. Use on-page and off-page connectors to avoid crossed lines and cluttered flowcharts.
5. Sketch a flowchart before designing the final draft. Graphical documentation software tools (discussed shortly) make this job easier.
6. Add descriptions and comments in flowcharts to clarify processing elements. You can place these inside the processing symbols themselves, include them in annotation symbols attached to process or file symbols, or add them as separate notes on your system's documentation.

3. Program Flowcharts

A program flowchart illustrates the sequence of logical operations performed by a computer in executing a program. It describes the specific logic to perform a process shown on a systems flowchart. A flow line connects the symbols and indicates the sequence of operations. The processing symbol represents a data movement or arithmetic calculation. Once designed and approved, the program flowchart serves as the blueprint for coding the computer program.

Note that the program flowchart details the logic of processes performed by the computer.

➢ The input/output symbol represents either reading of input or writing of output.

➢ The decision symbol represents a comparison of one or more variables and the transfer of flow to alternative logic paths.

➢ All points where the flow begins or ends are represented by the terminal symbol.

Differences between DFDs and Flowcharts

A. DFDs emphasize the flow of data and what is happening in a system, whereas a flowchart emphasizes the flow of documents or records containing data.
B. A DFD represents the logical flow of data, whereas a flowchart represents the physical flow of data.
C. Flowcharts are used primarily to document existing systems.
D. DFDs, in contrast, are primarily used in the design of new systems and do not concern themselves with the physical devices used to process, store, and transform data.
E. DFDs make use of only four symbols.
F. Flowcharts use many symbols and thus can show more detail.

Self-test 3.3. *Dear learners, check your progress!*

1. What is the major difference between document flow charts and system flow charts?
2. What are the three types of flow charts?
3. What are the difference between DFDs and flowcharts?

3.2.System Development Processes

Because the environment is competitive and ever changing, organizations continually face the need for new, faster, and more reliable ways of obtaining information. To meet this need, an information system must continually undergo changes, ranging from minor adjustments to major overhauls. Occasionally, the changes are so drastic that the old system is scrapped and replaces by an entirely new one. Change is so constant and frequent that most organizations are involved in some system improvement or change. This due to one of the following reasons:

1. **Changes in user or business needs:** increased completion, business growth or consolidation, merger and divestiture, new regulations, or changes in regional and global relationships can alter an organization's structure and purpose. To remain responsive, the system must change as well.

2. **Technological change**: as technology advances and becomes less costly, an organization can make use of the new capabilities or existing ones that were previously too expensive.
3. **Improved business processes:** many companies have inefficient business processes that require updating.
4. **Competitive advantage:** Increased quality, quantity and speed of information can result in an improved product or service and may help lower costs.
5. **Productivity gains:** computers automate clerical and repetitive tasks and significantly decrease the performance time of other tasks. Expert systems place specialized knowledge at the disposal of many others.
6. **Growth**: companies outgrow their systems and must either upgrade or replace them entirely.
7. **Downsizing**: companies often move from centralized mainframes to networked PCs or to Internet based systems to take advantage of their price/performance ratios. This places decision making and its corresponding information as far down the organization chart as possible.

3.2.1. The Systems Development Life Cycle (SDLC)

Whether systems changes are major or minor, most companies go through a systems development life cycle. The systems development life cycle (SDLC) is a conceptual model that describes the stages involved in an information system development project, from an initial feasibility study through maintenance of the completed application. It is a logical process by which systems analysts, software engineers, programmers and end-users build information systems and computer applications to solve business problems and needs.

Systems development methodology can be used as a synonym for the life cycle. Systems development methodology is a very formal and precise system development process that defines a set of activities, methods, best practices, deliverables, and automated tools that system developers and project managers are to use to develop and maintain information systems and software.

In general, an SDLC methodology follows the following steps:

1. **The existing system is evaluated**: deficiencies are identified. This can be done by interviewing users of the system and consulting with support personnel.
2. **The new system requirements are defined**: in particular, the deficiencies in the existing system must be addressed with specific proposals for improvement.
3. **The proposed system is designed**: plans are laid out concerning the physical construction, hardware, operating systems, programming, communications, and security issues.
4. **The new system is developed**: the new components and programs must be obtained and installed. Users of the system must be trained in its use, and all aspects of performance must be tested. If necessary, adjustments must be made at this stage.
5. **The system is put into use**: this can be done in various ways. The new system can have phased in, according to application or location, and the old system gradually replaced. In some cases, it may be more cost-effective to shut down the old system and implement the new system all at once.

6. Once the new system is up and running for a while, it should be ***exhaustively evaluated.*** Maintenance must be kept up rigorously at all times. Users of the system should be kept up-to-date concerning the latest modifications and procedures.

The Key Players in System Development Process

The Players refer to who are the people involved in developing and implementing AIS.

1. Top Management

Top management's role in systems development is to:

- Provide support and encouragement and a clear signal that user involvement is important
- Help align the systems with corporate strategies
- Establish system goals and objectives
- Review IS department performance and leadership
- Establish policies for project selection and organizational structure
- Participate in important systems decisions

User management needs to:

- Determine information requirements for departmental projects
- Assist systems analysts with project cost-benefit estimates
- Assign key staff members to development projects
- Allocate funds

2. Accountants

Accountants also play an important role in systems development:

- As ***AIS users***, they must determine their information needs and systems requirements and communicate them to system developers
- As ***members of project development teams or steering committees,*** they help management in the development process.
- They are also active in designing system controls and monitoring and testing these controls and ensuring the system is easy to audit.
- Controls and "auditability" need to be built in early to minimize costs and inefficiencies later.

3. The Information Systems Steering Committee

The information systems steering committee is an executive-level committee whose duty is to plan and oversee the IS function. The information systems steering committee:

Consists of high level management, such as Controller; IS Manager; and User department managers.

- Sets policies to govern the AIS and assure top-management participation, guidance, and control.
- Attempts to encourage goal congruence and reduce goal conflict

4. The Project Development Team

The project development team includes systems specialists, managers, accountants, auditors, and users whose responsibility is to guide development. Their job is to:

- Plan each project.
- Monitor to ensure timely and cost-effective completion.
- Ensure the human element is considered.
- Communicate project status to top management and steering committee.
- Communicate and meet with users to consider ideas; discuss progress.

5. **Systems Analysts**
   - Systems analysts study existing systems, design new ones, and prepare specifications that are used by programmers.
   - They interact with technical personnel and users to bridge the gap.
   - They are responsible for ensuring the system meets user needs.
6. **Computer programmers**
   - Computer programmers write the computer programs, using the specs developed by the systems analysts
   - They also modify and maintaining existing programs
7. **External Players**
   - External players include Customers, Vendors, Auditors, and Governmental entities
   - Their needs must also be met in systems development.

3.2.2. The stages of system development cycle

The SDLC model often has five phases. Phase 1: Systems Strategy, Phase 2: Project Initiation, Phase 3: In-House Development, Phase 4: Commercial Packages and Phase 5: Maintenance and Support. The five phases of this model are presented in the following figure.

Figure 3.9. Systems Development Life Cycle

3.2.2.1.Phase one: Systems Strategy

The first step in the SDLC is to develop a systems strategy, which requires understanding the strategic business needs of the organization. This may be derived from the organization's mission statement, an analysis of competitive pressures on the firm, and the nature of current and anticipated market conditions. These needs reflect the organization's current position relative to where it needs to be in the long term to maintain strategic advantage. In addition, project management must consider the information systems' implications pertaining to legacy systems and concerns registered through user feedback. A strategic plan for meeting these various and complex needs, along with a timetable for implementation of selected systems, is produced.

The objective of systems strategy is to link individual system projects to the strategic objectives of the firm. Firms that take systems strategy seriously establish a **steering committee** to provide guidance and oversight for systems projects. The composition of the steering committee may include the chief executive officer, the chief financial officer, the chief information officer, senior management from user areas, the internal auditor, and senior management from computer services. External parties, such as management consultants and the firm's external auditors, may also supplement the committee. This committee is involved not only in developing system strategy but in every major phase of the SDLC.

The strategy stage in the SDLC consists of three fundamental tasks: assessing the organization's strategic information needs, developing a strategic systems plan, and creating actions plans. The inputs to the systems strategy phase are the business plan, the legacy system situation, and feedback from the user of the information systems.

1. Assess Strategic Information Needs

Strategic systems planning involve the allocation of systems resources at the macro level, which usually deals with a time frame of three to five years. This process is very similar to budgeting resources for other strategic activities, such as product development, plant expansions, market research, and manufacturing technology. For most companies, key inputs in developing a sound systems strategy include the **strategic business needs of the organization, the legacy system situation, and user feedback.**

A. Strategic Business Needs

All functional areas should support the business strategy of the organization. Because this is most certainly true for the information systems function, the followings are some common aspects of business strategy that bear directly on developing a sound systems strategy.

Vision and Mission: Developing a systems strategy requires an understanding of top management's vision, which has shaped the organization's business strategy. Many CEOs communicate their strategic vision through a formal mission statement. In some cases, however, top management's strategic view for the company is not fully articulated or formulated. Organizations without a well-considered mission statement might have individuals who lack a clear vision for the future managing and directing them. Not surprisingly, companies in this situation often lack a viable systems strategy. Consequently, their management is prone to making thoughtlessly responses to information systems needs that emerge out of crisis rather than planning.

Industry and Competency Analysis: Industry analysis provides management with an analysis of the driving forces that affect its industry and its organization's performance. Such analysis offers a fact-based perspective on the industry's important trends, significant risks, and potential opportunities that may impact the business's performance. Competency analysis provides a complete picture of the organization's effectiveness as seen via four strategic filters: resources, infrastructure, products/services, and customers. By assessing these factors, an organization can

develop an accurate view of its relative strengths, weaknesses, and core competencies. The analysis helps in developing strategic options, which are based on an understanding of the future environment and the firm's core competencies. Strategic opportunities may include market-entry options or new product development options.

B. Legacy Systems

Applications, databases, and business processes that are currently in full operation constitute a firm's legacy systems. Often, these are complicated systems to maintain and to enhance. Even in modern companies, the information system is usually a mixture of old and modern technologies, which are critical to the organization's business success. Legacy components need to be mapped to current business processes to determine the extent to which they support the mission of the company. This evaluation, together with an assessment of future strategic business needs, will enable management to develop other strategy needed to move from legacy systems to future or new systems.

C. **User Feedback**

Assessing user feedback involves identifying areas of user needs, preparing written proposals, evaluating each proposal's feasibility and contribution to the business plan, and prioritizing individual projects. User feedback at this point pertains to identify substantial perceived problems in the existing information systems. The followings are key steps:

1) Recognizing the problem.
2) Defining the problem.
3) Specifying system objectives.
4) Determining project feasibility.
5) Preparing a formal project proposal.

1. Recognizing the Problem

The need for a new, improved information system may be manifested through various symptoms. In the early stages of a problem, these symptoms may seem vague and harmless or may go unrecognized. However, as the underlying source of the problem grows in severity, so do its symptoms, until they are alarmingly apparent. At this point, operations may have reached a state of crisis. Therefore, the point at which the problem is recognized is important. This is often a function of the philosophy of a firm's management. The followings are management's philosophy regarding to problems:

Reactive management responds to problems only when they reach a crisis state and can no longer be ignored. This approach creates a great deal of pressure to solve the problem quickly once it has been recognized. Too often, this results in hurried analysis, incomplete problem identification, shortcuts in design, poor user participation, and the final product of a generally suboptimal solution.

Proactive management stays alert to the subtle signs of problems and aggressively looks for ways to improve the organization's systems. This management style is more likely to recognize

symptoms early and, therefore, implement better solutions. Early problem detection avoids the crisis stage and provides the necessary time for a complete and thorough study of the information systems.

2. **Defining the Problem**

The manager must avoid the temptation to take a leap in logic from symptom recognition to problem definition. One must keep an open mind and avoid drawing conclusions about the nature of the problem that may channel attention and resources in the wrong direction. For example, increased product returns, excessive delays in product shipments to customers, excessive overtime for operations personnel, and slow inventory turnover rates are all problem symptoms. These are evidence of underlying problems, but they do not, in themselves, define the problems. The manager must learn enough about the problem to pursue a solution intelligently. The manager cannot, however, collect all the information needed to define the problem accurately and specify a solution. This would require a detailed system evaluation. The manager must specify the nature of the problem as he or she sees it based on the nature of the difficulties identified.

3. Specifying System Objectives

User information requirements need to be specified in terms of operational objectives for the new information system. For example, the user may need an order entry system that can handle 5,000 transactions per hour, maintain up-to-the-minute inventory status, and allow all orders received by 2 PM to be shipped to the customer by the end of the day. At this point, we need only define the objectives in general terms. More precise system requirements will be developed later in the SDLC.

4. Preliminary Project Feasibility

A preliminary project feasibility study is conducted at this early stage to determine how best to proceed with the project. By assessing the major constraints on the proposed system, management can evaluate the project's feasibility, or likelihood for success, before committing large amounts of financial and human resources. The acronym **TELOS** provides guidance for assessing project feasibility. The term stands for **technical, economic, legal, operational, and schedule feasibility**.

Technical feasibility is concerned with whether the system can be developed under existing technology or if new technology is needed. As a general proposition, the technology in the marketplace is far ahead of most firms' ability to apply it. Therefore, from an availability viewpoint, technical feasibility is not usually an issue. For most firms, the real issue is their desire and ability to apply available technology. Given that technology is the physical basis for most of the system's design features, this aspect bears heavily on the overall feasibility of the proposed system.

Economic feasibility pertains to the availability of funds to complete the project. At this point, we are concerned with management's financial commitment to this project in view of other competing

capital projects under consideration. The level of available economic support directly impacts the operational nature and scope of the proposed system.

Legal feasibility involves ensuring that the proposed system is not in conflict with the company's ability to discharge its legal responsibilities. For instance, many regulations and statutes of various countries deal with invasion of privacy and the confidentiality of stored information. We must be certain the proposed system does not breach any legal boundaries.

Operational feasibility pertains to the degree of compatibility between the firm's existing procedures and personnel skills and the operational requirements of the new system. Implementing the new system may require adopting new procedures and retraining operations personnel. The question that must be answered is: can enough procedural changes be made, personnel retrained, and new skills obtained to make the system operationally feasible?

Schedule feasibility relates to the firm's ability to implement the project within an acceptable time. This feasibility factor impacts both the scope of the project and whether it will be developed in-house or purchased from a software vendor. If the project, as originally envisioned, cannot be produced internally by the target date, then its design, its acquisition method, or the target date must be changed.

5. Preparing a Formal Project Proposal

The systems project proposal provides management with a basis for deciding whether to proceed with the project. The formal proposal serves two purposes. First, it summarizes the findings of the study conducted to this point into a general recommendation for a new or modified system. This enables management to evaluate the perceived problem along with the proposed system as a feasible solution. Second, the proposal outlines the linkage between the objectives of the proposed system and the business objectives of the firm. It shows that the proposed new system complements the strategic direction of the firm.

2. Develop a Strategic Systems Plan

After collecting and documenting input from the business plan, legacy issues, and user feedback, members of the steering committee and systems professionals evaluate the pros and cons (advantage and disadvantage) of each proposal. This involves **assessing each potential project's benefits, costs, and strategic implications to the organization**. Development will proceed on proposals that show the greatest potential for supporting the organization's business objectives at the lowest cost.

3.2.2.2. Phase 2: Project Initiation

Project initiation involves obtaining a detailed understanding of the user problem and proposing multiple alternative solutions. Each of these proposals is assessed in terms of its feasibility and cost-benefit characteristics. The option selected at this step then proceeds to the construct phase of the SDLC. Depending upon the nature of the project and the needs of the organization, a system will require in-house development, a commercial package, or both.

1. Systems Analysis

The systems analyst must fully understand a business problem before he or she can formulate a solution. An incomplete or defective analysis will lead to an incomplete or defective solution. Therefore, systems analysis is the foundation for the rest of the SDLC. Systems analysis is actually a **two-step process** involving an initial **survey of the current system** and then an **analysis of the user's needs**.

A. The Survey Step

Most systems are not developed from scratch. Usually, some form of information system and related procedures are currently in place. The analyst often begins the analysis by determining what elements, if any, of the current system should be preserved as part of the new system. This involves a rather detailed system survey. Facts pertaining to preliminary questions about the system are gathered and analyzed. As the analyst obtains a greater depth of understanding of the problem, he or she develops more specific questions for which more facts must be gathered. This process may go on through several iterations. Fact-gathering techniques include observing, participating, interviewing, and reviewing documents. When all the relevant facts have been gathered and analyzed, the analyst arrives at an assessment of the current system. Surveying the current system has both **disadvantages and advantages**.

The **advantages** are it allows aspects of the old system which should be kept to be identified; it aids in planning the implementation of the new system; and it may allow conclusive determination of the cause of the reported problem symptoms. Whereas, the **disadvantages** is that it involves with the current physical tar pit (sticking with the current system) and it can stifle (impair) new ideas in the system design.

B. The Analysis Step

Systems analysis is an intellectual process that is commingled (mixed) with fact gathering. The analyst is simultaneously analyzing as he or she gathers facts. After analyzing, a formal systems analysis report, prepared and presented to the steering committee, contains: reasons for system analysis, scope of study, problem identified with current system, statement of user requirements, resource implications, and recommendations.

2. Conceptualization of Alternative Designs

The purpose of the conceptualization phase is to produce several alternative conceptual solutions that satisfy the system requirements identified during systems analysis. By presenting users with a number of plausible alternatives, the project team avoids imposing preconceived constraints onto the new system. These alternative designs then go to the systems selection stage, where their respective costs and benefits are compared and a single optimum design is chosen for construction. The conceptual design phase should highlight the differences between critical features of competing systems rather than their similarities. Therefore, system designs at this point should be general. The designs should identify all the inputs, outputs, processes, and special features necessary to distinguish one alternative from another. This may be accomplished using data flow diagram (DFD). For instance, observe and predict how detailed features provided for the critical differences of the following two alternative conceptual DFD of purchasing system.

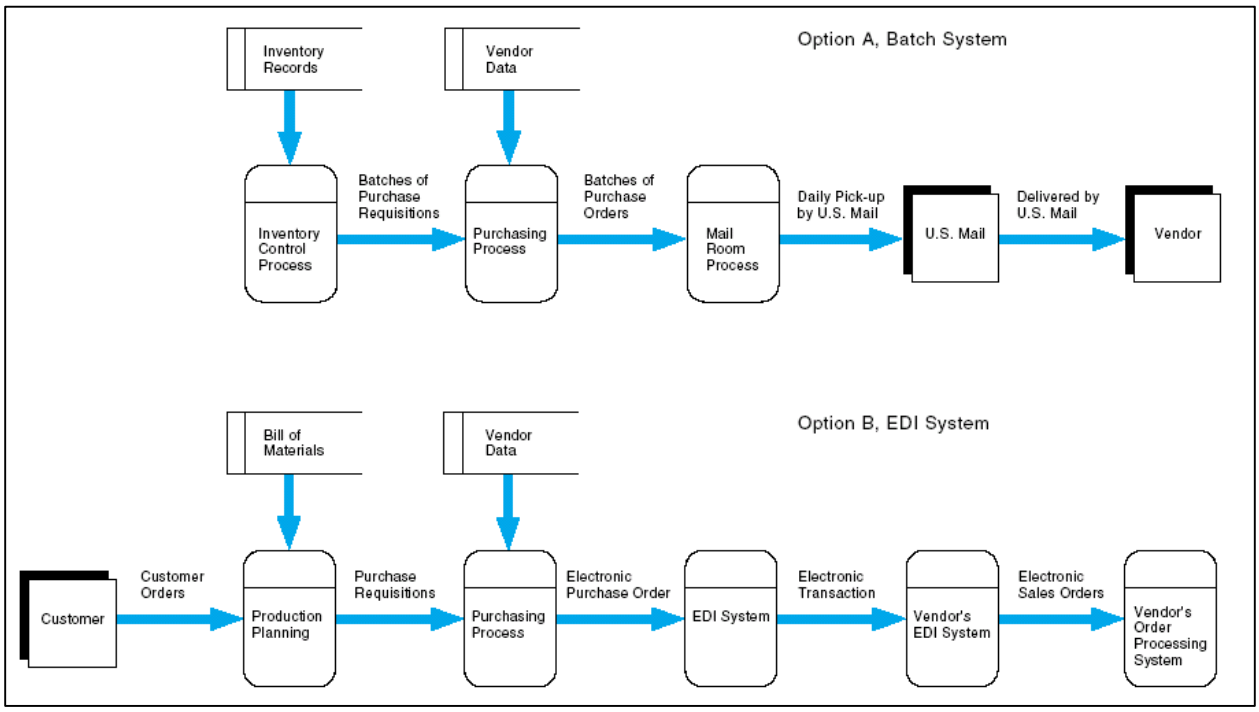


Figure 3.10.: Alternative Conceptual Designs for a Purchasing System

3. Systems Evaluation and Selection

This phase in the SDLC is a formal mechanism for selecting the one system from the set of alternative conceptual designs that will go forward for construction or design. The systems evaluation and selection phase is an optimization process that seeks to identify the best system. This decision represents a critical juncture (moment) in the SDLC. At this point, there is a great deal of uncertainty about the system, and a poor decision can be disastrous. The purpose of a formal evaluation and selection procedure is to structure this decision-making process and thereby reduce both uncertainty and the risk of making a poor decision.

There is no magic formula to ensure a good decision. Ultimately, the decision comes down to management judgment. The objective is to provide a means by which management can make an informed judgment. This selection process involves two steps:

1) Perform a detailed feasibility study.
2) Perform a cost-benefit analysis.

The results of these evaluations are then reported formally to the steering committee for final system selection.

1) Perform a Detailed Feasibility Study

This involves reexamining the feasibility factors **(TELOS)** that were evaluated on a preliminary basis as part of the systems proposal. But, at this point the factors should be examined in detail. The factors include **technical, economic, legal, operational, and schedule feasibility.**

2) Perform Cost-Benefit Analysis

Cost-benefit analysis helps management determine whether (and by how much) the benefits received from a proposed system will outweigh its costs. This technique is frequently used for estimating the expected financial value of business investments. In this case, how-ever, the investment is an information system, and the costs and benefits are more difficult to identify and quantify than those of other types of capital projects. Although imperfect in this setting, cost-benefit analysis is employed because of its simplicity and the absence of a clearly better alternative. In spite of its limitations, cost-benefit analysis, combined with feasibility factors, is a useful tool for comparing competing systems designs. There are three steps in the application of cost-benefit analysis: **identifying costs, identifying benefits, and comparing costs and benefits.**

Identify Costs: One method of identifying costs is to divide them into two categories: **one-time costs and recurring costs. One-time costs** include the initial investment to develop and implement the system. **Recurring costs** include operating and maintenance costs that recur over the life of the system. Table 1 shows a breakdown of typical one-time and recurring costs.

One-Time Costs	Recurring Costs
Hardware acquisition	Hardware maintenance
Site preparation	Software maintenance contracts
Software acquisition	Insurance
Systems design	Supplies
Programming and testing	Personnel
Data conversion from old system to new system	
Training personnel	

Table 3.1. Examples of One-Time and Recurring Costs

Identify Benefits: The next step in the cost-benefit analysis is to identify the benefits of the system. These may be both **tangible and intangible**. **Tangible benefits** are benefits that can be measured and expressed in financial terms. Tangible benefits fall into **two categories**: those that **increase revenue** and those that **reduce costs**. For example, assume a proposed Computerized Accounting Information System will allow the organization to reduce inventories and at the same time improve customer service by reducing stock outs. The reduction of inventories is a cost-reducing benefit. The proposed system will use fewer resources (inventories) than the current system. The value of this benefit is the dollar amount of the carrying costs that the annual reduction in inventory saves. The estimated increase in sales because of better customer service is a revenue-increasing benefit. Although intangible benefits are often of overriding importance in information system decisions, they cannot be easily measured and quantified. For example, assume that a proposed point-of-sale system for a department store will reduce the average time to process a customer sales transaction from 11 minutes to 3 minutes. The time saved can be quantified and produces a tangible benefit in the form of an operating cost savings. An intangible benefit is improved customer satisfaction; no one likes to stand in long lines to pay for purchases. But what is the true value of this intangible benefit to the organization? Increased customer satisfaction may translate into increased sales. More customers will buy at the store—and may be willing to pay slightly more to avoid long checkout lines. When measuring cost savings, only escapable costs (not junk cost) should be included in the analysis. Escapable costs are directly related to the system and cease to exist when the system ceases to exist. Some costs that appear to be escapable to the user are not truly escapable and, if included, can lead to a flawed analysis.

Compare Costs and Benefits: The last step in the cost-benefit analysis is to compare the costs and benefits identified in the first two steps. The **two most common methods used for evaluating information systems are net present value and payback.**

1) **The Net Present Value Method.** Under the net present value method, the present value of the costs is deducted from the present value of the benefits over the life of the system. Projects with a positive net present value are economically feasible. When comparing competing projects, **the optimal choice is the project with the greatest net present value.**
2) **The Payback Method:** The payback method is a variation of break-even analysis. Thus, it uses break-even analysis of total costs (one-time costs plus present value of recurring costs) and total benefits (present value of benefits). After the break-even point, the system earns future profits. When comparing competing projects, **the optimal choice is the project with the greatest future profits.**

The deliverable portion of the systems selection process is the **systems selection report**. This formal document consists of a revised feasibility study, a cost-benefit analysis, and a list and explanation of intangible benefits for each alternative design. On the basis of this report, the steering committee will select a single system that will go forward to the next phase of the construct phase of the SDLC.

Self-test 3.4. *Dear learners, check your progress!*

1. What are the three fundamental tasks in the strategy stage of the SDLC?
2. What are the two steps involved systems analysis?
3. What are the three steps involved in project initiation ?

Phase 3 and/or 4: In-House Development and/or Purchase Commercial Software

Two general options are open to the organization in the construct phase: develop the system in-house or purchase commercial software. At this juncture, management should have a good sense as to which option it will follow. Systems that need to meet unique and proprietary business needs are more likely to undergo in-house development. Systems that are expected to support best industry practices may be better suited to the purchased-software option. A third approach, which involves both options, is to tailor the commercial system to meet the organization's needs. This may require making extensive in-house modifications to the package. The previous analysis of legacy system, TELOS factors, system survey results, and preliminary cost-benefit issues will reveal to decision makers the suitability of one approach over the other.

3.2.2.3.Phase 3: In-House Systems Development

Many organizations require systems that are highly tuned to their unique operations. These firms design their own information systems through in-house systems development activities. Hence, many activities associated with in-house development. These activities fall conceptually into two categories: (1) construct the system and (2) deliver the system. Through these activities, systems selected in the project initiation phase are designed in detail and implemented. This involves creating input screen formats, output report layouts, database structures, and application logic. Finally, the completed system is tested, documented, and rolled out to the user. The main goal of the **construct phase** is to design and build working software that is ready to be tested and delivered to its user community. This phase involves modeling the system, programming the applications, and application testing.

3.2.2.4.Phase 4: Commercial Packages

The majority of companies today, particularly smaller firms and large firms with standardized information needs, employ prewritten software systems rather than develop in-house systems from scratch. Conceptually the commercial software approach also consists of construct and delivery activities. Four factors have stimulated the growth of the commercial software market: (1) the relatively low cost of general commercial software as compared to customized software; (2) the emergence of industry-specific vendors who target their software to the needs of particular types of businesses; (3) a growing demand from businesses that are too small to afford an in-house systems development staff; and (4) the trend toward downsizing of organizational units and the resulting move toward the distributed data processing environment, which has made the commercial software option more appealing to larger organizations.

3.2.2.5.Phase 5: Maintenance and Support

Maintenance involves both implementing the latest software versions of commercial packages and making in-house modifications to existing systems to accommodate changing user needs.

Maintenance may be relatively trivial, such as modifying an application to produce a new report, or more extensive, such as programming new functionality into a system.
The support function includes help desk services, user training and education classes, and formally documented user feedback pertaining to problems and system errors. To facilitate data gathering and analysis, knowledge management systems are effective maintenance tools. Knowledge management is a concept consisting of four basic processes: gathering, organizing, refining, and disseminating. Gathering brings data into the system. Organizing associates data items with subjects, giving them context. Refining adds value by discovering relationships between data, performing synthesis, and abstracting. Disseminating gets knowledge to the recipients in a usable form.

3.2.3. The Accountant's Role in Managing the SDLC

The SDLC process is of interest to accountants for two reasons. First, the creation of an information system represents a significant financial transaction that consumes both financial and human resources. Systems development is like any manufacturing process that produces a complex product through a series of stages. Such transactions must be planned, authorized, scheduled, accounted for, and controlled. Accountants are as concerned with the integrity of this process as they are with any manufacturing process that has financial resource implications. The second, and more pressing, concern for accountants is with the products that emerge from the SDLC. The quality of accounting information systems rests directly on the SDLC activities that produce them. These systems are used to deliver accounting information to internal and external users. The accountant's responsibility is to ensure that the systems apply proper accounting conventions and rules and possess adequate controls. Therefore, accountants are concerned with the quality of the process that produces accounting information systems. For example, a sales order system produced by a defective SDLC may suffer from serious control weaknesses that introduce errors into databases and, ultimately, the financial statements.

3.2.3.1.How Are Accountants Involved with SDLC?

Accountants are involved in systems development in three ways. First, accountants are users. All systems that process financial transactions impact the accounting function in some way. Like all users, accountants must provide a clear picture of their problems and needs to the systems professional. For example, accountants must specify accounting techniques to be used; internal control requirements, such as audit trails; and special algorithms, such as depreciation models.
Second, accountants participate in systems development as members of the development team. Their involvement often extends beyond the development of strictly accounting information systems (AIS) applications. Systems that do not process financial transactions may still draw on accounting data. The accountant may be consulted to provide advice or to determine if the proposed system constitutes an internal control risk.
Third, accountants are involved in systems development as auditors. Accounting information systems must be auditable. Some computer audit techniques require special features that must be

designed into the system. The auditor/accountant has a stake in such systems and must be involved early in their design.

3.2.3.2.The Accountant's Role in Systems Strategy

Auditors routinely review the organization's systems strategy. Careful systems planning is a cost-effective activity in reducing the risk of creating unneeded, unwanted, inefficient, and ineffective systems. Thus, both internal and external auditors have vested interests in this outcome.

3.2.3.3.The Accountant's Role in Conceptual Design

Accountants play an important role in the conceptual design of the system. Accountants recognize control implications of each alternative design and ensure that accounting conventions and legal requirements are understood. Furthermore, the auditability of a system depends in part on its design characteristics. Some computer auditing techniques require systems to be designed with built-in audit features. Such features require resources and need to be considered at conceptual design.

3.2.3.4.The Accountant's Role in Systems Selection

The economic feasibility of proposed systems is of primary concern to accountants. Specifically, the accountant should ensure that:

- Only escapable costs are used in calculations of cost-savings benefits.
- Reasonable interest rates are used in measuring present values of cash flows.
- One-time and recurring costs are completely and accurately reported.
- Realistic useful lives are used in comparing competing projects.
- Intangible benefits are assigned reasonable financial values.
- Errors, omissions, and misrepresentations in the accounting for such items can distort the analysis and result in a suboptimal decision.

Self-test 3.5. *Dear learners, check your progress!*

1. What is the main goal of the construct phase in SDLC?
2. What are the activities involved in-house systems development?
3. What are the three ways in which accountants can be Involved in SDLC?

Chapter summary

Documentation explains how AISs operate and is therefore a vital part of any accounting system. For example, documentation describes the tasks for recording accounting data, the procedures that users must perform to operate computer applications, the processing steps that AISs follow, and the logical and physical flows of accounting data through the system. Documentation includes the narratives, flowcharts, diagrams, and other written material that explain how the system works.
The two of the most common and basic documentation tools are data flow diagrams (DFDs) and flow charts.

DFDs are graphical descriptions of the sources and destinations of data. They show data flow within an organization i.e. where data comes from and where it goes, how it flows, the processes performed on it, and how data are stored. A DFD is composed of four basic symbols: data sources and destinations, data flows, transformation processes, and data stores. Each is represented in a DFD by a unique symbol. A Physical DFD documents the physical structure of an existing system. It answers questions such as where an entity works, how an entity works, the work is done by whom, etc. Whereas, Logical Data Flow Diagrams document the processes in an existing or proposed system. It used to document what tasks the system performs. The logical DFD focuses on the logical flow of data.

The flow charts are divided as document flowcharts, system flowcharts and program flowcharts. document flow chart are a graphical description of the flow of documents and information between departments or areas of responsibility within an organization. It traces the physical flow of documents through an organization. Whereas, system flowcharts are a graphical description of the relationship among the input, processing, and output in an information system. It shows the electronic flow of data and processing steps in an AIS. program flowcharts are a graphical description of the sequence of logical operations that a computer performs as it executes a program.

Whether systems changes are major or minor, most companies go through a systems development life cycle. The systems development life cycle (SDLC) is a conceptual model that describes the stages involved in an information system development project, from an initial feasibility study through maintenance of the completed application. It is a logical process by which systems analysts, software engineers, programmers and end-users build information systems and computer applications to solve business problems and needs. Systems development methodology can be used as a synonym for the life cycle. Systems development methodology is a very formal and precise system development process that defines a set of activities, methods, best practices, deliverables, and automated tools that system developers and project managers are to use to develop and maintain information systems and software.

The SDLC model often has five phases. Phase 1: Systems Strategy, Phase 2: Project Initiation, Phase 3: In-House Development, Phase 4: Commercial Packages and Phase 5: Maintenance and Support.

Accountants are involved in systems development in three ways. First, accountants are users. Second, accountants participate in systems development as members of the development team. finally, accountants are involved in systems development as auditors.

Chapter Review Questions

Part I: True or false: Write true if the statement is correct or false if it is incorrect.

1. Document Flow Chart a graphical description of the relationship among the input, processing, and output in an information system.
2. Program Flowchart is a graphical description of the sequence of logical operations that a computer performs as it executes a program.
3. DFDs do not show the physical storage medium such as disks, and paper, used to store data.
4. A data dictionary contains description of all the elements, stores, and flows in a system.
5. A Physical DFD document the processes in an existing or proposed system.

Part II: Multiple choices

Choices the best answer for the following questions.

The first three questions refer to the following diagram:

1. The above diagram is most likely a:
   A. Document flowchart
   B. System flowchart
   C. Data flow diagram
   D. Program flowchart
2. In the diagram given above, the symbol with the letter A represents:
   A. An on-page connector
   B. An off-page connector
   C. A file
   D. An answering machine
3. In this diagram, the arrow represents:
   A. A wireless transmission
   B. A telephone call
   C. An information flow
   D. A management order to a subordinate
4. Document flowcharts would not be able to represent:
   A. The flow of information when ordering office supplies
   B. The flow of information when hiring new employees
   C. The flow of information when creating orders for new magazine subscriptions
   D. The logic in performing payroll processing

5. Which of the following is *not* true about system flowcharts?
   A. They can depict the flow of information in computerized AISs
   B. They use standardized symbols
   C. They cannot show how documents flow in an AIS
   D. They often document an audit trail

Part III: Fill the blank

1. _____is a graphical description of the flow of documents and information between departments or areas of responsibility within an organization.

2. _____documents the physical structure of an existing system.

3. _____is an analytical technique used to describe some aspect of an information system in a clear, concise, and logical manner.

4. _____pertains to the availability of funds to complete the project.

5. _____ describes the specific logic to perform a process shown on a systems flowchart.

Answer for self-tests

Self-test 3.1.

1. Documentation explains how AISs operate and is therefore a vital part of any accounting system. For example, documentation describes the tasks for recording accounting data, the procedures that users must perform to operate computer applications, the processing steps that AISs follow, and the logical and physical flows of accounting data through the system.

2.

A. Depicting how the system work
B. Training users:
C. Designing new systems:
D. Controlling system development and maintenance costs:
E. Standardizing communications with others:
F. Auditing AISs:
G. Documenting business processes:
H. Complying with the Sarbanes-Oxley Act:
I. Establishing accountability.

Self-test 3.2.

1.

A. Entity: A data source or data destination symbol on the DFD represents an organization or individual that sends or receives data that they system uses or produces. An entity can be both a source and a destination. Data sources or destinations are represented by a square.

B. Data flows: Data flows appear as arrows. A data flow represents the flow of data between processes, data stores and data sources and destinations.

C. Transformation Process: A transformation process represents the transformations of data.

D. Data Stores: A data store is a temporary or permanent repository of data.

2.

A. Physical DFD
B. Logical DFD

Self-test 3.3.

1. System flowcharts are similar to document flowcharts, except that system flowcharts usually focus on the electronic flows of data in computerized AISs.
2. Document flow charts
   System flow chart
   Program flow chart
3. DFDs emphasize the flow of data and what is happening in a system, whereas a flowchart emphasizes the flow of documents or records containing data.

➢ A DFD represents the logical flow of data, whereas a flowchart represents the physical flow of data.

➢ Flowcharts are used primarily to document existing systems.

➢ DFDs, in contrast, are primarily used in the design of new systems and do not concern themselves with the physical devices used to process, store, and transform data.

➢ DFDs make use of only four symbols.

➢ Flowcharts use many symbols and thus can show more detail.

Self-test 3.4.

1. Assessing the organization's strategic information needs
developing a strategic systems plan
creating actions plans.
2. survey of the current system
analysis of the user's needs.
3. Systems Analysis
Conceptualization of Alternative Designs
Systems Evaluation and Selection

Self-test 3.5.

1. The main goal of the construct phase is to design and build working software that is ready to be tested and delivered to its user community.

2. in-house systems development involves
modeling the system,
programming the applications, and
application testing.

3. Accountants are involved in systems development in three ways.
First, accountants are users
Second, accountants participate in systems development as members of the development team.
Third, accountants are involved in systems development as auditors.

CHAPTER FOUR

RELATIONAL DATABASES

Chapter objectives

Dear learners, up on the completion of this chapter you should be able to;

- ✓ Identify the different types of database system models.
- ✓ Understand the database design process.
- ✓ Identify the element of the database management system.
- ✓ Understand the Relational (REA) database system and identify its elements.

Introduction

Dear students, the objective of this chapter is to introduce you with the concept of data base management. The chapter is composed of three sections the first section deals with the database systems, the second section presents the database design process and the last section describes the Relational (REA) Database management system.

4.1. Database Systems

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 chapter deals with four such models: manual processes, flat-file systems, the database approach, the database management system.

4.1.1. 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. This model also includes the physical task of record keeping that is manually. Manual procedures facilitate to understand the internal control activities, including segregation of functions, supervision, independent verification, audit trails, and access controls.

4.1.2. The Flat-File Model

The flat-file approach is most often associated with so-called legacy systems (outdated systems). These are large mainframe systems that were implemented in the late 1960s through the 1980s.

Organizations today still use these systems extensively. 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. The data redundancy in this model contributes to three significant problems in the flat-file environment: data storage, data updating, and currency of information.

Many so-called legacy (outdated) systems are characterized by the flat-file approach to data management. In this environment, users own their data files. Exclusive ownership of data is a natural consequence of two problems associated with the legacy-system era. The first is a business culture that erects barriers between organizational units that inhibit entity-wide integration of data. The second problem stems from limitations in flat-file management technology that require data files to be structured to the unique needs of the primary user. Thus the same data, used in slightly different ways by different users, may need to be restructured and reproduced in physically different files. Figure 4.1. illustrates this model.

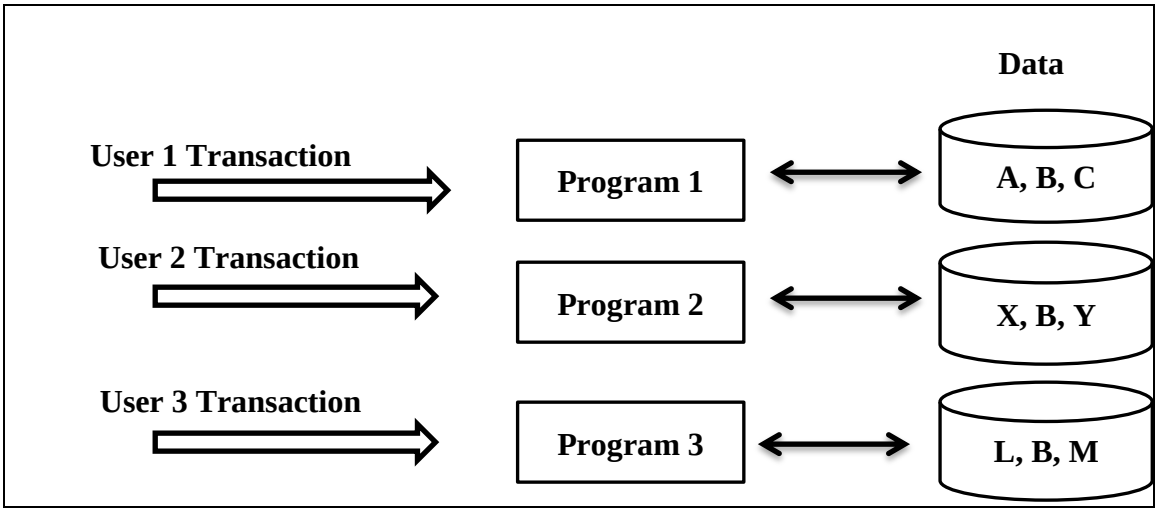


Figure 4.1., Flat-File Data Management

In the above figure, the file contents are represented conceptually with letters. Each letter could signify a single data attribute (field), a record, or an entire file. Note also that data element B is present in all user files. This is called data redundancy and is the cause of three types of data management problems: data storage, data updating, and currency of information. Each of these, as well as a fourth problem, task-data dependency, which is not directly related to data redundancy will be examined next.

a. Data Storage

An efficient information system captures and stores data only once and makes this single source available to all users who need it. This is not possible in the flat-file environment. To meet the private data needs of users, organizations must incur the costs of both multiple collection and

multiple storage procedures. Indeed, some commonly used data may be duplicated dozens, hundreds, or even thousands of times, creating excessive storage costs.

b. Data Updating

Organizations have a great deal of data stored on master files and reference files that require periodic updating to reflect operational and economic changes. For example, a change in a customer's name or address must be reflected in the appropriate master files. This piece of information may be important to several user departments in the organization, such as sales, billing, credit, customer services, sales promotion, and catalog sales. When users maintain separate files, any such change must be made separately for each user. This adds significantly to the cost of data management.

c. Currency of Information

In contrast to the problem of performing multiple updates is the problem of failing to update the files of all users affected by a change. If update messages are not properly disseminated, then some users may not record the change and will perform their duties and make decisions based on outdated data.

d. 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. For example, in Figure 4.1, if the information needs of User 1 change to include Data L, User 1's program would not have access to these data. Although Data L exists in the files of another user, keep in mind the culture of this environment. Users do not interact as members of a user community. They act independently. As such, User 1 may be unaware of the presence of Data L elsewhere in the organization. In this environment, it is difficult to establish a mechanism for the formal sharing of data. Therefore, Data L would need to be recreated from scratch. This will take time, inhibit User 1's performance, add to data redundancy, and drive data management costs even higher.

4.1.3. The Database Approach

Figure 4.2. presents a simple overview of the database approach with the same users and data requirements as in Figure 4.1. The most obvious change from the flat-file model is the pooling of data into a common database that is shared by all the users. Thus flat-file problems solved, because data sharing (the absence of ownership) is the central concept of the database approach. The followings are characteristics of database:

A. **No data redundancy:** Each data element is stored only once, thereby eliminating data redundancy and reducing storage costs.
B. **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.

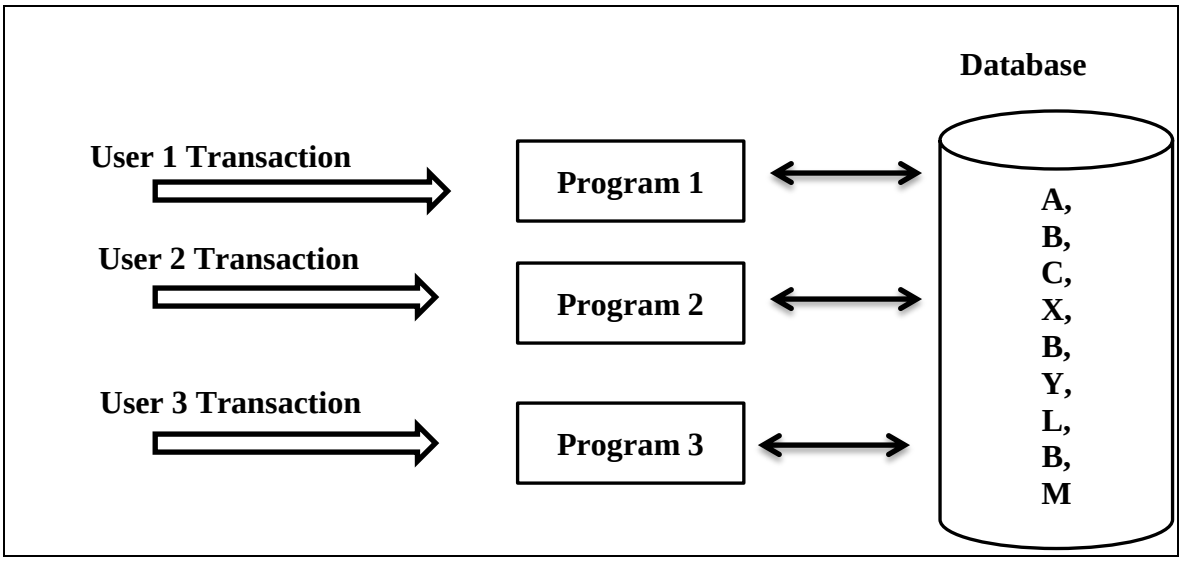


Figure 4.6., The Database Concept

- **Current values:** A change any user makes to the database yields current data values for all other users. For example, when User 1 records a customer address change, User 3 has immediate access to this current information.
- **Task-data independence;** Users have access to the full domain of data available to the firm. As users' information needs expand beyond their immediate domain, the new needs can be more easily satisfied than under the flat-file approach. Only the limitations of the data available to the firm (the entire database) and the legitimacy of their need to access it constrains users.

4.1.4. The Database Management System

Figure 4.3. adds a new element to Figure 4.2. Standing between the users' programs and the physical database is the database management system (DBMS). The purpose of the DBMS is to provide controlled access to the database. 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. The DBMS will deny requests for data that the user is unauthorized to access. As one might imagine, the organization's criteria, rules, and procedures for assigning user authority are important control issues for accountants to consider.

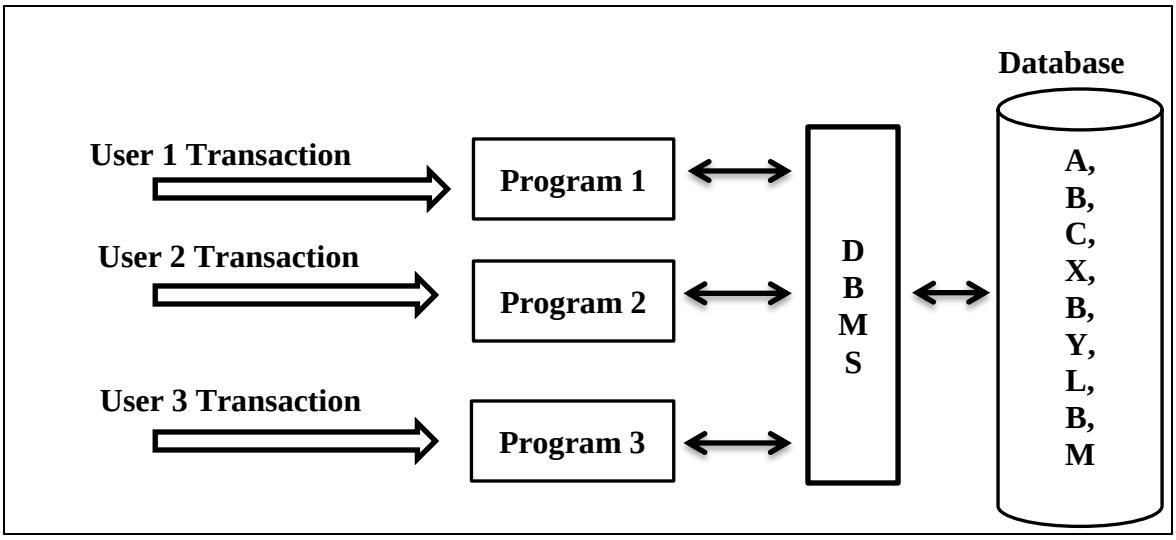


Figure 4.7., The Database Concept

Three Conceptual Models

Over the years, several different architectures have represented the database approach. Early database models are as different from modern database models as they were from traditional flat files. The most common database approaches used for business information systems are the hierarchical, the network, and the relational models. Because of certain conceptual similarities, the hierarchical and network databases are termed navigational or structured models. The way that data are organized in these early database systems forces users to navigate between data elements using predefined structured paths. The relational model is far more flexible by allowing users to create new and unique paths through the database to solve a wider range of business problems. Although their limitations are severe and their ultimate demise is inevitable, hierarchical and network models still exist as legacy systems that support mission-critical functions in some companies. Most modern systems, however, employ relational databases. This chapter also focuses on the relational model.

Self-test 4.1. *Dear learners, check your progress!*

3. What are the three problems in the flat-file environment?
4. What are the four characteristics of the database approach?
5. What are the four types of database systems?

4.2. Database Design Process

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. Figure 4.4. presents a breakdown of the database environment into four primary elements: users, the DBMS, the database administrator, and the physical database.

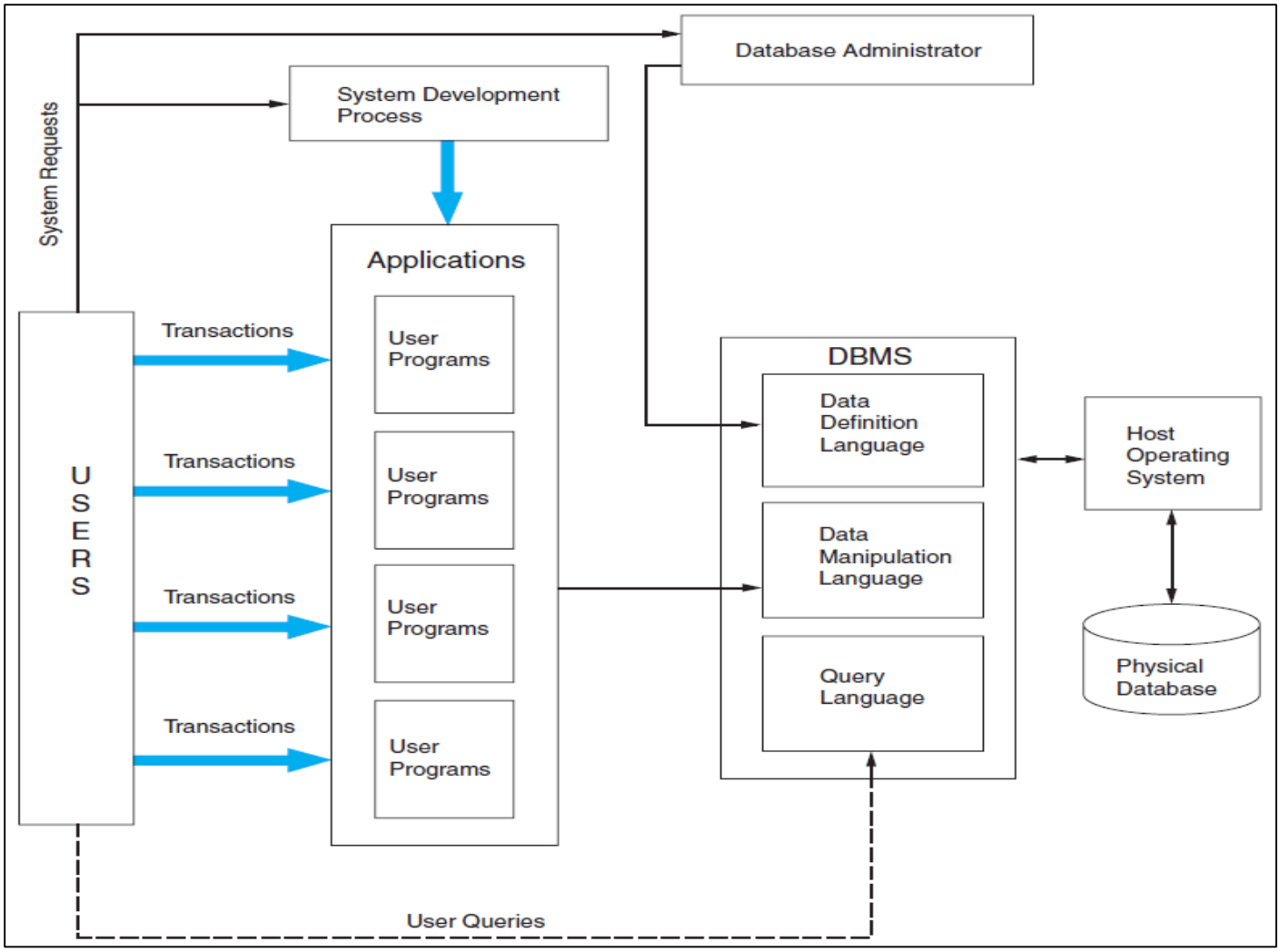


Figure 8.4: Elements of the Database Concept

A. Users

Figure 4.4. shows how users access the database in two ways. The first is via user application programs that systems professionals prepare. These programs send data access requests (calls) to the DBMS, which validates the requests and retrieves the data for processing. Under this mode of access, the presence of the DBMS is transparent to the users. Data processing procedures (both batch and real-time) for transactions such as sales, cash receipts, and purchases are essentially the same as they would be in the flat-file environment. The second method of database access is via direct query, which requires no formal user programs. The DBMS has a built-in query facility that allows authorized users to process data independent of professional programmers. The query facility provides a friendly environment for integrating and retrieving data to produce ad hoc management reports. This feature has been an attractive incentive for users to adopt the database approach.

B. Database Management System

The second element of the database approach depicted in Figure 4.4. is the database management system. The DBMS provides a controlled environment to assist (or prevent) user access to the database and to efficiently manage the data resource. Each DBMS model accomplishes these objectives differently, but some typical features include

i. Program development. The DBMS contains application development software. Both programmers and end users may employ this feature to create applications to access the database.
ii. Backup and recovery. During processing, the DBMS periodically makes backup copies of the physical database. In the event of a disaster (for example, disk failure, program error, or malicious act) that renders the database unusable, the DBMS can recover an earlier version that is known to be correct. Although some data loss may occur, without the backup and recovery feature, the database would be vulnerable to total destruction.
iii. Database usage reporting. This feature captures statistics on what data are being used, when they are used, and who uses them. The database administrator (DBA) uses this information to help in assigning user authorization and in maintaining the database. We discuss the role of the DBA later in this section.
iv. Database access. The most important feature of a DBMS is to permit authorized user access to the database. Figure 4 shows the three software modules that facilitate this task. These are the data definition language, data manipulation language, and the query language.

C. Database Administrator

The administrative position of database administrator (DBA) in Figure 4.4. does not exist in the flat-file environment. The DBA is responsible for managing the database resource. Multiple users sharing a common database require organization, coordination, rules, and guidelines to protect the integrity of the database. In large organizations the DBA function may consist of an entire department of technical personnel under the database administrator. In smaller organizations someone within the computer services group may assume DBA responsibility. The duties of the DBA fall into the following areas: database planning, database design, database implementation, database operation and maintenance, and database change and growth. Table 1 presents a breakdown of specific tasks within these broad areas.

Table 4.1: Functions of the Database Administrator

Database Planning	Implementation
Develop organization's database strategy	Determine access policy
Define database environment	Implement security controls
Define data requirements	Specify test procedures

Develop data dictionary

Design

Logical database (schema)

External users' views (subschemas)

Internal view of database

Database controls

Change and Growth

Plan for change and growth

Evaluate new technology

Establish programming standards

Operation and Maintenance

Evaluate database performance

Reorganize database as user needs demand

Review standards and procedures

D. The Physical Database

The fourth major element of the database approach as presented in Figure 4.4. is the physical database. This is the lowest level of the database. The physical database consists of magnetic spots on magnetic disks. The other levels of the database (for example, the user view, conceptual view, and internal view) are abstract representations of the physical level. At the physical level, the database is a collection of records and files.

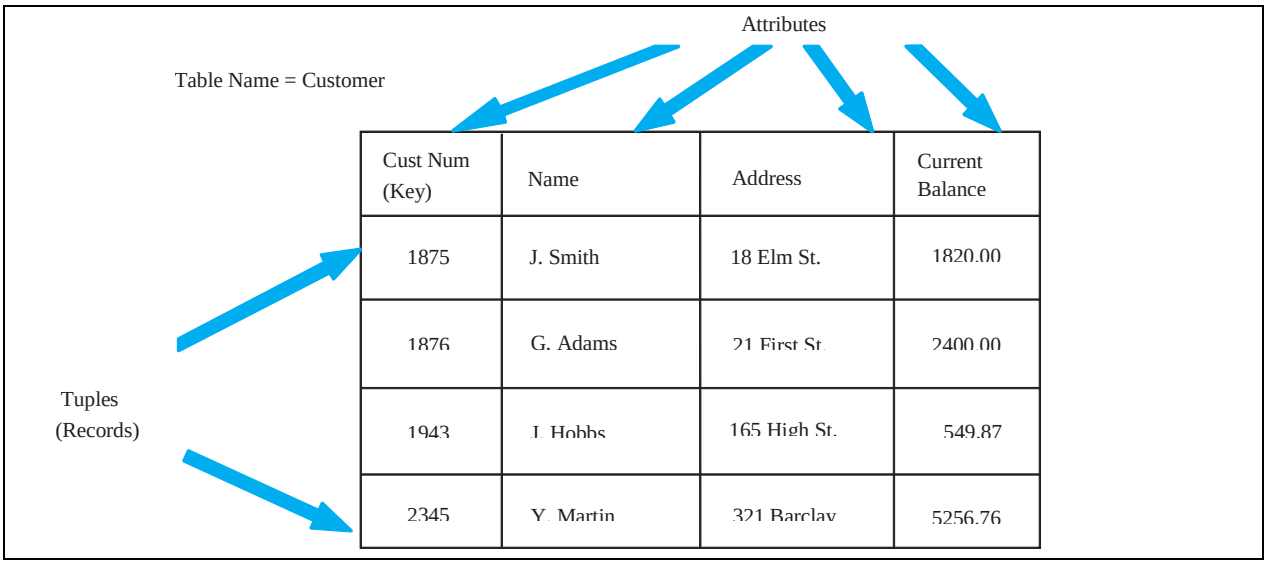
Self-test 4.2. *Dear learners, check your progress!*

1. What are the four elements of in the database environment?
2. What are the objectives of data base management system?
3. Who is responsible for managing the database resource?

4.3. The Relational (REA) Database Model

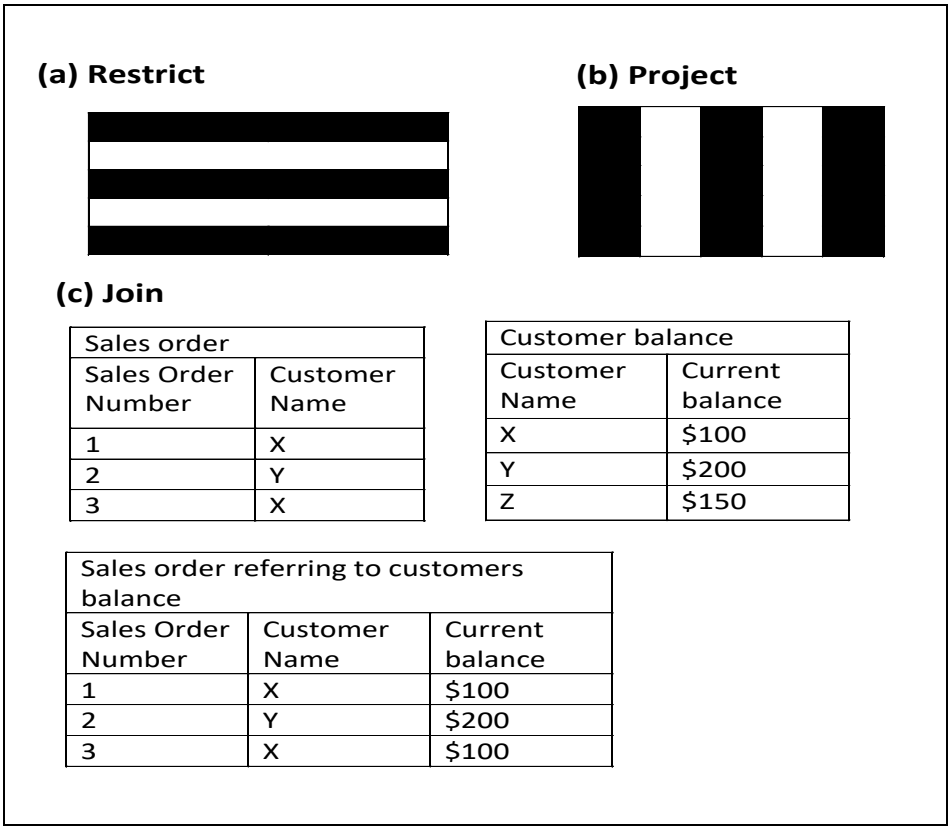
REA is an accounting framework for modeling an organization's critical resources, events, and agents (REA) and the relationships between them. Once specified, both accounting and non-accounting data about these phenomena can be identified, captured, and stored in a relational database. From this repository, 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. Advances in database technology have focused renewed attention on REA as a practical alternative to the classical accounting framework. The formal model has its foundations in relational algebra and set theory, which provide the theoretical basis for most of the data manipulation operations used. A system is relational if it:

a. Represents data in the form of two-dimensional tables such as the database table, called Customer, shown in Figure 4.5.
b. Supports the relational algebra functions of restrict, project, and join.



Cust Num (Key)	Name	Address	Current Balance
1875	J. Smith	18 Elm St.	1820.00
1876	G. Adams	21 First St.	2400.00
1943	J. Hobbs	165 High St.	549.87
2345	Y. Martin	321 Barclay	5256.76

Figure 4.9: A Relational Table Called Customer



Sales order	
Sales Order Number	Customer Name
1	X
2	Y
3	X

Customer balance	
Customer Name	Current balance
X	$100
Y	$200
Z	$150

Sales order referring to customers balance		
Sales Order Number	Customer Name	Current balance
1	X	$100
2	Y	$200
3	X	$100

Figure 4.10: The Relational Algebra Functions Restrict, Project, and Join

These three algebra functions are examined in the following section.

- ✓ **Restrict:** Extracts specified rows from a specified table. This operation, illustrated in Figure 4.6 (a), creates a virtual table (one that does not physically exist) that is a subset of the original table.
- ✓ **Project**: Extracts specified attributes (columns) from a table to create a virtual table. This is presented in Figure 4. 6 (b).
- ✓ **Join:** Builds a new physical table from two tables consisting of all concatenated pairs of rows, from each table. See Figure 4. 6 (c).

Although restrict, project, and join is not the complete set of relational functions, it is a useful subset that satisfies most business information needs.

The Elements of REA Database Model

The following summarizes the key elements of the REA models.

A. 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.

B. 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.

C. Agents (entities)

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. Entities may be physical, such as inventories, customers, or employees. They may also be conceptual, such as sales (to a customer), AR, or AP. Systems designers identify entities and prepare a model of them like the one presented in Figure 4.7. This data model is the blueprint for ultimately creating the physical database. The graphical representation used to depict the model is

called an entity relationship (ER) diagram. As a matter of convention, each entity in a data model is named in the singular noun form, such as Customer rather than Customers. The term occurrence is used to describe the number of instances or records that pertain to a specific entity. For example, if an organization has 100 employees, the Employee entity is said to consist of 100 occurrences. Attributes are the data elements that define an entity. For example, an Employee entity may be defined by the following partial set of attributes: Name, Address, Job Skill, Years of Service, and Hourly Rate of Pay. Each occurrence in the Employee entity consists of the same types of attributes, but values of each attribute will vary among occurrences. Because attributes are the logical and relevant characteristics of an entity, they are unique to it. In other words, the same attribute should not be used to define two different entities.

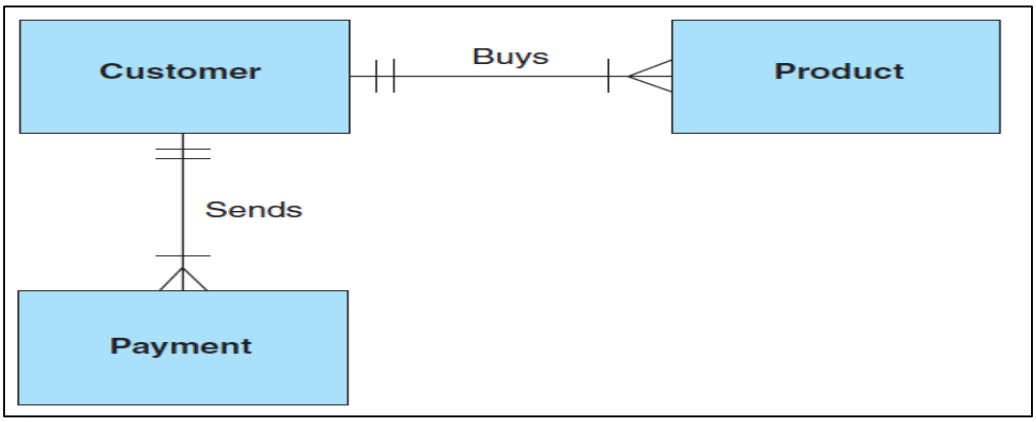


Figure 4.11: Data Model Using an Entity Relationship (ER) Diagram

Self-test 4.3. *Dear learners, check your progress!*

1. What are the two conditions that a system must satisfy to be considered as relational?
2. What are the three algebra functions in the REA database model?
3. What are the three elements of the REA models?

Chapter Summary

There are four data processing systems; manual processes, flat-file systems, the database approach, the database management system. 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. 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. In the database approach, the most obvious change from the flat-file model is the pooling of data into a common database that is shared by all the users. Thus flat-file problems solved, because data sharing (the absence of ownership) is the central concept of the database approach. 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.

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. There are four elements of database; users, the DBMS, the database administrator, and the physical database.

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 non-accounting data about these phenomena can be identified, captured, and stored in a relational database. A system is relational if it a) represents data in the form of two-dimensional tables such as the database table, and b) supports the relational algebra functions of restrict, project, and join. There are three elements in the REA. These are resources, events and agents or entities. resources are the assets of the organization, events are phenomena that affect changes in resources, and 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.

Chapter Review Questions

Part I: True or false: Write true if the statement is correct or false if it is incorrect.

1. The manual process model describes an environment in which individual data files are not related to
   other files.
2. In the data base approach, a change any user makes to the database yields current data values for all other users.
3. The purpose of the DBMS is to provide controlled access to the database.
4. The physical database is the lowest level of the database.
5. In the REA database model, agents are phenomena that affect changes in resources.

Part II: Multiple choices

Choices the best answer for the following questions.

1. Which of the followings is/are not the characteristics of database?
   A. Data redundancy
   B. Single update
   C. Current values
   D. Task-data independence
2. Which of the following is /are the common database approaches used for business information systems?
   A. The hierarchical model
   B. The network model
   C. The relational models
   D. All
3. All of the following are the elements of the database management system environment. **Except?**
   A. Users
   B. The database management system
   C. The database administrator
   D. The physical database.
   E. All
   F. None
4. Who is responsible for managing the database resource?
   A. Users
   B. The database management system
   C. The database administrator
   D. The physical database

5. Which of the following is/are the functions of database administrator?
   A. Develop organization's database strategy
   B. Define database environment
   C. Specify test procedures
   D. Establish programming standards
   A. All

Answer for self-tests

Self-test 4.1.

1. data storage
   data updating, and
   currency of information.
2.
   A. No data redundancy
   B. Single update
   C. Current values
   D. Task-data independence

3. The manual process model
   The flat file model
   The database approach
   The database management system

Self-test 4.2.

1. Users
   the DBMS
   the database administrator and
   the physical database.
2. Program development.
   Backup and recovery.
   Database usage reporting.
   Database access.
3. the database administrator

Self-test 4.3.

2.
   a. Represents data in the form of two-dimensional tables such as the database table.
   b. Supports the relational algebra functions of restrict, project, and join.
3.
   Restrict
   Project
   Join

4. Resources

Events
Agents (entities)

CHAPTER FIVE

TRANSACTION CYCLES AND ACCOUNTING APPLICATIONS

Chapter objectives:

Dear students, after completing this chapter you will be able to:

- Understand the revenue cycle, the activities to be performed in the revenue cycle, and the controls in the revenue cycle.
- Understand the manual and computer based transaction processing models.
- Understand the control considerations for computer-based Systems.
- Understand the expenditure cycle, identify the activities to be performed in the expenditure cycle, and the control activities in the expenditure cycle.
- Understand the payroll processing system, the activities and the control activities of the payroll system.
- Know the fixed asset system, the activities and the controlling techniques in the fixed assets system.
- Understand the general ledger system and
- Differentiate between the financial reporting and management reporting.

Introduction

Dear students, this chapter presents the transaction cycles and the accounting applications. The chapter is organized into four main sections. The first section presents the conceptual revenue cycle system. It provides an overview of key activities and the logical tasks, sources and uses of information, and movement of accounting information through the organization. The section concludes with a review of internal control issues. The second section presents the physical system. A manual system is first used to reinforce key concepts previously presented. Next, it explores large-scale computer-based systems. The focus is on alternative technologies used to achieve various levels of organizational change from simple automation to reengineering the work flow. The section concludes with a review of PC-based systems and control issues pertaining to end user computing. The third section presents the conceptual expenditure cycle system. It provides key activities and the tasks, and ends with a review of internal control issues. The last section presents the general ledger, financial reporting and management reporting.

5.1. The Revenue Cycle

Economic enterprises, both for-profit and not-for-profit, generate revenues through business processes that constitute their revenue cycle. In its simplest form, the revenue cycle is the direct exchange of finished goods or services for cash in a single transaction between a seller and a buyer. More complex revenue cycles process sales on credit. Many days or weeks may pass between the point of sale and the subsequent receipt of cash. This time lag splits the revenue transaction into two phases: (1) the physical phase, involving the transfer of assets or services from the seller to the buyer; and (2) the financial phase, involving the receipt of cash by the seller in payment of the account receivable. As a matter of processing convenience, most firms treat each phase as a separate transaction. Hence, the revenue cycle actually consists of two major subsystems: (1) the sales order processing subsystem and (2) the cash receipts subsystem.

5.1.1. Overview of Revenue Cycle Activities

This section examines the revenue cycle conceptually. Using data flow diagrams (DFDs) as a guide, we will trace the sequence of activities through three processes that constitute the revenue cycle for most retail, wholesale, and manufacturing organizations. These are: sales order procedures, sales return procedures, and cash receipts procedures.

A. Sales Order Procedures

Sales order procedures include the tasks involved in receiving and processing a customer order, filling the order and shipping products to the customer, billing the customer at the proper time, and correctly accounting for the transaction. The relationships between these tasks are presented with the DFD in Figure 5.1. and described in the following section.

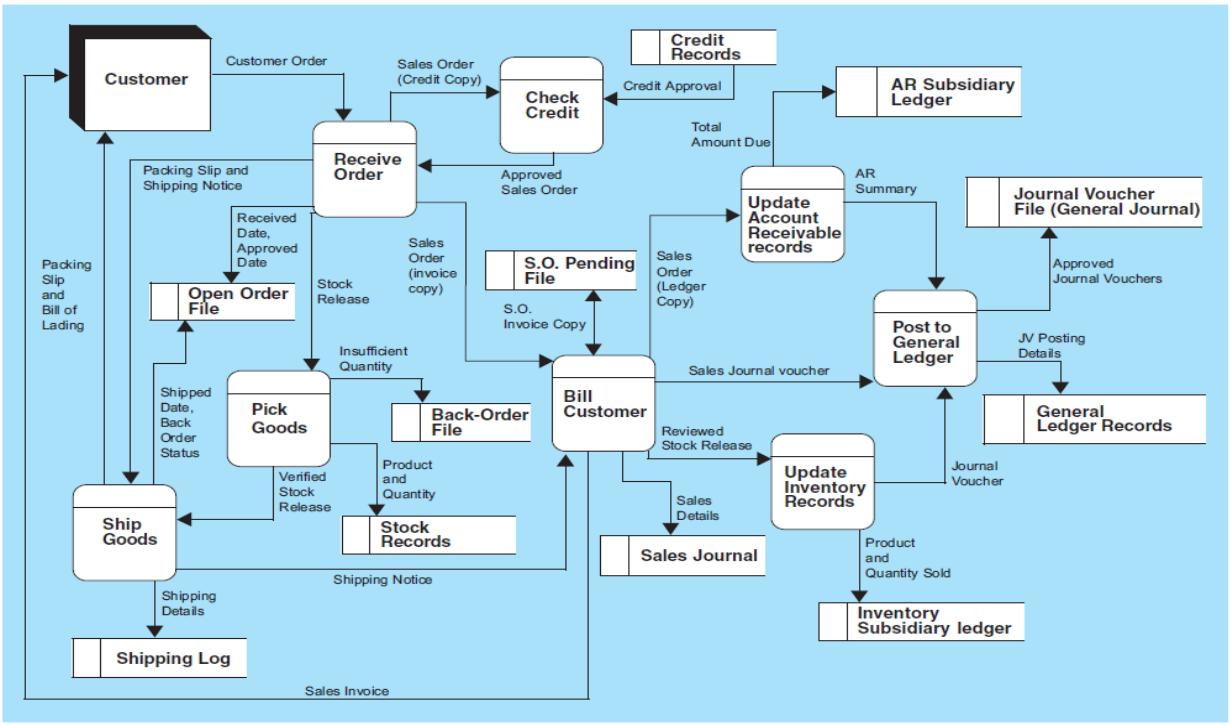


Figure 5.1. DFD of Sales Order Processing System

Receive Order: The sales process begins with the receipt of a customer order indicating the type and quantity of merchandise desired. At this point, the customer order is not in a standard format and may or may not be a physical document. Orders may arrive by mail, by telephone, or from a field representative who visited the customer.

Check Credit: Before processing the order further, the customer's creditworthiness needs to be established. The circumstances of the sale will determine the nature and degree of the credit check. For example, new customers may undergo a full financial investigation to establish a line of credit. Once a credit limit is set, however, credit checking on subsequent sales may be limited to ensuring that the customer has a history of paying his or her bills and that the current sale does not exceed the pre-established limit.

The credit approval process is an authorization control and should be performed as a function separate from the sales activity. In our conceptual system, the receive-order task sends the sales order (credit copy) to the check-credit task for approval. The returned approved sales order then triggers the continuation of the sales process by releasing sales order information simultaneously to various tasks. Several documents mentioned in the following sections, such as the stock release, packing slip, shipping notice, and sales invoice, are simply special-purpose copies of the sales order and are not illustrated separately.

Pick Goods: The receive order activity forwards the stock release document (also called the picking ticket) to the pick goods function, in the warehouse. This document identifies the items of inventory that must be located and picked from the warehouse shelves. It also provides formal authorization for warehouse personnel to release the specified items. After picking the stock, the order is verified for accuracy and the goods and verified stock release document are sent to the ship goods task. If inventory levels are insufficient to fill the order, a warehouse employee adjusts the verified stock release to reflect the amount actually going to the customer. The employee then prepares a back-order record, which stays on file until the inventories arrive from the supplier (not shown in this diagram).

Ship Goods: Before the arrival of the goods and the verified stock release document, the shipping department receives the packing slip and shipping notice from the receive order function. The packing slip will ultimately travel with the goods to the customer to describe the contents of the order. The shipping notice will later be forwarded to the billing function as evidence that the customer's order was filled and shipped. This document conveys pertinent new facts such as the date of shipment, the items and quantities actually shipped, the name of the carrier, and freight charges.

Bill Customer: The shipment of goods marks the completion of the economic event and the point at which the customer should be billed. Billing before shipment encourages inaccurate record keeping and inefficient operations. When the customer order is originally prepared, some details such as inventory availability, prices, and shipping charges may not be known with certainty. In the case of back-orders, for example, suppliers do not typically bill customers for out-of-stock items. Billing for goods not shipped causes confusion, damages relations with customers, and requires additional work to make adjustments to the accounting records. To prevent such problems, the billing function awaits notification from shipping before it bills.

Update Inventory Records: The inventory control function updates inventory subsidiary ledger accounts from information contained in the stock release document. In a perpetual inventory system, every inventory item has its own record in the ledger. Each stock release document reduces the quantity on hand of one or more inventory accounts. Periodically, the financial value of the total reduction in inventory is summarized in a journal voucher and sent to the general ledger function for posting the accounts of cost of goods sold and inventory.

Update Accounts Receivable: Customer records in the accounts receivable (AR) subsidiary ledger are updated from information the sales order (ledger copy) provides. Every customer has an account record in the AR subsidiary ledger containing, at minimum, the following data: customer name; customer address; current balance; available credit; transaction dates; invoice numbers; and credits for payments, returns, and allowances.

Post to General Ledger: By the close of the transaction processing period, the general ledger function has received journal vouchers from the billing and inventory control tasks and an account summary from the AR function. This information set serves two purposes. First, the general ledger uses the journal vouchers to post to the following control accounts:

	Debit	Credit
Accounts Receivable Control	XXXX	
Cost of Goods Sold	XXX	
Inventory Control		XXX
Sales		XXXX

Because general ledger accounts are used to prepare financial statements, they contain only summary figures (no supporting detail) and require only summary posting information. Second, this information supports an important independent verification control. The AR summary, which the AR function independently provides, is used to verify the accuracy of the journal vouchers from billing. The AR summary figures should equal the total debits to AR reflected in the journal vouchers for the transaction period. By reconciling these figures, the general ledger function can detect many types of errors.

B. Sales Return Procedures

An organization can expect that a certain percentage of its sales will be returned. This occurs for a number of reasons, some of which may be:

- The company shipped the customer the wrong merchandise.
- Defective goods.
- The product damaged in shipment.
- The buyer refused delivery because the seller shipped the goods too late or they were delayed in transit.

When a return is necessary, the buyer requests credit for the unwanted products. This involves reversing the previous transaction in the sales order procedure. Figure 5.2. shows the DFD of sales return procedures for approving and processing returned items.

Prepare Return Slip: When items are returned, the receiving department employee counts, inspects, and prepares a return slip describing the items. The goods, along with a copy of the return slip, go to the warehouse to be restocked. The employee then sends the second copy of the return slip to the sales function to prepare a credit memo.

Prepare Credit Memo: Upon receipt of the return slip, the sales employee prepares a credit memo. This document is the authorization for the customer to receive credit for the merchandise returned. In cases where specific authorization is required (that is, the amount of the return or circumstances surrounding the return exceed the sales employee's general authority to approve), the credit memo goes to the credit manager for approval. However, if the clerk has sufficient general authority to approve the return, the credit memo is sent directly to the billing function, where the customer sales transaction is reversed.

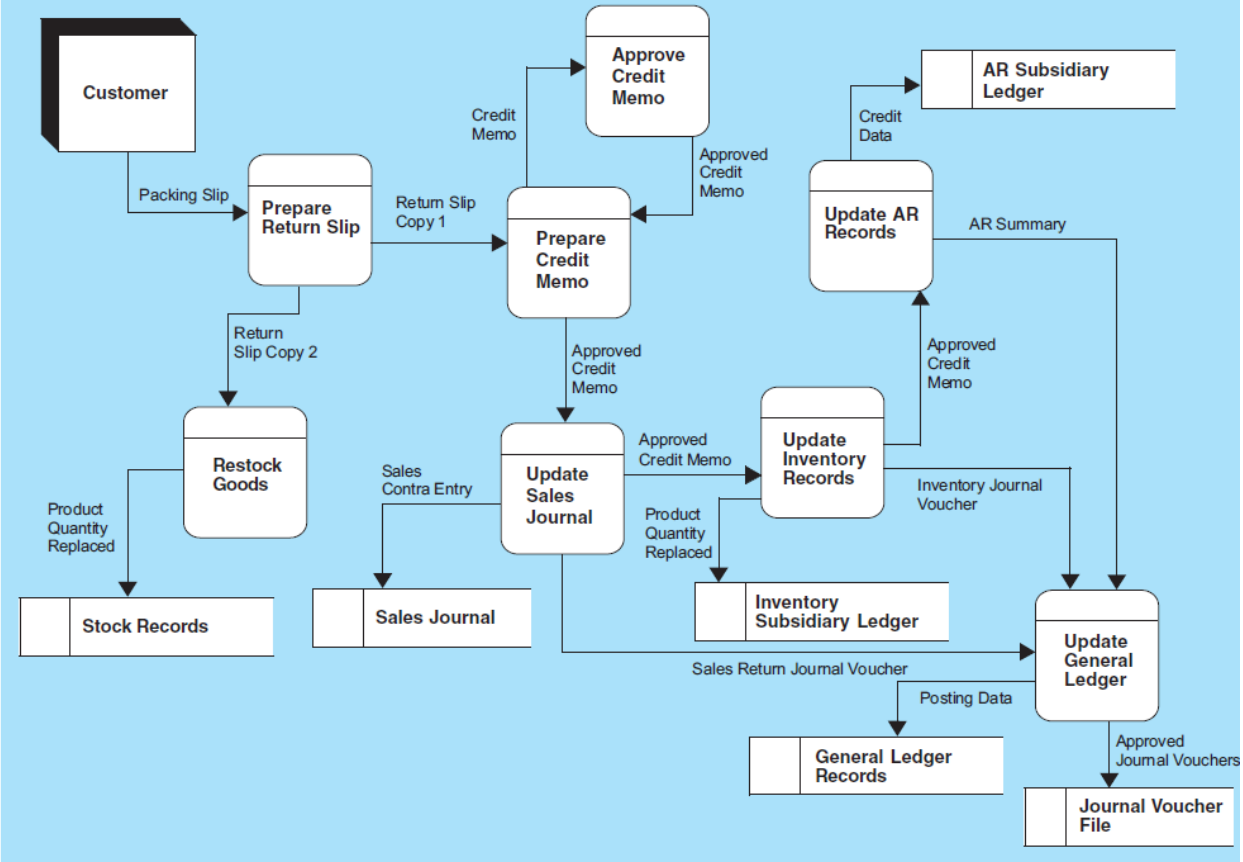


Figure 5.12. DFD of Sales Return Procedures

Approve Credit Memo: The credit manager evaluates the circumstances of the return and makes a judgment to grant (or disapprove) credit. The manager then returns the approved credit memo to the sales department.

Update Sales Journal: Upon receipt of the approved credit memo, the transaction is recorded in the sales journal as a contra entry. The credit memo is then forwarded to the inventory control function for posting. At the end of the period, total sales returns are summarized in a journal voucher and sent to the general ledger department.

Update Inventory and AR Records: The inventory control function adjusts the inventory records and forwards the credit memo to accounts receivable, where the customer's account is also adjusted. Periodically, inventory control sends a journal voucher summarizing the total value of inventory returns to the general ledger update task. Similarly, accounts receivable submits an AR account summary to the general ledger function.

Update General Ledger: Upon receipt of the journal voucher and account summary information, the general ledger function reconciles the figures and posts to the following control accounts:

	Debit	Credit
Inventory—Control	XXX	
Sales Returns and Allowances	XXXX	
Cost of Goods Sold		XXX
Accounts Receivable—Control		XXXX

C. Cash Receipts Procedures

The sales order procedure described a credit transaction that resulted in the establishment of an account receivable. Payment on the account is due at some future date, which the terms of trade determine. Cash receipts procedures apply to this future event. It involves receiving and securing the cash; depositing the cash in the bank; matching the payment with the customer and adjusting the correct account; and properly accounting for and reconciling the financial details of the transaction. The data flow diagram in Figure 5.3. shows the relationship between these tasks. They are described in detail in the following section.

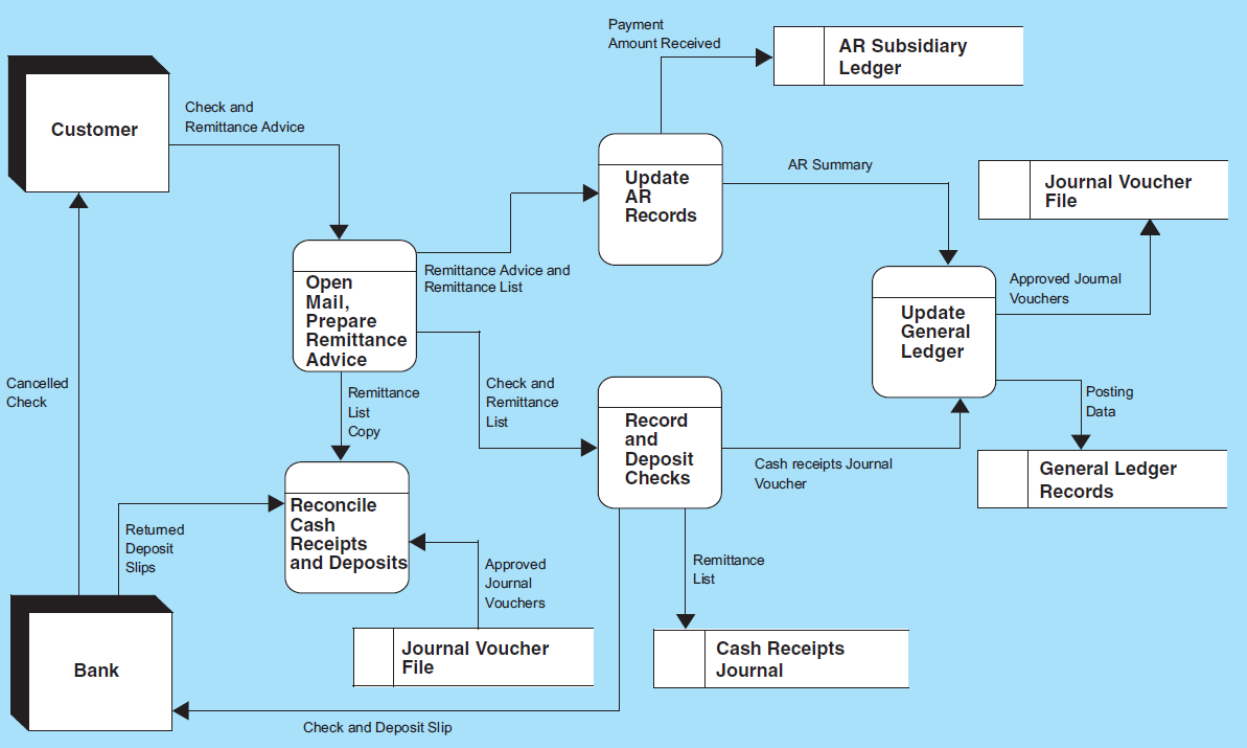


Figure 5.3. DFD of Cash Receipts Procedure

Open Mail and Prepare Remittance Advice: A mail room employee opens envelopes containing customers' payments and remittance advices. Remittance advices contain information needed to service individual customers' accounts. This includes payment date, account number, amount paid, and customer check number.

Record and Deposit Checks: A cash receipts employee verifies the accuracy and completeness of the checks against the prelist. Any checks possibly lost or misdirected between the mail room and this function are thus identified. After reconciling the prelist to the checks, the employee records the check in the cash receipts journal. All cash receipts transactions, including cash sales, miscellaneous cash receipts, and cash received on account, are recorded in the cash receipts journal. Thus, at the end of the day, the cash receipts employee summarizes the journal entries and sends the following journal voucher entry to the general ledger function.

	Debit	Credit
Cash	XXXX	
Accounts Receivable Control		XXXX

Update Accounts Receivable: The remittance advices are used to post to the customers' accounts in the AR subsidiary ledger. Periodically, the changes in account balances are summarized and forwarded to the general ledger function.

Update General Ledger: Upon receipt of the journal voucher and the account summary, the general ledger function reconciles the figures, posts to the cash and AR control accounts, and files the journal voucher.

Reconcile Cash Receipts and Deposits: Periodically (weekly or monthly), a clerk from the controller's office (or an employee not involved with the cash receipts procedures) reconciles cash receipts by comparing the following documents: (1) a copy of the prelist, (2) deposit slips received from the bank, and (3) related journal vouchers.

Self-test 5.1. *Dear learners, check your progress!*

6. What are the three procedures in the revenue cycle?
7. All of the following activities are performed in the cash receipt procedure, **except?**
   - **a.** Record and Deposit Checks
   - **b.** Prepare Return Slip
   - **c.** Update Accounts Receivable
   - **d.** Update General Ledger

5.1.2. Revenue Cycle Controls

There are six classes of internal control activities that guide us in designing and evaluating transaction processing controls. These are transaction authorization, segregation of duties, supervision, accounting records, access control, and independent verification. Table 5.1. summarizes these control activities as they apply in the revenue cycle.

CONTROL POINTS IN THE REVENUE SYSTEM

Control Activity	Sales Processing	Cash Receipts
Transactions authorization: the objective is to ensure that only valid transactions are processed	Credit checking Inventory Return policy	Remittance list (cash prelist): The cash prelist provides a means for verifying that customer checks and remittance advices match in amount.
Segregation of duties: ensures that no single individual or department processes a transaction in its entirety.	Credit department is separate from processing; inventory control department is separate from warehouse; AR subsidiary ledger is separate from general ledger	Cash receipts are separate from AR and cash account; AR subsidiary ledger is separate from GL
Supervision: closely supervising employees who perform potentially incompatible functions		Mail room: The individual who opens the mail has access both to cash (the asset) and to the remittance advice (the record of the transaction).
Accounting records: firm's source documents, journals, and ledgers form an audit trail that allows independent auditors to trace transactions through various stages of processing.	Sales orders, sales journals, AR subsidiary ledger, AR control (general ledger), inventory subsidiary ledger, inventory control, sales account (GL)	Remittance advices, checks, remittance list, cash receipts journal, AR subsidiary ledger, AR control account, cash account
Access: Access controls prevent and detect unauthorized and illegal access to the firm's assets.	Physical access to inventory; access to accounting records	Physical access to cash; access to accounting records
Independent verification: the objective is to verify the accuracy and completeness of tasks that other functions in the process perform.	Shipping department, billing department, general ledger	Cash receipts, general ledger, bank reconciliation

5.2. Physical Systems

In this section we examine the physical system. The physical systems include the people, organizational units, and documents and files involved in the system. The discussion begins with a review of manual procedures and then moves on to deal with the computer-based systems.

5.2.1. Manual Systems

The purpose of this section is to support the system concepts with models depicting people, organizational units, and physical documents and files. Thus, this section helps to envision the segregation of duties and independent verifications, which are essential to effective internal control regardless of the technology in place. In addition, we highlight inefficiencies intrinsic to manual systems, which gave rise to modern systems using improved technologies.

Sales Order Processing

The document flowchart in Figure 5.4. shows the procedures and the documents typical to a manual sales order system. In manual systems, maintaining physical files of source documents is critical to the audit trail. As we walk through the flowchart, notice that in each department, after completion of the assigned task, one or more documents are filed as evidence that the task was completed.

a. Sales Department

The sales process begins with a customer contacting the sales department by telephone, mail, or in person. The sales department records the essential details on a sales order. This information will later trigger many tasks, but for the moment is filed pending credit approval.

b. Credit Department Approval

To provide independence to the **credit authorization** process, the credit department is organizationally and physically segregated from the sales department. When credit is approved, the sales department clerk pulls the various copies of the sales orders from the pending file and releases them to the billing, warehouse, and shipping departments. The customer order and credit approval are then placed in the open order file.

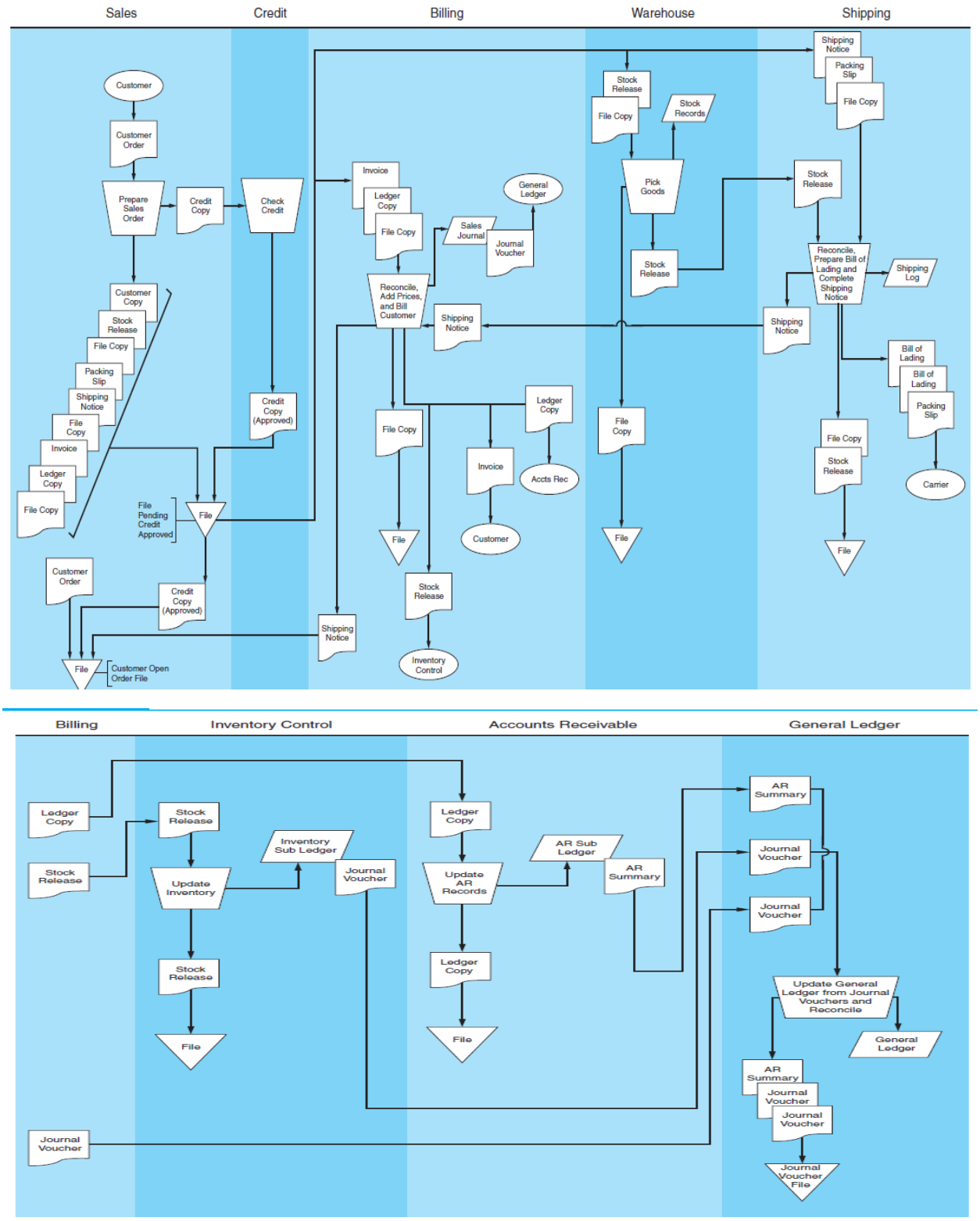


Figure 5.13: Manual Sales Order Processing Systems

c. Warehouse Procedures

The next step is to ship the merchandise, which should be done as soon after credit approval as possible. The warehouse clerk receives the stock release copy of the sales order and uses this to locate the inventory. The inventory and stock release are then sent to the shipping department. Finally, the warehouse clerk records the inventory reduction in the stock records.

d. The Shipping Department

The shipping clerk reconciles the products received from the warehouse with the shipping notice copy of the sales order received earlier. As discussed previously, this reconciliation is an important control point, which ensures that the firm sends the correct products and quantities to the customer. When the order is correct, a bill of lading is prepared, and the products are packaged and shipped via common carrier to the customer. The clerk then enters the transaction into the shipping log and sends the shipping notice to the billing department.

e. The Billing Department

The shipping notice is proof that the product has been shipped and is the trigger document that initiates the billing process. Upon receipt of the shipping notice, the billing clerk compiles the relevant facts about the transaction (product prices, handling charges, freight, taxes, and discount terms) and bills the customer. The billing clerk then enters the transaction into the sales journal and distributes documents to the AR and inventory control departments. Periodically, the clerk summarizes all transactions into a journal voucher and sends this to the general ledger department.

f. Accounts Receivable, Inventory Control, and General Ledger Departments

Up on receipt of sales order copies from the billing department, the AR and inventory control clerks update their respective subsidiary ledgers. Periodically they prepare journal vouchers and account summaries, which they send to the general ledger department for reconciliation and posting to the control accounts.

Generally, we can conclude about manual systems with two points of observation. First, notice how manual systems generate a great deal of hard-copy (paper) documents. Physical documents need to be purchased, prepared, transported, and stored. Hence, these documents and their associated tasks add considerably to the cost of system operation. As we shall see in the next section, their elimination or reduction is a primary objective of computer-based systems design.

Second, for purposes of internal control, many functions such as the billing, accounts receivable, inventory control, cash receipts, and the general ledger are located in physically separate departments. These are labor-intensive and thus error-prone activities that add greatly to the cost of system operation. When we examine computer-based systems, you should note that computer programs, which are much cheaper and far less prone to error, perform these clerical tasks. The various departments may still exist in computer-based systems, but their tasks are refocused on

Self-test 5.2. *Dear learners, check your progress!*

1. What are the control activities in authorizing transactions in the sales

financial analysis and dealing with exception-based problems that emerge rather than routine transaction processing.

5.2.2. Computer-Based Accounting Systems

Technological innovations in AIS improve the efficiency and effectiveness of a task that involved in accounting processes.

Sales Order Processing with Real-Time Technology

Figure 5.5. illustrates a real-time sales order system. Interactive computer terminals replace many of the manual procedures and physical documents of the previous system. This interactive system provides real-time input and output with batch updating of only some master files.

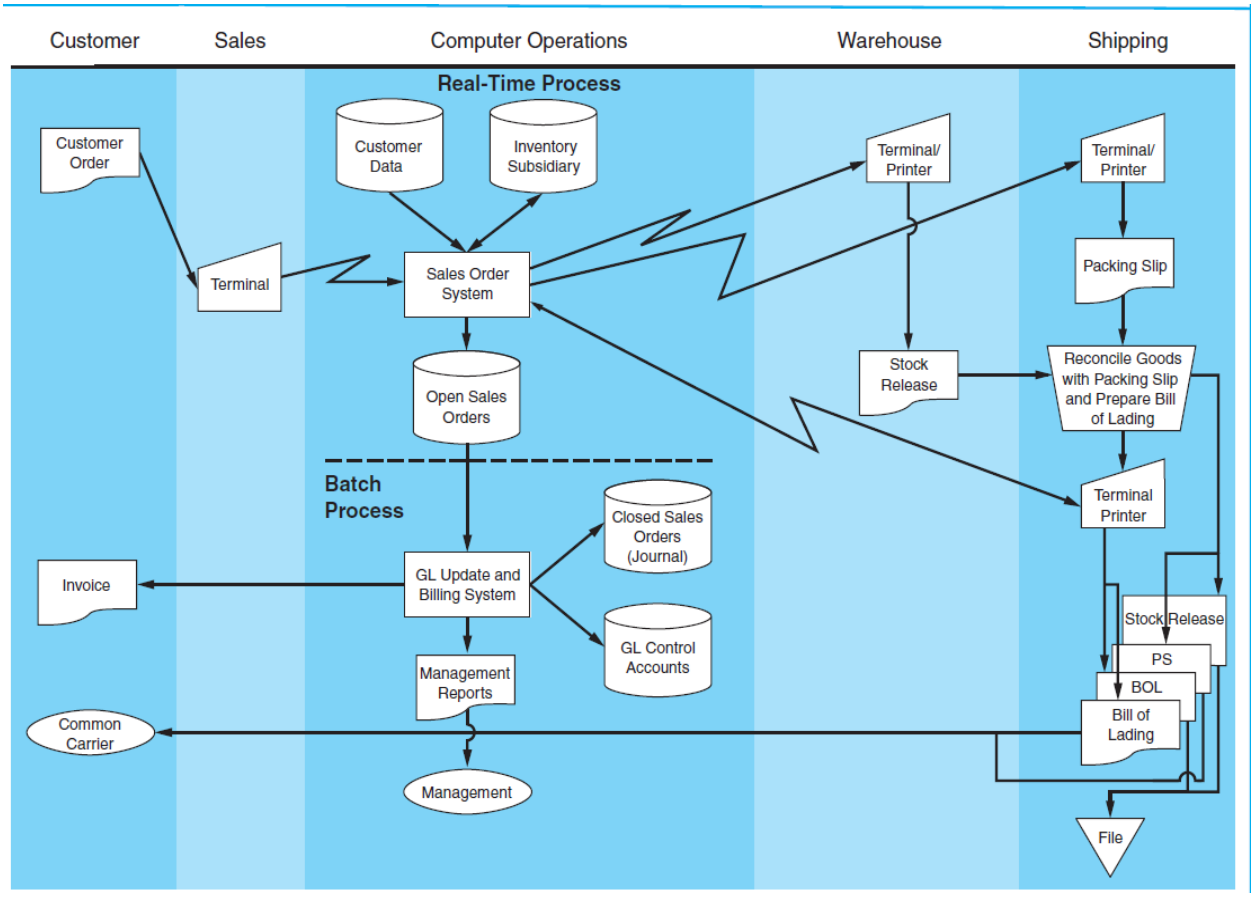


Figure 14.5.: Real-Time Sales Order System

a. Transaction Processing Procedures

Sales Procedures: Under real-time processing, sales clerks receiving orders from customers process each transaction separately as it is received. Using a computer terminal connected to a sales order system, the clerk performs the following tasks in real-time mode:

i. The system accesses the inventory subsidiary file and checks the availability of the inventory. It then performs a credit check, by retrieving the customer credit data in the customer's (AR) file. This file contains information such as the customer's credit limit, current balance, date of last payment, and current credit status. Based on programmed criteria, the customer's request for credit is approved or denied.

ii. If credit is approved, the system updates the customer's current balance to reflect the sale and reduces inventory by the quantities of items sold to present an accurate and current picture of inventory on hand and available for sale.

iii. The system automatically transmits a digital stock release document to the warehouse, a digital shipping notice to the shipping department, and records the sale in the open sales order file. The structure of this file includes a CLOSED field that contains either the value N or Y (No or Yes) to indicate the status of the order.

Closed records (those containing the value Y) have been shipped, so the customer can now be billed. This field is used later to identify closed records to the batch procedure. The default value in this field when the record is created is N. It is changed to Y when the goods are shipped to the customer. The sales clerk can determine the status of an order in response to customer inquiries by viewing the records.

Warehouse Procedures: The warehouse clerk's terminal immediately produces a hard-copy printout of the electronically transmitted stock release document. The clerk then picks the goods and sends them, along with a copy of the stock release document, to the shipping department.

Shipping Department: A shipping clerk reconciles the goods, the stock release document, and the hard-copy packing slip produced on the terminal. The clerk then selects a carrier and prepares the goods for shipment. From the terminal, the clerk transmits a shipping notice containing shipping date and freight charges. The system updates the open sales order record in real time and places a Y value in the CLOSED field, thus closing the sales order.

b. General Ledger Update Procedures

At the end of the day, the batch update program searches the open sales order file for records marked closed and updates the following general ledger accounts: Inventory—Control, Sales, AR—Control, and Cost of Goods Sold. The inventory subsidiary and AR subsidiary records were updated previously during the real-time procedures. Finally, the batch program prepares and mails customer bills and transfers the closed sales records to the closed sales order file (sales journal).

Advantages of Real-Time Processing

Reengineering the sales order processes to include real-time technology can significantly reduce operating costs while increasing revenues. The following advantages make this approach an attractive option for many organizations:

i. Real-time processing greatly shortens the cash cycle of the firm. Lags inherent in batch systems can cause delays of several days between taking an order and billing the customer. A real-time system with remote terminals reduces or eliminates these lags. An order received in the morning may be shipped by early afternoon, thus per-mitting same-day billing of the customer.

ii. Real-time processing can give the firm a competitive advantage in the marketplace. By maintaining current inventory information, sales staff can determine immediately whether the inventories are on hand. This enhances the firm's ability to maximize customer satisfaction, which translates into increased sales. In contrast, batch systems do not provide salespeople with current information. As a result, a portion of the order must sometimes be back-ordered, causing uncertainty for the customer.

iii. Manual procedures tend to produce clerical errors, such as incorrect account numbers, invalid inventory numbers, and price–quantity extension miscalculations. These errors may go undetected in batch systems until the source documents reach data processing, by which time the damage may have already been done. For example, the firm may find that it has shipped goods to the wrong address, shipped the wrong goods, or promised goods to a customer at the wrong price. Real-time editing permits the identification of many kinds of errors as they occur and greatly improves the efficiency and the effectiveness of operations.

iv. Finally, real-time processing reduces the amount of paper documents in a system. Hard-copy documents are expensive to produce and clutter the system. The permanent storage of these documents can become a financial and operational burden. Documents in digital form are efficient, effective, and adequate for audit trail purposes.

5.2.2.1. Control Considerations for Computer-Based Systems

a. Authorization

Transaction authorization in real-time processing systems is an automated task. Management and accountants should be concerned about the correctness of the computer-programmed decision rules and the quality of the data used in this decision.

b. Segregation of Duties

Tasks that would need to be segregated in manual systems are often consolidated within computer programs. For example, a computer application may perform such seemingly incompatible tasks as inventory control, AR updating, billing, and general ledger posting. In such situations, management and auditor concerns are focused on the integrity of the computer programs that perform these tasks. They should seek answers to such questions as: Is the logic of the computer program correct? Has anyone tampered with the application since it was last tested? Have changes been made to the program that could have caused an undisclosed error?

Answers to the questions lie, in part, in the quality of the general controls over segregation of duties related to the design, maintenance, and operation of computer programs. Programmers who write the original computer programs should not also be responsible for making program changes. Both of these functions should also be separate from the daily task of operating the system.

c. Supervision

A dishonest employee has an opportunity to steal the check and destroy the remittance advice. This risk exists in both manual systems and computer-based systems where manual mail room procedures are in place. Surveillance cameras can reduce this type of risk. These techniques are also used to observe sales clerks handling cash receipts from customers. In addition, the cash register's internal tape is a form of supervision. The tape contains a record of all sales transactions processed at the register. Only the clerk's supervisor should have access to the tape, which is used at the end of the shift to balance the cash drawer.

d. Access Control

In computerized systems, digital accounting records are vulnerable to unauthorized and undetected access. This may take the form of an attempt at fraud, an act of malice by a disgruntled employee, or an honest accident. Additional exposures exist in real-time systems, which often maintain accounting records entirely in digital form. Without physical source documents for backup, the destruction of computer files can leave a firm with in-adequate accounting records. To preserve the integrity of accounting records, organizations implement controls that restrict unauthorized access. Also at risk are the computer programs that make programmed decisions, manipulate accounting records, and permit access to assets. In the absence of proper access controls over programs, a firm can suffer devastating losses from fraud and errors.

e. Accounting Records

Digital Journals and Ledgers: Digital journals and master files are the basis for financial reporting and many internal decisions. Accountants should be skeptical about accepting, on face value, the accuracy of computer-produced hard-copy printouts of digital re-cords. The reliability of hard-copy documents for auditing rests directly on the quality of the controls that protect them from unauthorized manipulation. The accountant should, therefore, be concerned about the quality of controls over the programs that update, manipulate, and produce reports from these files.

File Backup: The physical loss, destruction, or corruption of digital accounting records is a serious concern. The data processing department should perform separate file-backup procedures. Typically, these are behind-the-scenes activities that may not appear on the system flowchart. The accountant should verify that such procedures are, in fact, performed for all subsidiary and general ledger files. Although backup requires significant time and computer resources, it is essential in preserving the integrity of accounting records.

f. Independent Verification

The consolidation of many accounting tasks under one computer program removes some of the traditional independent verification control from the system. Independent verification is restored somewhat by performing batch control balancing after each run and by producing management reports and summaries for end users to review.

Self-test 5.3. *Dear learners, check your progress!*

1. What are the advantages of Real-Time processing**?**
2. What are the accounting records to be maintained for Computer-Based Systems control?

5.3. The Expenditure Cycle

The objective of the expenditure cycle is to convert the organization's cash into the physical materials and the human resources it needs to conduct business. Most business entities operate on a credit basis and do not pay for resources until after acquiring them. The time lag between these events splits the procurement process into two phases: (1) the physical phase, involving the acquisition of the resource and (2) the financial phase, involving the disbursement of cash. As a practical matter, these are treated as independent transactions that are processed through separate subsystems.

This section presents the principal features of the four major subsystems that constitute the expenditure cycle: (1) the purchases processing subsystem, (2) the cash disbursements subsystem, (3) the payroll processing subsystem and (4) the fixed assets subsystem.

5.3.1. The Conceptual Expenditure Cycle Activities

In this section we examine the expenditure cycle conceptually. Using data flow diagrams (DFDs) as a guide, we will trace the sequence of activities through four of the processes that constitute the expenditure cycle for most retail, wholesale, and manufacturing organizations. These are purchases processing, cash disbursements, payroll and fixed asset systems procedures.

A. Purchases Processing Procedures

Purchases procedures include the tasks involved in identifying inventory needs, placing the order, receiving the inventory, and recognizing the liability. The relationships between these tasks are presented with the DFD in Figure 5. 6. In general, these procedures apply to both manufacturing and retailing firms. A major difference between the two business types lies in the way purchases are authorized. Manufacturing firms purchase raw materials for production, and their purchasing decisions are authorized by the production planning and control function. Merchandising firms purchase finished goods for resale. The inventory control function provides the purchase authorization for this type of firm.

Monitor Inventory Records: Firms deplete their inventories by transferring raw materials into the production process (the conversion cycle) and by selling finished goods to customers (revenue cycle). Our illustration assumes the latter case, in which inventory control monitors and records finished goods inventory levels. When inventories drop to a predetermined reorder point, a **purchase requisition** is prepared and sent to the prepare purchase order function to initiate the purchase process.

While procedures will vary from firm to firm, typically a separate purchase requisition will be prepared for each inventory item as the need is recognized. This can result in multiple purchase requisitions for a given vendor. These purchase requisitions need to be combined into a single purchase order, which is then sent to the vendor. In this type of system, each purchase order will be associated with one or more purchase requisitions.

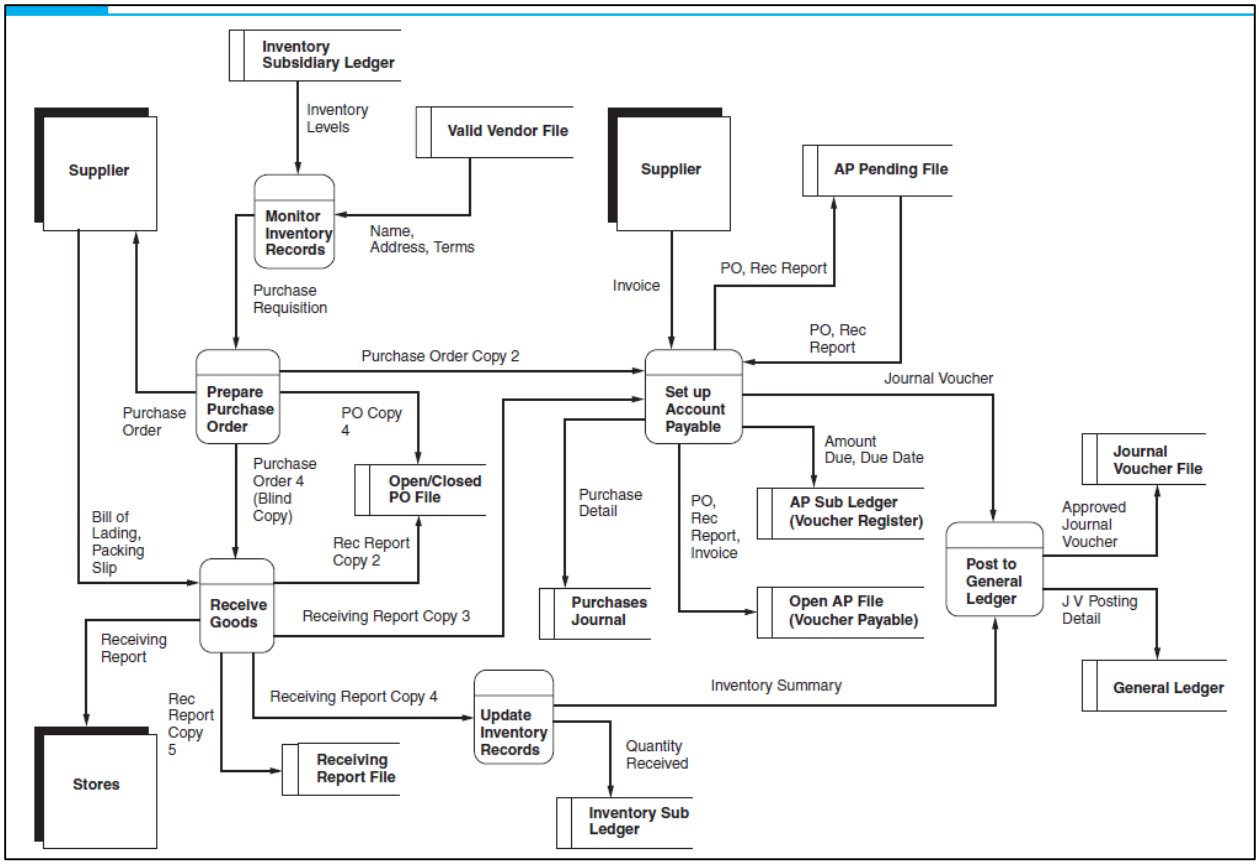


Figure5.6: DFD for Purchase System

Prepare Purchase Order: The prepare purchase order function receives the purchase requisitions, which are sorted by vendor if necessary. Next, a purchase order (PO) is prepared for each vendor. A copy of the PO is sent to the vendor. In addition, a copy is sent to the accounts payable (AP) function for filing temporarily in the AP pending file, and a blind copy is sent to the receive goods function, where it is held until the inventories arrive. The last copy is filed in the open/closed purchase order file.

To make the purchasing process efficient, the inventory control function will supply much of the routine ordering information that the purchasing department needs directly from the inventory and valid vendor files. This information includes the name and address of the primary supplier, the economic order quantity (EOQ) of the item, and the standard or expected unit cost of the item. This allows the purchasing department to devote its efforts to meeting scarce, expensive, or unusual inventory needs. To obtain the best prices and terms on special items, the purchasing department may need to prepare detailed product specifications and request bids from competing vendors. Dealing with routine purchases as efficiently as good control permits is desirable in all organizations. The valid vendor file contributes to both control and efficiency by listing only those vendors approved to do business with the organization. This reference helps to reduce certain vendor fraud schemes.

Receive Goods: Most firms encounter a time lag (sometimes a significant one) between placing the order and receiving the inventory. During this time, the copies of the PO reside in temporary files in various departments. Note that no economic event has yet occurred. At this point, the firm has received no inventories and incurred no financial obligation. Hence, there is no basis for making a formal entry into any accounting record. However, firms often make memo entries of pending inventory receipts and associated obligations.

The next event in the expenditure cycle is the receipt of the inventory. Goods arriving from the vendor are reconciled with the blind copy of the PO. The blind copy contains no quantity or price information about the products being received. The purpose of the blind copy is to force the receiving clerk to count and inspect inventories prior to completing the receiving report. At times, receiving docks are very busy and receiving staff are under pressure to unload the delivery trucks and sign the bills of lading so the truck drivers can go on their way. If receiving clerks are only provided quantity information, they may be tempted to accept deliveries on the basis of this information alone, rather than verify the quantity and condition of the goods. Shipments that are short or contain damaged or incorrect items must be detected before the firm accepts and places the goods in inventory. The blind copy is an important device in reducing this exposure.

Upon completion of the physical count and inspection, the receiving clerk prepares a receiving report stating the quantity and condition of the inventories. One copy of the receiving report accompanies the physical inventories to either the raw materials storeroom or finished goods warehouse for safekeeping. Another copy is filed in the open/closed PO file to close out the purchase order. A third copy of the receiving report is sent to the AP department, where it is filed in the AP pending file. A fourth copy of the receiving report is sent to inventory control for updating the inventory records. Finally, a copy of the receiving report is placed in the receiving report file.

Update Inventory Records: Depending on the inventory valuation method in place, the inventory control procedures may vary somewhat among firms. Organizations that use a standard cost system carry their inventories at a predetermined standard value regardless of the price actually paid to the vendor. Posting to a standard cost inventory ledger requires only information about the quantities received. Because the receiving report contains quantity information, it serves this purpose. Updating an actual cost inventory ledger requires additional financial information, such as a copy of the supplier's invoice when it arrives.

Set Up Accounts Payable: During the course of this transaction, the set up AP function has received and temporarily filed copies of the PO and receiving report. The organization has received inventories from the vendor and has incurred (realized) an obligation to pay for the goods. At this point in the process, however, the firm has not received the supplier's invoice containing the financial information needed to record the transaction. The firm will thus defer recording (recognizing) the liability until the invoice arrives. This common situation creates a slight lag (a

few days) in the recording process, during which time the firm's liabilities are technically understated. As a practical matter, this misstatement is a problem only at period-end when the firm prepares financial statements. To close the books, the accountant will need to estimate the value of the obligation until the invoice arrives. If the estimate is materially incorrect, an adjusting entry must be made to correct the error. Because the receipt of the invoice typically triggers AP procedures, accountants need to be aware that unrecorded liabilities may exist at period-end closing.

When the invoice arrives, the AP clerk reconciles the financial information with the receiving report and PO in the pending file. This is called a three-way match, which verifies that what was ordered was received and is fairly priced. Once the reconciliation is complete, the transaction is recorded in the purchases journal and posted to the supplier's account in the AP subsidiary ledger. Inventory valuation method will determine how inventory control will have recorded the receipt of inventories. If the firm is using the actual cost method, the AP clerk would send a copy of the supplier's invoice to inventory control. If standard costing is used, this step is not necessary. After recording the liability, the AP clerk transfers all source documents (PO, receiving report, and invoice) to the **open AP file.** Typically, this file is organized by payment due date and scanned daily to ensure that debts are paid on the last possible date without missing due dates and losing discounts. Finally, the AP clerk summarizes the entries in the purchases journal for the period (or batch) and prepares a journal voucher for the general ledger function. Assuming the organization uses the perpetual inventory method, the journal entry will be:

	DR	CR
Inventory—Control	XXX	
Accounts Payable—Control		XXX

If the periodic inventory method is used, the entry will be:

	DR	CR
Purchases	XXXX	
Accounts Payable—Control		XXXX

Post to General Ledger: The general ledger function receives a journal voucher from the AP department and an account summary from inventory control. The general ledger function posts from the journal voucher to the inventory and AP control accounts and reconciles the inventory control account and the inventory subsidiary summary. The approved journal vouchers are then posted to the journal voucher file. With this step, the purchases phase of the expenditure cycle is completed.

B. The Cash Disbursements Systems

The cash disbursements system processes the payment of obligations created in the purchases system. The principal objective of this system is to ensure that only valid creditors receive payment and that amounts paid are timely and correct. If the system makes payments early, the firm forgoes interest income that it could have earned on the funds. If obligations are paid late, however, the firm will lose purchase discounts or may damage its credit standing. Figure 5.7. presents a DFD conceptually depicting the information flows and key tasks of the cash disbursements system.

Identify Liabilities Due: The cash disbursements process begins in the AP department by identifying items that have come due. Each day, the AP function reviews the open AP file (or vouchers payable file) for such items and sends payment approval in the form of a voucher packet (the voucher and/or supporting documents) to the cash disbursements department.

Prepare Cash Disbursement: The cash disbursements clerk receives the voucher packet and reviews the documents for completeness and clerical accuracy. For each disbursement, the clerk prepares a check and records the check number, dollar amount, voucher number, and other pertinent data in the check register, which is also called the cash disbursements journal. Depending on the organization's materiality threshold, the check may require additional approval by the cash disbursements department manager or treasurer. The negotiable portion of the check is mailed to the supplier, and a copy of it is attached to the voucher packet as proof of payment. The clerk marks the documents in the voucher packets paid and returns them to the AP clerk.

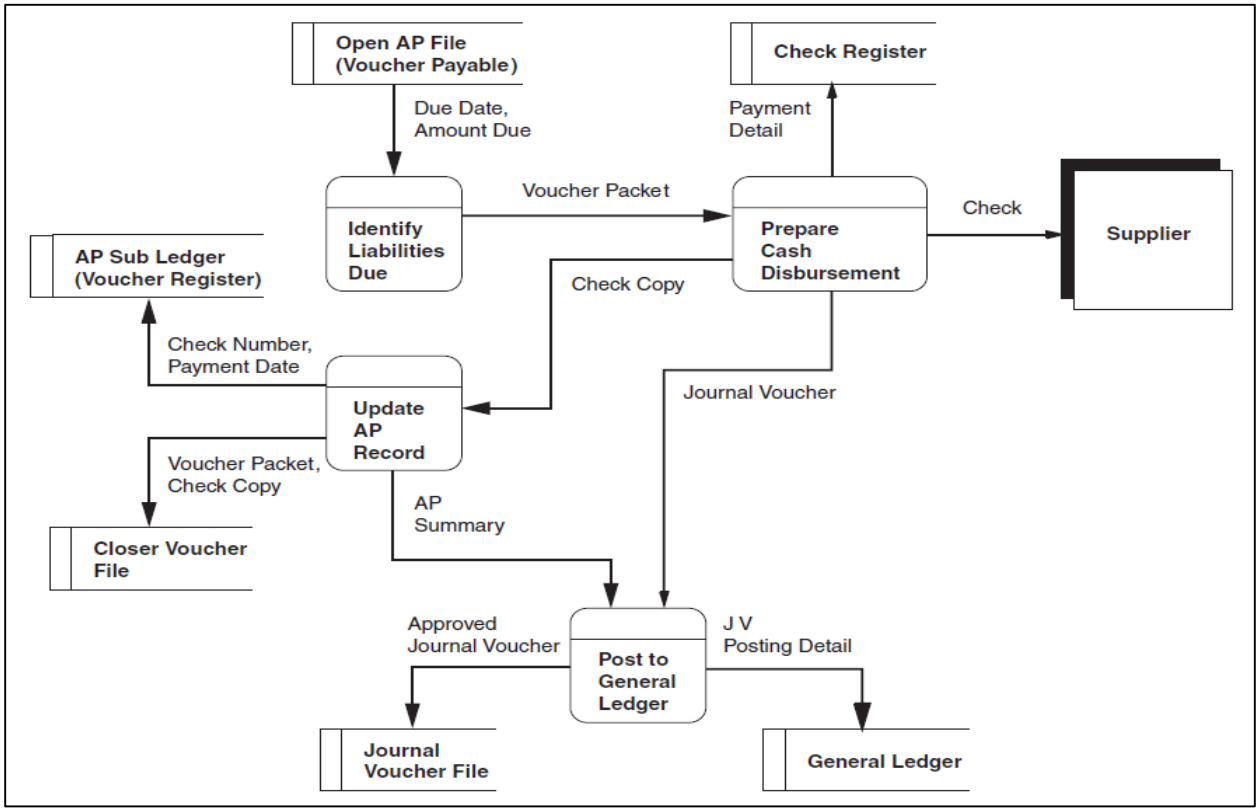


Figure 5.7: DFD for Cash Disbursements System

Finally, the cash disbursements clerk summarizes the entries made to the check register and sends a journal voucher with the following journal entry to the general ledger department:

	DR	CR
Accounts Payable	XXXX	
Cash		XXXX

Update AP Record: Upon receipt of the voucher packet, the AP clerk removes the liability by debiting the AP subsidiary account or by recording the check number and payment date in the voucher register. The voucher packet is filed in the closed voucher file, and an account summary is prepared and sent to the general ledger function.

Post to General Ledger: The general ledger function receives the journal voucher from cash disbursements and the account summary from AP. The voucher shows the total reductions in the firm's obligations and cash account as a result of payments to suppliers. These numbers are reconciled with the AP summary, and the AP control and cash accounts in the general ledger are updated accordingly. The approved journal voucher is then filed. This concludes the cash disbursements procedures.

C. The Payroll Processing System

Payroll processing is actually a special-case purchases system in which the organization purchases labor rather than raw materials or finished goods for resale. The nature of payroll processing, however, creates the need for specialized procedures, for the following reasons:

1. A firm can design general purchasing and disbursement procedures that apply to all vendors and inventory items. Payroll procedures, however, differ greatly among classes of employees. For example, different procedures are needed for hourly employees, salaried employees, piece workers, and commissioned employees. Also, payroll processing requires special accounting procedures for employee deductions and withholdings for taxes that do not apply to trade accounts.

2. General expenditure activities constitute a relatively steady stream of purchasing and disbursing transactions. Business organizations thus design purchasing systems to deal with their normal level of activity. Payroll activities, on the other hand, are discrete events in which disbursements to employees occur weekly, biweekly, or monthly. The task of periodically preparing large numbers of payroll checks in addition to the normal trade account checks can overload the general purchasing and cash disbursements system.

3. Writing checks to employees requires special controls. Combining payroll and trade transactions can encourage payroll fraud.

Although specific payroll procedures vary among firms, Figure 5.8. presents a data flow diagram (DFD) depicting the general tasks of the payroll system in a manufacturing firm. The key points of the process are described below.

Personnel Department: The personnel department prepares and submits personnel action forms to the prepare payroll function. These documents identify employees authorized to receive a paycheck and are used to reflect changes in hourly pay rates, payroll deductions, and job classification.

Production Department: Production employees prepare two types of time records: job tickets and time cards. Job tickets capture the time that individual workers spend on each production job. Cost accounting uses these documents to allocate direct labor charges to work-in-process (WIP) accounts. Time cards capture the time the employee is at work. These are sent to the prepare payroll function for calculating the amount of the employee's paycheck. Time card is the formal record of daily attendance.

Update WIP Account: After cost accounting allocates labor costs to the WIP accounts, the charges are summarized in a labor distribution summary and forwarded to the general ledger function.

Prepare Payroll: The payroll department receives pay rate and withholding data from the personnel department and hours-worked data from the production department.

A clerk in payroll then performs the following tasks.

1. Prepares the payroll register that shows gross pay, deductions, overtime pay, and net pay.
2. Enters the above information into the employee payroll records.
3. Prepares employee paychecks.
4. Sends the paychecks to the distribute paycheck function.
5. Files the time cards, personnel action form, and copy of the payroll register (not shown).

Distribute Paycheck: A form of payroll fraud involves submitting time cards for nonexistent employees. To prevent this, many companies use a paymaster to distribute the paychecks to employees. This individual is independent of the payroll process - not involved in payroll authorization or preparation tasks. If a valid employee does not claim a paycheck, the paymaster returns the check to payroll. The reason the check went unclaimed can then be investigated.

Prepare Accounts Payable: The accounts payable (AP) clerk reviews the payroll register for correctness and prepares copies of a cash disbursement voucher for the amount of the payroll. The clerk records the voucher in the voucher register and submits the voucher packet (voucher and payroll register) to cash disbursements. A copy of the disbursement voucher is sent to the general ledger function.

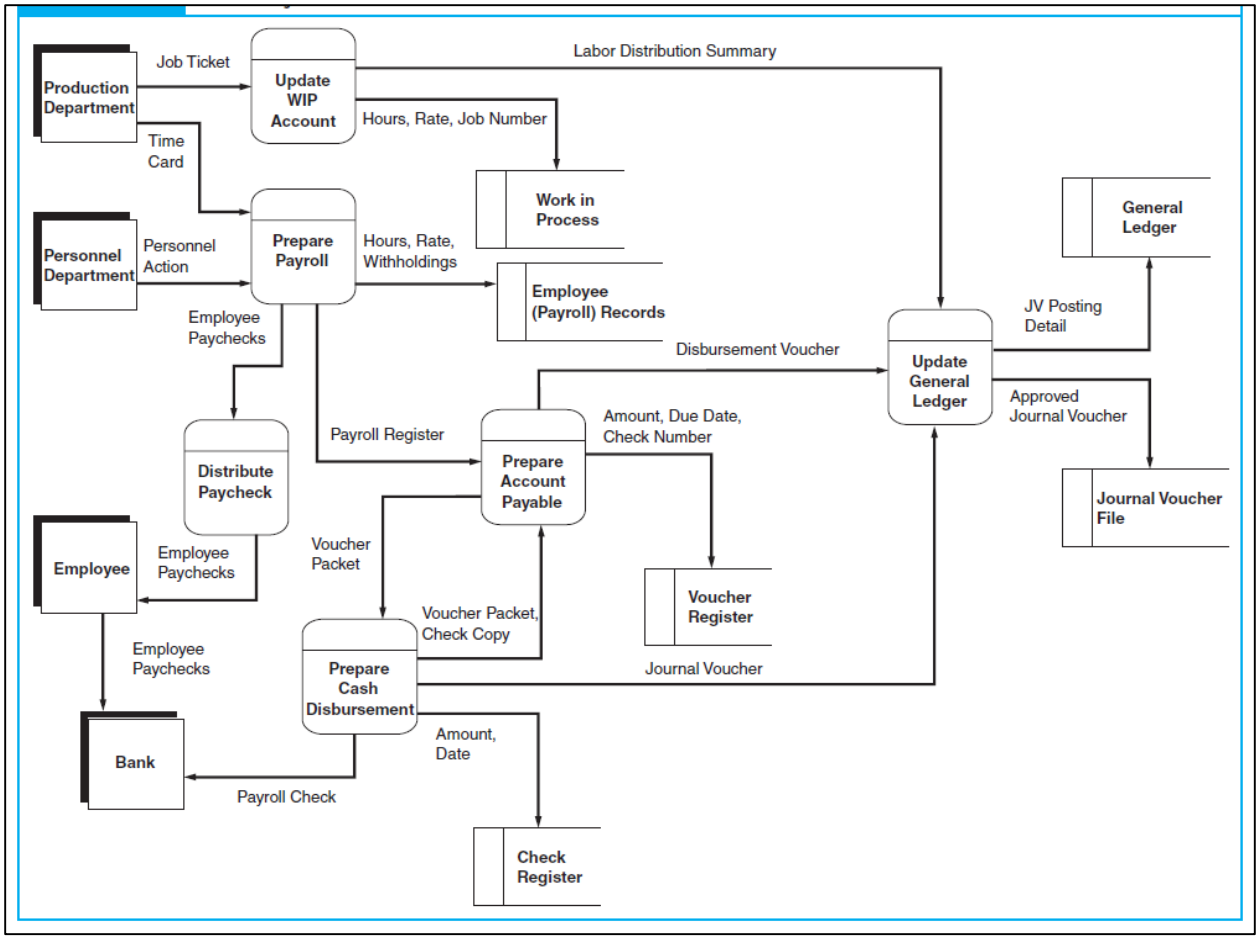


Figure 5.8: DFD of Payroll Procedures

Prepare Cash Disbursement: Upon receipt of the voucher packet, the cash disbursements function prepares a single check for the entire amount of the payroll and deposits it in the payroll imprest account. Imprest is money that is drawn as needed. The employee paychecks are drawn on this account, which is used only for payroll. Funds must be transferred from the general cash account to this imprest account before the paychecks can be cashed. The clerk sends a copy of the check along with the disbursement voucher and the payroll register to the AP department, where they are filed (not shown). Finally, a journal voucher is prepared and sent to the general ledger function.

Update General Ledger: The general ledger function receives the labor distribution summary from cost accounting, the disbursement voucher from AP, and the journal voucher from cash disbursements. With this information, the general ledger clerk makes the following two accounting entries:

- ***From the labor distribution summary***

	DR	CR
Work-in-Process (Direct labor)	XXX	

Factory Overhead (Indirect labor)	XXX	
Wages Payable		XXX

- ***From disbursement voucher***

	DR	CR
Wages Payable	XXX	
Cash		XXX
Income Tax Payable		XXX
Employees' Pension Fund Contribution Payable		XXX
Pension Fund Contribution Payable		XXX

Self-test 5.4. *Dear learners, check your progress!*

1. What are the four major subsystems that constitute the expenditure cycle?
2. Which of the following is not the activity in the purchase processing procedure of the expenditure cycle?
   a. Monitor Inventory Records
   b. Identify Liabilities Due
   c. Prepare Purchase Order
   d. Update Inventory Records

D. The Fixed Asset System

Fixed assets are the property, plant, and equipment used in the operation of a business. Examples of fixed assets include land, buildings, furniture, machinery, and motor vehicles. A firm's fixed asset system processes transactions pertaining to the acquisition, maintenance, and disposal of its fixed assets. The specific objectives of the fixed asset system are to:

1. Process the acquisition of fixed assets as needed and in accordance with formal management approval.
2. Maintain adequate accounting records of asset acquisition, cost, description, and physical location.
3. Maintain accurate depreciation records for depreciable assets in accordance with acceptable methods.
4. Provide management with information to help plan for future fixed asset investments.
5. Properly record the retirement and disposal of fixed assets.

The fixed asset system processes non-routine transactions for a wider group of users in the organization. Managers in virtually all functional areas of the organization make capital

investments in fixed assets, but these transactions occur with less regularity than inventory acquisitions. Because fixed asset transactions are unique, they require specific management approval and explicit authorization procedures. Fixed assets acquisition capitalized for long periods. Because the productive life of a fixed asset extends beyond one year, its acquisition cost is apportioned over its lifetime and depreciated in accordance with accounting conventions and statutory requirements. Therefore, fixed asset accounting systems include cost allocation and matching procedures that are not part of routine expenditure systems.

Figure 5.9. presents the general logic of the fixed asset system. The process involves three categories of tasks: asset acquisition, asset maintenance, and asset disposal.

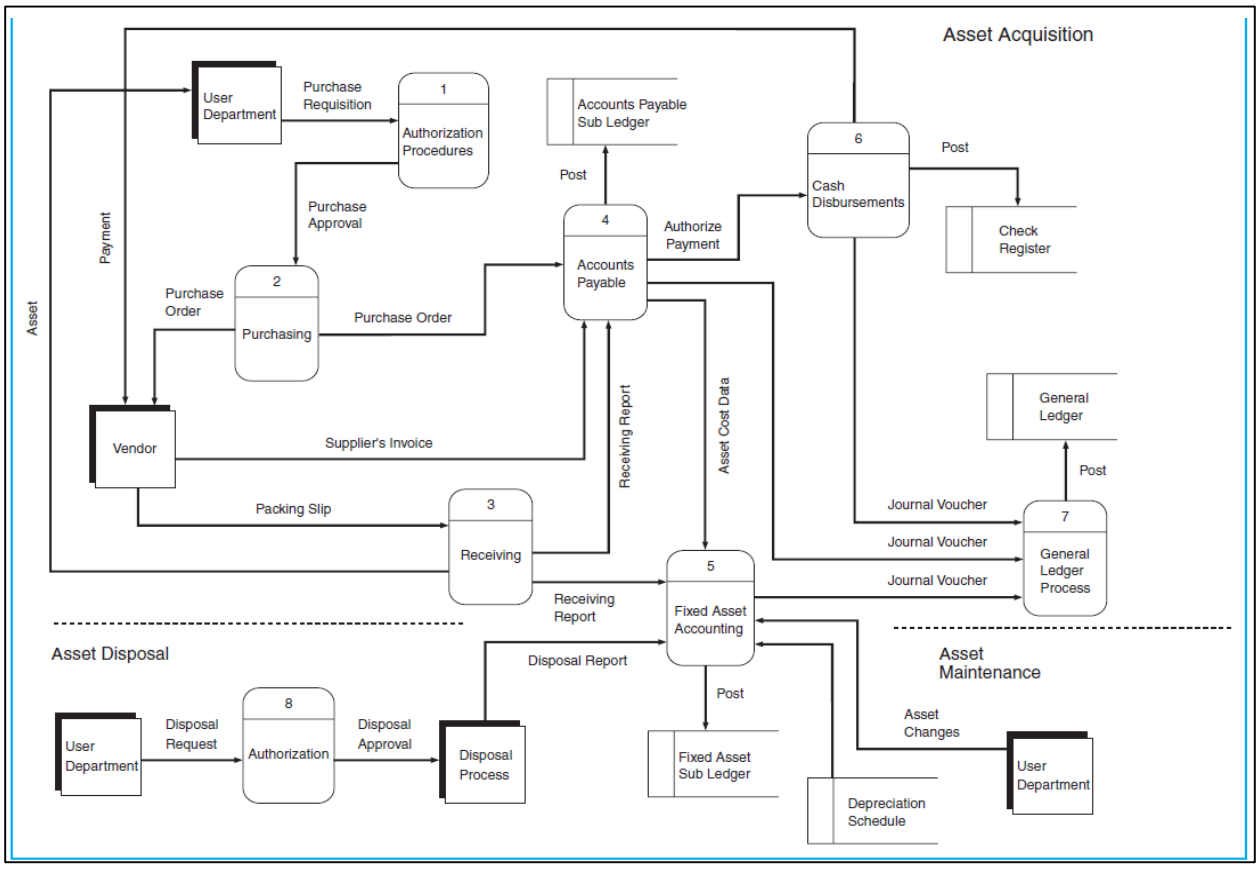


Figure 5.9: DFD for Fixed Asset System

Asset Acquisition: Asset acquisition usually begins with the departmental manager (user) recognizing the need to obtain a new asset or replace an existing one. Authorization and approval procedures over the transaction will depend on the asset's value. Department managers typically have authority to approve purchases below a certain materiality limit. Capital expenditures above

the limit will require approval from the higher management levels. This may involve a formal cost-benefit analysis and the formal solicitation of bids from suppliers.

Once the request is approved and a supplier is selected, the fixed asset acquisition task is similar purchase procedures described previously, with two note-worthy differences. First, the receiving department delivers the asset into the custody of the user/manager rather than a central store or warehouse. Second, the fixed asset department, not inventory control, performs the record-keeping function.

Asset Maintenance: Asset maintenance involves adjusting the fixed asset subsidiary account balances as the assets (excluding land) depreciate over time or with usage. Common depreciation methods in use are straight line, sum-of-the-years' digits, double-declining balance, and units of production. The method of depreciation and the period used should reflect, as closely as possible, the asset's actual decline in utility to the firm. The depreciation of fixed assets used to manufacture products is charged to manufacturing overhead and then allocated to WIP. Depreciation charges from assets not used in manufacturing are treated as expenses in the current period.

Depreciation calculations are transactions that the fixed asset system must be designed to anticipate internally when no external event (source document) triggers the action. An important record used to initiate this task is the **depreciation schedule**. A depreciation schedule shows when and how much depreciation to record. It also shows when to stop taking depreciation on fully depreciated assets. This information in a management report is also useful for planning asset retirement and replacement.

Asset maintenance also involves adjusting asset accounts to reflect the cost of physical improvements that increase the asset's value or extend its useful life. Such enhancements, which are themselves capital investments, are processed as new asset acquisitions.

Finally, the fixed asset system must promote accountability by keeping track of the physical location of each asset. Unlike inventories, which are usually consolidated in secure areas, fixed assets are distributed throughout the organization and are subject to risk from theft and misappropriation. When one department transfers custody of an asset to another department, information about the transfer should be recorded in the fixed asset subsidiary ledger. Each subsidiary record should indicate the current location of the asset. The ability to locate and verify the physical existence of fixed assets is an important component of the audit trail.

Asset Disposal: When an asset has reached the end of its useful life or when management decides to dispose of it, the asset must be removed from the fixed asset subsidiary ledger. The bottom left portion of Figure 5.9 illustrates the asset disposal process. It begins when the responsible manager issues a request to dispose of the asset. Like any other transaction, the disposal of an asset requires proper approval. The disposal options open to the firm are to sell, scrap, donate, or retire the asset

in place. A disposal report describing the final disposition of the asset is sent to the fixed asset accounting department to authorize its removal from the ledger.

5.3.2. Expenditure Cycle Controls

This section describes the primary internal controls in the expenditure cycle according to the control procedures specified in Statement on Auditing Standards No. 78.

5.1.1.1. Purchases Processing and Cash Disbursement Systems Controls

Control Activity	Purchases Processing System	Cash Disbursements System
Transactions authorization: promotes efficient inventory management and ensures the legitimacy of purchases transactions.	Inventory control function continually monitors inventory levels. As inventory levels drop to their predetermined reorder points, inventory control formally authorizes replenishment with a purchase requisition.	AP authorizes payment.
Segregation of duties	Inventory control separate from purchasing and inventory custody. AP subsidiary ledger separate from the general ledger.	Separate AP subsidiary ledger, cash disbursements, and general ledger functions.
Supervision: reduces the chances of two types of exposure: (1) failure to properly inspect the assets and (2) the theft of assets	Receiving area.	
Accounting records: maintain an audit trail adequate for tracing a transaction from its source document to the financial statements.	AP subsidiary ledger, general ledger, purchases requisition file, purchase order file, receiving report file.	Voucher payable file, AP subsidiary ledger, cash disbursements journal, general ledger cash accounts.
Access	Security of physical assets. Limit access to the accounting records.	Proper security over cash. Limit access to the accounting records.
Independent verification	AP reconciles source documents before liability is recorded. General ledger reconciles overall accuracy of process.	Final review by cash disbursements. Overall reconciliation by general ledger. Periodic bank reconciliation by controller.

5.4. Payroll Controls

Transaction Authorization: A form of payroll fraud involves submitting time cards for employees who no longer work for the firm. To prevent this, the personnel action form helps payroll keep the employee records current. This document describes additions, deletions, and other changes to the employee file and acts as an important authorization control to ensure that only the time cards of current and valid employees are processed.

Segregation of Duties: The time-keeping function and the personnel function should be separated. The personnel function provides payroll with pay rate information for authorized hourly employees. Typically, an organization will offer a range of valid pay rates based on experience, job classification, seniority, and merit. If the production (time-keeping) department provided this information, an employee might submit a higher rate and perpetrate a fraud.

For purposes of operational efficiency, the payroll function performs several tasks. Some of these are in contradiction with basic internal control objectives. For example, the payroll function has both asset custody (employee paychecks) and record-keeping responsibility (employee payroll records). This is the equivalent in the general purchases system of assigning accounts payable and cash disbursement responsibility to the same person (This opens the opportunity for the person to create a false liability to himself (or an agent), approve payment, and write the check). Segregating key aspects of the payroll transaction between AP and cash disbursement functions returns control to the process. AP reviews the work done by pay-roll (payroll register) and approves payment. Cash disbursements then writes the check to cover the total payroll. None of the employee paychecks is a negotiable instrument until the payroll check is deposited into the imprest account.

Supervision: Sometimes employees will sign for another worker who is late or absent. Supervisors should observe the time-keeping process and reconcile the time cards with actual attendance.

Accounting Records: The audit trail for payroll includes the following documents:

1. Time cards, job tickets, and disbursement vouchers.
2. Journal information, which comes from the labor distribution summary and the payroll register.
3. Subsidiary ledger accounts, which contain the employee records and various expense accounts.
4. The general ledger accounts: payroll control, cash, and the payroll clearing (imprest) account.

Access Controls: The assets associated with the payroll system are labor and cash. Both can be misappropriated through improper access to accounting records. A dishonest individual can

misrepresent the number of hours worked on the time cards and thus embezzle cash. Similarly, control over access to all journals, ledgers, and source documents in the payroll system are important, as it is in all expenditure cycle systems.

Independent Verification: The following are examples of independent verification controls in the payroll system:

1. Verification of time. Before sending time cards to payroll, the supervisor must verify their accuracy and sign them.
2. Paymaster. The use of an independent paymaster to distribute checks (rather than the normal supervisor) helps verify the existence of the employees. The supervisor may be party to a payroll fraud by pretending to distribute paychecks to nonexistent employees.
3. Accounts payable. The AP clerk verifies the accuracy of the payroll register before creating a disbursement voucher that transfers funds to the imprest account.
4. General ledger. The general ledger department provides verification of the overall process by reconciling the labor distribution summary and the payroll disbursement vouc

Self-test 5.5. *Dear learners, check your progress!*

1. Which of the following is not the activity in the fixed asset system of the expenditure cycle?
   a. Asset Acquisition
   b. Asset Maintenance
   c. Asset Disposal
   d. Prepare Cash Disbursement

2. What are the accounting records to be maintained for payroll control?

5.4.1. Physical Systems

In this section we examine the physical system. This begins with a review of manual procedures and then moves on to deal with computer-based systems. The purpose of this section is to support the conceptual treatment of systems presented in the previous section. This help to envision the relationships between organizational units, the segregation of duties, and the information flows essential to operations and effective internal control**.** In addition, we will highlight inefficiencies intrinsic to manual systems, which gave rise to improved technologies and techniques used by modern systems.

5.4.2. Manual Purchase System

The following discussion is based on Figure 5.10, which presents a flowchart of a manual purchases system.

Inventory Control: When inventories drop to a predetermined reorder point, the clerk prepares a purchase requisition. One copy of the requisition is sent to the purchasing department, and one copy is placed in the open purchase requisition file. Note that to provide proper authorization control, the inventory control department is segregated from the purchasing department, which executes the transaction.

Purchasing Department: The purchasing department receives the purchase requisitions, sorts them by vendor, and prepares a multipart purchase order (PO) for each vendor. Two copies of the PO are sent to the vendor. One copy of the PO is sent to inventory control, where the clerk files it with the open purchase requisition. One copy of the PO is sent to AP for filing in the AP pending file. One copy (the blind copy) is sent to the receiving department, where it is filed until the inventories arrive. The clerk files the last copy along with the purchase requisition in the open PO file.

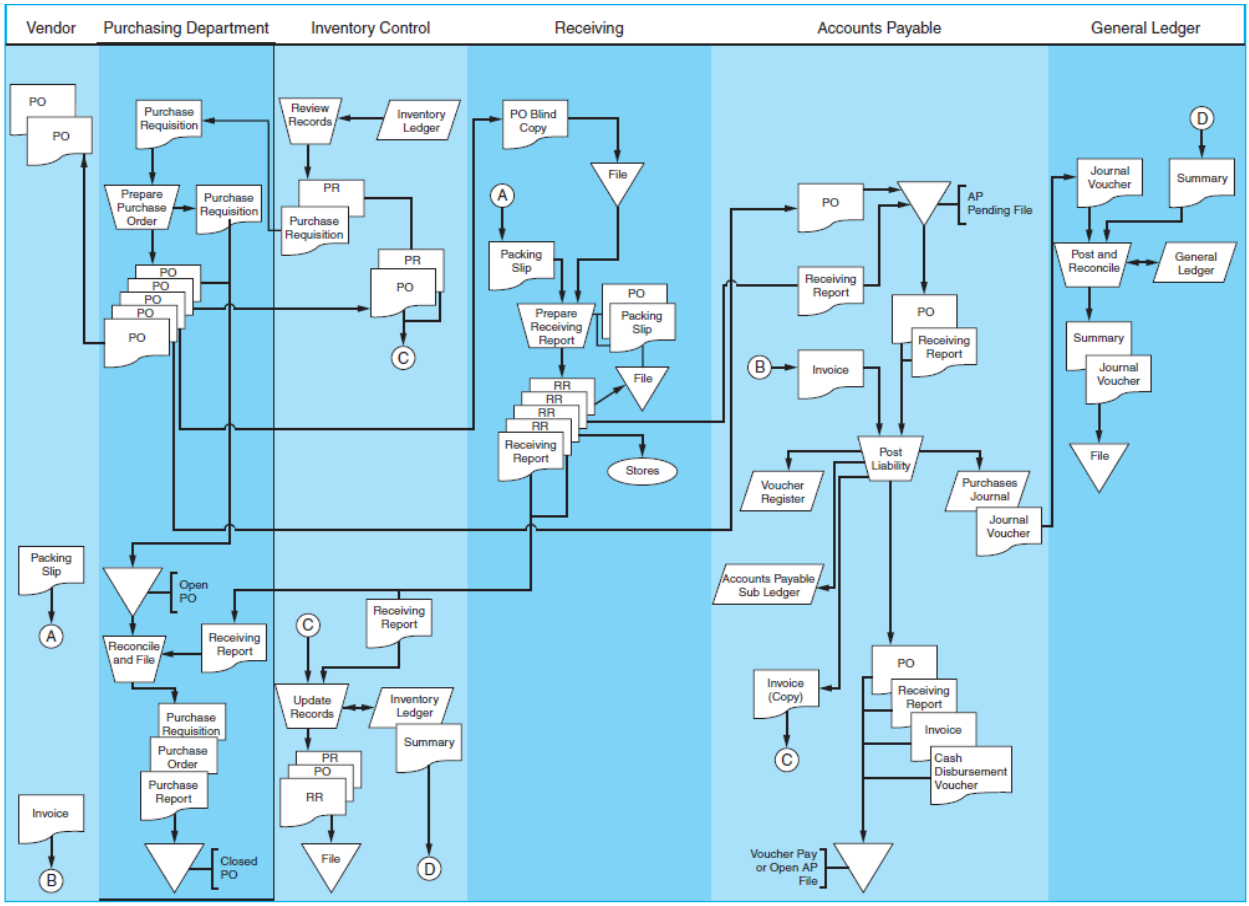


Figure 15.10: Manual Purchase System

Receiving: Goods arriving from the vendor are reconciled with the blind copy of the PO. Upon completion of the physical count and inspection, the receiving clerk prepares a multipart receiving report stating the quantity and condition of the inventories. One copy of the receiving report

accompanies the physical inventories to the storeroom. Another copy is sent to the purchasing department, where the purchasing clerk reconciles it with the open PO. The clerk closes the open PO by filing the purchase requisition, the PO, and the receiving report in the closed PO file. A third copy of the receiving report is sent to inventory control where (assuming a standard cost system) the inventory subsidiary ledger is updated. A fourth copy of the receiving report is sent to the AP department, where it is filed in the AP pending file. The final copy of the receiving report is filed in the receiving department.

AP Department: When the invoice arrives, the AP clerk reconciles the financial information with the documents in the pending file, records the transaction in the purchases journal, and posts it to the supplier's account in the AP subsidiary ledger (voucher register). After recording the liability, the AP clerk transfers the source documents (PO, receiving report, and invoice) to the open vouchers payable (AP) file.

General Ledger Department: The general ledger department receives a journal voucher from the AP department and an account summary from inventory control. The general ledger clerk reconciles these and posts to the inventory and AP control accounts. With this step, the purchases phase of the expenditure cycle is completed.

5.1.1.2.Manual Cash Disbursements Systems

A detailed document flowchart of a manual cash disbursements system is presented in Figure 5.11. The tasks performed in each of the key processes are discussed hereunder.

AP Department: Each day, the AP clerk reviews the open vouchers payable (AP) file for items due and sends the vouchers and supporting documents to the cash disbursements department.

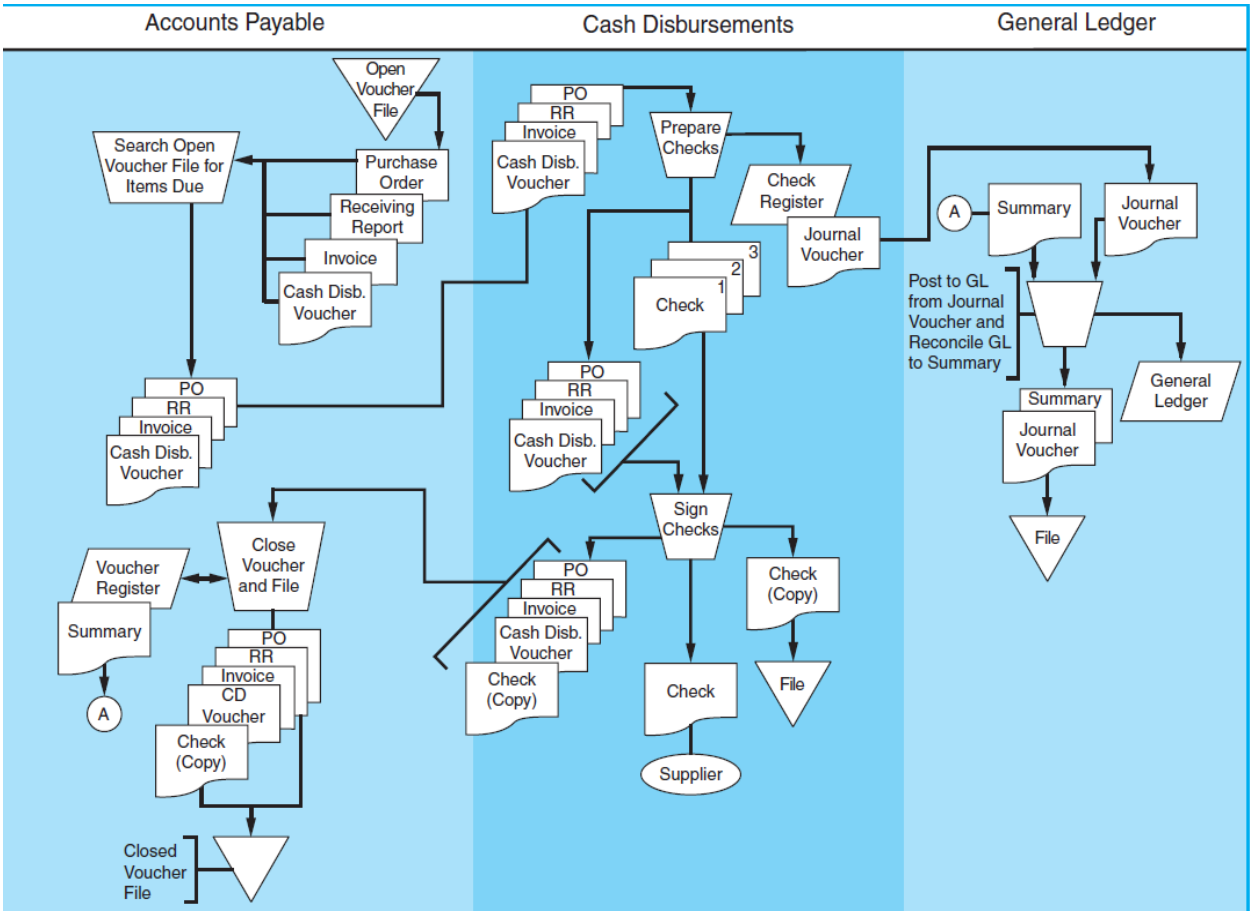


Figure 5.11.: Cash Disbursements System

Cash Disbursements Department: The cash disbursements clerk receives the voucher packets and reviews the documents for completeness and clerical accuracy. For each disbursement, the clerk prepares a three-part check and records the check number, dollar amount, voucher number, and other pertinent data in the check register.

The check, along with the supporting documents, goes to the cash disbursements department manager, or treasurer, for his or her signature. The negotiable portion of the check is mailed to the supplier. The clerk returns the voucher packet and check copy to the AP department and files one copy of the check. Finally, the clerk summarizes the entries made to the check register and sends a journal voucher to the general ledger department.

AP Department: Upon receipt of the voucher packet, the AP clerk removes the liability by recording the check number in the voucher register and filing the voucher packet in the closed voucher file. Finally, the clerk sends an AP summary to the general ledger department.

General Ledger Department: Based on the journal voucher from cash disbursements and the account summary from AP, the general ledger clerk posts to the general ledger control accounts and files the documents. This concludes the cash disbursements procedures.

5.5. Computer-Based Purchases and Cash Disbursements Applications

The manual system described in the previous section is labor-intensive and costly. This section shows how automated systems can produce considerable savings. The flowchart in Figure 5.12. depicts the key features of an automated or computer-based system.

Data Processing: The following tasks are performed automatically.

1. The inventory file is searched for items that have fallen to their reorder points.
2. A record is entered in the purchase requisition file for each item to be replenished.
3. Requisitions are consolidated according to vendor number.
4. Vendor mailing information is retrieved from the valid vendor file.
5. Purchase orders are prepared and added to the open PO file.
6. A transaction listing of purchase orders is sent to the purchasing department for review.

Receiving Department: When the goods arrive, the receiving clerk accesses the open PO file in real time by entering the PO number taken from the packing slip. The receiving screen then prompts the clerk to enter the quantities received for each item on the PO.

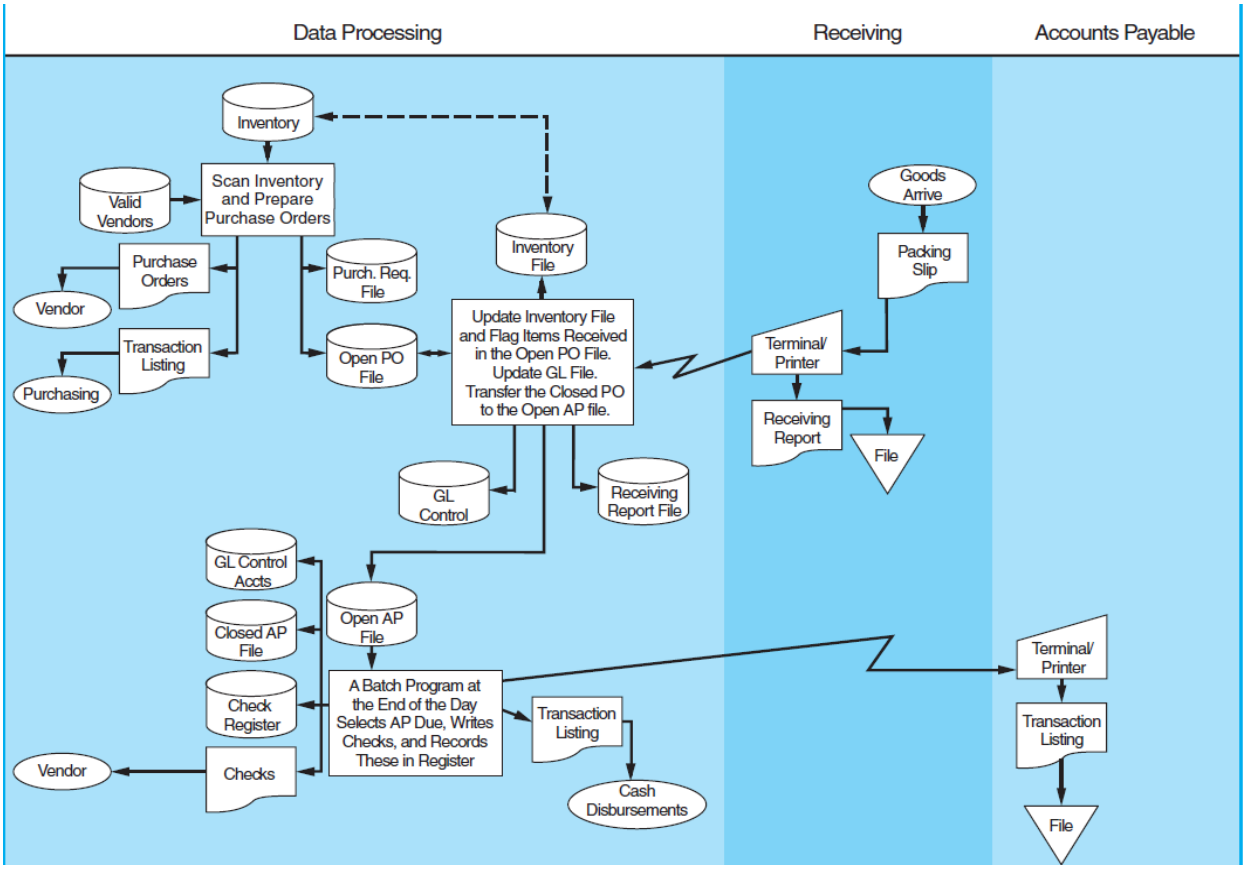


Figure 5.12: Computer-Based Purchases/Cash Disbursements System

Data Processing: The following tasks are performed automatically by the system.

1. Quantities of items received are matched against the open PO record, and a Y value is placed in a logical field to indicate the receipt of inventories.
2. A record is added to the receiving report file.
3. The inventory subsidiary records are updated to reflect the receipt of the inventory items.
4. The general ledger inventory control account is updated.
5. The record is removed from the open PO file and added to the open AP file, and a due date for payment is established.

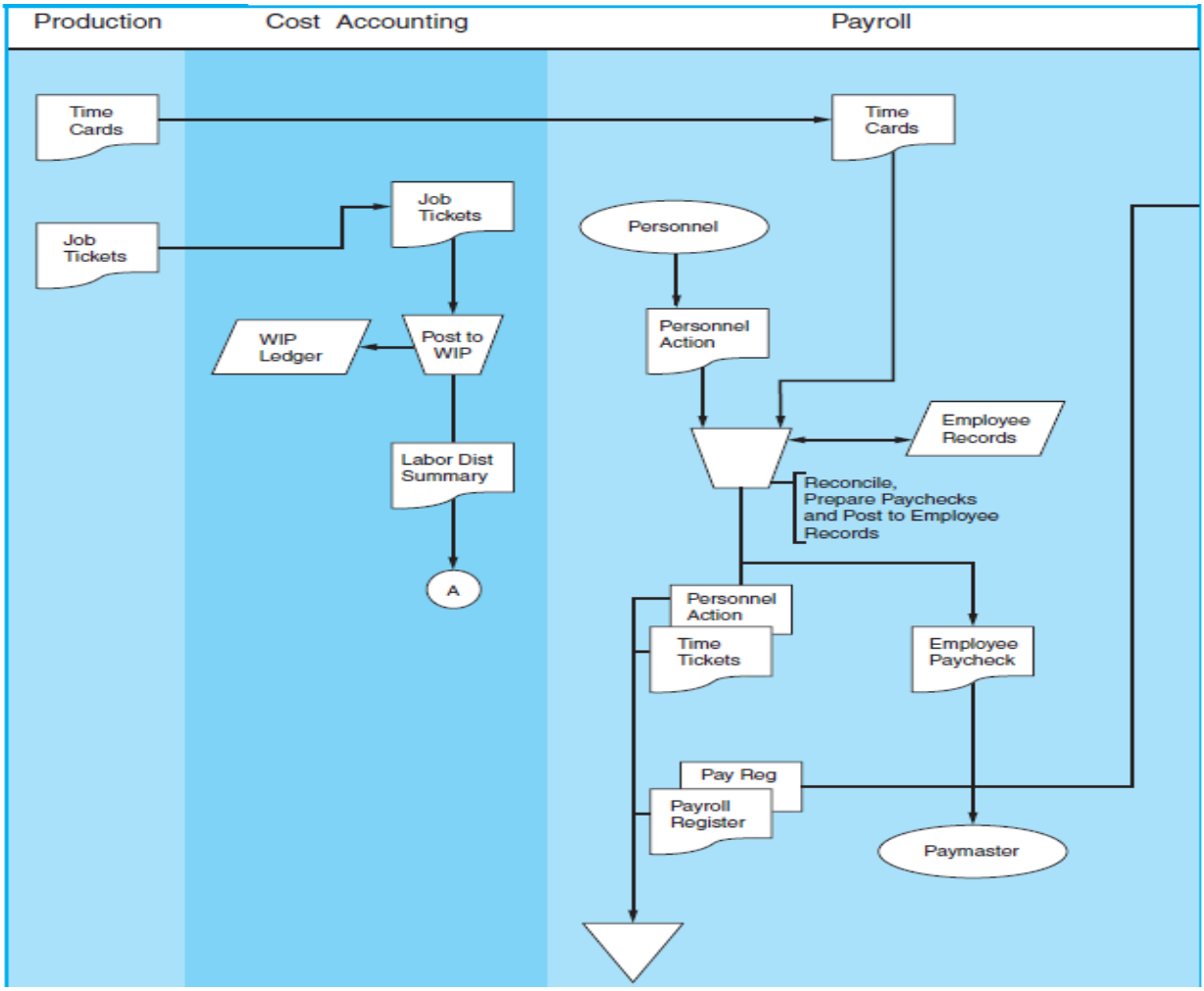
Each day, the DUE DATE fields of the AP records are scanned for items due to be paid. The following procedures are performed for the selected items.

1. Checks are automatically printed, signed, and distributed to the mail room for mailing to vendors. EDI vendors receive payment by electronic funds transfer (EFT).
2. The payments are recorded in the check register file.
3. Items paid are transferred from the open AP file to the closed AP file.
4. The general ledger AP and cash accounts are updated.
5. Reports detailing these transactions are transmitted via terminal to the AP and cash disbursements departments for management review and filing.

5.6. Manual Payroll System

Figure 5.13. presents a flowchart detailing the procedures of payroll system in the context of a manual system. The followings are key tasks involved in the system:

1. Payroll authorization and hours worked enter the payroll department from two different sources: personnel and production.
2. The payroll department reconciles this information, calculates the payroll, and distributes paychecks to the employees.
3. Cost accounting receives information regarding the time spent on each job from production. This is used for posting to WIP account.
4. AP receives payroll summary information from the payroll department and authorizes the cash disbursements department to deposit a single check, in the amount of the total payroll, in a bank imprest account on which the payroll is drawn.
5. The general ledger department reconciles summary information from cost accounting and AP. Control accounts are updated to reflect these transactions.


Production
Cost Accounting
Payroll
Time Cards
Job Tickets
Job Tickets
WIP Ledger
Post to WIP
Labor Dist Summary
A
Time Cards
Personnel
Personnel Action
Employee Records
Reconcile, Prepare Paychecks and Post to Employee Records
Personnel Action
Time Tickets
Employee Paycheck
Pay Reg
Payroll Register
Paymaster

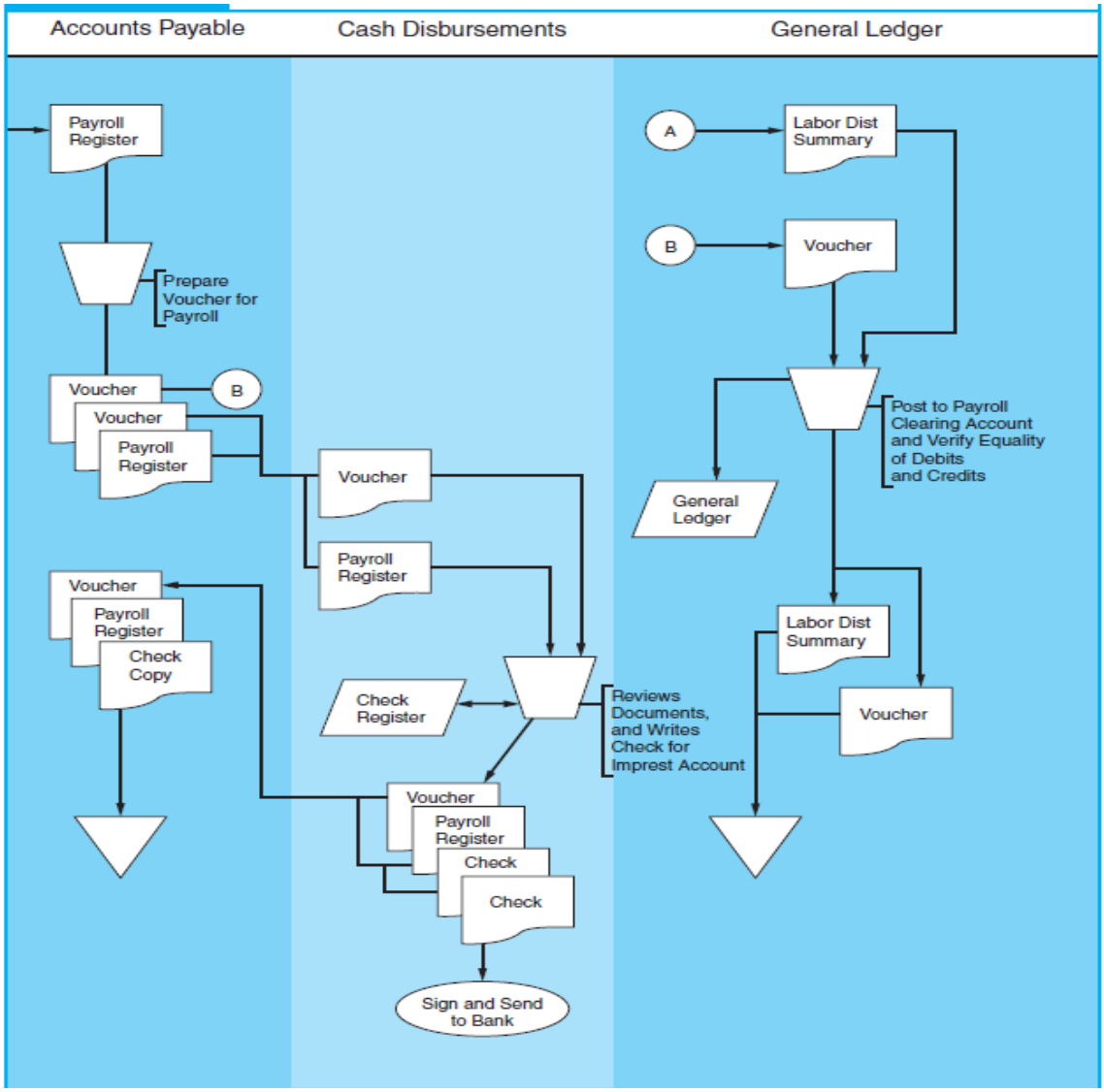


Figure 5.13: Manual Payroll System

5.7. Computer-Based Payroll System

Because payroll systems run periodically (weekly or monthly), they are well suited to batch processing. Figure 5.14. shows a flowchart for such a system. The data processing department receives hard copy of the personnel action forms, job tickets, and time cards, which it converts to digital files. Batch computer programs perform the check writing, detailed record keeping, and general ledger functions.

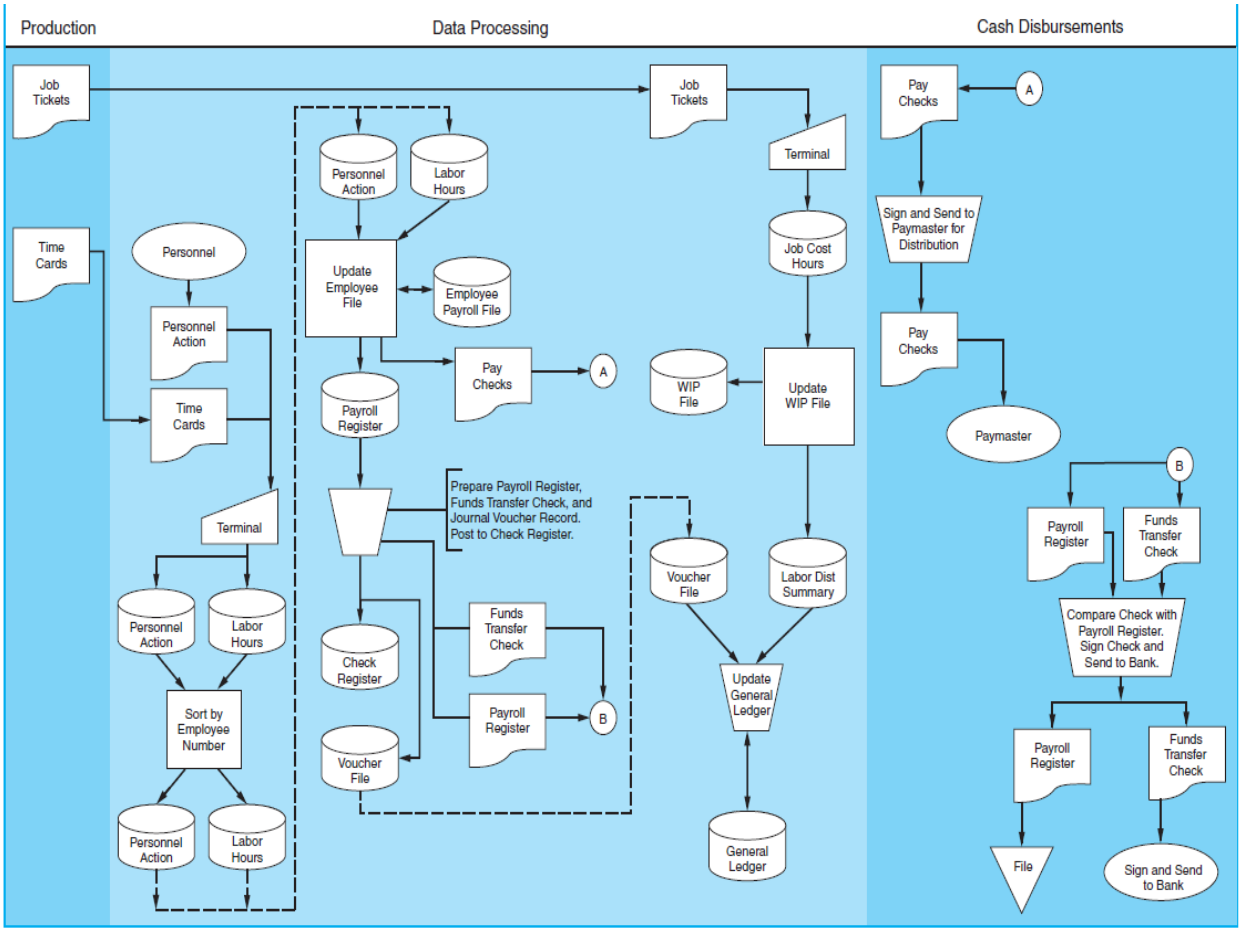


Figure 5.14: Batch Payroll System

5.8. Computer-Based Fixed Asset System

Because many of the tasks in the fixed asset system are similar in concept to the purchases system, we will not review of manual procedures. Figure 5.15. illustrates a computer-based fixed asset system, which demonstrates real-time processing. The top portion of the flowchart presents the fixed asset acquisition procedures, the center portion presents fixed asset maintenance procedures, and the bottom portion presents the asset disposal procedures. To simplify the flowchart and focus on the key features of the system, we have omitted the processing steps for AP and cash disbursements.

Acquisition Procedures: The process begins when the fixed asset accounting clerk receives a receiving report and a cash disbursement voucher. These documents provide evidence that the firm has physically received the asset and show its cost. From the computer terminal, a clerk creates a record of the asset in the fixed asset subsidiary ledger. The fixed asset system automatically updates the fixed asset control account in the general ledger and prepares journal vouchers for the general ledger department as evidence of the entry. The system also produces reports for accounting management. Based on the depreciation parameters contained in the fixed asset records, the system prepares a depreciation schedule for each asset when its acquisition is

originally recorded. The schedule is stored on computer disk to permit future depreciation calculations.

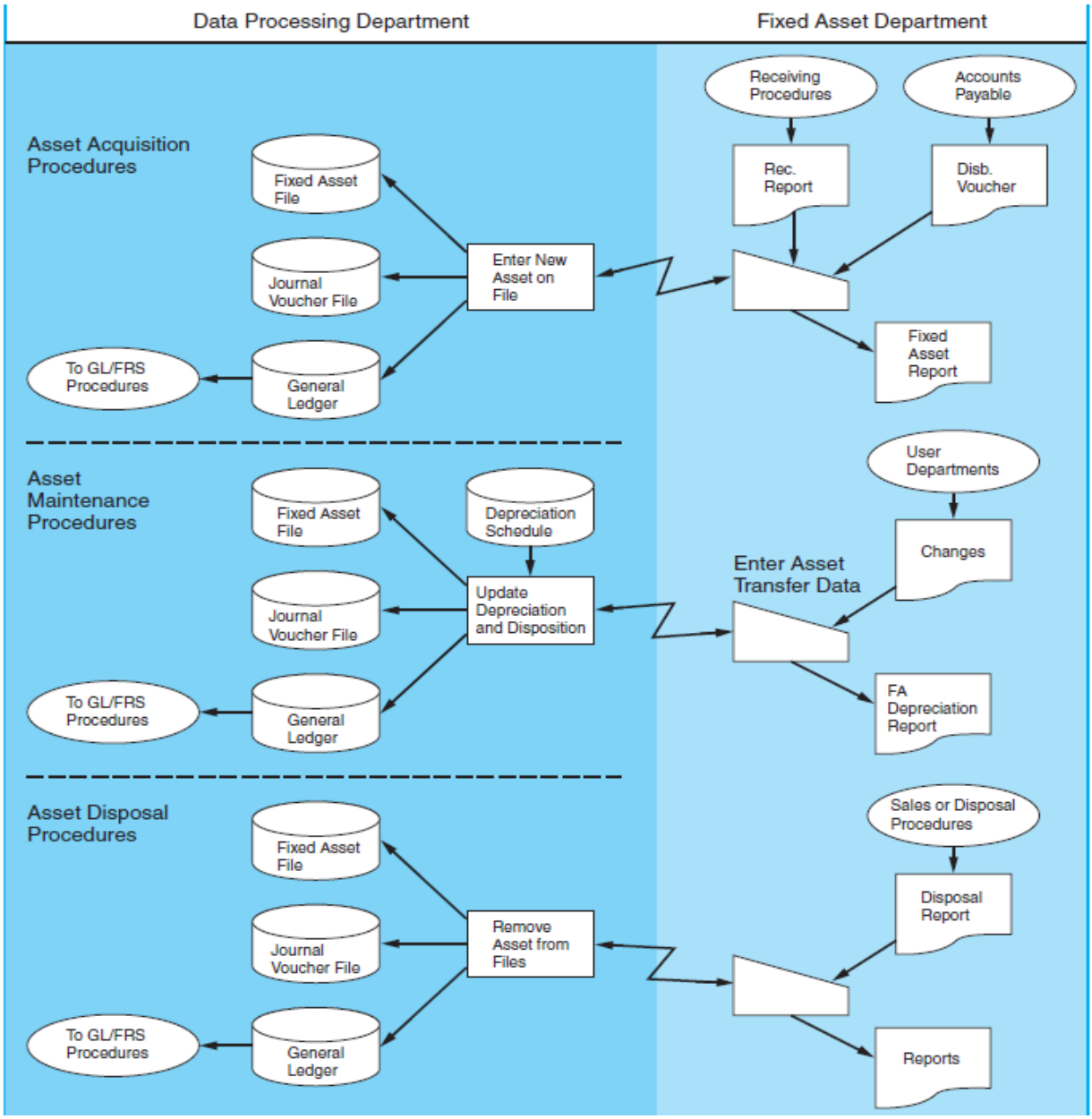


Figure 5.15: Computer-Based Fixed Asset System

Asset Maintenance: The fixed asset system uses the depreciation schedules to record end-of-period depreciation transactions automatically. The specific tasks include (1) calculating the current period's depreciation, (2) updating the accumulated depreciation and book value fields in the subsidiary records, (3) posting the total amount of depreciation to the affected general ledger accounts (depreciation expense and accumulated depreciation), and (4) recording the depreciation

transaction by adding a record to the journal voucher file. Finally, a fixed asset depreciation report is sent to the fixed asset department for review.

Department managers must report any changes in the custody or status of assets to the fixed asset department. From a computer terminal a clerk records such changes in the fixed asset subsidiary ledger.

Disposal Procedures: The disposal report formally authorizes the fixed asset department to remove from the ledger an asset disposed of by the user department. When the clerk deletes the record from the fixed asset subsidiary ledger, the system automatically (1) posts an adjusting entry to the fixed asset control account in the general ledger, (2) records any loss or gain associated with the disposal, and (3) prepares a journal voucher. A fixed asset status report containing details of the deletion is sent to the fixed asset department for review.

Self-test 5.6. *Dear learners, check your progress!*

1. In the manual cash disbursement system, which of the following department reviews the open vouchers payable file for items due and sends the vouchers and supporting documents to the cash disbursements department?
   1 AP Department
   2 Cash Disbursements Department
   3 General Ledger Department
2. What are the activities performed automatically processing in processing data in computer-based purchases and cash disbursements applications?

5.9. General Ledger and Reporting Systems

This section presents the general ledger system (GLS), the financial reporting system (FRS) and the management reporting system (MRS).

5.9.1. The General Ledger System (GLS)

Transaction cycles process individual events that are recorded in special journals and subsidiary accounts. Summaries of these transactions flow into the GLS and become sources of input for the management reporting system (MRS) and financial reporting system (FRS). The bulk of the flows into the GLS come from the transaction processing subsystems. GLS key elements are journal voucher, GLS database, and GLS procedures.

5.9.1.1.The Journal Voucher

The source of input to the general ledger is the journal voucher. A journal voucher, which can be used to represent summaries of similar transactions or a single unique transaction, identifies the financial amounts and affected GL accounts. Routine transactions, adjusting entries, and closing entries are all entered into the general ledger via journal vouchers. A responsible manager must approve journal vouchers; they offer a degree of control against unauthorized GL entries.

5.9.1.2.The GLS Database

The GLS database includes a variety of files. Whereas these will vary from firm to firm, the following examples are representative.

A. The general ledger master file: is the principal file in the GLS database. This file is based on the organization's chart of accounts. Each record in the general ledger master is either a separate GL account (for example, sales) or the control account (such as AR—control) for a subsidiary ledger in the transaction processing system. Figure 1 illustrates the structure of a typical GL master file. The FRS draws upon the GL master to produce the firm's financial statements. The MRS also uses this file to support internal information reporting.

Account Number	Account Description	Acct Class A = Asset L = Liab R = Rev E = Expense OE = Equity	Normal Balance D = Debit C = Credit	Beginning Balance	Total Debits This Period	Total Credits This Period	Current Balance

Figure 16: Record Layout for a General Ledger Master File

B. The general ledger history file has the same format as the GL master. Its primary purpose is to provide historic financial data for comparative financial reports.

C. The journal voucher file is the total collection of the journal vouchers processed in the current period. This file provides a record of all general ledger transactions and replaces the traditional general journal.

D. The journal voucher history file contains journal vouchers for past periods. This historic information supports management's stewardship responsibility to account for resource utilization. Both the current and historic journal voucher files are important links in the firm's audit trail.

E. The responsibility center file contains the revenues, expenditures, and other resource utilization data for each responsibility center in the organization. The MRS draws upon these data for input in the preparation of responsibility reports for management.

F. Finally, **the budget master file** contains budgeted amounts for revenues, expenditures, and other resources for responsibility centers. These data, in conjunction with the responsibility center file, are the basis for responsibility accounting.

5.9.1.3.GLS Procedures

Certain aspects of GLS update procedures performed as either a separate operation or integrated within transaction processing systems. However, the interrelationship between the GLS and financial reporting involves additional updates in the form of reversing, adjusting, and closing entries.

Self-test 5.7. *Dear learners, check your progress!*

1. Which of the following is the source of input to the general ledger?
   a. The GLS Database
   b. The journal voucher
   c. The GLS Procedures
2. which of the following contains the revenues, expenditures, and other resource utilization data for each responsibility center in the organization?
   a. The general ledger history file
   b. The journal voucher file
   c. The journal voucher history file
   d. The responsibility center file
3. What are the files in the GLS database?

5.9.2. The Financial Reporting System

The law dictates management's responsibility for providing stewardship information to external parties. This reporting obligation is met via the financial reporting system (FRS). Much of the information provided takes the form of standard financial statements, tax returns, and documents required by other regulatory agencies.

The primary recipients of financial statement information are external users, such as stockholders, creditors, and government agencies. Generally speaking, outside users of information are interested in the performance of the organization as a whole. Therefore, they require information that allows them to observe trends in performance over time and to make comparisons between different organizations. Given the nature of these needs, financial reporting information must be prepared and presented by all organizations in a manner that is generally accepted and understood by external users.

5.9.2.1.Financial Reporting Procedures

Financial reporting is the final step in the overall accounting process that begins in the transaction cycles. Figure 5.16. presents the FRS in relation to the other information subsystems.

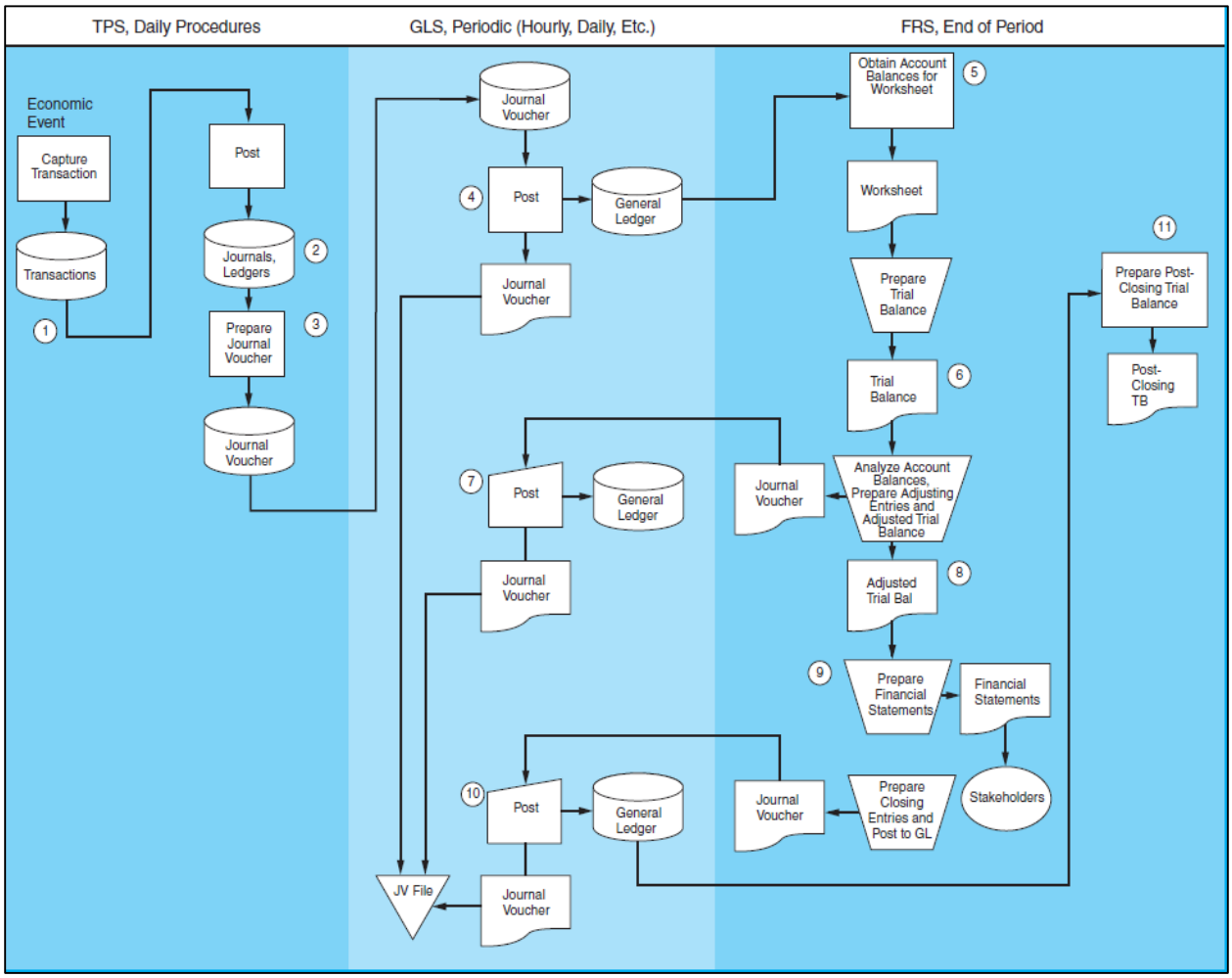


Figure 5.16: Financial Reporting Process

The steps illustrated and numbered in the figure are discussed as follows. The process begins with a clean slate at the start of a new fiscal year. Only the balance sheet (permanent) accounts are carried forward from the previous year. From this point, the following steps occur:

1. **Capture the transaction:** Within each transaction cycle, transactions are recorded in the appropriate transaction file.
2. **Record in special journal:** Each transaction is entered into the journal. Recall that frequently occurring classes of transactions, such as sales, are captured in special journals. Those that occur infrequently are recorded in the general journal or directly on a journal voucher.
3. **Post to subsidiary ledger:** The details of each transaction are posted to the affected subsidiary accounts.

4. **Post to general ledger:** Periodically, journal vouchers, summarizing the entries made to the special journals and subsidiary ledgers, are prepared and posted to the general ledger accounts. The frequency of updates to the general ledger will be determined by the degree of system integration.
5. **Prepare the unadjusted trial balance:** At the end of the accounting period, the ending balance of each account in the GL is placed in a worksheet and evaluated in total for debit–credit equality.
6. **Make adjusting entries:** Adjusting entries are made to the worksheet to correct errors and to reflect unrecorded transactions during the period, such as depreciation.
7. **Journalize and post adjusting entries:** Journal vouchers for the adjusting entries are prepared and posted to the appropriate accounts in the general ledger.
8. **Prepare the adjusted trial balance**: From the adjusted balances, a trial balance is prepared that contains all the entries that should be reflected in the financial statements.
9. **Prepare the financial statements:** The balance sheet, income statement, and statement of cash flows are prepared using the adjusted trial balance.
10. **Journalize and post the closing entries:** Journal vouchers are prepared for entries that close out the income statement (temporary) accounts and transfer the income or loss to retained earnings. Finally, these entries are posted to the general ledger.
11. **Prepare the post-closing trial balance**: A trial balance worksheet containing only the balance sheet accounts may now be prepared to indicate the balances being carried forward to the next accounting period.

The periodic nature of financial reporting in most organizations establishes it as a batch process, as illustrated in Figure 5.16. However, many organizations have moved to real-time general ledger updates and financial reporting systems that produce financial statements on short notice. Figure 5.17 presents an FRS using a combination of batch and real-time computer technology.

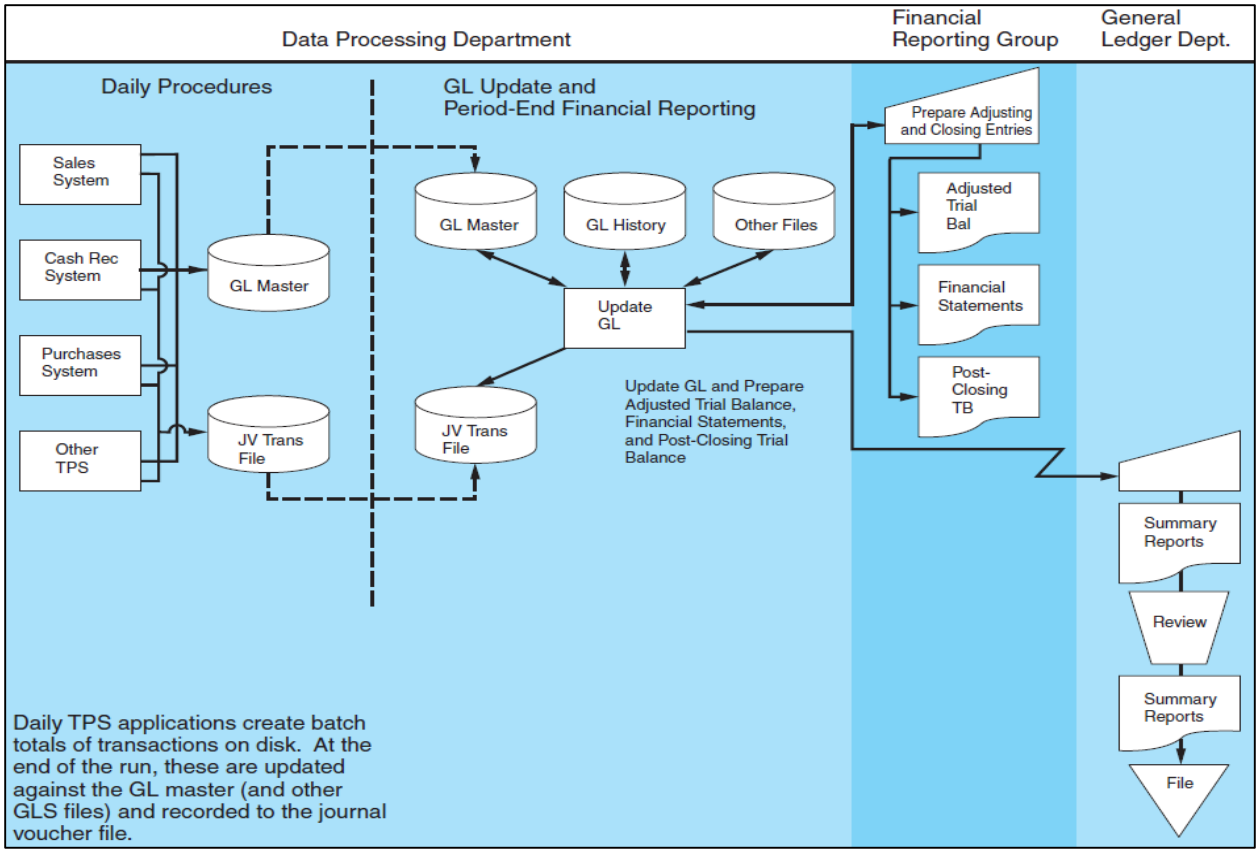


Figure 5.17: GL/FRS Using Database Technology

Controlling the FRS

Organization's management design and implement controls over the FRS. However, the system might have the potential risks. The potential risks to the FRS include:

a. A defective audit trail.
b. Unauthorized access to the general ledger.
c. General ledger accounts that are out of balance with subsidiary accounts.
d. Incorrect general ledger account balances because of unauthorized or incorrect journal vouchers.

However, if not controlled, these risks may result in misstated financial statements and other reports, thus misleading users of this information. The following is the internal control elements over FRS:

a) Transaction Authorization

The journal voucher is the document that authorizes an entry to the general ledger. Journal vouchers have numerous sources, such as the cash receipts processing, sales order processing, and the financial reporting group. It is vital to the integrity of the accounting records that the journal vouchers be properly authorized by a responsible manager at the source department.

b) Segregation of Duties

The task of updating the general ledger must be separate from all accounting and asset custody responsibility within the organization. Therefore, individuals with access authority to general ledger accounts should not:

i. Have record-keeping responsibility for special journals or subsidiary ledgers.
ii. Prepare journal vouchers.
iii. Have custody of physical assets.

c) Access Controls

Unauthorized access to the general ledger accounts can result in errors, fraud, and misrepresentations in financial statements. Thus, organizations implement controls that limit database access to only authorized individuals.

d) Accounting Records

The audit trail is a record of the path that a transaction takes through the input, processing, and output phases of transaction processing. This involves a network of documents, journals, and ledgers designed to ensure that a transaction can be accurately traced through the system from initiation to final disposition. Audit trail facilitates error prevention and correction when the data files are conveniently and logically organized. Also, the general ledger and other files that constitute the audit trail should be detailed and rich enough to (1) provide the ability to answer inquiries, for example, from customers or vendors; (2) be able to reconstruct files if they are completely or partially destroyed; (3) provide historical data required by auditors; (4) fulfill government regulations; and (5) provide a means for preventing, detecting, and correcting errors.

e) Supervision

Supervising the different functions of individuals that are assigned in the GLS of the organization.

f) Independent Verification

The FRS produces two operational reports—journal voucher listing and the general ledger change report that provide proof of the accuracy of this process. The journal voucher listing provides relevant details about each journal voucher posted to the GL. The general ledger change report presents the effects of journal voucher postings to the general ledger accounts.

5.9.2.2.The Management Reporting System (MRS)

Management reporting is often called discretionary reporting because it is not mandatory as is financial reporting. However, an MRS that directs management's attention to problems on a timely basis promotes effective management and thus supports the organization's business objectives. The MRS is distinguishable from the FRS in one key respect: financial reporting is mandatory and management reporting is discretionary. Management reporting information is needed for planning

and controlling business activities. Organization management implements MRS applications at their discretion, based on internal user needs.

Factors that Influence the MRS

Designing an effective MRS requires an understanding of the information that managers need to deal with the problems they face. Factors that influence management information needs are: management principles; management function, level, and decision type; problem structure; types of management reports; responsibility accounting; and behavioral considerations.

a. Management Principles

Management principles provide insight into management information needs. The principles that most directly influence the MRS are formalization of tasks, responsibility and authority, span of control, and management by exception.

Formalization of Tasks: The formalization of tasks principle suggests that management should structure the firm around the tasks it performs rather than around individuals with unique skills. The purpose of formalization of tasks is to avoid an organizational structure in which the organization's performance, stability, and continued existence depend on specific individuals. This implies that formal specification of the information needed to support the tasks. Thus when a personnel change occurs, the information the new employee will need is essentially the same as for his or her predecessor. The information system must focus on the task, not the individual performing the task.

Responsibility and Authority: The principle of responsibility refers to an individual's obligation to achieve desired results. Responsibility is closely related to the principle of authority. If a manager delegates responsibility to a subordinate, he or she must also grant the subordinate the authority to make decisions within the limits of that responsibility. In a business organization, managers delegate responsibility and authority downward through the organizational hierarchy from superior to subordinates. Thus, this implies that vertical reporting channels of the firm through which information flows. The manager's location in the reporting channel influences the scope and detail of the information reported. Managers at higher levels usually require more summarized information. Managers at lower levels receive information that is more detailed. In designing a reporting structure, the analyst must consider the manager's position in the reporting channel.

Span of Control: A manager's span of control refers to the number of subordinates directly under his or her control. The size of the span has an impact on the organization's physical structure. A firm with a narrow span of control has fewer subordinates reporting directly to managers. These firms tend to have tall, narrow structures with several layers of management. Firms with broad spans of control (more subordinates reporting to each manager) tend to have wide structures, with fewer levels of management. Thus, managers with narrow spans of control require detailed reports,

whereas, managers with broad control responsibilities operate most effectively with summarized information.

Management by Exception: The principle of management by exception suggests that managers should limit their attention to potential problem areas (that is, exceptions) rather than being involved with every activity or decision. Managers thus maintain control without being overwhelmed by the details. This implies that managers need information that identifies operations or resources at risk of going out of control. Reports should support management by exception by focusing on changes in key factors that are symptomatic of potential problems.

b. Management Function, Level, and Decision Type

The management functions of planning and control have a profound effect on the management reporting system. The planning function is concerned with making decisions about the future activities of the organization. Planning can be long range or short range. Long-range planning usually encompasses a period of between one and five years, but this varies among industries. Long-range planning involves a variety of tasks, including setting the goals and objectives of the firm, planning the growth and optimum size of the firm, and deciding on the degree of diversification among the firm's products.

Short-term planning involves the implementation of specific plans that are needed to achieve the objectives of the long-range plan. Effective control takes place in the present time frame and is triggered by feedback information that advises the manager about the status of the operation being controlled.

c. Problem Structure

The structure of a problem reflects how well the decision maker understands the problem. Structure has three elements:

1. Data—the values used to represent factors that are relevant to the problem.
2. Procedures—the sequence of steps or decision rules used in solving the problem.
3. Objectives—the results the decision maker desires to attain by solving the problem.

When all three elements are known with certainty, the problem is structured, otherwise unstructured problem exist.

d. Management Reports

Reports are the formal vehicles for conveying information to managers. The term report tends to imply a written message presented on sheets of paper. In fact, a management report may be a paper document or a digital image displayed on a computer terminal. The report may express information in verbal, numeric, or graphic form, or any combination of these.

To be useful, reports must have information content. Their value is the effect they have on users. This is expressed in two general reporting objectives: (1) to reduce the level of uncertainty associated with a problem facing the decision maker and (2) to influence the decision maker's behavior in a positive way. Reports that fail to accomplish these objectives lack information content and have no value. In fact, reliance on such reports may lead to dysfunctional behavior. Management reports fall into two broad classes: programmed reports and ad hoc reports.

Programmed Reporting: Programmed reports provide information to solve problems that users have anticipated. There are two subclasses of programmed reports: scheduled reports and on-demand reports. The MRS produces scheduled reports according to an established time frame. This could be daily, weekly, quarterly, and so on. Examples of such reports are a daily listing of sales, a weekly payroll action report, and annual financial statements. On-demand reports are triggered by events, not by the passage of time. For example, when inventories fall to their pre-established reorder points, the system sends an inventory reorder report to the purchasing agent. Another example is an accounts receivable manager responding to a customer problem over the telephone. The manager can, on demand, display the customer's account history on the computer screen. Note that this query capability is the product of an anticipated need.

Ad Hoc Reporting: Managers cannot always anticipate their information needs. This is particularly true for top and middle management. In the dynamic business world, problems arise that require new information on short notice, and there may be insufficient time to write computer programs to produce the required information. In the past, these needs often went unsatisfied. Now database technology provides direct inquiry and report generation capabilities. Managers with limited computer background can quickly produce ad hoc reports from a terminal or PC, without the assistance of data processing professionals.

e. Responsibility Accounting

A large part of management reporting involves responsibility accounting. This concept implies that every economic event that affects the organization is the responsibility of and can be traced to an individual manager. The responsibility accounting system personalizes performance by saying to the manager, "This is your original budget, and this is how your performance for the period compares to your budget." Most organizations structure their responsibility reporting system around areas of responsibility in the firm. A fundamental principle of this concept is that responsibility area managers are accountable only for items (costs, revenues, and investments) that they control.

The flow of information in responsibility systems is both downward and upward through the information channels. These top-down and bottom-up information flows represent the two phases of responsibility accounting: (1) creating a set of financial performance goals (budgets) pertinent to the manager's responsibilities and (2) reporting and measuring actual performance as compared to these goals. To achieve accountability, business entities frequently organize their operations

into units called **responsibility centers**. The most common forms of responsibility centers are cost centers, profit centers, and investment centers.

Cost Centers: A cost center is an organizational unit with responsibility for cost management within budgetary limits. For example, a production department may be responsible for meeting its production obligation while keeping production costs (labor, materials, and overhead) within the budgeted amount. The performance report for the cost center manager reflects its controllable cost behavior by focusing on budgeted costs, actual costs, and variances from budget. Performance measurements should not consider costs that are outside of the manager's control, such as investments in plant equipment or depreciation on the building.

Profit Centers: A profit center manager has responsibility for both cost control and revenue generation. For example, the branch manager of Ambessa Shoe Company may be responsible for decisions about: Which items of shoe to stock in the store. What prices to charge. The kind of promotional activities for products. The level of advertising. The size of the staff and the hiring of employees. Building maintenance and limited capital improvements.

The performance report for the profit center manager is different from that of the cost center. Nevertheless, the reporting emphasis for both should be on controllable items. Whereas only controllable items are used to assess the manager's performance, the profit center itself is assessed by its contribution after non-controllable costs.

Investment Centers: The manager of an investment center has the general authority to make decisions that profoundly affect the organization. Assume that a division of a corporation is an investment center with the objective of maximizing the return on its investment assets. The division manager's range of responsibilities includes cost management, product development, marketing, distribution, and capital disposition through investments of funds in projects and ventures that earn a desired rate of return.

f. Behavioral Considerations

Goal Congruence: When management principles of authority, responsibility, and the formalization of tasks properly applied within an organization, these principles promote **goal congruence**. Lower-level managers pursuing their own objectives contribute in a positive way to the objectives of their superiors. For example, by controlling costs, a production supervisor contributes to the division manager's goal of profitability. Thus as individual managers serve their own best interests they also serve the best interests of the organization.

A carefully structured MRS plays an important role in promoting and preserving goal congruence. On the other hand, a badly designed MRS can cause dysfunctional actions that are in opposition to the organization's objectives. Two pitfalls that cause managers to act dysfunctionally are information overload and inappropriate performance measures.

Information Overload: Information overload occurs when a manager receives more information than he or she can assimilate. This happens when designers of the reporting system do not properly con-sider the manager's organizational level and span of control. For example, consider the information volume that would flow to the president if the reports were not properly summarized. The details required by lower-level managers would quickly overload the president's decision-making process. Although the report may have many of the information attributes discussed earlier (complete, accurate, timely, and concise), it may be useless if not properly summarized.

Information overload causes managers to disregard their formal information and rely on informal cues to help them make decisions. Thus the formal information system is replaced by heuristics (rules of thumb), tips, hunches, and guesses. The resulting decisions run a high risk of being suboptimal and dysfunctional.

Inappropriate Performance Measures: Recall that one purpose of a report is to stimulate behavior consistent with the objectives of the firm. When inappropriate performance measures are used, however, the report can have the opposite effect. Let's see how this can happen using a common performance measure - return on investment (ROI).

Assume that the corporate management of an organization evaluates division management performance solely on the basis of ROI. Each manager's objective is to maximize ROI. Naturally, the organization wants this to happen through prudent cost management and increased profit margins. However, when ROI is used as the single criterion for measuring performance, the criterion itself becomes the focus of attention and object of manipulation.

Performance measures should consider all relevant aspects of a manager's responsibility. In addition to measures of general performance (such as ROI), management should measure trends in key variables such as sales, cost of goods sold, operating expenses, and asset levels. Nonfinancial measures such as product leadership, personnel development, employee attitudes, and public responsibility may also be relevant in assessing management performance.

Self-test 5.8. *Dear learners, check your progress!*

1. Which of the following is the final step in the overall accounting process that begins in the transaction cycles?
   a. Financial reporting
   b. Management reporting
   c. Preparation of the general ledger master file
   d. Preparation of the general ledger history file
2. What are the potential risks to the FRS?
3. What is the major difference between FRS and MRS?

Chapter Summary

The revenue cycle is the direct exchange of finished goods or services for cash in a single transaction between a seller and a buyer. More complex revenue cycles process sales on credit. Many days or weeks may pass between the point of sale and the subsequent receipt of cash. This time lag splits the revenue transaction into two phases: (1) the physical phase, involving the transfer of assets or services from the seller to the buyer; and (2) the financial phase, involving the receipt of cash by the seller in payment of the account receivable. Hence, the revenue cycle actually consists of two major subsystems: (1) the sales order processing subsystem and (2) the cash receipts subsystem.

There are three main procedures in the revenue cycle. These are sales order procedures, sales return procedures and cash receipts procedures. The activities in sales order procedures includes, receiving order, checking credit, picking goods, shipping goods, billing customer, updating inventory records, updating accounts receivable, and posting to general ledger. The activities in sales return procedures includes preparation of return slip, preparation of credit memo, approval of credit memo, updating sales journal, updating inventory and AR records, and updating general ledger. The activities in the cash receipts procedures includes, open mail and prepare remittance advice, recording and depositing checks, updating accounts receivable, updating general ledger, and reconciling cash receipts and deposits.

The physical systems include the people, organizational units, and documents and files involved in the system. In the physical system there are two accounting systems; a) the manual system and b) the computer based accounting systems.

The objective of the expenditure cycle is to convert the organization's cash into the physical materials and the human resources it needs to conduct business. Most business entities operate on a credit basis and do not pay for resources until after acquiring them. The time lag between these events splits the procurement process into two phases: (1) the physical phase, involving the acquisition of the resource and (2) the financial phase, involving the disbursement of cash. As a practical matter, these are treated as independent transactions that are processed through separate subsystems. Thus, there are four major subsystems that constitute the expenditure cycle: (1) the purchases processing subsystem, (2) the cash disbursements subsystem, (3) the payroll processing subsystem and (4) the fixed assets subsystem.

Transaction cycles process individual events that are recorded in special journals and subsidiary accounts. Summaries of these transactions flow into the GLS and become sources of input for the management reporting system (MRS) and financial reporting system (FRS). The bulk of the flows into the GLS come from the transaction processing subsystems. GLS key elements are journal voucher, GLS database, and GLS procedures. The MRS is distinguishable from the FRS in one key respect: financial reporting is mandatory and management reporting is discretionary. Management reporting information is needed for planning and controlling business activities. Organization management implements MRS applications at their discretion, based on internal user needs.

Chapter Review Questions

Part I: True or false: Write true if the statement is correct or false if it is incorrect.

1. When items are returned, the receiving department employee counts, inspects, and prepares a return slip describing the items.
2. The shipping notice is proof that the product has been shipped and is the trigger document that initiates the billing process.
3. Under real-time processing, sales clerks receiving orders from customers process each transaction separately as it is received.
4. The payroll system processes the payment of obligations created in the purchases system.
5. The fixed asset system processes non-routine transactions for a wider group of users in the organization.

Part II: Multiple choices

Choices the best answer for the following questions.

1. Which of the following is/ are the activities in the sales order procedure of the revenue cycle?
   A. Receive Order
   B. Check Credit
   C. Bill Customer
   D. Prepare Credit Memo

2. Which document is not prepared by the sales department?
   A. Packing slip
   B. Shipping notice
   C. Bill of lading
   D. Stock release

3. Which document triggers the update of the inventory subsidiary ledger?
   A. Bill of lading
   B. Stock release
   C. Sales order
   D. Shipping notice

4. Which function should the billing department not perform?
   A. Record the sales in the sales journal
   B. Send the ledger copy of the sales order to accounts receivable
   C. Send the stock release document and the shipping notice to the billing department as proof of shipment
   D. Send the stock release document to inventory control

5. Which function or department below records the decrease in inventory due to a sale?
   A. Warehouse
   B. Sales department
   C. Billing department
   D. Inventory control

Answer for self – test

1. Sales Order Procedures
   Sales Return Procedures
   Cash Receipts Procedures
2. All of the following activities are performed in the cash receipt procedure, **except?**
   B. Prepare Return Slip

Self-test 5.2.

1. Credit checking
   Inventory Return policy1

2. List the segregation of duties in the cash receipt procedure of the revenue cycle?
   Cash receipts are separate from AR and cash account;
   AR subsidiary ledger is separate from GL

Self-test 5.3.

1.

- ✓ Real-time processing greatly shortens the cash cycle of the firm.
- ✓ Real-time processing can give the firm a competitive advantage in the marketplace.
- ✓ Manual procedures tend to produce clerical errors, such as incorrect account numbers, invalid inventory numbers, and price–quantity extension miscalculations.
- ✓ Real-time processing reduces the amount of paper documents in a system.

2. Digital Journals and Ledgers
   File Backup

Self-test 5.4.

1. What are the four major subsystems that constitute the expenditure cycle?
   1. the purchases processing subsystem,
   2. the cash disbursements subsystem,
   3. the payroll processing subsystem and
   4. the fixed assets subsystem.

2. B. Identify Liabilities Due

Self-test 5.5.

1. D. Prepare Cash Disbursement

2.

- ✓ Time cards, job tickets, and disbursement vouchers.

- ✓ Journal information, which comes from the labor distribution summary and the payroll register.
- ✓ Subsidiary ledger accounts, which contain the employee records and various expense accounts.
- ✓ The general ledger accounts: payroll control, cash, and the payroll clearing (imprest) account.

Self-test 5.6.

1. A. AP Department
2. Data Processing: The following tasks are performed automatically.
   - ✓ The inventory file is searched for items that have fallen to their reorder points.
   - ✓ A record is entered in the purchase requisition file for each item to be replenished.
   - ✓ Requisitions are consolidated according to vendor number.
   - ✓ Vendor mailing information is retrieved from the valid vendor file.
   - ✓ Purchase orders are prepared and added to the open PO file.
   - ✓ A transaction listing of purchase orders is sent to the purchasing department for review.

Self-test 5.7.

1. B: The journal voucher.
2. D: The responsibility center file
3. What are the files in the GLS database?
   i. The general ledger master file:
   ii. The general ledger history file
   iii. The journal voucher file
   iv. The journal voucher history file
   v. The responsibility center file
   vi. the budget master file

Self-test 5.8.

1. A: Financial reporting

2.What are the potential risks to the FRS?

a. A defective audit trail.
b. Unauthorized access to the general ledger.
c. General ledger accounts that are out of balance with subsidiary accounts.
d. Incorrect general ledger account balances because of unauthorized or incorrect journal vouchers.

3.What is the major difference between FRS and MRS?

The MRS is distinguishable from the FRS in one key respect: financial reporting is mandatory and management reporting is discretionary. Management reporting information is needed for planning and controlling business activities. Organization management implements MRS applications at their discretion, based on internal user needs.

CHAPTER SIX

CONTROL AND AIS

Chapter objectives

Dear students, at the end of this chapter you should be able to:

- Understand the various control concepts.
- Identify the elements of internal control.
- Understand the information system control.
- Understand computer control and security.
- Know how to audit computer based information systems.

Introduction

Dear students, the purpose of this chapter is to introduce you with the concept of information systems controls and audits. The chapter is divided in to four section. The first section is an overview of the control concepts, the second section deals about the information system controls. The third section presents the computer controls and securities and the last section deals with an audit of computer based information systems.

6.1. Overview of control concepts

The internal control system of organization comprises policies, practices, and procedures to achieve the following four broad objectives:

1. To safeguard assets of the firm.
2. To ensure the accuracy and reliability of accounting records and information.
3. To promote efficiency in the firm's operations.
4. To measure compliance with management's prescribed policies and procedures.

Inherent in these control objectives, there are four assumptions that guide designers and auditors of internal controls.

1. **Management Responsibility:** This concept holds that the establishment and maintenance of a system of internal control is a management responsibility.
2. **Reasonable Assurance:** The internal control system should provide reasonable assurance that the four broad objectives of internal control are met in a cost-effective manner. This means that no system of internal control is perfect and the cost of achieving improved control should not outweigh its benefits.
3. **Methods of Data Processing:** Internal controls should achieve the four broad objectives regardless of the data processing method used. The control techniques used to achieve these objectives will, however, vary with different types of technology.
4. **Limitations:** Every system of internal control has limitations on its effectiveness. These include (1) the possibility of error no system is perfect, (2) circumvention personnel may circumvent the system through collusion or other means, (3) management override management is in a position to override control procedures by personally distorting

transactions or by directing a subordinate to do so, and (4) changing conditions may change over time so that existing controls may become ineffectual.

The internal control system protects the firm's assets from numerous undesirable events. These include attempts at unauthorized access to the firm's assets (including information); fraud perpetrated by persons both inside and outside the firm; errors due to employee incompetence, faulty computer programs, and corrupted input data; and mischievous acts, such as unauthorized access by computer hackers and threats from computer viruses that destroy programs and databases.

The absence or weakness of a control is called an exposure. Exposures increase the firm's risk to financial loss or injury from undesirable events. A weakness in internal control may expose the firm to one or more of the following types of risks: (1) Destruction of assets (both physical assets and information), (2) Theft of assets, (3) Corruption of information or the information system, and (4) Disruption of the information system.

6.1.1. The Preventive–Detective–Corrective Internal Control Model

In the preventive – detective - corrective (PDC) control model, the internal control composed of three levels of control: preventive controls, detective controls, and corrective controls.

Preventive Controls: Prevention is the first line of defense in the control structure. Preventive controls are passive techniques designed to reduce the frequency of occurrence of undesirable events. Preventive controls force compliance with prescribed or desired actions and thus screen out abnormal events. When designing internal control systems, an ounce of prevention is most certainly worth a pound of cure. Preventing errors and fraud is far more cost-effective than detecting and correcting problems after they occur. The vast majority of undesirable events can be blocked at this first level. For example, a well-designed source document is an example of a preventive control. The logical layout of the document into zones that contain specific data, such as customer name, address, items sold, and quantity, forces the clerk to enter the necessary data. The source documents can therefore prevent necessary data from being omitted. However, not all problems can be anticipated and prevented.

Detective Controls: Detective controls form the second line of defense. These are devices, techniques, and procedures designed to identify and expose undesirable events that elude preventive controls. Detective controls reveal specific types of errors by comparing actual occurrences to pre-established standards. When the detective control identifies a departure from standard, it sounds an alarm to attract attention to the problem. For example, assume a clerk entered the following data on a customer sales order:

Quantity	Price	Total
10	$10	$1,000

Before processing this transaction and posting to the accounts, a detective control should recalculate the total value using the price and quantity (i.e. **$100**). Thus the error in total price would be detected.

Corrective Controls: Corrective controls are actions taken to reverse the effects of errors detected in the previous step. There is an important distinction between detective controls and corrective controls. Detective controls identify anomalies and draw attention to them; corrective controls actually fix the problem. For any detected error, however, there may be more than one feasible corrective action, but the best course of action may not always be obvious. For example, in viewing the error above, your first inclination may have been to change the total value from $1,000 to $100 to correct the problem. This presumes that the quantity and price values on the document are correct; they may not be for instance the quantity could be **100** units. At this point, we cannot determine the real cause of the problem; we know only that one exists.
Linking a corrective action to a detected error, as an automatic response, may result in an incorrect action that causes a worse problem than the original error. For this reason, error correction should be viewed as a separate control step that should be taken cautiously.

6.1.2. SAS Internal Control Framework

The current authoritative document for specifying internal control objectives and techniques is Statement on Auditing Standards (SAS) No. 78. The SAS 78 framework consists of five components: the control environment, risk assessment, information and communication, monitoring, and control activities.

6.1.2.1 The Control Environment

The control environment is the foundation for the other four control components. The control environment sets the tone for the organization and influences the control awareness of its management and employees. Important elements of the control environment are:

- ✓ The integrity and ethical values of management.
- ✓ The structure of the organization.
- ✓ The participation of the organization's board of directors and the audit committee, if one exists.
- ✓ Management's philosophy and operating style.
- ✓ The procedures for delegating responsibility and authority.
- ✓ Management's methods for assessing performance.
- ✓ External influences, such as examinations by regulatory agencies.
- ✓ The organization's policies and practices for managing its human resources.

6.1.2.2.Risk Assessment

Organizations must perform a risk assessment to identify, analyze, and manage risks relevant to financial reporting. Risks can arise or change from circumstances such as:

- Changes in the operating environment that impose new or changed competitive pressures on the firm.
- New personnel who have a different or inadequate understanding of internal control.
- New or reengineered information systems that affect transaction processing.
- Significant and rapid growth that strains existing internal controls.
- The implementation of new technology into the production process or information system that impacts transaction processing.
- The introduction of new product lines or activities with which the organization has little experience.
- Organizational restructuring resulting in the reduction and/or reallocation of personnel such that business operations and transaction processing are affected.
- Entering into foreign markets that may impact operations (that is, the risks associated with foreign currency transactions).
- Adoption of a new accounting principle that impacts the preparation of financial statements.

6.1.2.3.Information and Communication

The accounting information system (AIS) consists of the records and methods used to initiate, identify, analyze, classify, and record the organization's transactions and to account for the related assets, liabilities, equities, revenues, and/or expenses. The quality of information the AIS generates impacts management's ability to take actions and make decisions in connection with the organization's operations and to prepare reliable financial statements. An effective accounting information system will:

- Identify and record all valid financial transactions.
- Provide timely information about transactions in sufficient detail to permit proper classification and financial reporting.
- Accurately measure the financial value of transactions so their effects can be recorded in financial statements.
- Accurately record transactions in the time period in which they occurred.

6.1.2.4.Monitoring

Management must determine that internal controls are functioning as intended. Monitoring is the process by which the quality of internal control design and operation can be assessed. This may be accomplished by separate procedures or by ongoing activities. An organization's internal auditors may monitor the entity's activities in separate procedures. They gather evidence of control adequacy by testing controls and then communicate control strengths and weaknesses to management. As part of this process, internal auditors make specific recommendations for improvements to controls.

Ongoing monitoring may be achieved by integrating special computer modules into the information system that capture key data and/or permit tests of controls to be conducted as part of routine operations. Embedded modules thus allow management and auditors to maintain constant surveillance over the functioning of internal controls.

Another technique for achieving ongoing monitoring is the judicious use of management reports. Timely reports allow managers in functional areas such as sales, purchasing, production, and cash disbursements to oversee and control their operations. By summarizing activities, highlighting trends, and identifying exceptions from normal performance, well-designed management reports provide evidence of internal control function or malfunction.

6.1.2.5.Control Activities

Control activities are the policies and procedures used to ensure that appropriate actions are taken to deal with the organization's identified risks. Control activities can be grouped into two distinct categories: IT controls and physical controls.

IT Controls: IT controls relate specifically to the computer environment. They fall into two broad groups: general controls and application controls. **General controls** pertain to entity-wide concerns such as controls over the data center, organization databases, systems development, and program maintenance. **Application controls** ensure the integrity of specific systems such as sales order processing, accounts payable, and payroll applications

Physical Controls: This class of controls relates primarily to the human activities employed in accounting systems. These activities may be purely manual, such as the physical custody of assets, or they may involve the physical use of computers to record transactions or update accounts. Physical controls do not relate to the computer logic that actually performs accounting tasks. Rather, they relate to the human activities that trigger and utilize the results of those tasks. In other words, physical controls focus on people, but are not restricted to an environment in which clerks update paper accounts with pen and ink. Virtually all systems, regardless of their sophistication, employ human activities that need to be controlled. There are six categories of physical control activities: transaction authorization, segregation of duties, supervision, accounting records, access control, and independent verification.

A. Transaction Authorization

The purpose of transaction authorization is to ensure that all material transactions processed by the information system are valid and in accordance with management's objectives. Authorizations may be general or specific. General authority is granted to operations personnel to perform day-to-day operations. An example of general authorization is the procedure to authorize the purchase of inventories from a designated vendor only when inventory levels fall to their predetermined reorder points. This is called a programmed procedure (not necessarily in the computer sense of the word) where the decision rules are specified in advance, and no additional approvals are

required. On the other hand, specific authorizations deal with case-by-case decisions associated with non-routine transactions. An example of this is the decision to extend a particular customer's credit limit beyond the normal amount. Specific authority is usually a management responsibility.

B. Segregation of Duties

One of the most important control activities is the segregation of employee duties to minimize incompatible functions. Segregation of duties can take many forms, depending on the specific duties to be controlled. However, the following three objectives provide general guidelines applicable to most organizations.

Objective 1. The segregation of duties should separate the authorization for a transaction from the processing of the transaction. For example, the purchasing department should not initiate purchases until the inventory control department gives authorization. This separation of tasks is a control to prevent individuals from purchasing unnecessary inventory.

Objective 2. Responsibility for the custody of assets should be separate from the record-keeping responsibility. For example, the department that has physical custody of finished goods inventory (the warehouse) should not keep the official inventory records. Accounting for finished goods inventory is performed by inventory control, an accounting function. When a single individual or department has responsibility for both asset custody and record keeping, the potential for fraud exists. Assets can be stolen or lost and the accounting records falsified to hide the event.

Objective 3. The organization should be structured in order to avoid or minimize the collusion between two or more individuals with incompatible responsibilities. For example, no individual should have sufficient access to accounting records to perpetrate a fraud. Thus journals, subsidiary ledgers, and the general ledger are maintained separately. For most people, the thought of approaching another employee with the proposal to collude in a fraud presents a challenging psychological barrier. The fear of rejection and subsequent disciplinary action discourages solicitations of this sort. However, when employees with incompatible responsibilities work together daily in same room, the resulting familiarity tends to erode this barrier. For this reason, the segregation of incompatible tasks should be physical as well as organizational. Indeed, concern about personal familiarity on the job is the justification for establishing rules prohibiting nepotism.

C. Supervision.

Implementing adequate segregation of duties requires firms to employ a sufficiently large number of employees. Achieving adequate segregation of duties often presents difficulties for small organizations. Obviously, it is impossible to separate five incompatible tasks among three employees. Therefore, in small organizations or in functional areas that lack sufficient personnel, management must compensate for the absence of segregation controls with close **supervision**. For this reason, supervision is often called a compensating control.

D. Accounting Records

The accounting records of an organization consist of source documents, journals, and ledgers. These records capture the economic essence of transactions and provide an audit trail of economic events. The audit trail enables the auditor to trace any transaction through all phases of its processing from the initiation of the event to the financial statements. Organizations must maintain audit trails for two reasons. First, this information is needed for conducting day-to-day operations. The audit trail helps employees respond to customer inquiries by showing the current status of transactions in process. Second, the audit trail plays an essential role in the financial audit of the firm. It enables external (and internal) auditors to verify selected transactions by tracing them from the financial statements to the ledger accounts, to the journals, to the source documents, and back to their original source. For reasons of both practical conveniences and legal obligation, business organizations must maintain sufficient accounting records to preserve their audit trails.

E. Access Control

The purpose of access controls is to ensure that only authorized personnel have access to the firm's assets. Unauthorized access exposes assets to misappropriation, damage, and theft. Therefore, access controls play an important role in safeguarding assets. Access to assets can be direct or indirect. Physical security devices, such as locks, safes, fences, and electronic and infrared alarm systems, control against direct access. Indirect access to assets is achieved by gaining access to the records and documents that control the use, ownership, and disposition of the asset. For example, an individual with access to all the relevant accounting records can destroy the audit trail that describes a particular sales transaction. Thus, by removing the records of the transaction, including the account receivable balance, the sale may never be billed and the firm will never receive payment for the items sold. The access controls, needed to protect accounting records, will depend on the technological characteristics of the accounting system. Indirect access control is accomplished by controlling the use of documents and records and by segregating the duties of those who must access and process these records.

F. Independent Verification

Verification procedures are independent checks of the accounting system to identify errors and misrepresentations. Verification differs from supervision because it takes place after the fact, by an individual who is not directly involved with the transaction or task being verified. Supervision takes place while the activity is being performed, by a supervisor with direct responsibility for the task. Through independent verification procedures, management can assess (1) the performance of individuals, (2) the integrity of the transaction processing system, and (3) the correctness of data contained in accounting records. Examples of independent verifications include:

- ✓ Reconciling batch totals at points during transaction processing.
- ✓ Comparing physical assets with accounting records.
- ✓ Reconciling subsidiary accounts with control accounts.
- ✓ Reviewing management reports (both computer and manually generated) that summarize business activity.

The timing of verification depends on the technology employed in the accounting system and the task under review. Verifications may occur several times, in some cases, verification may occur daily, weekly, monthly, or annually.

Self-test 6.1. *Dear learners, check your progress!*

1. Which of the following is/are not the objectives of internal control system?
   - **a.** To safeguard assets of the firm.
   - **b.** To ensure the accuracy and reliability of accounting records and information.
   - **c.** To promote efficiency in the firm's operations.
   - **d.** To measure compliance with management's prescribed policies and procedures.
   - **e.** All
   - **f.** None
2. What are the three internal control models?
3. What are the six categories of physical control activities?

6.2. Information System Control

Information technology drives the financial reporting processes of modern organizations. Automated systems initiate, authorize, record, and report the effects of financial transactions. As such, they are inextricable elements of the financial reporting processes that SOX considers and must be controlled. COSO identifies two broad groupings of information system controls: **application controls and general controls.**

6.2.1. Application Controls

The objectives of application controls are to ensure the validity, completeness, and accuracy of financial transactions. These controls are designed to be application-specific. Examples include:

- ✓ A cash disbursements batch balancing routine that verifies that the total payments to vendors reconciles with the total postings to the accounts payable subsidiary ledger.
- ✓ An account receivable check digits procedure that validates customer account numbers on sales transactions.
- ✓ A payroll system limit check that identifies employee time card records with reported hours worked in excess of the predetermined normal limit.

These examples illustrate how application controls have a direct impact on the integrity of data that make their way through various transaction processing systems and into the financial reporting process. Application controls are associated with specific applications, such as payroll, purchases,

and cash disbursements systems. These fall into three broad categories: input controls, processing controls, and output controls.

6.2.1.1. Input Controls

Input controls are programmed procedures (routines) that perform tests on transaction data to ensure that they are free from errors. Input control routines should be designed into the system at different points, depending on whether transaction processing is real time or batch. Input controls in real-time systems are placed at the data collection stage to monitor data as they are entered from terminals. Batch systems often collect data in transaction files, where they are temporarily held for subsequent processing. In this case, input control tests are performed as a separate procedure (or run) prior to the master file update process. In any case, transaction data should never be used to update master files until the transactions have been tested for validity, accuracy, and **completeness.** If a record fails an input control test, it is flagged as an error record. Later, we will see how to deal with these records. The following are examples of input controls.

Check Digit: Data codes are used extensively in transaction processing systems for representing such things as customer accounts, items of inventory, and general ledger accounts in the chart of accounts. If the data code of a particular transaction is entered incorrectly and goes undetected, then a transaction processing error will occur, such as posting to the wrong account. Two common classes of data input errors cause such processing problems:
transcription errors and transposition errors.

Transcription errors are divided into three categories:

1. Addition errors occur when an extra digit or character is added to the code. For example, inventory item number 83276 is recorded as 832766.
2. Truncation errors occur when a digit or character is removed from the end of a code. In this type of error, the inventory item above would be recorded as 8327.
3. Substitution errors are the replacement of one digit in a code with another. For example, code number 83276 is recorded as 83266.

Transposition errors are of two types.

1. Single transposition errors occur when two adjacent digits are reversed. For instance, 83276 is recorded as 38276.
2. Multiple transposition errors occur when nonadjacent digits are transposed. For example, 83276 is recorded as 87236.

These problems may be controlled using a **check digit.** This is a control digit (or digits) added to the data code when it is originally assigned that allows the integrity of the code to be established during subsequent processing. The check digit can be located anywhere in the code, as a prefix, a suffix, or embedded someplace in the middle. The simplest form of check digit is to sum the digits in the code and use this sum as the check digit. For example, for the customer account code 5372, the calculated check digit would be 5 + 3 + 7 + 2 =7. By dropping the tens column, the check digit 7 is added to the original code to produce the new code 53727. The entire string of digits (including

the check digit) becomes the customer account number. During data entry, the system can recalculate the check digit to ensure that the code is correct. This technique will detect only transcription errors. For example, if a substitution error occurred and the above code were entered as 52727, the calculated check digit would be 6 (5 + 2 + 7 + 2 = 16 = 6), and the error would be detected. However, this technique would fail to identify transposition errors. For example, transposing the first two digits yields the code 35727, which still sums to 17 and produces the check digit 7. This error would go undetected. A popular check digit technique for dealing with transposition errors is modulus 11. Using the code 5372, the steps in this technique are outlined next.

1. *Assign weights:* Each digit in the code is multiplied by a different weight. In this case, the weights used are 5, 4, 3, and 2, shown as follows:

Digit	Weight
5	5 = 25
3	4 =12
7	3= 21
2	2 = 4

2. *Sum the products:* (25 +12 + 21 + 4 = 62).
3. *Divide by the modulus.* We are using modulus 11 in this case, giving 62/11 = 5 with a remainder of 7.
4. *Subtract the remainder from the modulus to obtain the check digit:* (11 - 7 =4 [check digit]).
5. *Add the check digit to the original code to yield the new code:* 53724.

Using this technique to recalculate the check digit during processing, a transposition error in the code will produce a check digit other than 4. For example, if the code above was incorrectly entered as 35724, the recalculated check digit would be 6.

Missing Data Check: Some programming languages are restrictive as to the justification (right or left) of data within the field. If data are not properly justified or if a character is missing (has been replaced with a blank), the value in the field will be improperly processed. In some cases, the presence of blanks in a numeric data field may cause a system failure. When the control routine detects a blank where it expects to see a data value, the error is flagged.

Numeric–Alphabetic Check: This control identifies when data in a particular field are in the wrong form. For example, a customer's account balance should not contain alphabetic data, and the presence of it will cause a data processing error. Therefore, if alphabetic data are detected, the error record flag is set.

Limit Check: Limit checks are used to identify field values that exceed an authorized limit. For example, assume the firm's policy is that no employee works more than 44 hours per week. The payroll system input control program can test the hours-worked field in the weekly payroll records for values greater than 44.

Range Check: Many times, data have upper and lower limits to their acceptable values. For example, if the range of pay rates for hourly employees in a firm is between $8 and $20, this control can examine the pay rate field of all payroll records to ensure that they fall within this range. The purpose of this control is to detect keystroke errors that shift the decimal point one or more places. It would not detect an error where a correct pay rate of, say, $9 is incorrectly entered as $15.

Reasonableness Check: The error above may be detected by a test that determines if a value in one field, which has already passed a limit check and a range check, is reasonable when considered along with data in other fields of the record. For example, an employee's pay rate of $18 per hour falls within an acceptable range. This rate is excessive, however, when compared to the employee's job skill code of 693; employees in this skill class should not earn more than $12 per hour.

Validity Check: A validity check compares actual field values against known acceptable values. This control is used to verify such things as transaction codes, state abbreviations, or employee job skill codes. If the value in the field does not match one of the acceptable values, the record is flagged as an error. This is a frequently used control in cash disbursement systems. One form of cash disbursement fraud involves manipulating the system into making a fraudulent payment to a nonexistent vendor. To prevent this, the firm may establish a list of valid vendors with whom it does business exclusively. Thus, before payment of any trade obligation, the validation program matches the vendor number on the cash disbursement voucher against the valid vendor list. If the code does not match, payment is denied, and management reviews the transaction.

6.2.1.2. Processing Controls

After passing through the data input stage, transactions enter the processing stage of the system. Processing controls are programmed procedures and may be divided into three categories: batch controls, run-to-run controls, and audit trail controls.

A. Batch controls: are used to manage the flow of high volumes of transactions through batch processing systems. The objective of batch control is to reconcile system output with the input originally entered into the system. This provides assurance that:

- ✓ All records in the batch are processed.
- ✓ No records are processed more than once.
- ✓ An audit trail of transactions is created from input through processing to the output stage of the system.

Batch control begins at the data input stage and continues through all data processing phases of the system. Batch control involves grouping together into batches similar types of transactions (such as sales orders) and controlling them as a unit of work throughout data processing. To achieve this, a batch control record is created when the batch of transactions is entered into the

system. This may be a user department action or a separate data control step. The control record contains relevant information about the
batch, such as:

- ✓ A unique batch number.
- ✓ A batch date.
- ✓ A transaction code (indicating the type of transactions, such as a sales order or cash receipt).
- ✓ The number of records in the batch (record count).
- ✓ The total dollar value of a financial field (batch control total).
- ✓ The total of a unique nonfinancial field (hash total).

Figure 6.1. depicts a batch control record in relation to the batch of transactions it describes. The data in the control record are used to assess the integrity of the batch during all subsequent processing. For example, the batch control record in the figure shows a batch of 50 sales order records with a total dollar value of $122,674.87 and a hash total of 4537838.

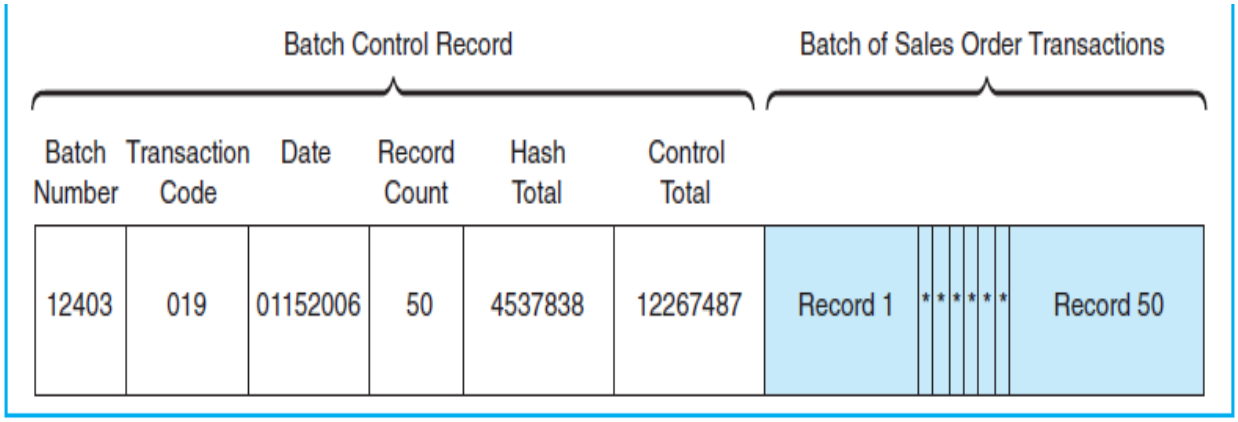


Figure 6.1. Batch control record

B. Run-to-run control: is the use of batch figures to monitor the batch as it moves from one programmed procedure (run) to another. Thus at various points throughout processing and at the end of processing, the batch totals are recalculated and compared to the batch control record. This ensures that each run in the system processes the batch correctly and completely. Figure 6.2. illustrates the use of run-to-run control in a sales order system. This application comprises four runs: (1) data input, (2) accounts receivable update, (3) inventory update, and (4) output. At the end of the accounts receivable run, batch control figures are recalculated and reconciled with the control totals passed from the data input run. These figures are then passed to the inventory update run, where they are again recalculated, reconciled, and passed to the output run. Errors detected in each run are flagged and placed in an error file. The run batch control figures are then adjusted to reflect the deletion of these records. Notice from Figure 6.2. that error records may be placed on the error file at several different points in the process.

In a separate procedure (not shown), an authorized user representative will make corrections to the error records and resubmit them as a special batch for reprocessing. Errors detected during processing require careful handling, because these records may already be partially processed. Simply resubmitting the corrected records to the system at the data input stage may result in processing portions of these transactions twice. Two methods are used to deal with this complexity. The first is to reverse the effects of the partially processed transactions and resubmit the corrected records to the data input stage. The second method is to reinsert corrected records into the processing stage at which the error was detected.

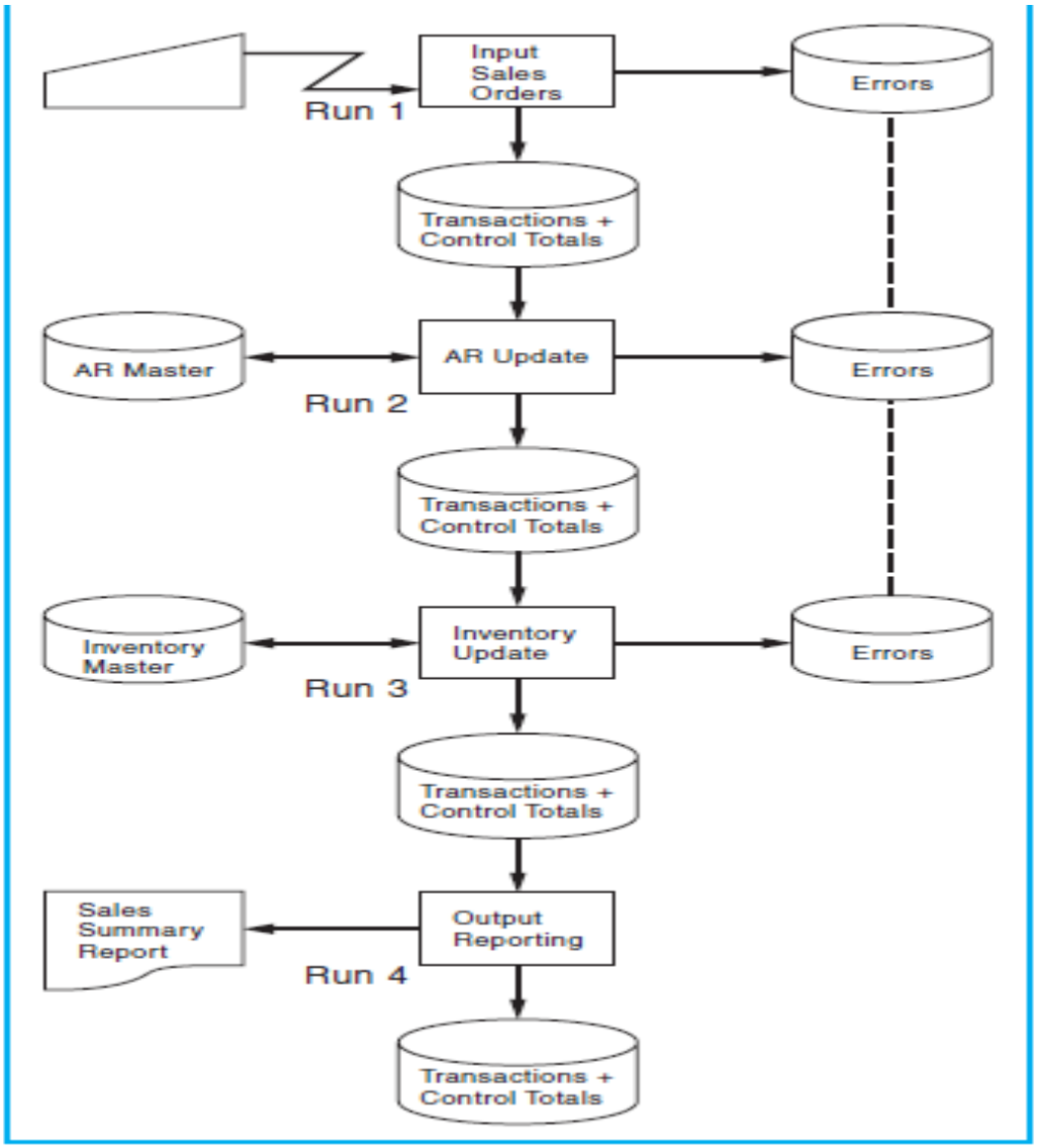


Figure 6.2. Run -to -Run controls

C. **Audit trail controls:** in an IT environment ensure that every transaction can be traced through each stage of processing from its economic source to its presentation in financial statements. The following are examples of audit trail control.

Transaction Logs: Every transaction the system successfully processes should be recorded on a transaction log, which serves as a journal. Figure 6.3. shows this process. Two reasons underscore the importance of this log. First, the transaction log is a permanent record of transactions, though the input transaction file is typically a temporary file. Once processed, the records on the input file are erased to make room for the next batch of transactions. Second, not all of the records in the input file may be successfully processed. Some of them will fail tests during subsequent processing and will be passed to an error file. A transaction log contains only successful transactions those that have changed account balances. The transaction log and error files combined should account for all the transactions in the batch. The validated transaction file may then be scratched with no loss of data.

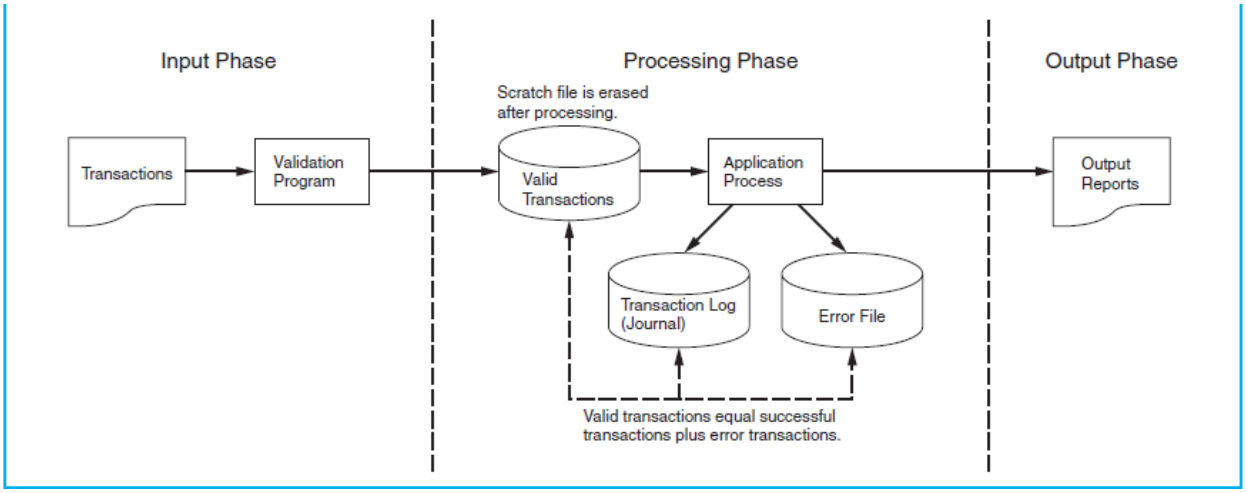


Figure 6.3. Transaction Log to Preserve the Audit Trail

Log of Automatic Transactions: The system triggers some transactions internally. For example, when inventory drops below the reorder point, the system automatically generates a purchase order. To maintain an audit trail of these activities, all internally generated transactions must be placed in a transaction log.

Transaction Listings: The system should produce a (hard-copy) transaction listing of all successful transactions. These listings should go to the appropriate users to facilitate reconciliation with input. In addition, the responsible end user should receive a detailed listing of all internally generated transactions.

6.2.1.3. Output Controls

Output controls are a combination of programmed routines and other procedures to ensure that system output is not lost, misdirected, or corrupted and that privacy is not violated. Exposures of

this sort can cause serious disruptions to operations and may result in financial losses to a firm. For example, if the checks a firm's cash disbursements system produces are lost, misdirected, or destroyed, trade accounts and other bills may go unpaid. This could damage the firm's credit rating and result in lost discounts, interest, or penalty charges. If the privacy of certain types of output is violated, a firm could have its business objectives compromised or could become exposed to litigation. Examples of privacy exposures include the disclosure of trade secrets, patents pending, marketing research results, and patient medical records. This section examines output exposures and controls for both hard copy and digital output.

A. Controlling Hard Copy Output

Batch systems usually produce hard copy, which typically requires the involvement of intermediaries in its production and distribution. Figure 6.4. shows the stages in this output process and serves as the basis for this section.

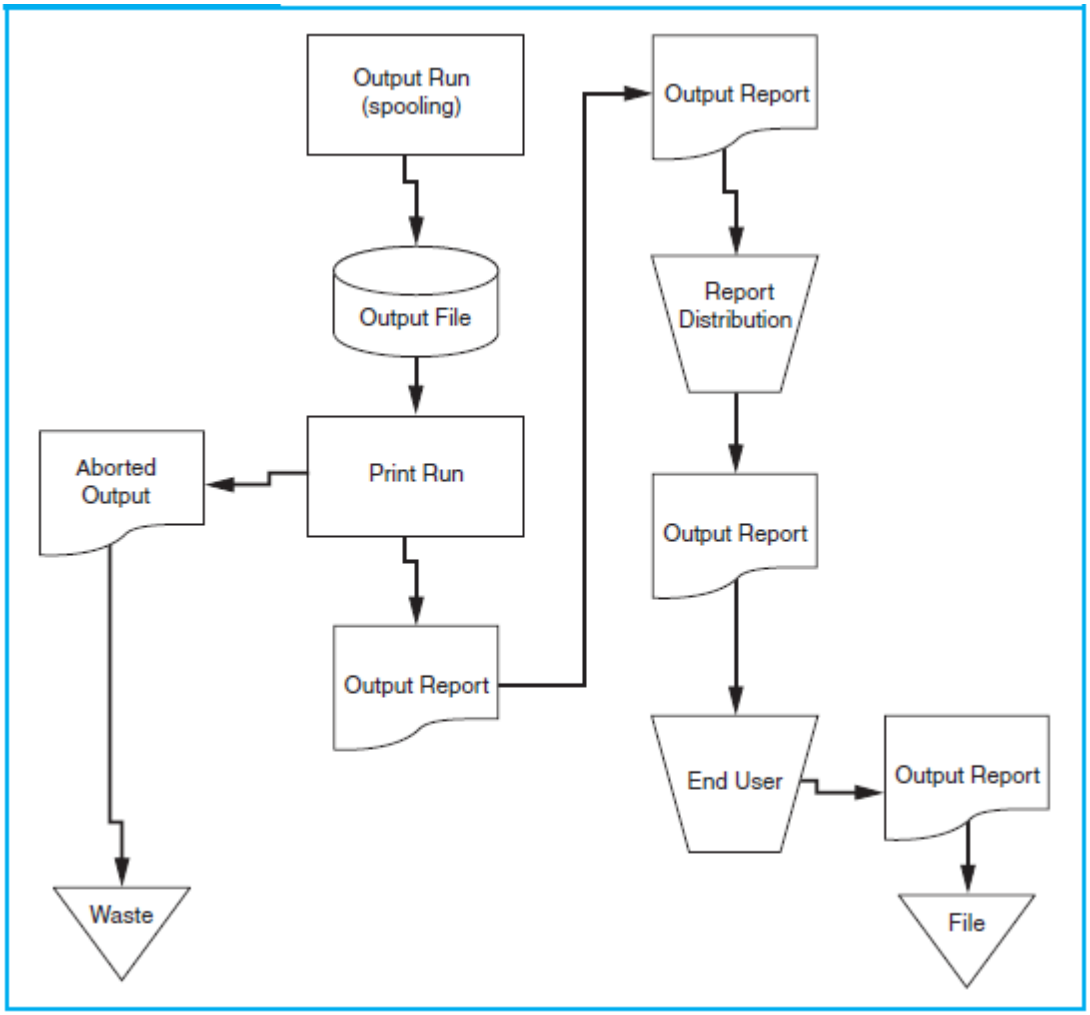


Figure 6.4. Stages in the output process

Output Spooling: In large-scale data processing operations, output devices such as line printers can become backlogged with many programs simultaneously demanding limited resources. This can cause a bottleneck and adversely affect system throughput. To ease this burden, applications are often designed to direct their output to a magnetic disk file rather than print it directly. This is called **spooling.** Later, when printer resources become available, the output files are printed. The creation of an output file as an intermediate step in the printing process presents an added exposure. A computer criminal may use this opportunity to:

1. Access the output file and change critical data values (such as dollar amounts on checks). The printer program will then print the fallacious output as if the system produced it.
2. Access the file and change the number of copies of output to be printed. The extra copies may then be removed without notice during the printing stage.
3. Make a copy of the output file to produce illegal output reports.
4. Destroy the output file before output printing takes place.

The management and auditors need to be aware of these potential exposures and ensure that proper access and backup procedures are in place to protect output files.

Print Programs: When a printer becomes available, the print run program produces hard-copy output from the output file. Print programs are often complex systems that require operator intervention. Four common types of operator actions are:

1. Pausing the print program to load the correct type of output documents (check stocks, invoices, or other special forms).
2. Entering parameters that the print run needs, such as the number of copies to be printed.
3. Restarting the print run at a prescribed checkpoint after a printer malfunction.
4. Removing printed output from the printer for review and distribution.

Print program controls should be designed to deal with two types of exposures present in this environment: (1) the production of unauthorized copies of output and (2) employee browsing of sensitive data. Some print programs allow the operator to specify more copies of output than the output file calls for, which allows for the possibility of producing unauthorized copies of output. One way to control this is to employ output document controls. This is feasible only when dealing with pre numbered invoices for billing customers or pre numbered check stock. At the end of the run, the number of copies the output file specifies should be reconciled with the actual number of output documents used.

To prevent operators and others from viewing sensitive output, special multi part paper can be used, with a grayed-out top copy to prevent the print from being read. This type of product is often used for payroll check printing. An alternative privacy control is to direct the output to a special remote printer that can be closely supervised.

Waste: Computer output waste is a potential source of exposure. Aborted reports and the carbon copies from multipart paper need to be disposed of properly. Computer criminals disguised as janitorial staff have been known to sift through trash cans searching for are lessly discarded output that is presumed to be of no value. From such trash, computer criminals may obtain information about a firm's market research, credit ratings of its customers, or even trade secrets, which they can sell to a competitor. Computer waste is also a source of passwords that a perpetrator may use to access the firm's computer system. To control against this threat, all sensitive computer output should be passed through a paper shredder.

Report Distribution: The primary risks associated with the distribution of sensitive reports include their being lost, stolen, or misdirected in transit to the user. The following control techniques can be used:

1. The reports may be placed in a secure mailbox to which only the user has the key.
2. The user may be required to appear in person at the distribution center and sign for the report.
3. A security officer or special courier may deliver the report to the user.

End-User Controls: Once in the hands of the user, output reports should be examined for correctness. Errors the user detects should be reported to the appropriate computer services management. Such errors may be symptoms of an improper systems design, incorrect procedures, errors accidentally inserted during systems maintenance, or unauthorized access to data files or programs. Once a report has served its purpose, it should be stored in a secure location until its retention period has expired and then shredded.

B. Controlling Digital Output

Digital output can be directed to the user's computer screen or printer. The primary output threat is the interception, disruption, destruction, or corruption of the output message as it passes across the communications network. This threat comes from two types of exposures: (1) exposures from equipment failure and (2) exposures from subversive acts.

Self-test 6.2. *Dear learners, check your progress!*

1. What are the two common classes of data input errors that cause processing problems?
2. Mention the types of input controls?

6.2.2. General controls

The second broad group of controls that COSO identifies is **general controls.** They are so named because they are not application-specific but, rather, apply to all systems. General controls have other names in other frameworks, including **general computer controls** and **information technology controls**. Whatever name is used, they include controls over IT governance, IT infrastructure, security and access to **operating systems** and databases, application acquisition and development, and program changes. Whereas general controls do not control specific transactions, they have an effect on transaction integrity. For example, consider an organization with poor database security controls. In such a situation, even data processed by systems with adequate built-in application controls may be at risk. An individual who is able to circumvent database security (either directly or via a malicious program), may then change, steal, or corrupt stored transaction data. Thus, general controls are needed to support the functioning of application controls, and both are needed to ensure accurate financial reporting.

6.2.2.1.IT Governance Control

IT governance is a broad concept relating to the decision rights and accountability for encouraging desirable behavior in the use of IT. Though important, not all elements of IT governance relate specifically to control issues that SOX addresses and that are outlined in the COSO framework. In this section, we consider three governance issues that do: organizational structure of the IT function. The discussion on each of these governance issues begins with an explanation of the nature of risk and a description of the controls needed to mitigate the risk.

1. Organizational structure control

Previous sections have stressed the importance of segregating incompatible duties within manual activities. Specifically, operational tasks should be separated to:

1. Segregate the task of transaction authorization from transaction processing.
2. Segregate record keeping from asset custody.
3. Divide transaction-processing tasks among individuals so that fraud will require collusion between two or more individuals.

The tendency in an IT environment is to consolidate activities. A single application may authorize, process, and record all aspects of a transaction. Thus, the focus of segregation control shifts from the operational level (transaction processing tasks that computer programs now perform) to higher-level organizational relationships within the IT function. The interrelationships among systems development, application maintenance, database administration, and computer operations activities are of particular concern. The following section examines organizational control issues within the context of two generic models. (i.e. the centralized model and the distributed model).

A. Segregation of Duties within the Centralized Firm

Figure 6.5. presents an organizational chart of a centralized IT function.

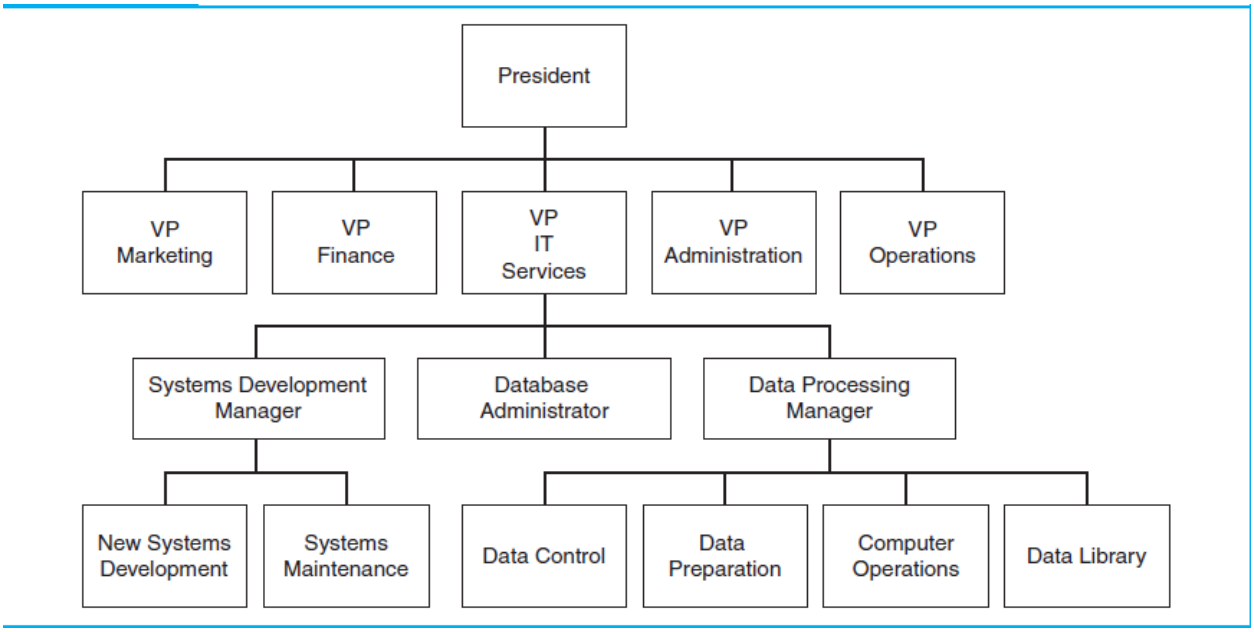


FIGURE 6.5. Organizational Chart of a Centralized IT Function

Separating Systems Development from Computer Operations

The segregation of systems development (both new systems development and maintenance) and operations activities is of the greatest importance. The responsibilities of these groups should not be commingled. Systems development and maintenance professionals acquire (by in-house development and purchase) and maintain systems for users. Operations staff should run these systems and have no involvement in their design and implementation. Consolidating these functions invites fraud. With detailed knowledge of an application's logic and control parameters along with access to the computer operations, an individual could make unauthorized changes to application logic during execution. Such changes may be temporary (on the fly) and will disappear with little or no trace when the application terminates.

Separating the Database Administrator from Other Functions

Another important organizational control is the segregation of the database administrator (DBA) function from other IT functions. The DBA is responsible for a number of critical tasks pertaining

to database security, including creating the database schema, creating **user views** (subschemas), assigning access authority to users, monitoring database usage, and planning for future expansion. Delegating these responsibilities to others who perform incompatible tasks threatens database integrity. Figure 6.5. shows how the DBA function is organizationally independent.

Separating the DBA from Systems Development: Programmers create applications that access, update, and retrieve data from the database. Chapter 9 illustrated how database access control is achieved through the creation of user views, which is a DBA responsibility. To achieve database access, therefore, both the programmer and the DBA need to agree as to the attributes and tables (the user view) to make available to the application (or user) in question. If done properly, this permits and requires a formal review of the user data needs and security issues surrounding the request. Assigning responsibility for user view definition to individuals with programming responsibility removes this need to seek agreement and thus effectively erodes **access controls** to the DBMS.

Separating New Systems Development from Maintenance

Some companies organize their systems development function into two groups: systems analysis and programming. This organizational alternative is presented in Figure 6.6. The systems analysis group works with the user to produce a detailed design of the new system. The programming group codes the programs according to these design specifications. Under this approach, the programmer who codes the original programs also maintains them during the maintenance phase of the systems development life cycle (SDLC). Although a popular arrangement, this approach promotes two potential problems: inadequate documentation and fraud.

Inadequate Documentation: Poor-quality systems documentation is a chronic IT problem and a significant challenge for many organizations seeking SOX compliance. There are at least two explanations for this phenomenon. First, documenting systems is not as interesting as designing, testing, and implementing them. Systems professionals much prefer to move on to an exciting new project rather than document one just completed.

The second possible reason for poor documentation is job security. When a system is poorly documented, it is difficult to interpret, test, and debug. Therefore, the programmer who understands the system (the one who coded it) maintains bargaining power and becomes relatively indispensable. When the programmer leaves the firm, however, a new programmer inherits maintenance responsibility for the undocumented system. Depending on its complexity, the transition period may be long and costly.

Program Fraud: When the original programmer of a system also has maintenance responsibility, the potential for fraud is increased. Program fraud involves making unauthorized changes to program modules for the purpose of committing an illegal act. The original programmer may have successfully concealed fraudulent code among the thousands of lines of legitimate code and the hundreds of modules that constitute a system. For the fraud to work successfully, however, the programmer must be able to control the situation through exclusive and unrestricted access to the application's programs. The programmer needs to protect the fraudulent code from accidental detection by another programmer performing maintenance or by auditors testing application

controls. Therefore, having sole responsibility for maintenance is an important element in the duplicitous programmer's scheme. Through this maintenance authority, the programmer may freely access the system, disabling fraudulent code during audits and then restoring the code when the coast is clear. Frauds of this sort may continue for years without detection.

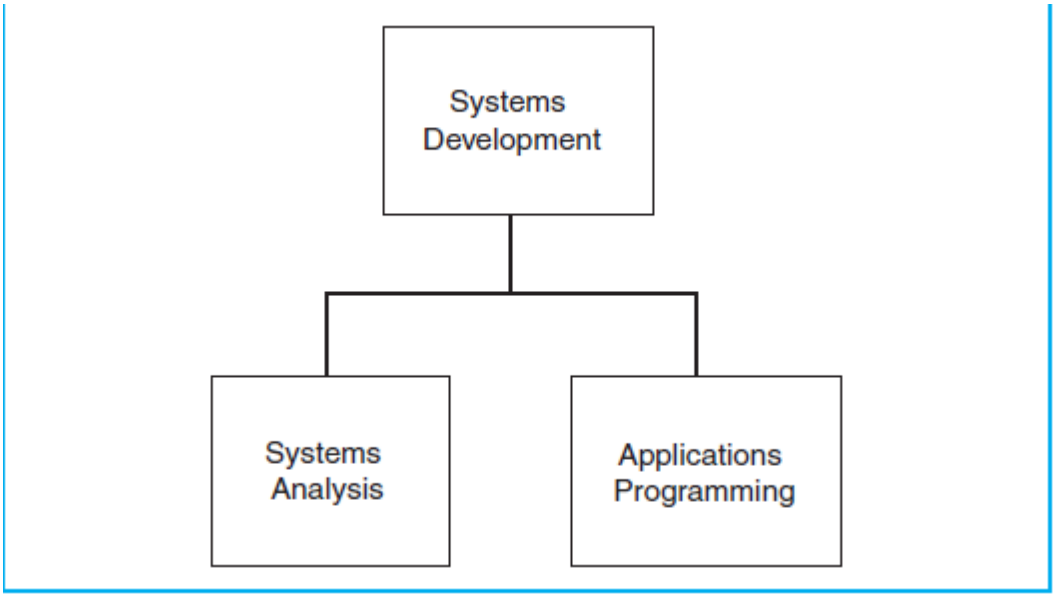


Figure 6.6. Alternative Organization of Systems Development

A Superior Structure for Systems Development

Figure 6.5. presents a superior organizational structure in which the systems development function is separated into two independent groups: new systems development and systems maintenance. The new systems development group is responsible for designing, programming, and implementing new systems projects. Upon successful implementation, responsibility for the system's ongoing maintenance falls to the systems maintenance group. This structure helps resolve the two control problems described previously. First, documentation standards are improved because the maintenance group will require adequate documentation to perform their maintenance duties. Without complete documentation, the formal transfer of system responsibility from new systems development to systems maintenance cannot occur. Second, denying the original programmer future access to the application code deters program fraud. Fraudulent code in an application, which is out of the perpetrator's control, increases the risk that the fraud will be discovered.

Self-test 6.3. *Dear learners, check your progress!*

1. list the three categories of processing controls?
2. Mention the activities in segregation of duties of organizational structure controls?

6.3. Computer Controls and Security

Fires, floods, wind, sabotage, earthquakes, or even power outages can deprive an organization of its data processing facilities and bring to a halt those functions that are performed or aided by the computer. Although the likelihood of such a disastrous event is remote, the consequences to the organization could be serious. If a disaster occurs, the organization not only loses its investment in data processing facilities, but more importantly, it also loses its ability to do business.

The objective of this section is to present computer center controls that help create a secure environment. We will begin with a look at controls designed to prevent and detect threats to the computer center. However, no matter how much is invested in control, some disasters simply cannot be anticipated and prevented. What does a company do to prepare itself for such an event? How will it recover? These questions are at the heart of the organization's disaster recovery plan. The next section deals specifically with issues pertaining to the development of a disaster recovery plan.

6.3.1. Computer Center Controls

Weaknesses in computer center security have a potential impact on the function of application controls related to the financial reporting process. Therefore, this physical environment is a control issue for SOX compliance. The following are some of the control features that contribute directly to computer center security.

A. Physical Location

The physical location selected for a computer center can influence the risk of disaster. To the extent possible, the computer center should be located away from human-made and natural hazards, such as processing plants, gas and water mains, airports, high-crime areas, flood plains, and geological faults.

B. Construction

Ideally, a computer center should be located in a single-story building of solid construction with controlled access (discussed in the following section). Utility (power and telephone) and communications lines should be underground. The building windows should not open. An air filtration system should be in place that is capable of excluding pollens, dust, and dust mites.

C. Access

Access to the computer center should be limited to the operators and other employees who work there. Programmers and analysts who occasionally need to correct program errors should be required to sign in and out. The computer center should maintain accurate records of all such events to verify the function of access control. The main entrance to the computer center should be through a single door, though fire exits with alarms are necessary. To achieve a higher level of security, closed-circuit cameras and video recording systems should monitor access.

D. Air-Conditioning

Computers function best in an air-conditioned environment. For mainframe computers, providing adequate air-conditioning is often a requirement of the vendor's warranty. Computers operate best in a temperature range of 70 to 75 degrees Fahrenheit and a relative humidity of 50 percent. Logic errors can occur in computer hardware when temperatures depart significantly from this range. Also, the risk of circuit damage from static electricity is increased when humidity drops. High humidity, on the other hand, can cause molds to grow and paper products (such as source documents) to swell and jam equipment.

E. Fire Suppression

The most common threat to a firm's computer equipment is fire. Half of the companies that suffer fires go out of business because of the loss of critical records, such as accounts receivable. The implementation of an effective fire suppression system requires consultation with specialists. Some of the major features of such a system are listed in the following section.

- **a.** Automatic and manual alarms should be placed in strategic locations around the installation. These alarms should be connected to a permanently staffed firefighting station.
- **b.** There must be an automatic fire-extinguishing system that dispenses the appropriate type of suppressant (carbon dioxide or halon) for the location. For example, spraying water and certain chemicals on a computer can do as much damage as the fire.
- **c.** There should be manual fire extinguishers placed at strategic locations.
- **d.** The building should be of sound construction to withstand water damage that fire suppression equipment causes.
- **e.** Fire exits should be clearly marked and illuminated during a fire.

F. Fault Tolerance Controls

Fault tolerance is the ability of the system to continue operation when part of the system fails because of hardware failure, application program error, or operator error. Implementing redundant system components can achieve various levels of fault tolerance. Redundant disks and power supplies are two common examples.

Redundant arrays of independent disks (RAID: involves using parallel disks that contain redundant elements of data and applications. If one disk fails, the lost data are automatically reconstructed from the redundant components stored on the other disks.

Uninterruptible power supplies help prevent data loss and system corruption. In the event of a power supply failure, short-term backup power is provided to allow the system to shut down in a controlled manner. Implementing fault tolerance control ensures that there is no single point of potential system failure. Total failure can occur only in the event of the failure of multiple components.

6.3.2. Disaster Recovery planning (DRP)

Some disasters cannot be prevented or evaded. Recent events include hurricanes, widespread flooding, earthquakes, and the events of September 11, 2001. The survival of a firm affected by a disaster depends on how it reacts. With careful contingency planning, the full impact of a disaster can be absorbed and the organization can still recover.

A **disaster recovery plan (DRP)** is a comprehensive statement of all actions to be taken before, during, and after a disaster, along with documented, tested procedures that will ensure the continuity of operations. Although the details of each plan are unique to the needs of the organization, all workable plans possess common features. The remainder of this section is devoted to a discussion of the following control issues: providing second-site backup, identifying critical applications, performing backup and **off-site storage** procedures, creating a disaster recovery team, and testing the DRP.

1. Providing Second-Site Backup

A necessary ingredient in a DRP is that it provides for duplicate data processing facilities following a disaster. The viable options available include the empty shell, recovery operations center, and internally provided backup.

A. The Empty Shell

The empty shell or cold site plan is an arrangement where the company buys or leases a building that will serve as a data center. In the event of a disaster, the shell is available and ready to receive whatever hardware the temporary user needs to run essential systems. This approach, however, has a fundamental weakness. Recovery depends on the timely availability of the necessary computer hardware to restore the data processing function. Management must obtain assurances (contracts) from hardware vendors that in the event of a disaster, the vendor will give the company's needs priority. An unanticipated hardware supply problem at this critical juncture could be a fatal blow.

B. The Recovery Operations Center

A **recovery operations center (ROC)** or hot site is a fully equipped backup data center that many companies share. In addition to hardware and backup facilities, ROC service providers offer a range of technical services to their clients, who pay an annual fee for access rights. In the event of a major disaster, a subscriber can occupy the premises and, within a few hours, resume processing critical applications. September 11 was a true test of the reliability and effectiveness of the ROC approach. Comdisco, a major ROC provider, had 47 clients who declared 93 separate disasters on the day of the attack. All 47 companies relocated and worked out of Comdisco's recovery centers. At one point, 3,000 client employees were working out of the centers. Thousands of computers were configured for clients' needs within the first 24 hours, and systems recovery teams were on-site wherever police permitted access. By September 25, nearly half of the clients were able to return to their facilities with a fully functional system. A problem with this approach is the potential

for competition among users for the ROC resources. For example, a widespread natural disaster, such as a flood or an earthquake, may destroy the data processing capabilities of several ROC members located in the same geographic area. All the victims will find themselves vying for access to the same limited facilities. The situation is analogous to a sinking ship that has an inadequate number of lifeboats.

The period of confusion following a disaster is not an ideal time to negotiate property rights. Therefore, before entering into an ROC arrangement, management should consider the potential problems of overcrowding and geographic clustering of the current membership.

C. Internally Provided Backup

Larger organizations with multiple data processing centers often prefer the self-reliance that creating internal excess capacity provides. This permits firms to develop standardized hardware and software configurations, which ensure functional compatibility among their data processing centers and minimize cutover problems in the event of a disaster. Pershing, a division of Donaldson, Lufkin & Jenrette Securities Corporation, processes more than 36 million transactions per day, about 2,000 per second. Pershing management recognized that an ROC vendor could not provide the recovery time they wanted and needed. The company, therefore, built its own remote **mirrored data center.**

The facility is equipped with high-capacity storage devices capable of storing more than 20 terabytes of data and two IBM mainframes running high-speed copy software. All transactions that the main system processes are transmitted in real time along fiber optic cables to the remote backup facility. At any point in time, the mirrored data center reflects current economic events of the firm. The mirrored system has reduced Pershing's data recovery time from 24 hours to 1 hour.

2. Identifying Critical Applications

Another essential element of a DRP involves procedures to identify the critical applications and data files of the firm to be restored. Eventually, all applications and data must be restored to pre disaster business activity levels. Immediate recovery efforts, however, should focus on restoring those applications and data that are critical to the organization's short-run survival. In any disaster scenario, it is short-term survivability that determines long-term survival. For most organizations, short-term survival requires the restoration of those functions that generate cash flows sufficient to satisfy short-term obligations. For example, assume that the following functions affect the cash flow position of a particular firm: Customer sales and service Fulfillment of legal obligations

Accounts receivable maintenance and collection Production and distribution Purchasing Communications between branches or agencies Public relations. The computer applications that support these functions directly are critical. Hence, these applications should be so identified and prioritized in the restoration plan.

3. Performing Backup and Off-Site Storage Procedures

All data files, application documentation, and supplies needed to perform critical functions should be specified in the DRP. Data processing personnel should routinely perform backup and storage procedures to safeguard these critical resources.

A. Backup Data Files

The state-of-the-art in database backup is the remote mirrored site, described previously, which provides complete data currency. Not all organizations are willing or able to invest in such backup resources. As a minimum, however, databases should be copied daily to tape or disks and secured off-site. In the event of a disruption, reconstruction of the database is achieved by updating the most current backup version with subsequent transaction data. Likewise, master files and transaction files should be protected.

B. Backup Documentation

The system documentation for critical applications should be backed up and stored offsite in much the same manner as data files. The large volumes of material involved and constant application revisions complicate the task. The process can be made more efficient through the use of CASE documentation tools.

C. Backup Supplies and Source Documents

The firm should maintain backup inventories of supplies and source documents used in the critical applications. Examples of critical supplies are check stocks, invoices, purchase orders, and any other special-purpose forms that cannot be obtained immediately.

4. Creating a Disaster Recovery Team

Recovering from a disaster depends on timely corrective action. Failure to perform essential tasks (such as obtaining backup files for critical applications) prolongs the recovery period and diminishes the prospects for a successful recovery. To avoid serious omissions or duplication of efforts during implementation of the contingency plan, individual task responsibility must be clearly defined and communicated to the personnel involved. The team members should be experts in their areas and have assigned tasks. Following a disaster, team members will delegate subtasks to their subordinates. It should be noted that traditional control concerns do not apply in this setting. The environment the disaster creates may necessitate the breaching of normal controls such as segregation of duties, access controls, and supervision. At this point, business continuity is the primary consideration.

5. Testing the DRP

The most neglected aspect of contingency planning is testing the plans. Nevertheless, DRP tests are important and should be performed periodically. Tests provide measures of the preparedness of personnel and identify omissions or bottlenecks in the plan. A test is most useful in the form of a surprise simulation of a disruption. When the mock disaster is announced, the status of all processing that it affects should be documented. This provides a benchmark for subsequent

performance assessments. The plan should be carried as far as is economically feasible. Ideally, this will include the use of backup facilities and supplies.

Self-test 6.4. *Dear learners, check your progress!*

1. Mention the control features that contribute to computer center security?
2. What are the control activities in disaster removing plan?

6.4. Overview of Auditing of Computer Based IS

The previous sections presented overviews of the control concepts, information system controls and the computer controls and securities. This section presented the audit objective in computer based information systems. This establishes what needs to be verified regarding the function of the control in place. These control objectives and associated tests may be performed by internal auditors providing evidence of management's compliance with SOX or by external auditors as part of their attest function. In this regard, we make no distinction between the two roles.

6.4.1. Audit Objectives Relating to Organizational Structure

The auditor's objective is to verify that individuals in incompatible areas are segregated in accordance with the level of potential risk and in a manner that promotes a working environment. This is an environment in which formal, rather than casual, relationships need to exist between incompatible tasks.

Audit Procedures Relating to Organizational Structure

The following tests of controls would enable the auditor to achieve the control objectives.

- Obtain and review the corporate policy on computer security. Verify that the security policy is communicated to responsible employees and supervisors.
- Review relevant documentation, including the current organizational chart, mission statement, and job descriptions for key functions, to determine if individuals or groups are performing incompatible functions.
- Review systems documentation and maintenance records for a sample of applications. Verify that maintenance programmers assigned to specific projects are not also the original design programmers.
- Through observation, determine that the segregation policy is being followed in practice. Review operations room access logs to determine whether programmers enter the facility for reasons other than system failures.

- Review user rights and privileges to verify that programmers have access privileges consistent with their job descriptions.

6.4.2. Audit Objectives Relating to Computer Center Security

The auditor's objective is to evaluate the controls governing computer center security. Specifically, the auditor must verify that (1) physical security controls are adequate to reasonably protect the organization from physical exposures; (2) insurance coverage on equipment is adequate to compensate the organization for the destruction of, or damage to, its computer center; and (3) operator documentation is adequate to deal with routine operations as well as system failures.

6.4.3. Audit Procedures for Assessing Physical Security Controls

The following are tests of physical security controls.

Tests of Physical Construction: The auditor should obtain architectural plans to determine that the computer center is solidly built of fireproof material. There should be adequate drainage under the raised floor to allow water to flow away in the event of water damage from a fire in an upper floor or from some other source. In addition, the auditor should assess the physical location of the computer center. The facility should be located in an area that minimizes its exposure to fire, civil unrest, and other hazards.

Tests of the Fire Detection System: The auditor should establish that fire detection and suppression equipment, both manual and automatic, are in place and are tested regularly. The fire detection system should detect smoke, heat, and combustible fumes. The evidence may be obtained by reviewing official fire marshal records of tests, which are stored at the computer center.

Tests of Access Control: The auditor must establish that routine access to the computer center is restricted to authorized employees. Details about visitor access (by programmers and others), such as arrival and departure times, purpose, and frequency of access, can be obtained by reviewing the access log. To establish the veracity of this document, the auditor may covertly observe the process by which access is permitted.

Tests of Fault Tolerance Controls

RAID. Many RAID configurations provide a graphical mapping of their redundant disk storage. From this mapping, the auditor should determine if the level of RAID in place is adequate for the organization, given the level of business risk associated with disk failure. If the organization is not employing RAID, the potential for a single point of system failure exists. The auditor should review with the system administrator alternative procedures for recovering from a disk failure.

Power Supplies Backup: The auditor should verify from test records that computer center personnel perform periodic tests of the backup power supply to ensure that it has sufficient capacity to run the computer and air-conditioning. These important tests and their results should be formally recorded.

6.4.4. Audit Procedures for Verifying Insurance Coverage

The auditor should annually review the organization's insurance coverage on its computer hardware, software, and physical facility. The auditor should verify that all new acquisitions are listed on the policy and that obsolete equipment and software have been deleted. The insurance policy should reflect management's needs in terms of extent of coverage. For example, the firm may wish to be partially self-insured and require minimum coverage. On the other hand, the firm may seek complete replacement-cost coverage.

6.4.5. Audit Procedures for Verifying Adequacy of Operator Documentation

Computer operators use documentation called a run manual to run certain aspects of the system. In particular, large batch systems often require special attention from operators. During the course of the day, computer operators may execute dozens of computer programs that each process multiple files and produce multiple reports. To achieve effective data processing operations, the run manual must be sufficiently detailed to guide operators in their tasks. The auditor should review the run manual for completeness and accuracy.

The typical contents of a run manual include:

- ✓ The name of the system, such as "Purchases System"
- ✓ The run schedule (daily, weekly, time of day)
- ✓ Required hardware devices (tapes, disks, printers, or special hardware)
- ✓ File requirements specifying all the transaction (input) files, master files, and output files used in the system
- ✓ Run-time instructions describing the error messages that may appear, actions to be taken, and the name and telephone number of the programmer on call, should the system fail
- ✓ A list of users who receive the output from the run

Also, the auditor should verify that certain systems documentation, such as systems flowcharts, logic flowcharts, and program code listings, are not part of the operator's documentation. For reasons previously discussed, operators should not have access to the operational details of a system's internal logic.

6.4.6. Audit Objective: Assessing Disaster Recovery Planning

The auditor should verify that management's disaster recovery plan is adequate and feasible for dealing with a catastrophe that could deprive the organization of its computing resources. The following tests focus on the areas of greatest concern.

6.4.6.1.Audit Procedures for Assessing Disaster Recovery Planning

1. Second-Site Backup

The auditor should evaluate the adequacy of the backup site arrangement. The client should possess vendor contracts guaranteeing timely equipment delivery to the cold site. In the case of ROC membership, the auditor should obtain information as to the total number of members and

their geographic dispersion. A widespread disaster may create a demand that the backup facility cannot satisfy.

2. Critical Application List

The auditor should review the list of critical applications and ensure that it is current and complete. Missing applications may result in failure to recover. On the other hand, restoring noncritical applications diverts scarce resources to nonproductive tasks.

3. Backup Critical Applications and Critical Data Files

The auditor should verify that the organization has procedures in place to back up stored off-site copies of critical applications and data. Evidence of this can be obtained by selecting a sample of data files and programs and determine if they are being backed up as required.

4. Backup Supplies, Source Documents, and Documentation

The system documentation, supplies, and source documents needed to restore and run critical applications should be backed up and stored off-site. The auditor should verify that the types and quantities of items specified in the DRP exist in a secure location.

5. The Disaster Recovery Team

The DRP should clearly list the names, addresses, and emergency telephone numbers of the disaster recovery team members. The auditor should verify that members of the team are current employees and are aware of their assigned responsibilities. On one occasion, while reviewing a firm's DRP, the author discovered that a team leader listed in the plan had been deceased for nine months.

Chapter summary

The internal control system of organization comprises policies, practices, and procedures to safeguard assets of the firm, ensure the accuracy and reliability of accounting records and information, promote efficiency in the firm's operations, measure compliance with management's prescribed policies and procedures. The internal control composed of three levels of control: preventive controls, detective controls, and corrective controls. The control environment, risk assessment, Information and communication, monitoring and control activities are the elements of internal control.

COSO identifies two broad groupings of information system controls: application controls and general controls. Application controls are associated with specific applications, such as payroll, purchases, and cash disbursements systems. These fall into three broad categories: input controls, processing controls, and output controls. Input controls are programmed procedures (routines) that perform tests on transaction data to ensure that they are free from errors. Processing controls are programmed procedures and may be divided into three categories: batch controls, run-to-run controls, and audit trail controls. Output controls are a combination of programmed routines and other procedures to ensure that system output is not lost, misdirected, or corrupted and that privacy is not violated.

Fires, floods, wind, sabotage, earthquakes, or even power outages can deprive an organization of its data processing facilities and bring to a halt those functions that are performed or aided by the computer. Weaknesses in computer center security have a potential impact on the function of application controls related to the financial reporting process. Therefore, this physical environment is a control issue for SOX compliance. Physical Location, Construction, Access, Air-Conditioning, Fire Suppression, and Fault Tolerance Controls are some of the control features that contribute directly to computer center security.

A disaster recovery plan (DRP) is a comprehensive statement of all actions to be taken before, during, and after a disaster, along with documented, tested procedures that will ensure the continuity of operations. Providing Second-Site Backup, Identifying Critical Applications, Performing Backup and Off-Site Storage Procedures, creating a Disaster Recovery Team and testing the DRP are the techniques of the DRP.

Chapter Review Questions

Part I: True or false: Write true if the statement is correct or false if it is incorrect.

1. Detective controls are passive techniques designed to reduce the frequency of occurrence of undesirable events.
2. Preventing errors and fraud is more cost-effective than detecting and correcting problems after they occur.
3. Detective controls reveal specific types of errors by comparing actual occurrences to pre-established standards.
4. Physical Controls relates primarily to the human activities employed in accounting systems.
5. A well-designed source document is an example of a preventive control.

Part II: Multiple choices

Choices the best answer for the following questions.

1. Which of the following is/are not the objectives of internal control system?
   D. To safeguard assets of the firm.
   E. To ensure the accuracy and reliability of accounting records and information.
   F. To promote efficiency in the firm's operations.
   G. To measure compliance with management's prescribed policies and procedures.
   H. All
   I. None
2. Which of the following is/are the elements of internal control system?
   A. The Control Environment
   B. Risk Assessment
   C. Information and Communication
   D. Monitoring
   E. Control Activities
   F. All
3. Which of the following is/are not physical control?
   a. Transaction Authorization
   b. Segregation of Duties
   c. Supervision
   d. IT Controls
4. **_____** ensure the integrity of specific systems such as sales order processing, accounts payable, and payroll applications
   A. General controls
   B. Application controls
   C. IT Controls
5. _____are programmed procedures (routines) that perform tests on transaction data to ensure that they are free from errors?
   A. Input controls

B. Processing controls
C. Output controls

Answer for self-tests

Self-test 6.1.

1. F
2. The Preventive–Detective–Corrective Internal Control Model
3. What are the six categories of physical control activities?

- ✓ transaction authorization
- ✓ segregation of duties
- ✓ supervision
- ✓ accounting records
- ✓ access control, and
- ✓ independent verification.

Self-test 6.2.

1. Transcription errors
Transposition errors

2. Check Digit
Missing Data Check
Numeric–Alphabetic Check
Limit Check
Range Check
Reasonableness Check
Validity Check

Self-test 6.3.

1.

- ✓ Batch controls
- ✓ Run-to-run control
- ✓ Audit trail controls

2.

- ✓ Separating Systems Development from Computer Operations
- ✓ Separating the Database Administrator from Other Functions
- ✓ Separating New Systems Development from Maintenance
- ✓ A Superior Structure for Systems Development

Self-test 6.4.

1.

- ✓ Physical Location
- ✓ Construction
- ✓ Access
- ✓ Air-Conditioning
- ✓ Fire Suppression

- ✓ Fault Tolerance Controls

2.

- ✓ Providing Second-Site Backup
- ✓ Identifying Critical Applications
- ✓ Performing Backup and Off-Site Storage Procedures
- ✓ Creating a Disaster Recovery Team
- ✓ Testing the DRP

Answer for review questions

Chapter One

Part I: True or False

6. True
7. False
8. True
9. False

True

Part II: Choice

1. B
2. A
3. C
4. C
5. B

Part III: Fill the blank

1. Information system
2. Transaction
3. Database
4. An attribute
5. Information generation

Chapter Two

Part I: True or False

1. True
2. False
6. True
7. False
8. True

Part II: Choice

1. C
2. D
3. A
4. E
5. B

Part III: Fill the blank

1. Transaction (Data) processing
2. Source data automation
3. Coding
4. An audit trail.
5. Documents

Chapter Three

Part I: True or False

1. False
2. True
3. True
4. True
5. False

Part II: Choice

1. A
2. C
3. C
4. D
5. C

Part III: Fill the blank

1. Document Flow Chart
2. A Physical DFD
3. A flowchart
4. Economic feasibility
5. A program flowchart

Chapter Four

Part I: True or False

1. False
6. True
7. True
8. True
9. False

Part II: Choice

1. A
2. D
3. F
4. C
5. E

Chapter Five

Part I: True or False

1. True
2. True
3. True
4. False
5. True

Part II: Choice

1. D
2. C
3. B
4. C
5. A

Chapter Six

Part I: True or False

6. False
7. True
8. True
9. True
10. True

Part II: Choice

1. F
2. F
3. D
4. B
5. A