ACCOUNTING INFORMATION SYSTEMS

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BY: BIZUNEH GIRMA (MSc.)

MUBAREK OUMER (MSc.)

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Prepared by: Bizuneh Girma (MSc.) and

Mubarek Oumer (MSc.)

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Preface

The study of accounting information system (AIS) provides a very important set of concepts to prepare you for an accounting and business career. We hope the features of this module make your study of AIS a little more enjoyable, interesting, and understandable.

This module includes the imperative content which found in Accounting Information System course, basically Accounting Information Systems: an overview, overview of business process, the system development Process, relational database, transaction cycles and accounting applications, and control activity related to accounting information system. We place extra emphasis on the students' understanding. We explain AIS in the context of business processes and incorporate many real-world examples. The richness of these examples improves the module, the discussion questions, and end-of-chapter exercises. We explain IT controls by employing the framework in the AICPA Trust Services Principles. This is an encompassing, but easy to understand, framework of IT controls.

Finally, we think that including all these characteristics in a single module has resulted in an extremely user-friendly product: one that will help students to achieve a better foundation in accounting information systems.

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CHAPTER ONE

ACCOUNTING INFORMATION SYSTEMS: AN OVERVIEW

Chapter objectives

After studying this chapter, you should be able to:

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

1.1 Introduction

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

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. ***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.

What are Data?

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

What is information?

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

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

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

Activity 1.1

What are the features of useful information?

Characteristics of Useful Information

Relevant: Reduces uncertainty, improves decision making, or confirms or corrects prior expectations.

Reliable: Free from error or bias; accurately represents organization events or activities.

Complete: Does not omit important aspects of the events or activities it measures.

Timely: Provided in time for decision makers to make decisions.

Understandable: Presented in a useful and intelligible format.

Verifiable: Two independent, knowledgeable people produce the same information.

Accessible: Available to users when they need it and in a format they can use.

1.1.1 An accounting information system framework

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

The distinction between AIS and MIS centers on the concept of a transaction.

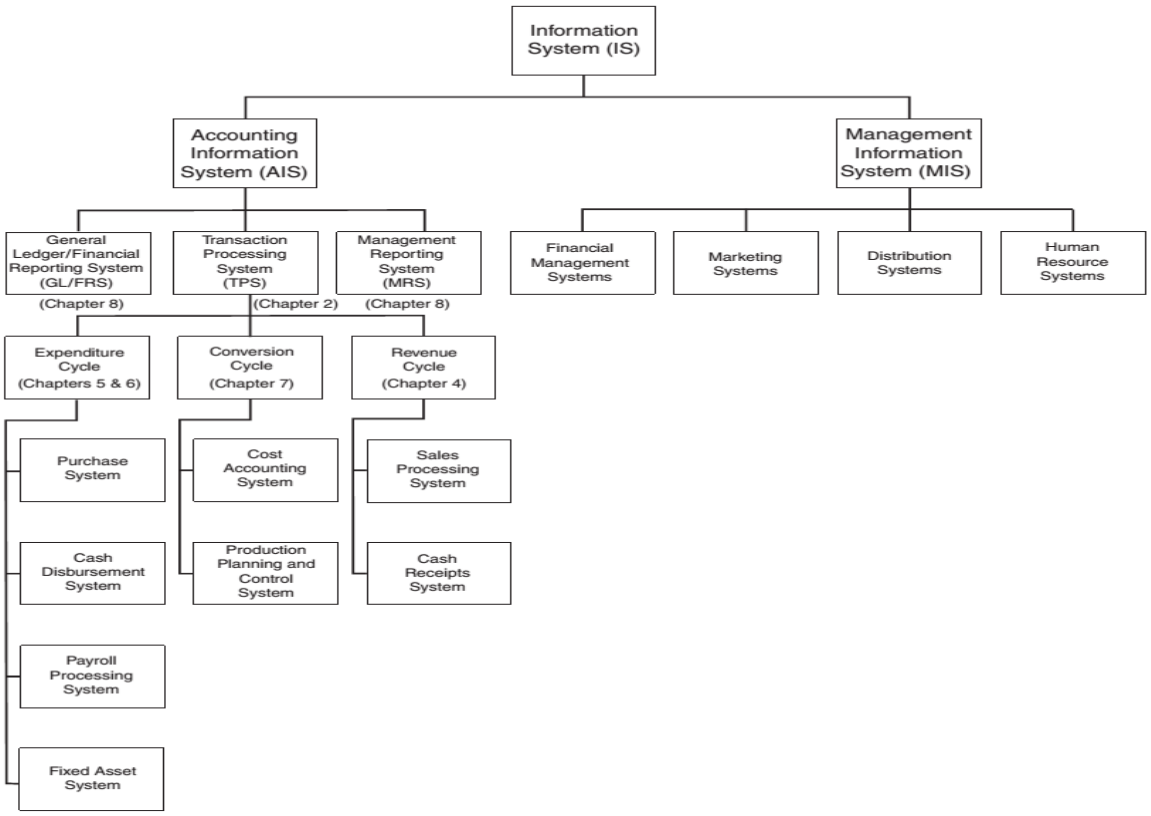
The information system accepts input, called transactions, which are converted through various processes into output information that goes to users. Transactions fall into two classes: ***financial transactions*** and ***nonfinancial transactions***. Before exploring this distinction, let's first broadly define:

A ***transaction,*** as an event that affects or is of interest to the organization and is processed by its information system as a unit of work, this definition encompasses both financial and nonfinancial events. Because financial transactions are of particular importance to the accountant's understanding of information systems, we need a precise definition for this class of transaction:

A ***financial transaction*** is an economic event that affects the assets and equities of the organization, is reflected in its accounts, and is measured in monetary terms. Sales of products to customers, purchases of inventory from vendors, and cash disbursements and receipts are examples of financial transactions. Every business organization is legally bound to correctly process these types of transactions.

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

FIGURE 1-3 A Framework for Information Systems



Information Needs and Business Processes

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

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

Information Needs

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

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

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

1.2 Business Processes

Solomon decides to reorganize the business processes listed in Table 1-1 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. For example, S&S will have thousands of sales to customers every year in exchange for cash. Likewise, S&S will continuously buy inventory from suppliers in exchange for cash. 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.

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

Business Processes	Key Decisions	Information Needs
	Find investors or borrow funds	**Pro forma financial statements**
	If borrowing, obtaining best terms	**Loan amortization schedule**
Acquire	Size of building	**Capacity needs**
	Amount of equipment	**Building and equipment prices**
	Rent or buy	**Market study**
	Location	**Tax tables and depreciation**
	How to depreciate	
Hire and train	Experience requirements	**Job descriptions**
	How to assess integrity and competence of	**Applicant job history and skills**
	How to train employees	
Acquire	What models to carry	**Market analyses**
	How much to purchase	**Inventory status reports**
	How to manage inventory (store, control, etc.)	**Vendor performance**
	Which vendors	

Advertising	Which media	**Cost analyses**
	Content	**Market coverage**
Sell	Markup percentage	**Pro forma income statement**
	Offer in-house credit	**Credit card costs**
	Which credit cards to accept	**Customer credit status**
Collect	If offering credit, what terms	**Customer account status**
	How to handle cash receipts	**Accounts receivable aging report**
		Accounts receivable records
Pay	Amount to pay	**Sales (for commissions)**
	Deductions and withholdings	**Time worked (hourly**
	Process payroll in-house or use outside	**W-4 forms**
		Costs of external payroll service
Pay taxes	Payroll tax requirements	**Government regulations**
	Sales fax requirements	**Total wage expense**
		Total sales
Pay vendors	Whom to pay	**Vendor invoices**
	When to pay	**Accounts payable records**
	How much to pay	**Payment terms**

These cycles process a few related transactions repeatedly. For example, most revenue cycle transactions are either selling goods or services to customers or collecting cash for those sales. Figure 1-2 shows the main transaction cycles and the give-get exchange inherent in each cycle. These basic give-get exchanges are supported by a number of other business activities. For example, S&S may need to answer a number of customer inquiries and check inventory levels before it can make a sale. Likewise, it may have to check customer credit before a credit sale is made. Accounts receivable will have to be increased each time a credit sale is made and decreased each time a customer payment is received. Table 1-2 lists the major activities in each transaction cycle

TABLE 1-3 Common Cycle Activities

TRANSACTION CYCLE	MAJOR ACTIVITIES IN THE CYCLE
Revenue	Receive and answer customer inquiries
	Take customer orders and enter them into the AIS
	Approve credit sales
	Check inventory availability
	Initiate back orders for goods out of stock
	Pick and pack customer orders
	Ship goods to customers or perform services
	Bill customers for goods shipped or services performed
	Update (increase) sales and accounts receivable
	Receive customer payments and deposit them in the bank
	Update (reduce) accounts receivable
	Handle sales returns, discounts, allowances, and bad debts
	Prepare management reports
	Send appropriate information to the other cycles
Expenditure	Request goods and services be purchased
	Prepare, approve, and send purchase orders to vendors
	Receive goods and services and complete a receiving report
	Store goods
	Receive vendor invoices
	Update (increase) accounts payable
	Approve vendor invoices for payment
	Pay vendors for goods and services
	Update (reduce) accounts payable
	Handle purchase returns, discounts, and allowances
	Prepare management reports
	Send appropriate information to the other cycles
Human Resources/Payroll	Recruit, hire, and train new employees
	Evaluate employee performance and promote employees
	Discharge employees
	Update payroll records
	Collect and validate time, attendance, and commission data
	Prepare and disburse payroll
	Calculate and disburse taxes and benefit payments

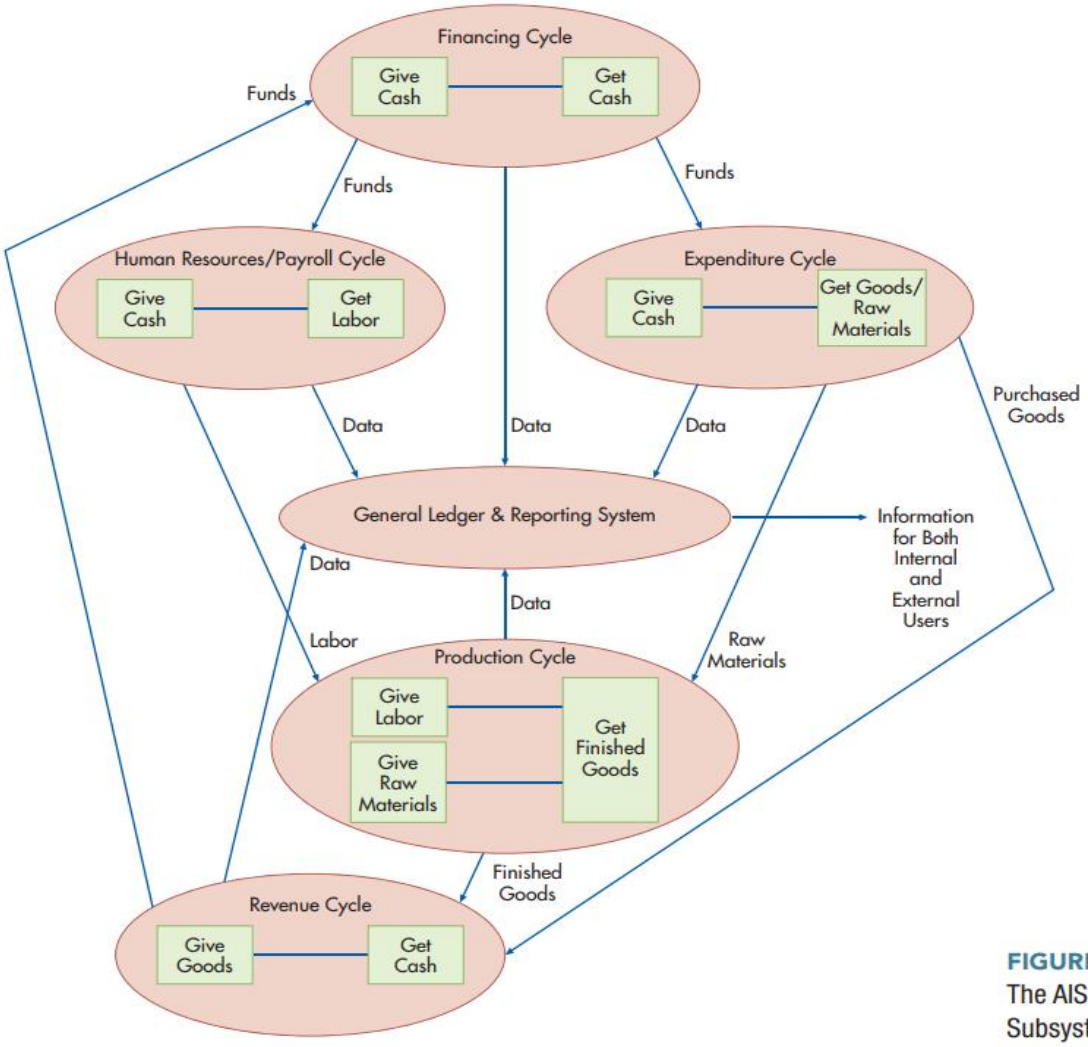


FIGURE 1-2
The AIS and Its Subsystems

After preparing Tables 1-1 and 1-2 and Figures 1-1 and 1-2, Solomon and Selam believe that they understand S&S well enough to begin shopping for an information system. Selam recalled a previous employer that had several separate information systems, because their software was not designed to accommodate the information needs of all managers. She also vividly recalled attending one meeting where she witnessed the negative effects of having multiple systems. The head of marketing had one report on year-to-date sales by product, the production manager had a different report that contained different sales figures, and the controller's report, which was produced by the general ledger system, had

yet a third version of year-to-date sales. Over an hour was wasted trying to reconcile those different reports! Selam vowed that she would make sure that S&S did not ever find itself in such a mess. She would make sure that any system selected would have the capability to integrate both financial and nonfinancial data about S&S's various business processes so that everyone could pull information from the same system.

1.2.1 Accounting Information Systems

Activity 1.2

1. **Based on the above introduction how do we define Accounting information system?**

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

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.

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

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

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

There are six components of an AIS:

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

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

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

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.

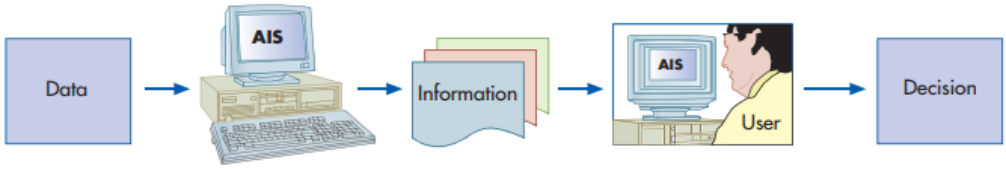


FIGURE 1-3
An AIS Processes Data to Produce Information for Decision Makers

1.2.2 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.

Activity 1.3

1. **What is value?**
2. **What is value addition?**
3. **How accounting information system add value to *organization?***

1.2.3 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.

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

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

Many other technological advances affect company strategy and provide an opportunity to gain a competitive advantage. An example is ***predictive analysis,*** which uses data warehouses and complex algorithms to forecast future events, based on historical trends and calculated probabilities. Predictive analysis provides an educated guess of what one may expect to see in the near future, allowing companies to make better business decisions and improve their processes. FedEx uses predictive analysis to predict, with 65% to 90%

accuracy, how customers respond to price changes and new services. Blue Cross Blue Shield of Tennessee uses a neural-based predictive model to predict the health care that specific patients will need, the severity of illnesses, and organ failures. Stock market analysts are using predictive analysis to predict short-term trends in the stock market.

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

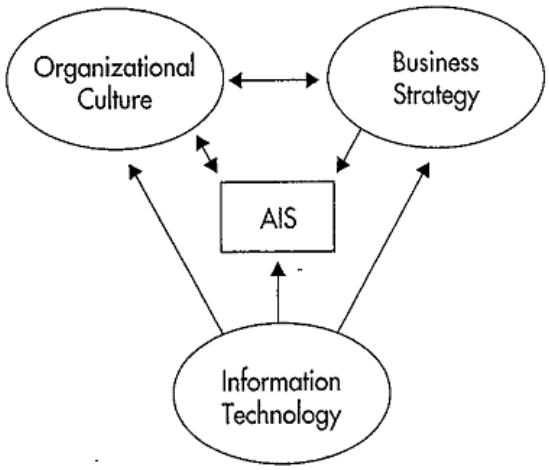


FIGURE 1-4
Factors Influencing Design of the AIS

1.2.4 The Role of the AIS in the Value Chain

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

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

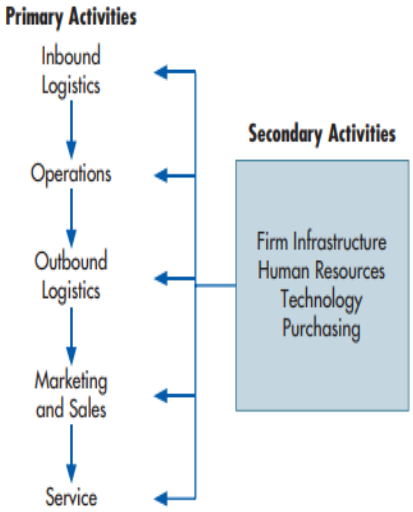
4) ***Marketing and sales*** activities help customers buy the organization's products or services. Advertising is an example of a marketing and sales activity.
5) ***Service*** activities provide post-sale support to customers. Examples include repair and maintenance services.

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

FIGURE 1-5
The Value Chain



1.3 Uses of AIS

A. Producing External Reports

Businesses use (AIS) to produce special reports that follow a required structure established by organizations such as (FASB). These reports include financial statements, tax returns, etc

B. Supporting Routine Activities

Managers need an (AIS) for handling routine operating activities during the firm's operating cycle. Computer systems excel at handling repetitive transaction by many accounting software support these routine functions.

C. Decision Support

Information is needed for non-routine decision support at all levels of an organization. Some information is critical for planning, deciding, marketing functions.

D. Planning and Control

An information system is required for planning and control activities as well. Historical data can be extracted from the database and used to forecast growth and cash flows. Planners can use data mining to reveal long-term trends and relationships.

E. Implementing Internal Control

Internal control includes the policies, procedures, and information system used to protect a company's assets from loss and to maintain accurate financial data. It is possible to build controls into a computerized accounting information system to help reach these goals.

1.4 The Role of the Accountant

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

A. **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.

B. **Accountants as System Designers**

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

These traditional systems were physical, observable, and unambiguous. The procedures for processing information were manual, and the medium for transmitting and storing data was paper. With the arrival of the computer, computer programs replaced manual procedures,

and paper records were stored digitally. The role accountants would play in this new era became the subject of much controversy. Lacking computer skills, accountants were generally uncertain about their status and unwilling to explore this emerging technology. Many accountants relinquished their traditional responsibilities to the new generation of computer professionals who were emerging in their organizations. Computer programmers, often with no accounting or business training, assumed full responsibility for the design of accounting information systems. As a result, many systems violated accounting principles and lacked necessary controls. Large system failures and computer frauds marked this period in accounting history. By the mid-1970s, in response to these problems, the accounting profession began to reassess the accountant's professional and legal responsibilities for computer-based systems.

Today, we recognize that the responsibility for systems design is divided between accountants and IT professionals as follows: the accounting function is responsible for the conceptual system, and the IT function is responsible for the physical system. To illustrate the distinction between conceptual and physical systems, consider the following example: The credit department of a retail business requires information about delinquent accounts from the AR department. This information supports decisions made by the credit manager regarding the creditworthiness of customers.

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

Accountants as System Auditors

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

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.

Summary

The accounting information system comprises the processes, procedures, and systems that capture accounting data from business processes; record the accounting data in the appropriate records, process the detailed accounting data by classifying, summarizing and consolidating; and report the summarized accounting data to users.

As business processes occur, accounting data from those processes are entered into the accounting information system, processed, and reported to the appropriate internal and external parties. The internal reports can be used as feedback to monitor and control business processes.

The business process linkage throughout the supply chain. Not only do business processes occur within an organization, but they can also be linked to related organizations. For example, when an organization buys raw materials, it is engaging in a business process linked to the vendor's selling process. Business processes occur throughout the supply chain. The supply chain is the organizations, processes, and information flows that involve the movement of materials, funds, and related information through the full logistics process, from the acquisition of raw materials to delivery of finished products to the end

user. Supply chain management controls all materials, funds, and related information in the logistics process.

Accountants must understand accounting information systems because they are users, participants in the design and implementation, and auditors of the AIS.

Self-Assessment questions

1. Data differ from information in which way?
   A. Data are output, and information is input.
   B. Information is output, and data are input.
   C. Data are meaningful bits of information
   D. There is no difference.
2. Which of the following is NOT a characteristic that makes information useful?
   A. It is reliable.
   B. It is timely.
   C. It is inexpensive.
   D. It is relevant.
3. Which of the following is a primary activity in the value chain?
   A. purchasing
   B. accounting
   C. post-sales service
   D. human resource management
4. Which transaction cycle includes interactions between an organization and its suppliers?
   A. revenue cycle
   B. expenditure cycle
   C. human resources/payroll cycle
   D. general ledger and reporting system
5. Which of the following is NOT a means by which information improves decision making?
   A. increases information overload
   B. reduces uncertainty
   C. provides feedback about the effectiveness of prior decisions
   D. identifies situations requiring management action

6. In the value chain concept, upgrading IT is considered what kind of activity?
   A. primary activity
   B. support activity
   C. service activity
   D. structured activity
7. In which cycle does a company ship goods to customers?
   A. production cycle
   B. financing cycle
   C. revenue cycle
   D. expenditure cycle
8. Which of the following is a function of an AIS?
   A. reducing the need to identify a strategy and strategic position
   B. transforming data into useful information
   C. allocating organizational resources
   D. automating all decision making
9. A firm, its suppliers, and its customers collectively form which of the following?
   A. supply chain
   B. value chain
   C. ERP system
   D. AIS
10. A report telling how well all approved vendors have performed in the prior 12 months is information that is MOST needed in which business process?
   A. paying vendors
   B. acquiring inventory
   C. selling merchandise
   D. paying employee

Discussion

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

CHAPTER TWO

OVERVIEW OF BUSINESS PROCESSES AND ERP SYSTEMS

Chapter Objectives

After studying this chapter, you should be able to:

- Describe the data processing cycle used to process transactions, including how data is input, stored, and processed and how information is output.
- Discuss how organizations use enterprise resource planning (ERP) systems to process transactions and provide information

Brainstorming

1. Define business?
2. What is business process?
3. Which one is come first business or business

2.1 Introduction

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

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

2.2 Business Processes and Events

All organizations need information in order to make effective decisions. In addition, all organizations have certain business processes in which they are continuously engaged.

A **business process** is a set of related, coordinated, and structured activities and tasks that are performed by a person, a computer, or a machine, and that help accomplish a specific organizational goal.

To make effective decisions, organizations must decide what decisions they need to make, what information they need to make the decisions, and how to gather and process the data needed to produce the information. This data gathering and processing is often tied to the basic business processes in an organization.

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: Sell goods to customers; depreciate equipment.

- The ***transaction cycle*** is a process that begins with capturing data about a transaction and ends with an information output, such as a set of financial statements.
- Many business activities are paired in give-get exchanges
- The basic exchanges can be grouped into five major transaction cycles.
  - ***Revenue cycle***—Interactions with customers. Give goods; get cash.
  - ***Expenditure cycle***—Interactions with suppliers. Give cash; get goods.
  - ***Production cycle***—Give labor and raw materials; get finished product.
  - ***Human resources/payroll cycle***—Give cash; get labor.
  - ***Financing cycle***—Give cash; get cash.

- Thousands of transactions can occur within any of these cycles, but there are relatively few types of transactions in a cycle.
- Every transaction cycle relates to other cycles and interfaces with the general ledger and reporting system, which generates information for management and external parties.
- The revenue cycle gets finished goods from the production cycle; provides funds to the financing cycle; and provides data to the general ledger and reporting system.
- The expenditure cycle gets funds from the financing cycle; provides raw materials to the production cycle; and provides data to the general ledger and reporting system.
- The production cycle gets raw materials from the expenditure cycle; gets labor from the HR/payroll cycle; provides finished goods to the revenue cycle; and provides data to the general ledger and reporting system.
- The HR/payroll cycle gets funds from the financing cycle; provides labor to the production cycle; and provides data to the general ledger and reporting system.
- The financing cycle gets funds from the revenue cycle; provides funds to the expenditure and HR/payroll cycles; and provides data to the general ledger and reporting system.
- The general ledger and reporting system gets data from all of the cycles and provides information for internal and external users.
- Many accounting software packages implement the different transaction cycles as separate modules. Not every module is needed in every organization, e.g., retail companies don't have a production cycle. Some companies may need extra modules. So the implementation of each transaction cycle can differ significantly across companies.
- However the cycles are implemented, it is critical that the AIS be able to accommodate the information needs of managers and integrate financial and non-financial data.

2.3 Identifying Events in Business Processes

Events can be identified in a business process and the following are Guidelines for Recognizing Events:

1. Recognize first event - when a person or department within an organization becomes responsible for an activity.

2. Ignore - activities that do not require participation by an internal agent.

3. Recognize - new event when responsibility is transferred from one internal agent to another.

4. Recognize -new event when process has been interrupted and resumed later by the same internal agent.

After the interruption, someone outside the organization or the process may restart the process. Or the process may continue at a scheduled time.

Common ways:

A person/organization outside the company initiates the continuation of the process. And the process continues at a scheduled time.

5. Use an event name and description that reflects the broad nature of the event.

2.4 Organizing Data in an AIS: the data processing cycle

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

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

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

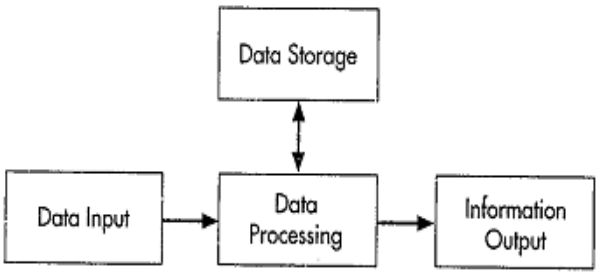
One important AIS function is to process company transactions efficiently and effectively. In manual (non-computer-based) systems, data are entered into journals and ledgers maintained on paper. In computer-based systems, data are entered into computers and stored in files and data bases. The operations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

2.4.1 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

FIGURE 2-1
The Data Processing Cycle



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.

2.4.2 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 S&S to find an invoice if all documents were randomly dumped into file cabinets. Fortunately, information in an AIS is organized for easy and efficient access. This section explains basic data storage concepts and definitions.

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

ledgers

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

The general ledger account corresponding to a subsidiary ledger is called a ***control account***. The relationship between the general ledger control account and the total of individual subsidiary ledger account balances helps maintain the accuracy of AIS data. Specifically, the sum of all subsidiary ledger account balances should equal the amount in

the corresponding general ledger control account. Any discrepancy between them indicates that a recording error has occurred.

Coding Techniques

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

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

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

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

There are four 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.

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

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

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

Chart of accounts

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

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

nature of each sales transaction. If S&S used separate general ledger accounts for cash and credit sales, then reports showing both types of sales could be easily produced. Total sales could also be easily reported by summing each type of sale.

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

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

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

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

Subsidiary ledger accounts often have longer account codes than general ledger accounts. At S&S, each account receivable will have a seven-digit code. The first three digits are

120, the code for accounts receivable. The next four digits identify up to 10,000 individual customers.

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

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

Journals

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

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

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

TABLE 2-3 Sample Sales Journal

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

FIGURE 2-2
Recording and Posting a Credit Sale

Sales Journal (SJ)
Page 5

SALES JOURNAL Pg. 5

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

GENERAL LEDGER
Account: Accounts Receivable **Account Number:** 120

Date	Description	Post Ref	Debit	Credit	Balance
Oct. 14					67,285.00
14	Sales	SJ4	12,432.00		79,717.00
14	Collections	CR6		22,162.00	57,555.00
15	Sales	SJ5	15,511.00		73,066.00

15,511.00
Total sales
Oct. 15

GENERAL LEDGER
Account: Credit Sales **Account Number:** 502

Date	Description	Post Ref	Debit	Credit	Balance
Oct. 14					267,762.00
14	Sales	SJ4		12,432.00	280,194.00
15	Sales	SJ5		15,511.00	295,705.00

ACCOUNTS RECEIVABLE SUBSIDIARY LEDGER
Name: KDR Builders **Address:** 6867 Stornaway
Account Number: 120–135 Memphis, TN 38119-1234

Date	Description	Post Ref	Debit	Credit	Balance
Sept. 12	Sales	SJ1	3,682.00		3,682.00
Oct. 1	Payment	CR4		3,682.00	0.00
Oct. 15	Sales	SJ5	1,876.50		1,876.50

1,876.50–
amount of
individual sale

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

$15,511.00 posted to both the Accounts Receivable and the Credit Sales general ledger accounts).

Audit trail

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

Computer-based storage concepts

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

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

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

employee master files store information about important agents with whom the organization interacts.

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

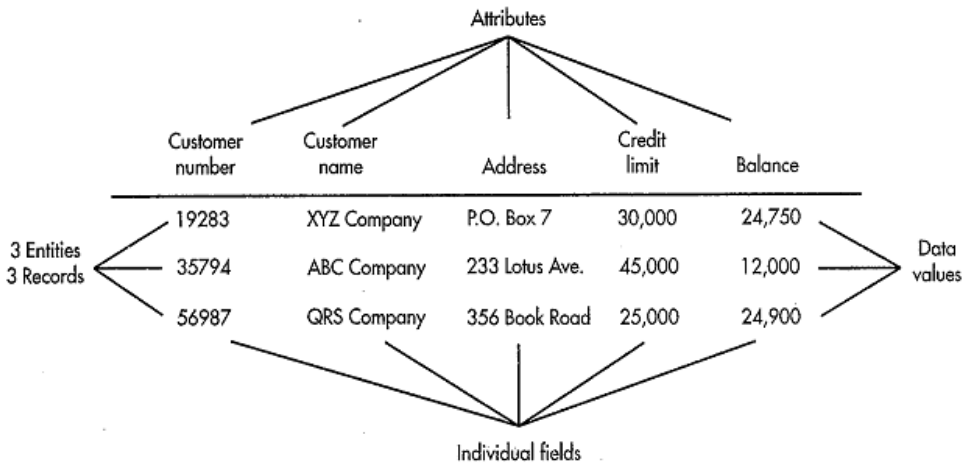


FIGURE 2-3
Data Storage Elements

This accounts receivable file stores information about three separate entities: XYZ Company, ABC Company, and QRS Company. As a result, there are three records in the file. Five separate attributes are used to describe each customer: customer number, customer name, address, credit limit, and balance. There are, therefore, five separate fields in each record. Each field contains a data value that describes an attribute of a particular entity (customer). For example, the data value19283 is the customer number for the *XYZ* Company.

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

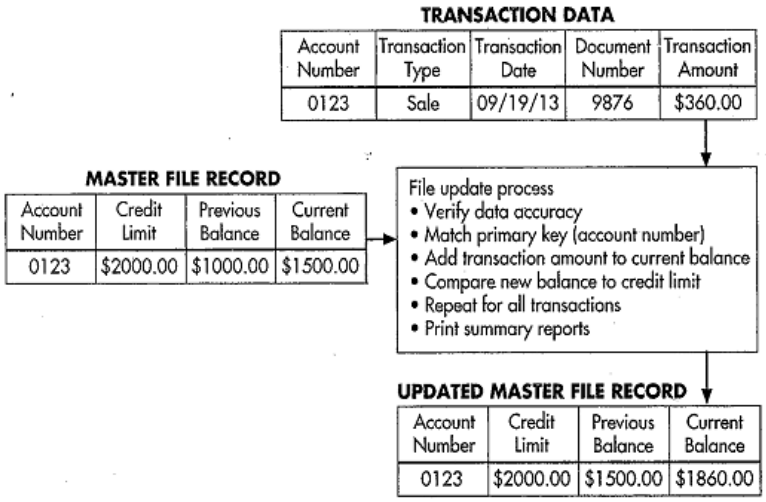
A set of interrelated, centrally coordinated files is referred to as a ***database.*** For example, the accounts receivable file might be combined with customer, sales analysis, and related files to form a customer database.

2.4.3 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 2-4 depicts the steps required to update an accounts receivable record with a sales transaction. The two records are matched using the account number. The sale amount ($360) is added to the account balance ($1,500) to get a new current balance ($1,860).
4) ***Deleting*** data, such as purging the vendor master file of all vendors the company no longer does business with.

FIGURE 2-4
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.

2.4.4 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, S&S could have its system produce a report to indicate when product returns exceed a certain percentage of sales. Reports can also be produced on demand. For example, Susan could produce a report to identify the salesperson who sold the most items during a specific promotional period.

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

A database ***query*** is used to provide the information needed to deal with problems and questions that need rapid action or answers. A user enters a request for a specific piece of

information; it is retrieved, displayed, or analyzed as requested. Repetitive queries are often developed by information systems specialists. One-time queries are often developed by users. Some companies, such as Wal-Mart, allow suppliers to access their databases to help them better serve Wal-Mart's needs. Suppliers can gauge how well a product is selling in every Wal-Mart store in the world and maximize sales by stocking and promoting items that are selling well.

Activity 2.1

What are information outputs and their differences?

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.

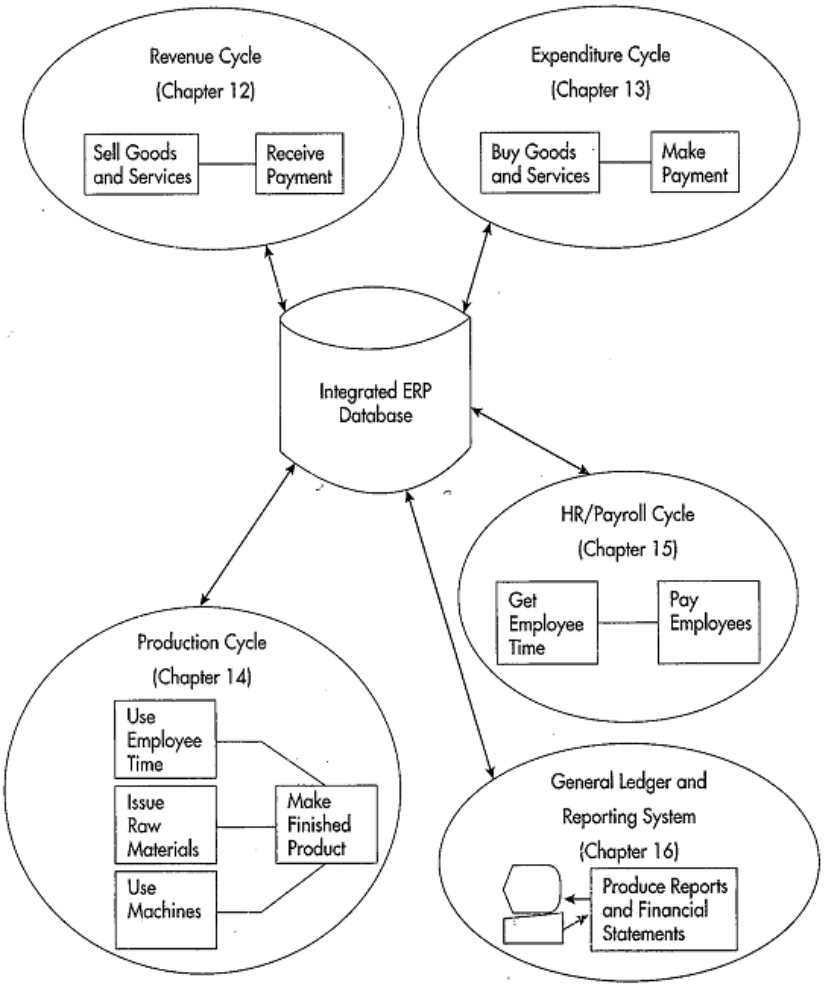
As shown in Figure 2-6, a properly configured ERP system uses a centralized database to share information across business processes and coordinate activities. This is important because an activity that is part of one business process often triggers a complex series of activities throughout many different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

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 2-6
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.

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

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

are many ERP vendors, the two largest being SAP and Oracle. Other leading vendors are The Sage Group, Microsoft, and Infor.

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

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

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

Activity 2.2

1. **Why enterprise resource planning (ERP) system?**
2. **What are potential benefits of enterprise resource planning (ERP) system?**

Summary

sequence of work steps completed in order to produce a desired result for the organization. A business process is initiated by a particular kind of event, has a well-defined beginning and end, and is usually completed in a relatively short period. Many business processes have direct or indirect effects on accounting records, and these can be categorized into revenue processes, expenditure processes, conversion processes, and administrative processes

As transactions occur, the systematic and defined steps that take place within the organization to complete the underlying tasks of the transaction are called business processes. These business processes generate accounting information that must be captured, recorded, and processed. The accounting information system comprises the processes, procedures, and systems that capture accounting data from business processes; records the accounting data in the appropriate records; processes the detailed accounting data by classifying, summarizing, and consolidating; and reports the summarized accounting data to internal and external users. Business processes, IT systems, and the accounting information system are inextricably linked.

Data can be processed by batch processing or online and real-time processing. Batch processing is less complex, but due to its time lag, the accounting data are not always current. Online and real-time systems process data individually as business transactions occur, making outputs available immediately.

Self-Assessment question

1. Which of the following is NOT a step in the data processing cycle?
   A. data collection
   B. data input
   C. data storage
   D. data processing
2. All of the information (name, GPA, major, etc.) about a particular student is stored in the same _____.
   A. file
   B. record
   C. attribute
   D. field
3. Which of the following would contain the total value of all inventory owned by an organization?
   A. source document
   B. general ledger
   C. cash budget
   D. none
4. Which of the following is most likely to be a general ledger control account?
   A. accounts receivable
   B. petty cash
   C. prepaid rent
   D. retained earnings
5. Which of the following documents is most likely to be used in the expenditure cycle?
   A. sales orders
   B. credit memo
   C. receiving report
   D. job time ticket
6. Which of the following is LEAST likely to be a specialized journal?
   A. sales journal
   B. cash receipts journal
   C. prepaid insurance journal
   D. cash disbursements journal
7. How does the chart of accounts list general ledger accounts?
   A. alphabetical order
   B. chronological
   C. size order
   D. the order in which they appear in financial statements
8. Which of the following is NOT an advantage of an ERP system?
   A. better access control
   B. standardization of procedures and reports
   C. improved monitoring capabilities
   D. simplicity and reduced costs

9. Records of company data sent to an external party and then returned to the system as input are called _____.
   A. turnaround documents
   B. source data automation documents
   C. source documents
   D. external input documents

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

Discussion

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

CHAPTER THREE

THE SYSTEM DEVELOPMENT PROCESS

Chapter objectives

After studying this chapter, you should be able to:

- Prepare and use data flow diagrams to understand, evaluate, and document information systems
- Prepare and use flowcharts to understand, evaluate, and document information systems.
- Prepare and use business process diagrams to understand, evaluate, and document information systems
- explain the five phases of the systems development life cycle.
- Discuss the people involved in systems development and the roles they play.
- explain the importance of systems development planning and describe planning techniques.
- Discuss the various types of feasibility analysis and calculate economic feasibility.
- explain why system changes trigger behavioral reactions, what form this resistance to change takes, and how to avoid or minimize the resulting problems.
- Discuss the key issues and steps in systems analysis.

3.1 Introduction

Documentation explains how a system works, including the who, what, when, where, why, and how of data entry, data processing, data storage, information output, and system controls. Documentation is a vital part of any Accounting Information System.

Because we live in a highly competitive and ever-changing world, at any given time most organizations are improving or replacing their information systems. To improve and replace the information system they need to analyze the existing system and make cost benefit of the proposed system. Not only this they need to develop the system which best fit with the required information and make the company best compute in its industry. To do all this system development process is vital.

3.2 System Development and Documentation Tools and Techniques

Accountants use many different types of diagrams to trace the flow of accounting data through an Accounting Information System. A wide variety of software is available for documenting AISs. Documentation includes 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. These tools save the organization both time and money.

Importance of documentation in System Development

Depending on the job function being performed, documentation tools are important on one or more of the following levels:

1. At minimum, you must be able to read documentation to determine how the system works.
2. Internal control documentations are evaluated to identify control strengths and weaknesses and to recommend improvements.
3. The greatest amount of skill is needed to prepare documentation.

An understanding of documentation tools is required regardless of the type of accounting career chosen. For example, auditors are required to understand the client's system of internal controls before conducting an audit. In general, documentation is important as in the following manners:

- **It depicts how the system works**

Studying and reviewing written descriptions of the inputs, processing steps, and outputs of the system make the job easier.

- **It is used to give training to users**

Documentation also includes the user guides, procedure manuals, and other operating instructions that help people learn how the AIS operate.

- **It is used as a framework for designing the new systems**

Documentation helps system designers develop new systems in much the same way that blueprints help architects design buildings.

- **It is used to control system development and maintenance costs**

Good documentation helps system designers develop object-oriented SW, that is, programs that

contain modular, reusable code. This object-orientation helps programmers avoid writing duplicate programs and facilities changes when programs must be modified later.

- **It is a means of standardizing communications with others**

Documentation techniques such as flowcharts and data flow diagrams are standard industry tools, and they are more likely to be interpreted the same way by all parties viewing them.

- **It can be used as guideline for Auditing AISs**

Documentation helps auditors determine the strengths and weaknesses of a system's controls.

- **It is used for documenting business processes**

By mapping the business processes, documentation helps managers better understand the ways in

which their businesses operate.

- **It is used to establish accountability**

Basic Documentation Tools

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 Include three types:**
   1. **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.
   2. **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.
   3. **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. They are easier to use than most word processors. Once a few basic commands are mastered, users can quickly and easily prepare, store, revise, and print presentation-quality DFDs or Flowcharts.

Which method should you use — Flowcharts or DFDs?

- 62.5% of IS professionals use DFDs in USA
- 97.6% use flowcharts in USA
- Both can be prepared relatively simply using available software
- Both are tested on professional exams
- **Conclusion**: You need to know them both

Activity 3.1

1. **What is documentation?**
2. **What is the importance of documentation?**
3. **What are the types of documentation?**
4. **Which of the documentation technique is better?**

3.2.1 Data Flow Diagrams (DFDs)

A data flow diagram (DFD) graphically describes the flow of data within an organization. **Data Flow Diagrams (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. 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.

Guideline 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.

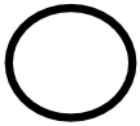
6. ***Group data flows***- a data flow consists of one or more pieces of datum. Data elements that always flow together should be grouped together and shown as one data flow until they are separated. If the data elements do not always flow together, then they should be shown as two separate data flows.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

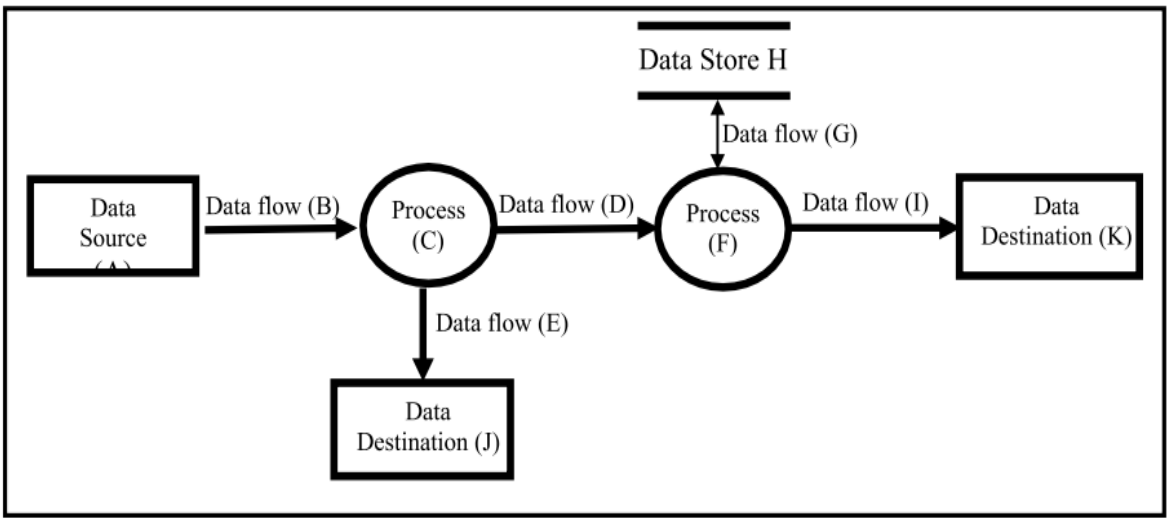
12. ***Subdivide the DFD-*** a cluttered DFD is hard to read and understand. If there are more than five to seven processes on a single page, then, **higher level and lower level DFDs** shall be used. The context diagram shall be decomposed into **high level processes**, and then exploded into successively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

Elements in a Data Flow Diagram

A DFD is composed of four basic elements: data sources and destinations, data flows, transformation processes, and data stores. Each is represented in a DFD by a unique symbol. The **Demarco & Yourdon** Symbols are as follows:

Symbol	Name	Explanation
	> Data Source and Destinations	> The people and organizations that send data to and receive data from the system are represented by square boxes. Data destinations are also referred to as data sinks.
	> Data Flows	> The flow data into or out of a process is represented by curved or straight line with arrows.
	> Transformation Processes	> The processes that transform data from inputs to outputs are represented by oval circles or circle. They are often referred to as bubbles.
	> Data Stores	> The storage of data is represented by two Horizontal lines.

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.

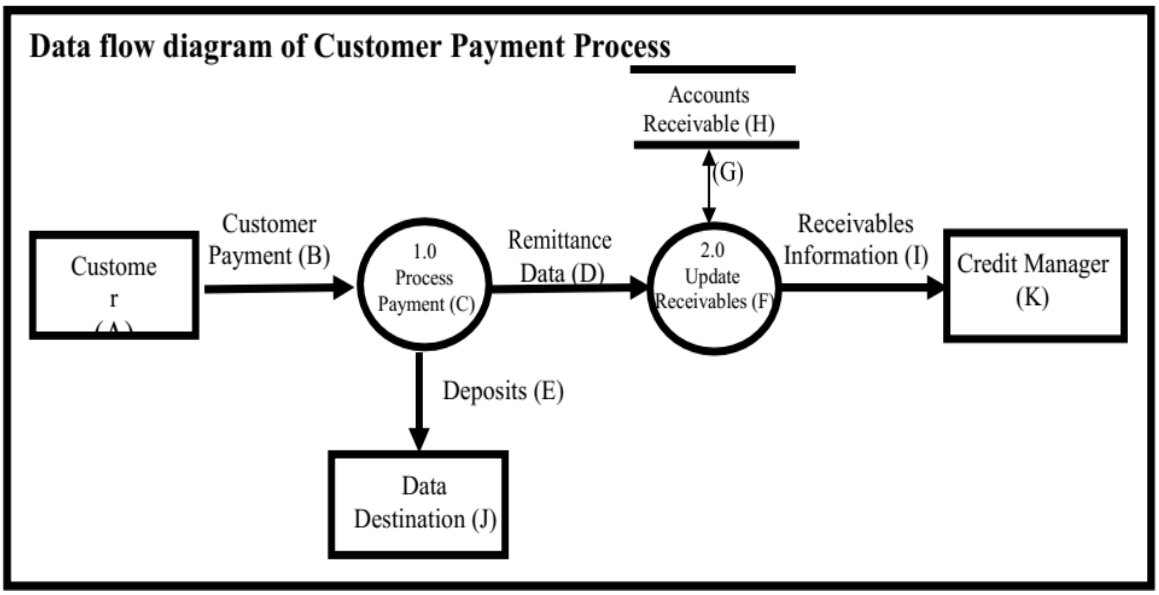


1. **Data Sources and Destinations**

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: Physical Data Flow Diagram

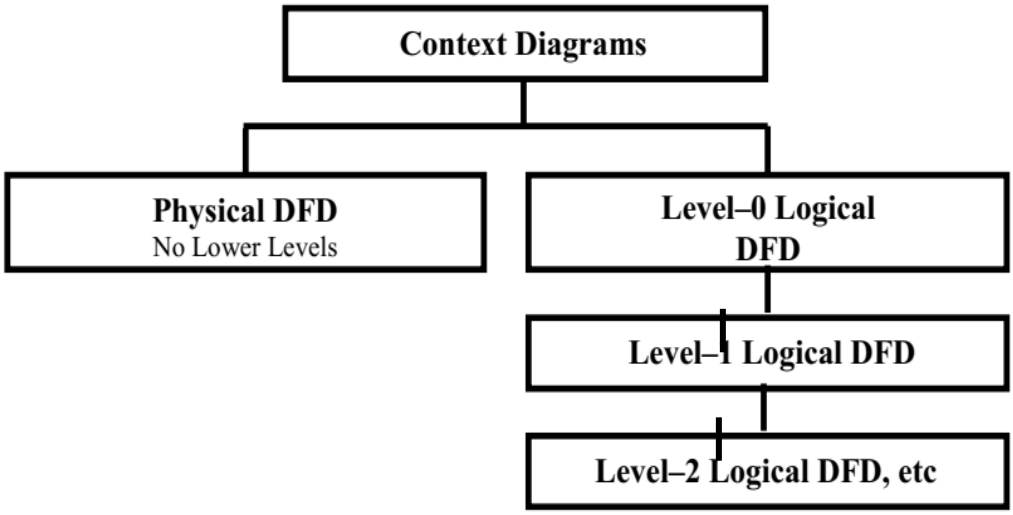
2. **Logical Data Flow Diagrams**

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 Hierarchy of Data Flow Diagrams



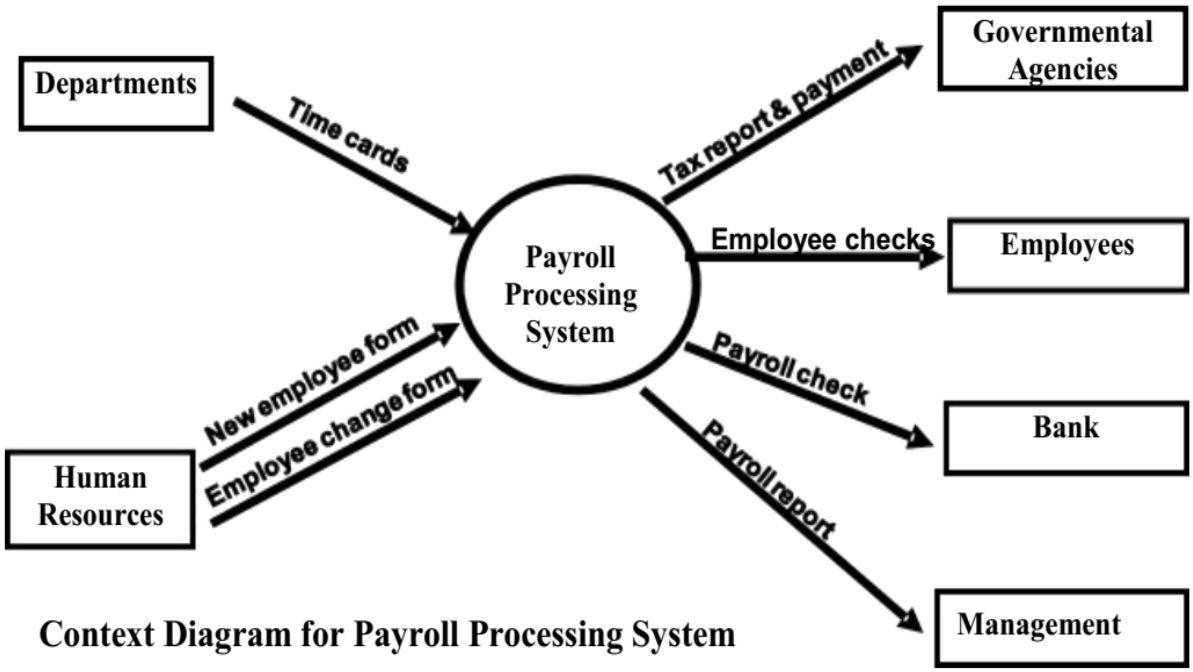
Decomposing (Subdividing) the DFD

Decomposition is the act of exploding data flow diagrams to create more detail. Data Flow Diagrams are usually drawn in levels that include increasing amounts of detail. A Context Diagram is then decomposed, or exploded, or broken down into successively lower levels of detail. The Decomposition or Subdivision into successively lower levels is made in order to provide ever-increasing amounts of detail because few systems can be diagrammed on one sheet of paper. Physical DFD is not subdivided into lower successive levels. The Logical DFD is decomposed as required. Logical DFDs typically have levels below the Level-0 Diagram. Level- 0 DFDs may be exploded into successive lower levels of detail. The next level of detail would be a Level-1 DFDs. The DFDs become linked together in a hierarchy, which would fully document the system.

For example, the following can be considered as the **Context Diagram of Payroll Processing System** for a certain company. It shows that the payroll processing system receives time card data from different departments and employees' data from the human resource department. When these data are processed, the system produces:

- >Tax reports and payments for governmental agencies
- Employee payments
- A deposit in the payroll account at the bank, and
- Payroll data for management.

The context diagram is decomposed into successively lower levels, each with an increasing amount of detail. In exploding the Context DFD the number of processing activities involved and the data inputs and outputs from each processing activity must be identified.



Context Diagram for Payroll Processing System

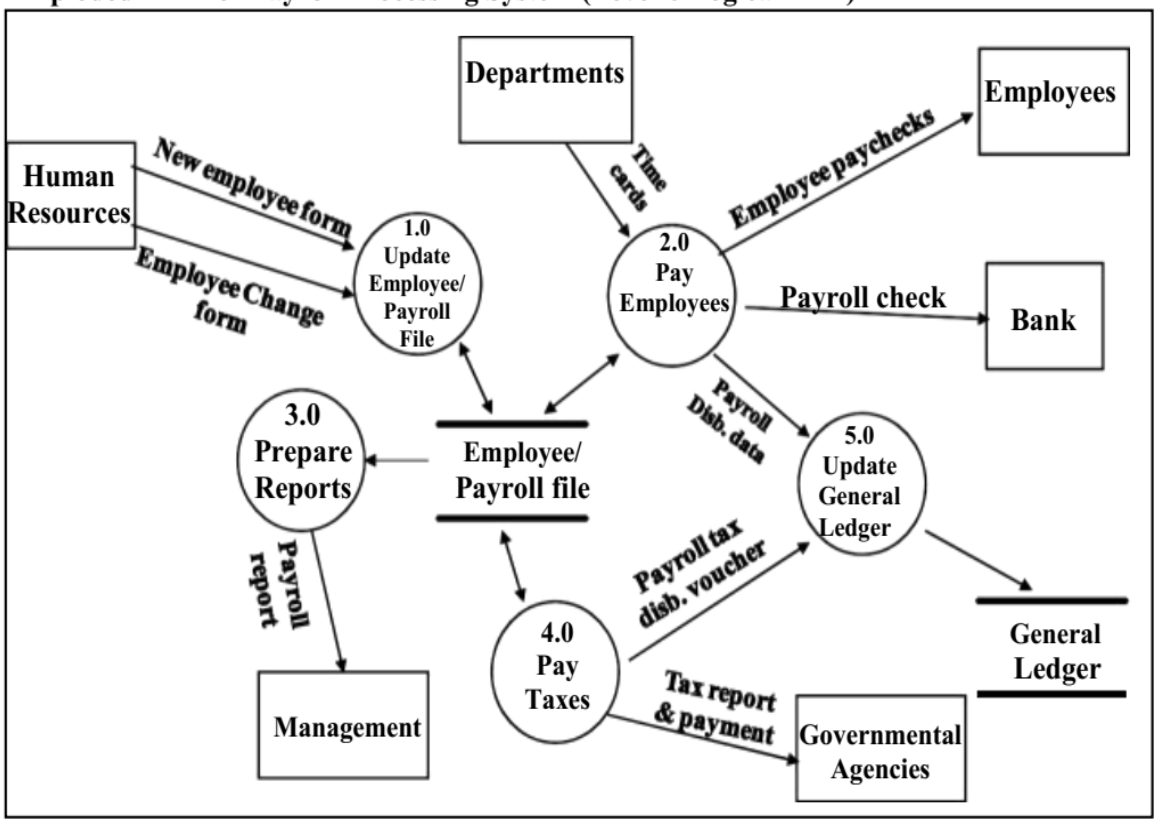
For payroll processing system, five data processing activities are identified as follows:

- The first activity is updating the employee/payroll master file
- The second activity is handling employee compensation. This activity can be broken down into smaller parts
- The third activity is generating management reports
- A fourth activity is paying taxes; and
- A fifth activity is posting entries to the general ledger

All data inflows and outflows, and the five activities that forms DFD are summarized as follows

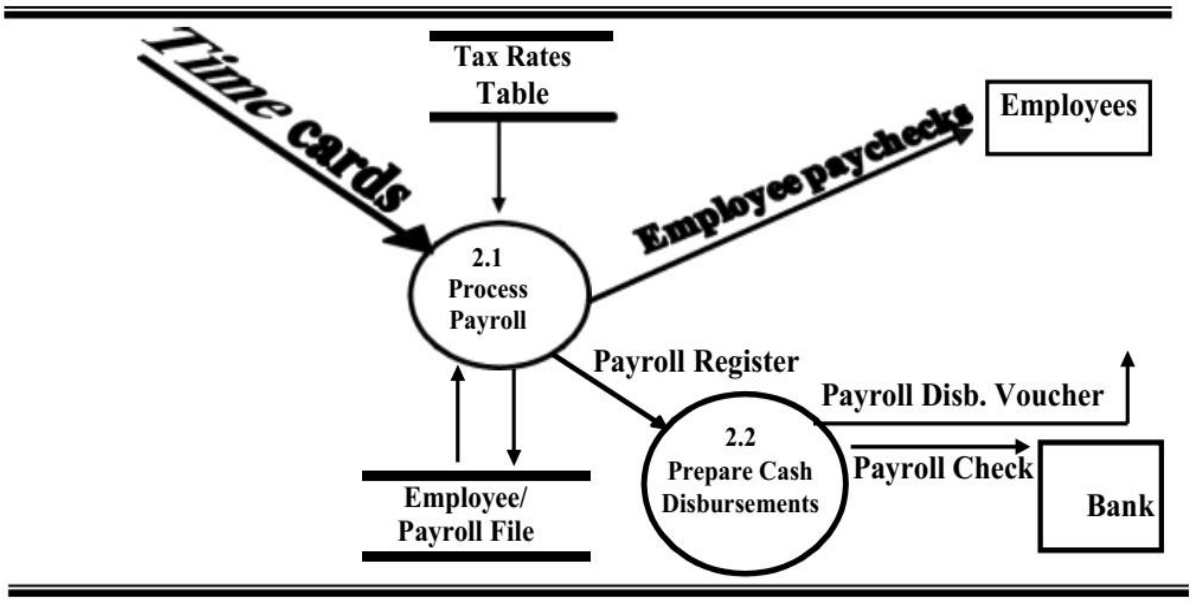
Data Inputs	Activities (Processes)	Data Outputs
New employee form Employee change form Employee/payroll file	Update Employee/Payroll file	Updated employee/payroll file
Time cards Employee/payroll file Tax rates table	Pay Employees	Employee checks Payroll register Updated employee/payroll file Payroll check Payroll cash disbursements vouchers
Employee/payroll file	Prepare Reports	Payroll report
Employee/payroll file	Pay Taxes	Tax report Tax payment Payroll tax cash disbursements voucher Update general ledger
Payroll tax cash disbursements voucher Payroll cash disbursement voucher	Update General Ledger	Updated general ledger

Exploded DFD for Payroll Processing System (Level-0 Logical DFD)



Some data inputs and outputs have been excluded from the above DFD. For example, in process 2.0, the data inflows and outflows that are not related to an external entity or to

another process are not depicted (tax tables and payroll register in this case), which does not show a greater level of detail. These data flows are internal to the "Pay Employees" activity and are shown on the next DFD Level. Suppose Process 2.0 (Pay Employees) can be further exploded in the next level as follows and the sub-processes would be numbered 2.1, 2.2, etc.



Activity 3.2

1. **What is data flow diagram?**
2. **Which guideline better helps us to move backward and forth to read data flow diagram?**
3. **Discuss the type of data flow diagram?**
4. **Discuss the elements of data flow diagram?**

3.2.2 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. The following are general guidelines for preparing flowcharts that are readable, clear, concise, consistent, and understandable.

1. Understanding a system before flowcharting it by interviewing users, developers, auditors, and management or having them complete a questionnaire as well as by reading through a narrative description of the system, or walking through system transactions.
2. Identifying the entities to be flowcharted such s departments, job functions, or external parties as well as identifying documents and information flows in the system and the activities or processes performed on the data, for instance drawing a box around the entities, a circle around the documents and a line around the activities.
3. Dividing the flowchart into columns when several entities such as departments and functions need to be shown on the flowchart with a label for each followed by flowcharting the activities of each entity in its respective columns.
4. Flowcharting only the normal flow of operations, ensuring that all procedures and processes are in proper order and identifying exception procedures by using an annotation symbol.
5. Designing the flowchart so that flow proceeds from top to bottom and from left to right.
6. Giving the flowchart a clear beginning and ending by designing where the document originated and showing the final disposition of all documents so there are no loose ends that leave the reader dangling.
7. Using the standard flowcharting symbols and drawing them with a template or a computer
8. Clearing labeling all symbols by writing a description of the input, process, or output inside the symbol. If description may not fit, annotation symbol shall be used.

9. Placing document numbers in the top right-hand corner of the symbol when using multiple copies of a document. The document numbers should accompany the symbols as it moves through the system.
10. Having an input and output for each manual processing symbol. Two documents shall not be connected directly except when moving from one column to another column.
11. Using on page connectors to avoid excess flow lines, which results in a neat looking page as well as using off-page connectors to move from one flowchart page to another. All connectors shall be clearly labeled to avoid confusion.
12. Using arrowheads on all flow lines and not assuming that the reader will know the direction of the flow.
13. Clearly labeling the pages 1 of 3, 2 of 3 etc if a flowchart cannot fit into a single page.
14. Showing documents or reports first in the column in which they are created and then moving to another column for further processing. A manual process is not needed to show documents being flowcharted.
15. Showing all data entered into or retrieved from a computer file as passing through a processing operation (a computer program) first.
16. Drawing a line from the document to a file to indicate that it is being filed. A manual process is not needed to show a document entering a file.
17. Drawing a rough sketch of the flowchart as a first effort. Concern shall be with capturing content than perfect drawing. Few systems can be flowcharted in a single draft.
18. Redesigning the flowchart to avoid clutter and a large number of crossed lines.
19. Verifying the flowchart's accuracy by reviewing it with the people familiar with the system. It shall be assured that all uses of flowchart conventions are consistent.
20. Drawing the final copy of the flowchart, placing the name of the flowchart, the date, and the preparer's name on each page.

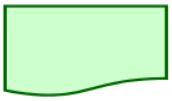
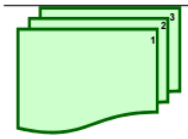
Flowchart Symbols

There are various types of symbols used to create flowcharts. Each symbol has a special meaning that is easily conveyed by its shape. The shape indicates and describes the operation performed and the input, processing, output, and storage media employed. The symbols are drawn by a software program or with a flowcharting template.

Flowcharting symbols can be divided into the following four categories:

1. **Input/output symbols**- represent devices or media that provide input to or record output from processing operations.
2. **Processing symbols**- either show what type of device is used to process data or indicate when processing is completed manually.
3. **Storage symbols**- represent the device used to store data that the system is not currently using.
4. **Flow and miscellaneous symbols**- indicate the flow of data and goods. They also represent such operations as where flowcharts begin and end, where decisions are made, and when to add explanatory notes to flowcharts.

Flowchart Symbols:

Symbol	Name	Explanation
Input/Output Symbols		
	**Document**	> Represents a document or report that is prepared by hand or printed by a computer.
	**Multiple Copies of One Document**	> Indicates multiple copies of a paper document or report. > The document copies should be numbered in the upper, right-hand corner.
	Input/output; Journal/Ledger	> Can represent any input or output on a program flowchart. It also represents accounting journals or ledgers in a document flowchart.
	Display	> Represents information displayed by an online output device such as a terminal, monitor, or screen
	Online Keying	> Represents data entry by an online device such as a terminal or personal computer
	Terminal or Personal Computer	> Combines the display and online keying symbols to represent terminals and personal computers.
	Transmittal Tape	> Represents manually prepared control totals which are to be compared to computer totals for control purposes.

Processing Symbols		
	Computer Processing	>Represents a process performed by a computer, which usually results in a change in data or information.
	Manual Operation	>Represents a processing operation that is performed manually
	Auxiliary Operation	>Represents a processing operation carried out by a device other than a computer, e.g., an optical character scanner.
	Off-line Keying Operation	>Represents an operation that uses an off-line keying device, such as a cash register or keying to a disk.
Storage Symbols		
	Magnetic disk	>Represents data stored permanently on a magnetic disk. Frequently used to represent master files and databases.
	Magnetic Tape	>Represents data stored on a magnetic tape. >Sometimes represents transaction files
	Diskette	>Represents data stored on a floppy disk or zip disk
	Online Storage	>Represents data stored in a temporary online file in a direct-access medium such as a magnetic disk.

A	**File**	>Represents a file of documents that are manually stored and retrieved. Letter indicates the ordering sequence: A = Alphabetic order; D = Date order; and N = Numeric order

Flow And Miscellaneous Symbols		
	Document or Processing Flow	>Represents the direction of processing or document flow >Normal flow is top to bottom and left to right
	Data/Information Flow	>Represents the direction of data/information flow. >Often used to show data being copied from one document to another.
	Communication Link	>Represents the transmission of data from one location to another via communication lines.
	On-page connector	>Connects processing from one location to another on the same page. Used to avoid crisscrossing lines.
	Off-page connector	>Connects the processing flow between two different pages. Signals the exit from one page and the corresponding entrance on another page.
	Terminal	>Represents the beginning, end, or a point of interruption in a process or program. >Also used to indicate an external party.
	Decision	>Represents a decision-making step. Used in a program flowchart to show branching to alternate paths.
	Annotation	>Provides for the addition of descriptive comments or explanatory notes as clarification

1) Document Flowcharts

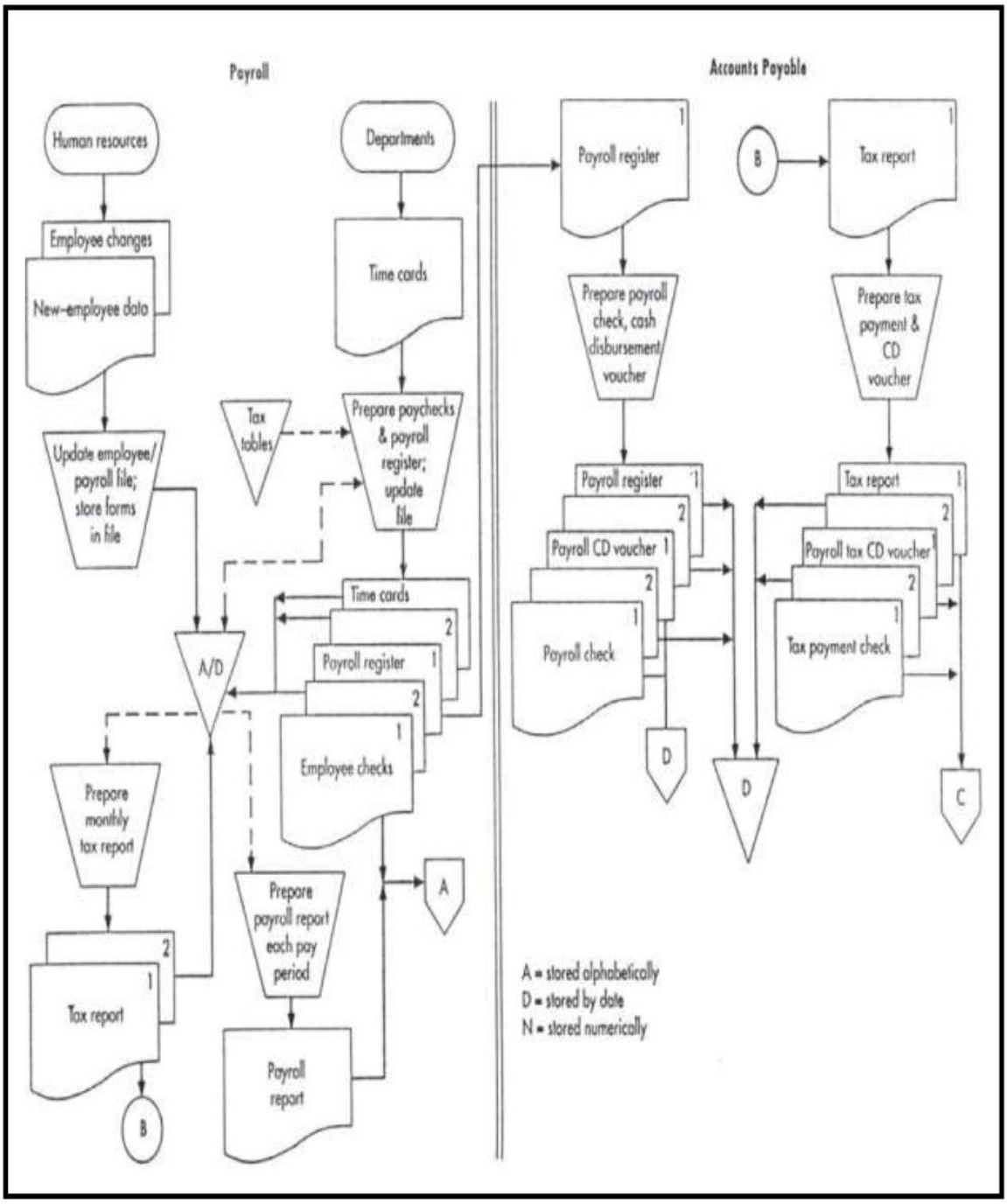
A ***document flowchart*** illustrates the flow of documents and information among areas of responsibility within an organization. Document flowcharts trace a document from its cradle to its grave. They show:

- Where each a document originates,
- Its distribution,
- The purposes for which it is used,
- Its ultimate disposition, and
- Everything that happens as it flows through the system.

A document flowchart is particularly useful in analyzing the adequacy of control procedures in a system, such as internal checks and segregation of duties. Flowcharts that describe and evaluate internal controls are often referred to as **internal control flowcharts**. The document flowchart can reveal weaknesses or inefficiencies in a system, such as inadequate communication flows, unnecessary complexity in document flows, or

procedures responsible for causing wasteful delays. They also can be prepared as part of the system design process and should be included in the documentation of an information system.

Following is a typical example of how a **Document Flowchart** can be designed:



2) System Flowcharts

System flowcharts depict the relationship among the input, processing, and output of an AIS. A system flowchart begins by identifying both the inputs that enter the system and their origins. These inputs can be:

- New data
- Data stored for future use
- Both

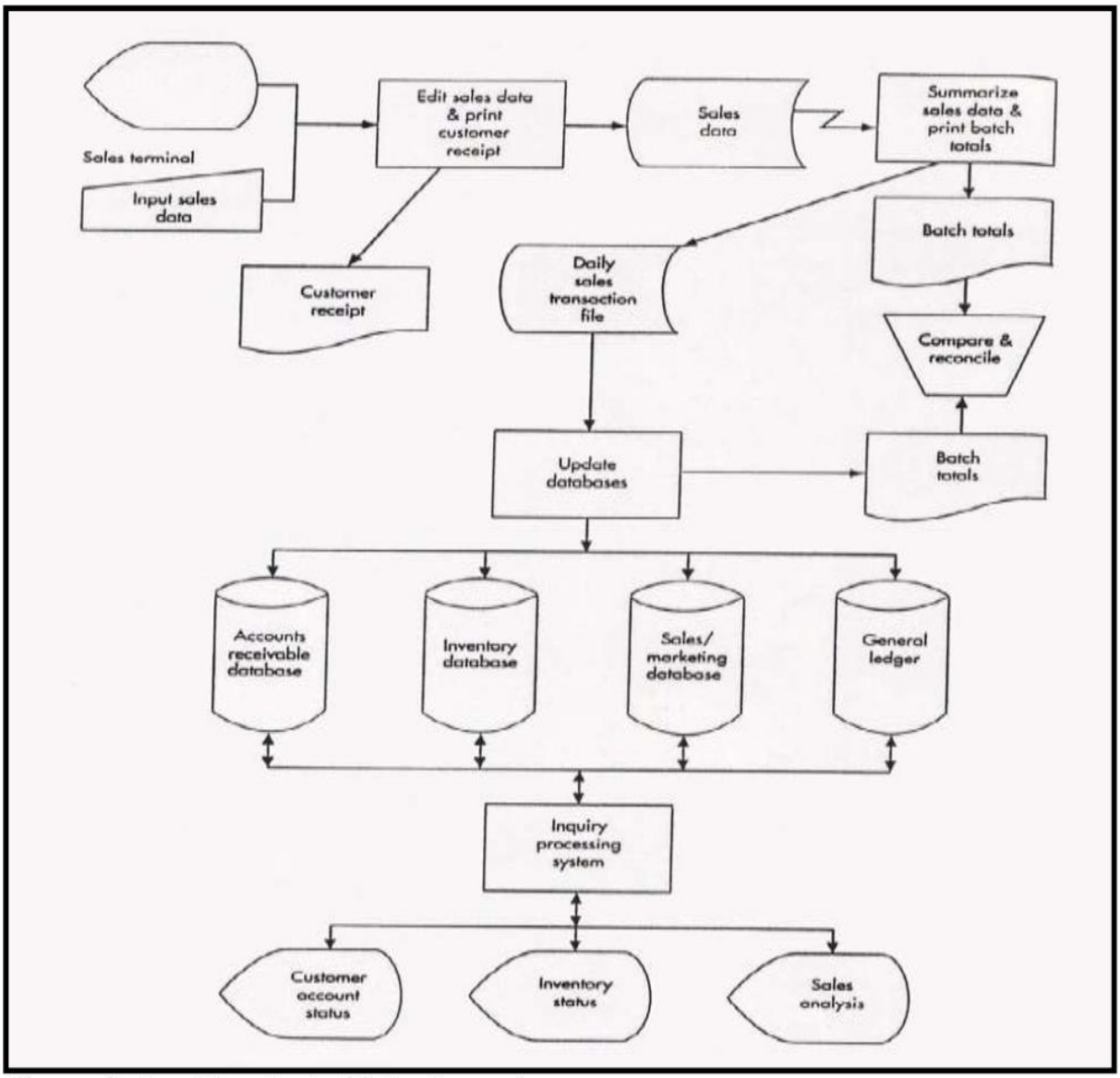


Figure: System Flowchart of Sales Processing

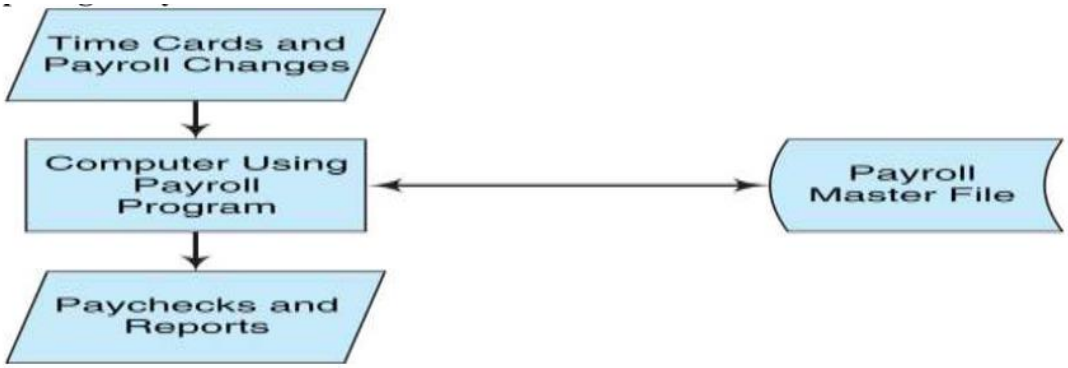
The input is followed by the processing portion of the flowchart. The input is followed by processing portion of the flowchart that is the steps performed on the data. The logic the computer uses to perform the processing task is shown on a program flowchart. That is, if the process is performed by a computer, the logic of the computer program would be depicted in a program flowchart. The resulting new information is **the output component**, which can be stored for later use, displayed on a screen, or printed on paper. In many instances, the output from one process is an input to another.

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

A system flowchart depicts the relationship among the inputs, processes, and outputs of an AIS.

- The system flowchart begins by identifying the inputs to the system.
- Each input is followed by a process, i.e., the steps performed on the data.
- The process is followed by outputs—the resulting new information.
- In other words, it's the same basic input – process – output pattern that we saw in the document flowchart.

See the above System Flow Chart of Sales Processing and the Following System Flowchart for Preparing a Payroll

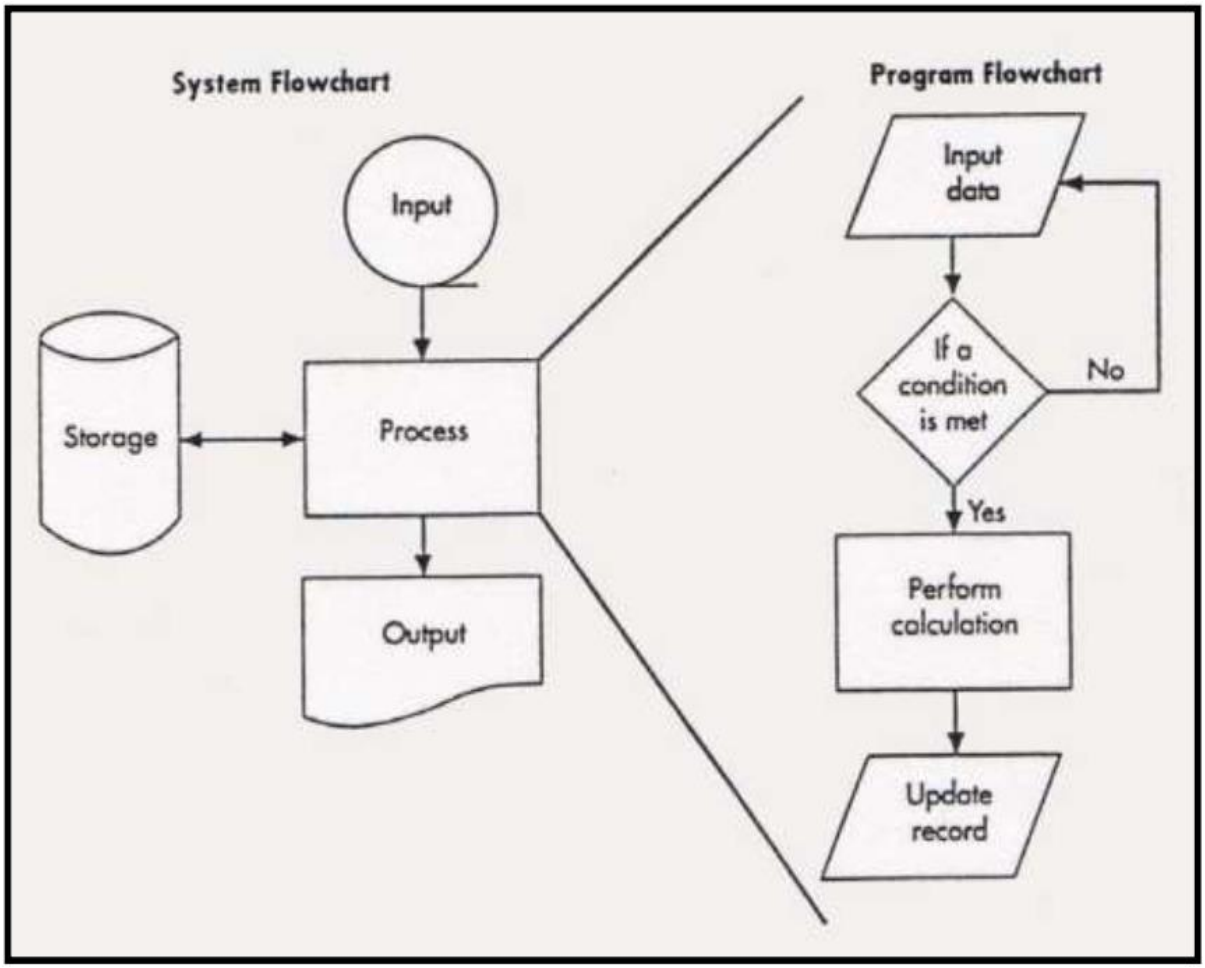


3) Program Flowcharts

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.

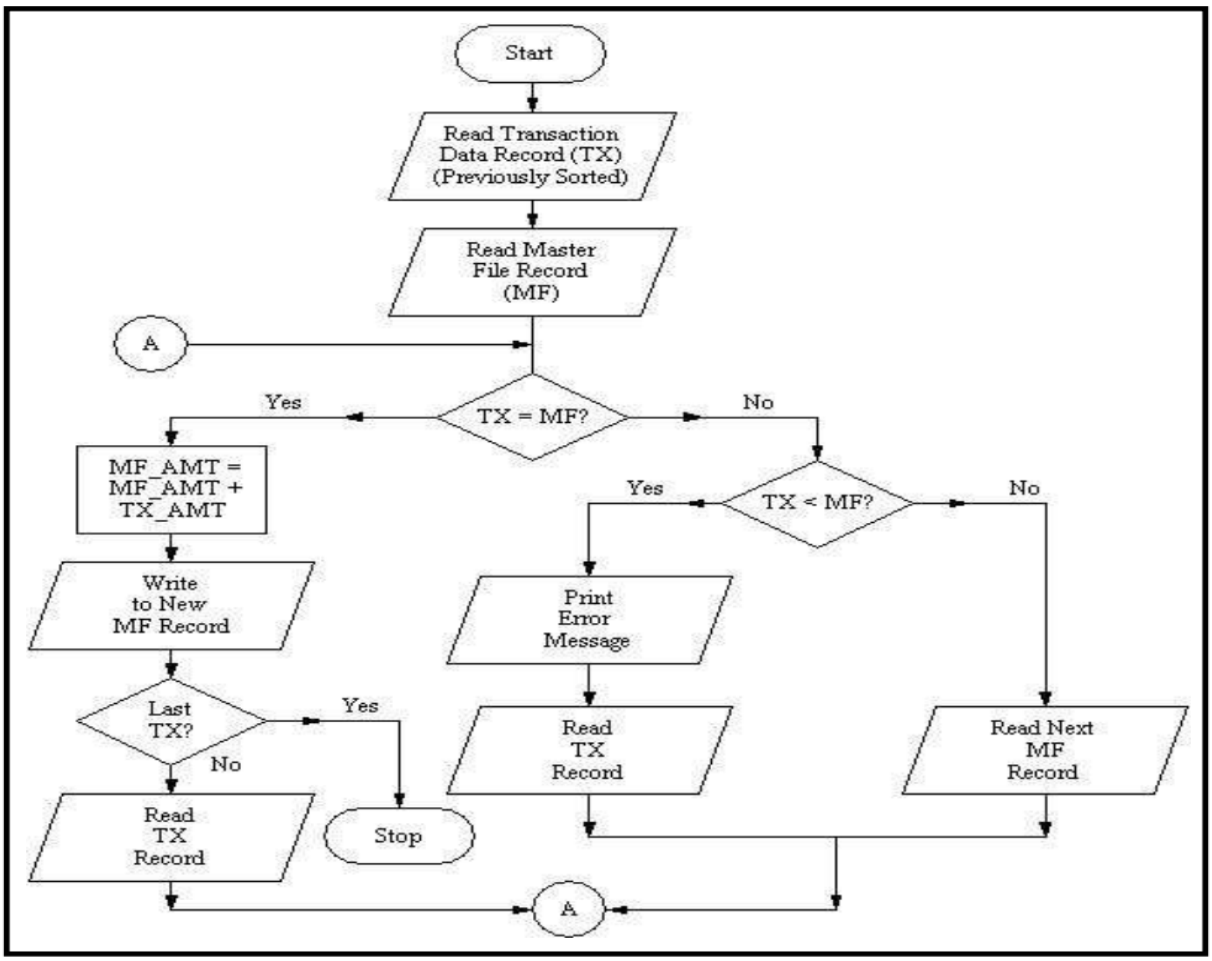
- The input/output symbol represents either reading of input or writing of output.
- The decision symbol represents a comparison of one or more variables and the transfer of flow to alternative logic paths.
- All points where the flow begins or ends are represented by the terminal symbol.



Differences between DFDs and Flowcharts

- 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.



Activity 3.3

1. **Discuss the different types of symbols used in system flow charts?**
2. **Discuss different types of flowcharts?**
3. **What is difference between flowcharts and dataflow diagram?**

3.3 The Systems Development Process

3.3.1 Introduction to Systems Development and Systems Analysis

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.

This Topic Discusses Five Subtopics:

1) Systems development life cycle – process that organizations follow to obtain and implement a new AIS
2) Planning activities during the systems development life cycle
3) Feasibility analysis
4) Behavioral aspects of change
5) Systems analysis

3.3.1.1 The Systems Development Life Cycle

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.

Various SDLC methodologies have been developed to guide the processes involved, including: The Waterfall Model (Which Was the Original SDLC Method); Rapid Application Development (RAD); Joint Application Development (JAD); The Fountain Model; The Spiral Model; Build and Fix; And Synchronize-And-Stabilize.

Frequently, several models are combined into some sort of hybrid methodology. Documentation is crucial regardless of the type of model chosen or devised for any application, and is usually done in parallel with the development process. Some methods

work better for specific types of projects, but in the final analysis, the most important factor for the success of a project may be how closely the particular plan was followed.

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 five stages in the systems development life cycle are: (1) Systems analysis; (2) Conceptual Design; (3) Physical Design; (4) Implementation and Conversion; and (5)

Operation and Maintenance

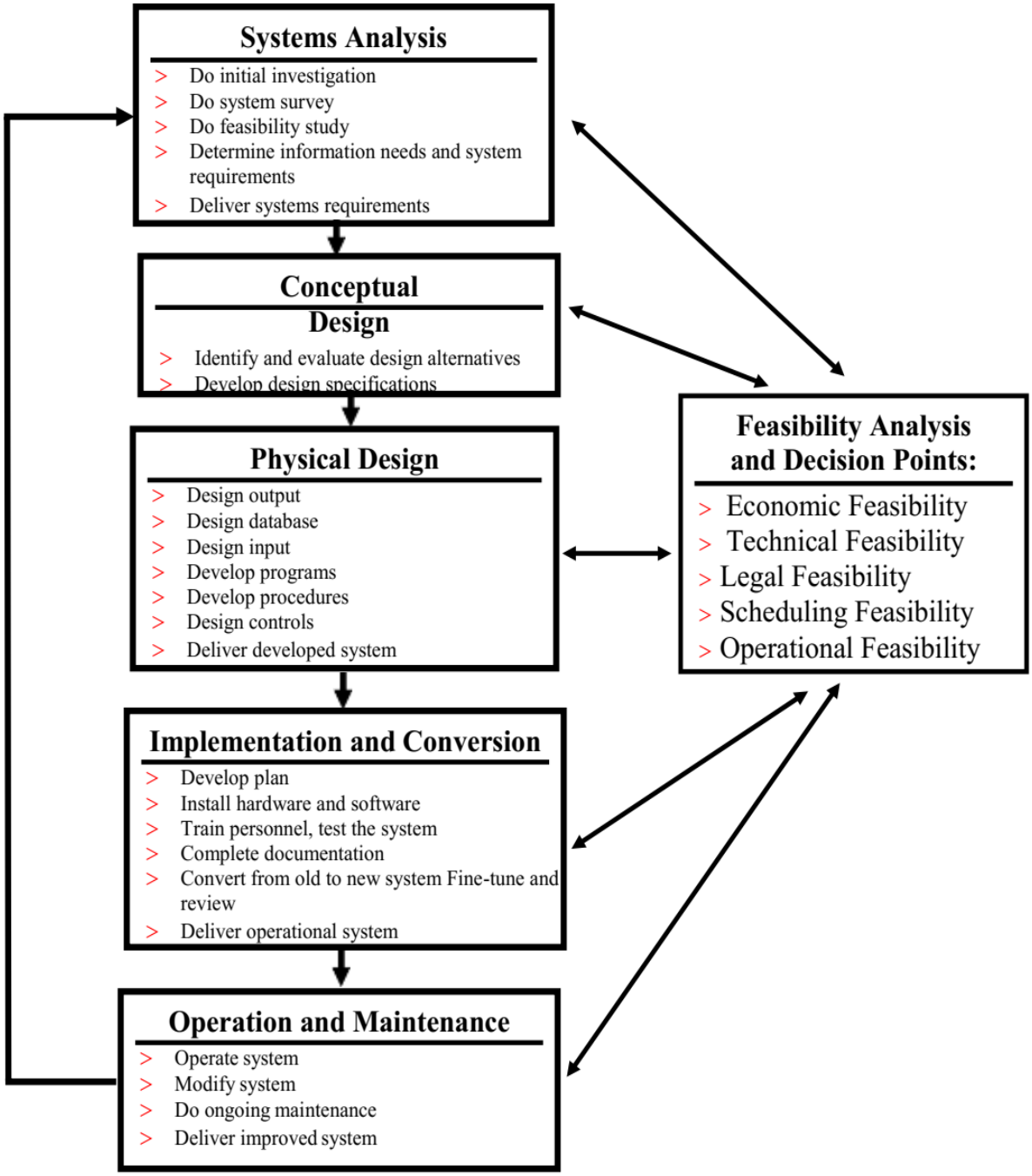


Figure: The Systems Development Life Cycle

In addition to **these five phases**, the following three activities are preformed throughout the life cycle; ***Planning Systems Development; Assessing the ongoing Feasibility of the Project; and Managing Behavioral Reactions to Change.***

The Key Players in System Development Process

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

1. **Top Management**

Management's most important systems development roles are to emphasize the importance of involving users in the process, to provide support and encouragement for development projects, and to align systems with corporate strategies. Other key roles include establishing system goals and objectives, selecting system department leadership and reviewing their performance, establishing policies for project selection and organizational structure, and participating in important system decisions. User management determine information requirements, assist analysts with cost and benefit estimates, assign staff to development projects, and allocate funds for development and operation.

2. **Users**

AIS users communicate their information needs to system developers. As project development team or steering committee members, they help manage systems development. As requested, accountants help design, test, and audit the controls that ensure the accurate and complete processing of data.

3. **The Information Systems Steering Committee**

Information systems steering committee is high-level management who plan and oversee the Information System function, setting Information System policies that govern the accounting Information System, ensuring top-management guidance and control, and coordinating and integrating systems activities.

An executive level **information system steering committee** plans and oversees the information systems function. It consists of high-level management, such as the controller and systems and user-department management. The steering committee sets AIS policies; ensures top-management participation, guidance, and control; and facilitates the coordination and integration of systems activities.

4. **The Project Development Team**

Each development project has a team of systems analysts and specialists, managers, accountants, and users to guide its development. Team members plan each project, monitor it to ensure timely and cost-effective completion, make sure proper consideration is given to the human element, and communicate project status to top management and the steering committee. They should communicate frequently with users and hold regular meetings to consider ideas and discuss progress so that there are no surprises upon project completion. A team approach usually produces better results and facilitates user acceptance of the system.

5. **Systems Analysts**

Systems analysts people who help users determine their information needs, study existing systems and design new ones, and prepare specifications used by computer programmers. **Systems analysts** help users determine their information needs, study existing systems and design new ones, and prepare the specifications used by computer programmers. Analysts interact with employees throughout the organization to bridge the gap between the user and technology. Analysts are responsible for ensuring that the system meets user needs.

6. **Computer programmers**

Computer programmers' people who write and test programs using the specifications developed by the analysts and modify and maintain existing computer programs.

Computer programmers write and test programs using the specifications developed by systems analysts. They also modify and maintain existing computer programs.

7. **External Players**

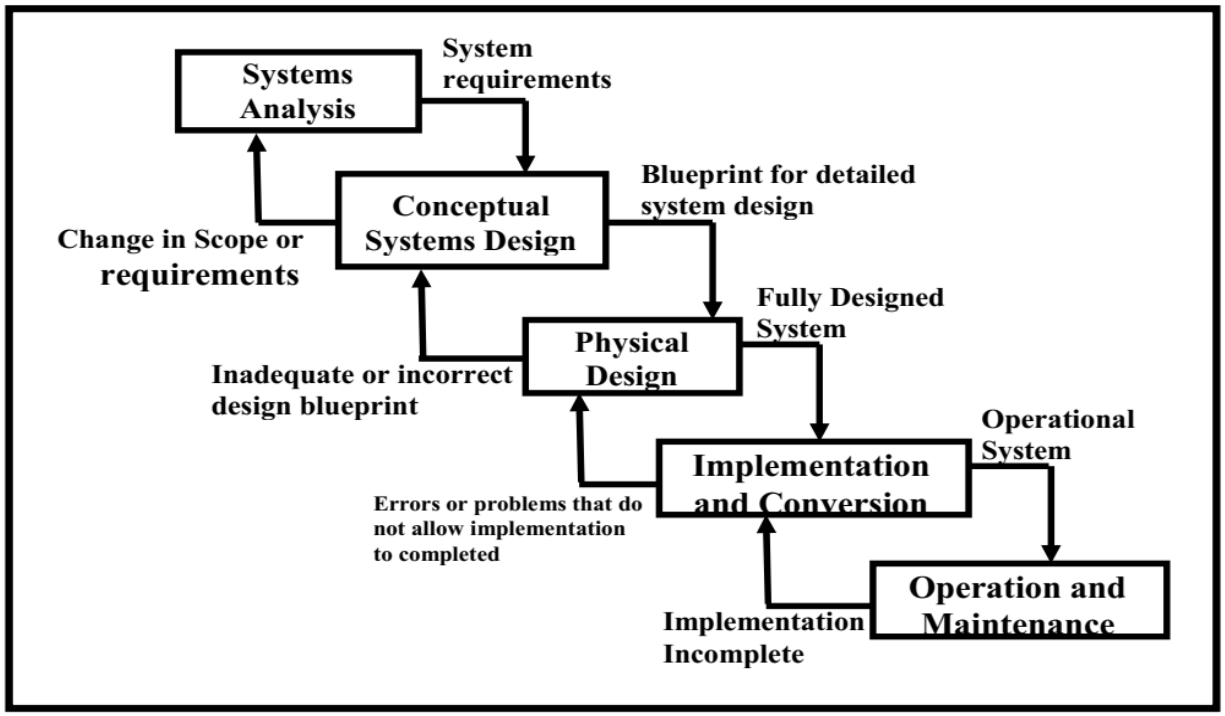
Customers, vendors, external auditors, and governmental entities play a role in systems development. For example, Walmart vendors are required to implement and use electronic data interchange (EDI).

3.3.1.2 Planning Systems Development

Several activities must be performed at various times throughout the System Development Life Cycle. One of these activities is planning. The organization should have plans for ***the long range, each systems development project, and each phase of each systems development project.*** **T**his sub-topic discusses these plans and a number of techniques to develop them.

Planning has distinct advantages. It enables the system's goals and objectives to correspond to the organization's overall strategic plan. Systems are more efficient, subsystems are coordinated, and there is a sound basis for selecting new applications for development. The company remains abreast of the ever-present changes in information technology (IT). Duplication, wasted effort, and cost and time overruns are avoided. The system is less costly and easier to maintain. Finally, management is prepared for resource needs, and employees are prepared for the changes that will occur.

When a system is poorly planned, a company must often return to a prior phase and correct errors and design flaws. These returns are costly and result in delays, frustration, and low morale. See the next diagram.



Two types of systems development plans are needed:

a) Individual project plans developed by the project teams (Project Plans)
b) A master plan developed by the IS steering committee (Master Plan)

a) Individual project plans developed by the project teams

Project development plan Document showing project requirements (people, hardware, software, and financial), a cost benefit analysis, and how a project will be completed (modules or tasks to be performed, who will perform them, and completion dates).

A project development plan, prepared by the project team, contains a cost–benefit analysis, developmental and operational requirements (people, hardware, software, and financial), and a schedule of the activities required to develop and operate the new application.

b) A master plan developed by the IS steering committee

Master plan It describes what a system will consist of, how it will be developed, who will develop it, when it will be developed, how needed resources will be acquired, the status of projects in process, the prioritization of planned projects, and the prioritization criteria.

A long-range master plan, prepared by the information systems steering committee, specifies what the system will consist of, how it will be developed, who will develop it, how needed resources will be acquired, and where the AIS is headed. It describes the status of projects in process, prioritizes planned projects, describes the criteria used for prioritization, and provides development timetables. Projects with the highest priority are developed first. A three-year planning horizon is common, with the plan updated quarterly or monthly

Planning Techniques

Two techniques for scheduling and monitoring systems development activities are: Program Evaluation and Review Technique (PERT) and Gantt Charts.

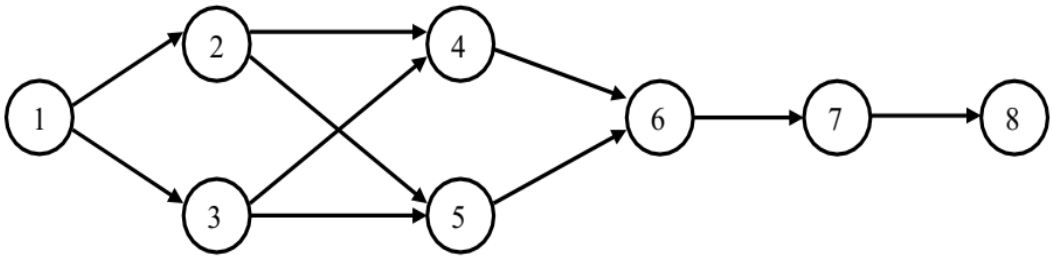
A) PERT (Program Evaluation and Review Techniques);

Program evaluation and review technique (pert) - a way to plan, develop, coordinate, control, and schedule systems development activities; all activities, and precedent and subsequent relationships among activities, are identified and shown on a pert diagram.

The program evaluation and review technique (PERT) requires that all activities and the precedent and subsequent relationships among them be identified. The activities and relationships are used to draw a PERT diagram, which is a network of arrows and nodes representing project activities that require an expenditure of time and resources and the completion and initiation of activities. Completion time estimates are made, and the critical path—the path requiring the greatest amount of time—is determined. If any activity on the critical path is delayed, then the whole project is delayed. If possible, resources can be shifted to critical path activities to reduce project completion time

Sample PERT Chart

- Building and selling a doghouse
- Each block contains a task and a time estimate (may include best time, worst time, and average time)
- May indicate who will be responsible for the task



1. Design doghouse; 2 weeks
2. Buy Wood & Nails; 1 week
3. Buy Paint; 1 week
4. Build Base; 2 weeks
5. Build Roof; 1 week
6. Nail Together; 2 weeks
7. Paint & Decorate; 3 weeks
8. Sell; 2 weeks

B) Gantt Chart

Gantt chart - a bar graph used for project planning. It shows project activities on the left, units of time across the top, and the time each activity is expected to take as a horizontal bar. A Gantt chart is a bar chart with project activities on the left-hand side and units of time across the top. For each activity, a bar is drawn from the scheduled starting date to the

ending date, thereby defining expected project completion time. As activities are completed, they are recorded on the Gantt chart by filling in the bar; thus, at any time it is possible to determine which activities are on schedule and which are behind. The primary advantage of the Gantt chart is the ability to show graphically the entire schedule for a large, complex project, including progress to date and status. A disadvantage is that the charts do not show the relationships among project activities.

See the following Gantt chart:

A) = Complete
B) = Testing
C) = In Development
D) = Not yet started
E) ◆ = Milestone

	Period									
	1	2	3	4	5	6	7	8	9	10
Organize Implementation Team										
Prepare System Support Procedures										
Develop Conversion and Testing Plan										
Prepare Program Specifications										
Revise System Documentation										
Perform Programming Tasks										
System Test and Install System										
Acceptance Test and Conversion										

Activity 3.4

1. **Why information system improved/changed?**
2. **What are steps used in system development life cycle?**
3. **Discuss the key players in system development process?**
4. **Identify the planning techniques?**

3.3.1.3 Feasibility Analysis

Feasibility study - an investigation to determine whether it is practical to develop a new application or system. During the systems analysis phase, a feasibility study (also called a business case) is prepared and is updated during the remaining steps in the SDLC. The extent of the feasibility study depends on the size and nature of the system. Feasibility team should include Management, Accountants skilled in controls and auditing, Systems personnel, and Users

At major decision points, the steering committee reassess feasibility to decide whether to terminate a project, proceed unconditionally, or proceed if specific problems are resolved. Early go/no-go decisions are particularly important because each subsequent SDLC step requires more time and monetary commitments. The further along a development project is, the less likely it is to be canceled if a proper feasibility study has been prepared and updated. Although uncommon, systems have been scrapped after implementation because they did not work or failed to meet an organization's needs.

The five important aspects need to be considered during a feasibility study are:

1) Technical feasibility: Determining if a proposed system can be developed given the available technology.
2) Operational feasibility: Determining if the organization has access to people who can design, implement, and operate the proposed system and if employees will use the system.
3) Legal feasibility: Determining if a proposed system will comply with all applicable federal and state laws, administrative agency regulations, and contractual obligations.
4) Scheduling feasibility: Determining if a proposed system can be developed and implemented in the time allotted.
5) Economic feasibility: Determining whether system benefits justify the time, money, and resource

Economic feasibility is now discussed in greater depth.

Calculating Economic Feasibility

Economic feasibility is probably the most important and frequently analyzed aspect. Economic feasibility requires a careful investigation of costs and benefits of a proposed system. It typically uses a capital budgeting model that considers: cost savings and other benefits, initial outlay costs, operating costs and Other costs.

When possible, benefits and costs should be estimated and included even if they are not easily quantifiable. If some costs and benefits cannot be accurately estimated, they should at least be listed, along with the likelihood of their occurrence and their expected impact.

Benefits might include: Cost savings, Improved customer service, productivity, decision making, or data processing, better management control and increased job satisfaction and employee morale.

On the hand the Costs might include: Equipment costs – initial outlay plus ongoing operating costs, software costs – costs of acquiring, maintaining, supporting, and operating, human resource costs – salaries, as well as costs of hiring, training, and relocating staff, site preparation costs, installation and conversion costs, supplies costs, overhead costs, financial charges and operating costs - the primary operating cost is maintaining the system.

Capital Budgeting

Most organizations use a capital budgeting return on investment technique to evaluate the economic merits of different system alternatives. There are three commonly used capital budgeting techniques:

Payback period - calculates the number of years before the new savings from the project equal the initial cost of the investment. Select projects with shorter payback periods.

Net present value (NPV) - calculates and sums the discounted future cash flows of the costs and benefits. Select projects with higher positive NPV.

Internal rate of return (IRR) – calculates the effective interest rate that would result in a net present value of zero for the project. Select projects with higher IRRs.

3.3.1.4 Behavioral Aspects of Change

Behavioral aspects of change the positive and negative way people react to change managing these behavioral reactions is crucial to successfully implementing a new system. Individuals involved in systems development are agents of change who are continually confronted by people's reaction and resistance to change. The best system will fail without the support of the people it serves. So, the behavioral aspects of change are crucial. You need to be aware of and sensitive to the types of behavioral problems that can result from change.

Why Behavioral Problems Occur?

Employees will tend to view change as good if they believe it will affect them positively and vice versa. To minimize adverse behavioral reactions, one must first understand why resistance occurs. Some of the more important factors include the following:

- ✓ **Fear**. People fear the unknown, losing their jobs, losing respect or status, failure, technology and automation, and the uncertainty accompanying change.
- ✓ **Top-management support**. Employees who sense a lack of top-management support for change wonder why they should endorse it.
- ✓ **Experience with prior changes.** Employees who had a bad experience with prior changes are more reluctant to cooperate.
- ✓ **Communication.** Employees are unlikely to support a change unless the reasons behind it are explained.
- ✓ **Disruptive nature of change.** Requests for information and interviews are distracting and place additional burdens on people, causing negative feelings toward the change that prompted them.
- ✓ **Manner in which change is introduced.** Resistance is often a reaction to the methods of instituting change rather than to change itself. The rationale used to sell the system to top management may not be appropriate for lower-level employees. The elimination of menial tasks and the ability to advance and grow are often more important to users than are increasing profits and reducing costs.

- ✓ **Biases and emotions.** People with emotional attachments to their duties or coworkers may not want to change if those elements are affected.
- ✓ **Personal characteristics and background**. Generally speaking, the younger and more highly educated people are, the more likely they are to accept change. Likewise, the more comfortable people are with technology, the less likely they are to oppose changes.

How People Resist AIS Changes?

Resistance to change often takes one of three forms:

1. **Aggression** – behavior intended to destroy, cripple, or weaken the system's effectiveness. Examples: Increased error rates, disruptions, or deliberate sabotage.
2. **Projection** – blaming the new system for any and every unpleasant occurrence, i.e., the system becomes a scapegoat. To preserve the integrity of the system, these criticisms must be controlled or answered.
3. **Avoidance -** "If I don't use this thing, maybe it will go away!" resistance to change where users ignore a new Information System in the hope that the new system will eventually go away.

Overcoming behavioral problems to changes

Reactions to change can be improved by observing the following guidelines:

- ➢ ***Meet user's needs*** with respect to the form, content, and volume of system output.
- ➢ ***Keep communication lines open***. Managers and users should be fully informed about: What changes are being made; why the change is made; how it will benefit them. This helps employees identify with the company's efforts and feel they are key players in the company's future goals and plans. It also helps prevent rumors and misunderstandings. Employees should be told whom they can contact if they have questions or concerns.
- ➢ ***Obtain management support***. Appoint a champion who can provide resources and motivate others to assist and cooperate with systems development.
- ➢ **Involve users.** Those affected by the system should participate in its development by making suggestions and helping make decisions. To avoid misunderstandings,

users should be told which suggestions are being used and how, and which are not and why. Participation is ego enhancing, challenging, and intrinsically satisfying. Users who participate in development are more knowledgeable, better trained, and more committed to using the system.

- **Allay fears, and stress new opportunities.** Users are vitally interested in how system changes affect them personally. Address their concerns and provide assurances (to the extent possible) that job losses and responsibility shifts will not occur—for example, through relocation, attrition, and early retirement. If employees are terminated, provide severance pay and outplacement services. Emphasize that the system may provide advancement opportunities and greater job satisfaction because the job has become more interesting and challenging.
- **Avoid emotionalism.** When logic vies with emotion, it rarely stands a chance. Emotional issues should be allowed to cool, handled in a nonconfrontational manner, or sidestepped.
- **Provide training.** Effective use and support are not possible if users do not understand the system. User training needs are often underestimated.
- **Reexamine performance evaluation.** Performance standards and criteria should be reevaluated to ensure that they are congruent with the new system.
- **Test the system.** The system should be properly tested prior to implementation to minimize initial bad impressions.
- **Keep the system simple, and humanize it.** Avoid complex systems that cause radical changes. Make the change as simple as possible by conforming to existing organizational procedures. The new system is unlikely to be accepted if individuals believe the computer is controlling them or has usurped their positions.
- **Control users' expectations.** A system is sold too well if users have unrealistic expectations of its capabilities and performance. Be realistic when describing the merits of the system.

Activity 3.5

1. **What is feasibility analysis?**
2. **What are the methods used to calculate economic feasibility?**
3. **Why behavioral problems occur during the change?**
4. **How do people resist change and what are possible over coming methods?**

3.3.2 Completing Systems Development Life Cycle

Phase-1: Systems Analysis

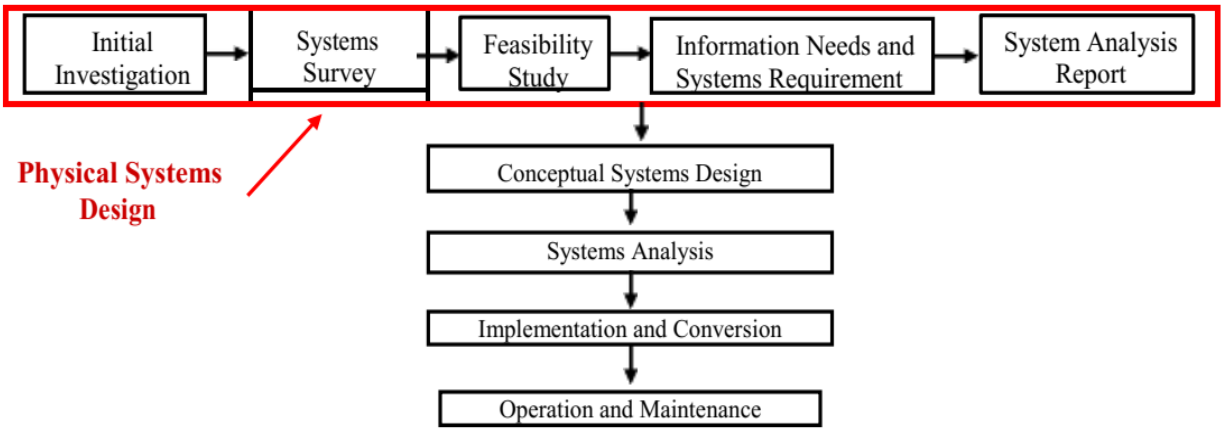
As organizations grow and change, management and employees recognize the need for more or better information and request a new or improved information system. The first step in systems development is systems analysis. During systems analysis, the information needed to purchase or develop a new system is gathered. Requests for systems development are prioritized to maximize the use of limited development resources. If a project passes the initial screening, the current system is surveyed to define the nature and scope of the project and to identify its strength and weaknesses. Then an in-depth study of the proposed system is conducted to determine its feasibility. If the proposed system is feasible, the information needs of system users and managers are identified and documented. This is the most important part of systems analysis, as these needs are used to select or develop a new system. To summarize the work done during systems analysis, a report is prepared and submitted to the information systems steering committee.

Since System analysis is too costly (in terms of time, effort, money, etc), it is mostly started after the project is approved and green light is obtained from the management. When a new or improved system is needed, a written ***request for systems development*** is prepared. The

request describes the current system's problems, why the change is needed, and the proposed system's goals and objectives. It also describes the anticipated benefits and costs. When a new or improved system is needed, a written request for systems development is prepared. That request describes the current system's problems; the reasons for the proposed changes; the goals and objectives of a proposed system; and the anticipated benefits and costs. In general, system analysis is the stage of studying the current business system; understanding how the existing system works; determining the weakness and strength of the existing system; and defining the business needs and requirements (user requirement determination and system requirement determination independent of technology issues), etc

There are five steps in the system analysis phase:

- Initial Investigation
- Systems Survey
- Feasibility Study
- Information Needs and Systems Requirements
- Systems Analysis Report



A. **Initial investigation**- is conducted to screen projects. It involves; gathering the information needed to buy or develop a new system and determining whether it is a priority and gaining a clear picture of the problem or need – sometimes what is thought to be the cause of the problem is not the real source. Determining the project's viability

and expected costs and payoffs, evaluating the project's scope and the nature of the new AIS, and Recommending whether to continue the development project as proposed or modified or abandon.

At this stage the exact nature of the problems under review must be determined. If the project is approved: A proposal to conduct systems analysis is prepared, the project is assigned a priority and added to the master plan, the development team begins a survey of the existing AIS and the proposal will be modified as more information becomes available.

B. Systems survey- at this stage, an extensive study of the current AIS is undertaken. It may take weeks or months depending on the complexity and the scope of the system. The objectives of a system survey include:

- Gain a thorough understanding of the company operations, policies, and procedures; data and information flows; AIS strengths and weaknesses; and available hardware, software, and personnel.
- Make preliminary assessment of current and future processing needs, and determine the extent and nature of the changes needed.
- Develop working relationships with users and build support for the AIS
- Collect data that identify user needs, conduct a feasibility analysis and make recommendations to management.

Data about the current AIS is gathered from employees and from documentation such as organizational charts and procedure manuals. External sources include consultants, customers and suppliers, industry associations, and government agencies.

Methods of Collecting Data are:

Interviews – is a tool that helps to collect data which is answers to "why" questions: why is there a problem? Why does the AIS work this way? Why is this information important?

Questionnaires – questionnaires can be used when the amount of information to be gathered is small and well defined.; the information is to be obtained from many people or from those who are remotely located; and the information is intended to verify data from other sources

Observation – is used to verify information gathered using other approaches and to determine how a system actually works, rather than how it should work.

System Documentation – describes how the AIS is intended to work. Throughout the systems survey, the project team should be alert to differences between intended and actual systems operation. Systems documentation – a complete description of how the system is supposed to work, including questionnaire copies, interview notes, memos, document copies, and models.

Systems analysis work is documented so it can be used throughout the development project. Documentation consists of questionnaire copies, interview notes, memos, document copies, and models. **Physical models** illustrate how a system functions by describing document flow, computer processes performed, the people performing them, and the equipment used. **Logical models** focus on essential activities (what is being done) and the flow of information, not on the physical processes of transforming and storing data. Once data gathering is complete, the team evaluates the AIS's strengths and weaknesses to develop ideas for designing and structuring the new AIS. When appropriate, strengths are retained and weaknesses corrected. The systems survey culminates with a systems survey report. Sometimes, revolutionary rather than evolutionary change is needed, called re-engineering. The system survey culminates with a system survey report. The report is supported by documentation such as memos, interview and observation notes, etc.

Joint Application Design (JAD) - started in late 1970s at IBM. It brings together key users, managers and systems analysts involved in the analysis of the current system. Its structure of roles and its agenda differentiates it from group interview. The purpose is to collect system requirements simultaneously from key people. It should be conducted off-site – away from the normal work place for the people involved to minimize distraction

C. **Feasibility study-** a more thorough feasibility analysis is conducted to determine the project's viability. Especially important is economic feasibility. The feasibility analysis is updated as the project proceeds and costs and benefits become clearer.

D. **Information needs and systems requirements-** once a project is deemed to be feasible, the company identifies the information needs of the AIS users and documents system requirements, which include:

- Processes – describes what is to be done and by whom.
- Data elements – describes name, size, format, source, and significance of necessary data elements
- Data structure – A preliminary structure showing how the data elements will be organized into logical records
- Outputs – layouts of system outputs and a description of their purpose, frequency, and distribution
- Inputs – a copy of system inputs and a description of their contents, source, and who is responsible for them
- Constraints – a description of deadlines, schedules, security requirements, staffing limitations, and legal requirements
- Controls – controls that are needed to ensure accuracy and reliability
- Reorganizations – changes in staffing, job functions, etc., that would be necessary.

Determining information needs can be a challenging process due to the sheer quantity and variety of information needs that must be specified, even for relatively simple AIS. In addition, it may be difficult for employees to articulate their information needs or they may identify them incorrectly. Thus, systems requirements must be determined accurately.

Systems Objectives and Constraints

Many entities take a **systems approach** to determining information needs and systems requirements; Problems and alternatives are viewed from the standpoint of the entire organization—as opposed to a single department. Systems objectives must be identified, so analysts and users can focus on those elements most vital to success of the AIS. These objectives may include:

- Usefulness – information produced by the system should help management and users in decision making

- Economy – the benefits of the system should exceed the cost
- Reliability – the system should process data accurately and completely
- Availability – users should be able to access it when they need it.
- Timeliness – More critical information is provided first.
- Customer service - Efficient and courteous customer service should be provided
- Capacity – system should be capable to handle peak period operations
- Ease of use – it should be user-friendly
- Flexibility – should accommodate reasonable changes
- Tractability – should be easily understood and facilitates problem solving and future development.
- Auditability – it should be auditable
- Security – only authorized users should be granted access to it

A system's success often depends on the ability to cope with organizational constraints. Common constraints include governmental agency requirements, management policies, lack of qualified staff, user capabilities and attitudes, technology, and limited finances. To maximize system performance, these constraints must be minimized.

Strategies for Determining Requirements:

The following four strategies are used to determine AIS requirements:

1. **Ask users what they need.** This is the simplest and fastest strategy, but many people do not understand their needs. They know their job but may be unable to break it down into the individual information elements they use. It is sometimes better to ask what decisions they make and what processes they are involved in and then design systems to address their answers. Users must think beyond current information needs so that new systems do not simply replicate current information in improved formats.
2. **Analyze external systems.** If a solution already exists, do not "reinvent the wheel."
3. **Examine existing systems.** Determine if existing modules are used as intended, may be augmented by manual tasks, or may be avoided altogether. This approach helps determine whether a system can be modified or must be replaced.

4. **Create a prototype.** When it is difficult to identify requirements, a developer can quickly rough out a system for users to critique. Users identify what they like and dislike about the system and request changes. This iterative process of looking at what is developed and improving it continues until users agree on their needs.

Detailed AIS requirements that explain exactly what the system is to produce are created and documented. The requirements are supported by sample input and output forms, as well as charts, so users can conceptualize the system. A nontechnical summary of important user requirements and development efforts to date is often prepared for management. The project team meets with the users, explains the requirements, and obtains their approval. When an agreement is reached, user management signs the system requirements documents to indicate approval.

E. Systems analysis report

The concluding step in systems analysis is preparing a systems analysis report to summarize and document analysis activities. The outlines include: Goals and objectives of the new system, Scope of the project, How the new system fits into the company's master plan, User processing requirements and information needs, Feasibility analysis and Recommendations for the new system.

A go/no-go decision is made up to three times during systems analysis: first, during the initial investigation, to determine whether to conduct a systems survey; second, at the end of the feasibility study, to determine whether to proceed to the information requirements phase; third, at the completion of the analysis phase, to decide whether to proceed to conceptual systems design.

Phase-2: Conceptual System Design

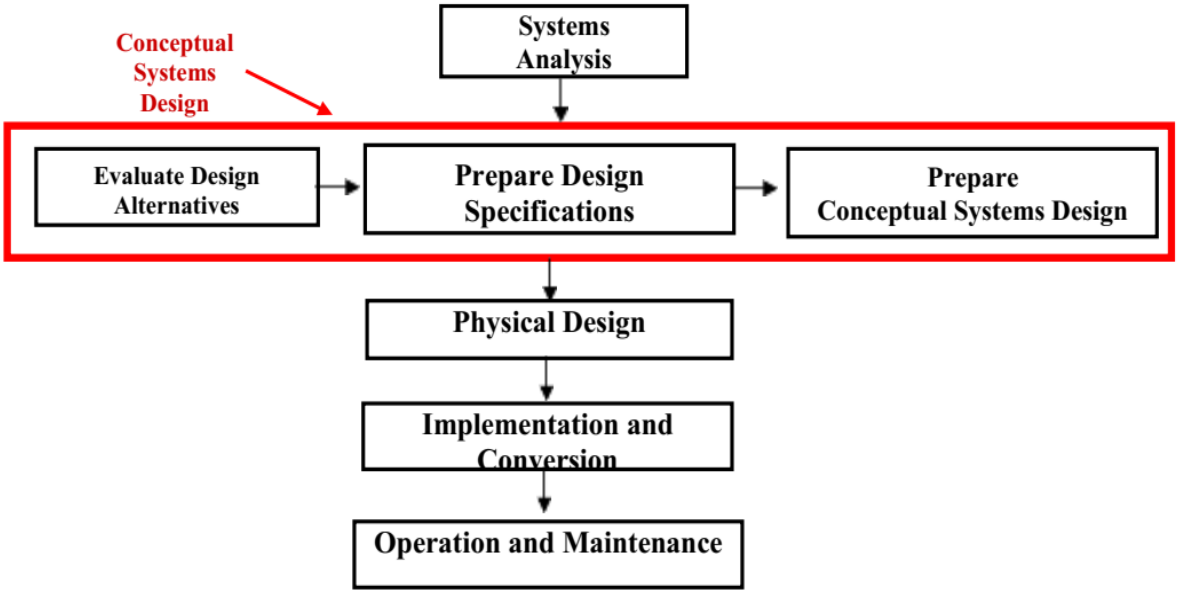
During conceptual design, the company decides how to meet user needs. The first task it to identify and evaluate appropriate design alternatives. There are many different ways to obtain a new system, including buying software, developing it in-house, or out-sourcing the system to someone else. Detailed specifications outlining what the system is to accomplish and how it is to be controlled must be developed. This phase is complete when

conceptual design requirements are communicated to the information systems steering committee.

In the conceptual systems design phase, a general framework is developed for implementing user requirements and solving problems identified in the analysis phase. What are the three steps in conceptual design?

- Identify and Evaluate design alternatives
- Develop design specifications
- Deliver conceptual Prepare conceptual systems design report

The system analysis phase is related to the conceptual design phase based on the diagram shown below:



a. Evaluate design alternatives

There are many ways to design an AIS, so systems designers must make many design decisions. For example, should a document be hard-copy or sent by EDI? Should the company use a large centralized mainframe or some form of distributed processing? What form should data entry take, e.g., keyboard, optical character recognition, point of-sale devices?

There are many ways to approach the systems development process. It can purchase software, ask in-house information systems (IS) staff to develop it, or hire an outside

company to develop and manage the system. The company could modify existing software or redesign its business processes and develop software to support the new processes.

The following standards should be used to evaluate design alternatives: (1) how well it meets organizational and system objectives, (2) how well it meets user needs, (3) whether it is economically feasible, and (4) how advantages weigh against disadvantages. The steering committee evaluates the alternatives and selects the one that best meets the organization's needs.

The company also chooses between: Modifying or enhancing existing software, replacing existing software and Reengineering its business processes.

Design considerations and alternatives:

- How should the communications channel be configured?
- What type of communications channel should be used?
- What type of communications network should be used?
- What type of storage media should be used for data? Diskette, Hard drive, and CD, and Paper
- What type of data storage structure should be used? Files or Database
- How should files be organized and accessed? Random, Sequential, or Indexed-Sequential
- What media should be used to input data? Keying, OCR, MICR, POS, EDI, and Voice
- What format will the input take? Source documents, Turnaround documents, and/or Screen
- How will the system be operated? In-house and/or Outsourcing
- How frequently will outputs be produced? Instantly, Hourly, Daily, Weekly, and/or Monthly
- What media will be used for output? Paper, Screen, Voice, Diskette, CD, and/or Microfilm
- How will output be scheduled? On demand and/or at predetermined times
- What format will the output take? Narrative, Table, Graph, and/or Electronic file

- What processing mode will be used? Manual, Batch, and/or Real time
- What type of processor will be utilized? PC, Minicomputer, and/or Mainframe

b. Prepare design specifications

Once a design alternative has been selected, the team develops the conceptual design specifications for the following elements:

Output – since the system is designed to meet users' information needs, output specifications must be prepared first. The following must be decided at this step: How often to produce a report? What the report should contain? What the report will look like? And what format of the report users require?

Data storage – this involves determining which data elements must be stored to produce a report.

Input – involves determining which data elements to capture and enter into the system

Processing procedures and operations – involves designing how to process the input and stored data in order to produce different reports.

c. Prepare conceptual systems design report

A conceptual systems design report summarizes conceptual design activities, guides physical design activities, communicates how all information needs will be met, and helps the steering committee assess feasibility. The main component is a description of one or more recommended system designs.

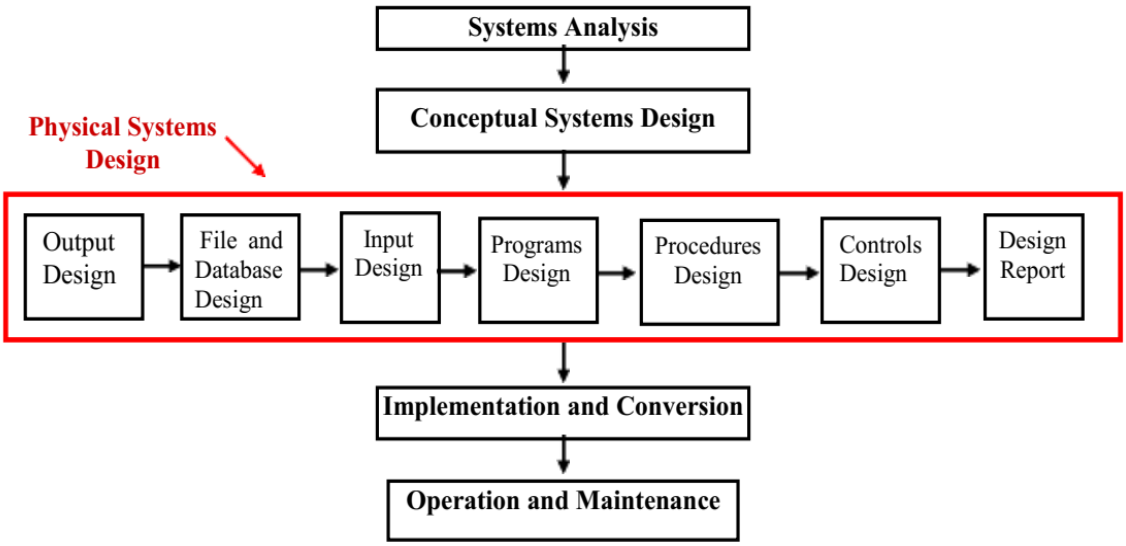
The main component is a description of one or more recommended system designs. This description contains:

- The contents of each output, database, and input
- Processing flows and the relationships among programs, files, inputs, and outputs
- Hardware, software, and resource requirements
- Audit, control, and security processes and procedures
- A discussion of assumptions or unresolved problems that might affect the final design

Phase-3: Physical Systems Design

During the physical systems design phase, the company determines how the conceptual AIS design is to be implemented. Physical design translates the broad, user-oriented requirements of the conceptual design into detailed specifications that are used to code and test the computer programs. Input and output documents are designed, computer programs are written, files and databases are created, procedures are developed, and controls are built into the new system. This phase is complete when physical system design results are communicated to the information systems steering committee.

System design is the evaluation of alternative solutions and the specification and construction of a detailed computer-based solution. It is also called physical design as it deals with implementation issues. Systems analysis depends more on the logical aspect and implementation-independent aspects of a system. Systems design concentrates on the physical or implementation-dependent aspects of a system (the systems technical specifications). The physical systems design as a series of steps as shown by the diagram below:



1. Output Design

The objective of ***output design*** is to determine the characteristics of reports, documents, and screen displays. It requires cooperation between users and designers. Important output design considerations include:

- Use of the output - Who will use it and why? When is it needed? What decisions will it facilitate?
- Output medium – Paper, Screen, Voice response, Diskette, Microfilm, Other
- Output format - the format that clearly conveys the most important information should selected (E.g. it could be Table, Narrative, and Graphic)
- Pre-printed – Should paper output be on preprinted form? Should turnaround document be used?
- Location – Where should AIS output be sent?
- Access - Who should have access to hard-copy and screen output?
- Detail – Length of the output, executive summary, a table of contents, headings and legends, highlight of important items, detailed information, appendix, etc
- Timeliness – How often should the output be produced?

Output fits into one of four categories:

1. **Scheduled reports** have a prespecified content and format and are prepared on a regular basis. Examples include monthly performance reports, weekly sales analyses, and annual financial statements.
2. **Special-purpose analysis reports** have no prespecified content or format and are not prepared on a regular schedule. They are prepared in response to a management request to evaluate an issue, such as which of three new products would provide the highest profits.
3. **Triggered exception reports** have a prespecified content and format but are prepared only in response to abnormal conditions. Excessive absenteeism, cost overruns, inventory shortages, and situations requiring immediate corrective action trigger such reports.
4. **Demand reports** have a prespecified content and format but are prepared only on request. Both triggered exception reports and demand reports can be used effectively to facilitate the management process.

AIS developers prepare sample outputs and users evaluate them to ensure they are complete, relevant, and useful. Modifications are made as needed to ensure acceptability.

Many organizations require users to sign off on these documents before proceeding through the SDLC.

2. File and Database Design

Various company segments need to store data in compatible formats so that data can be shared across units. Important file and database design considerations include:

- Storage medium – Hard drive, Disk, Diskette, CD, Tape, Paper
- Processing mode – Manual, Batch, Real time
- Maintenance –procedures needed to effectively maintain the data
- Size – How many records and how big are they? How fast are they expected to grow?
- Activity level – portion of records added or deleted or updated each year

3. Input Design

Systems designers must identify the different types of data input and optimal input methods. There are two principal types of data input: Forms and Computer screens.

Considerations in input design include:

- Input medium – Keyboard, OCR, MICR, POS terminal, EDI, Voice input
- Input source - data may originate from computer, customer, and remote location
- Input format – turnaround document, screen, and source data automation
- Input type - the nature of the data
- Volume – how much data are to be entered
- Personnel – functions and expertise of the data entry operators
- Frequency - how often is data to be entered?
- Cost – How can costs be minimized without adversely affecting efficiency and accuracy?
- Error detection and correction – What errors are possible? How can they be detected and corrected?

Forms Design

Although input is evolving toward source data automation, forms design is still important. Following are important principles for designing new forms and evaluating existing ones:

General considerations in Forms Design

- Preprint as much data as possible.
- Use appropriate weight and grade of paper.
- Use bold type, double-thick lines, and shading to highlight different parts of the form.
- Use a standard size and one that is consistent with requirements for filing, binding, or mailing.
- If mailed to external parties, position the address for placement in a window envelope.
- Have copies of the form printed in different colors to facilitate accurate distribution.
- Include clear instructions for completing the form.

Introductory section of Forms

- Place the form name at the top in bold type.
- Have the forms pre-numbered consecutively.
- If distributed to external parties, have company name and address pre-printed on the form

Main body of Forms

Group together logically related information (e.g., info about the customer, info about the product)

- Provide sufficient room to record each item.
- Order the data items consistent with the sequence in which the data is likely to be gathered.
- Use codes and check-offs in places where standardized explanations are likely.

Conclusion section of Forms

- Provide space for recording final disposition of the form; approval signatures; dates of approval and final disposition; and a dollar or numeric total.
- Clearly indicate the distribution of each form.

Designing Computer Screens

It is more efficient to enter data directly into the computer than to record it on paper for subsequent entry. Therefore, it's important to design computer screens for input as well as output. Computer screens are most effective when the following principles are used:

- Organize the screen so data can be entered quickly, accurately, and completely. Minimize data input by retrieving as much data as possible from the system. For example, entering a customer number could cause the system to retrieve the customer's name, address, and other key information.
- Enter data in the same order as displayed on paper forms that capture the data.
- Group logically related data together. Complete the screen from left to right and top to bottom.
- Design the screen so users can jump from one data entry location to another or use a single key to go directly to screen locations.
- Make it easy to correct mistakes. Clear and explicit error messages that are consistent across all screens are essential. There should be a help feature to provide online assistance.
- Restrict the data or the number of menu options on a screen to avoid clutter.

4. Program Design

Program development is one of the most time-consuming activities in the SDLC. A structured programming process should be followed:

- With structured programming, programs should be subdivided into small, well-defined modules to reduce complexity and enhance reliability and modifiability.
- Modules should interact with a control module rather than with each other.
- To facilitate testing and modification, each module should have only one entry and exit point.

To improve software quality, organizations should develop programming standards (rules for writing programs).

- Contributes to consistency among programs.
- Makes them easier to read and maintain.

Doing structured program walk-throughs to find incorrect logic, errors, omissions, or other problems is essential. Program preparation time may range from a few days to a few years, depending on complexity. Though accountants need not be programmers, they should understand how software is created. The eight steps for developing software and where these steps take place in the SDLC.

1. **Determine user needs.** Systems analysts consult with users and reach an agreement on user needs and software requirements.
2. **Create and document a development plan.**
3. **Write program instructions (computer code).** Program preparation time may range from a few days to a few years, depending on program complexity. Programming standards (rules for writing programs) contribute to program consistency, making them easier to read and maintain. Computer programs should be subdivided into small, well-defined modules to reduce complexity and enhance reliability and modifiability, a process called **structured programming.** Modules should interact with a control module rather than with each other. To facilitate testing and modification, each module should have only one entry and exit point.
4. **Test the program.** Debugging is the process of discovering and eliminating program errors. A program is tested for logic errors using test data that simulate as many real processing situations and input data combinations as possible. Large programs are often tested in three stages: individual program modules, the linkages between modules and a control module, and interfaces with other application programs.
5. **Document the program.** Documentation explains how programs work and is used to correct errors. Program documentation includes flowcharts, data flow diagrams, E-R diagrams, data models, record layouts, and narrative descriptions. These items are stored in a documentation manual.
6. **Train program users.** Program documentation is often used to train users.
7. **Install the system.** All system components, including the programs and the hardware, are combined, and the company begins to use the system.

8. **Use and modify the system.** Factors that require existing programs to be revised, referred to as program maintenance, include requests for new or revised reports; changes in input, file content, or values such as tax rates; error detection; and conversion to new hardware.

5. Procedures Design

Individuals who interacts with a system needs procedures that answer the who, what, when, where, why, and how questions related to IS activities. Procedures should cover input preparation, transaction processing, error detection and correction, controls, reconciliation of balances, database access, output preparation and distribution, and computer operator instructions. Procedures documentation and training may take the form of system manuals, user instruction classes, training materials, or online help screens. Developers, users, or teams representing both groups may write procedures. The adage "garbage in, garbage out" emphasizes that improperly controlled input, processing, and data storage functions produce unreliable information. Controls must be built where, and how questions related to all AIS activities. Procedures design cover: The procedures may be written by development teams; Users; or teams representing both groups

6. Control Design

Improperly controlled input, processing, and database functions produce information of questionable value. Controls must be built into an AIS to ensure its effectiveness, efficiency, and accuracy. They should minimize errors as well as detect and correct them when they occur. Accountants play a vital role in this area. Failing to produce good policies and procedures and failing to implement controls can be devastating.

Important control design concerns that must be addressed include:

- Validity – Are all interactions valid?
- Authorization – Are input, processing, storage, and output activities authorized by the appropriate managers?
- Accuracy – Is input verified to ensure accuracy? What controls ensure that data is not lost when passing between processing activities?

- Security – Is the system protected against unauthorized physical and logical access to prevent improper use, alteration, destruction, or disclosure of information and software? Is the system protected against theft of system resources?
- Numerical Control – Are documents pre-numbered to prevent errors or intentional misuse and to detect when documents are missing or stolen?
- Availability – Is the system available as set forth in agreements? Can users enter, update, and retrieve data during those times?
- Maintainability – Can the system be modified without affecting system availability, security, and integrity?
- Integrity – Is processing complete, accurate, timely, and authorized? Is it free from unauthorized or inadvertent manipulations?
- Audit Trial – Can data be traced from source to output and vice versa?

7. Physical Systems Design Report

At the end of the physical system design phase, the team prepares a physical systems design report. This report becomes the basis for management's decision whether to proceed to the implementation phase.

Phase-4: Implementation and Conversion

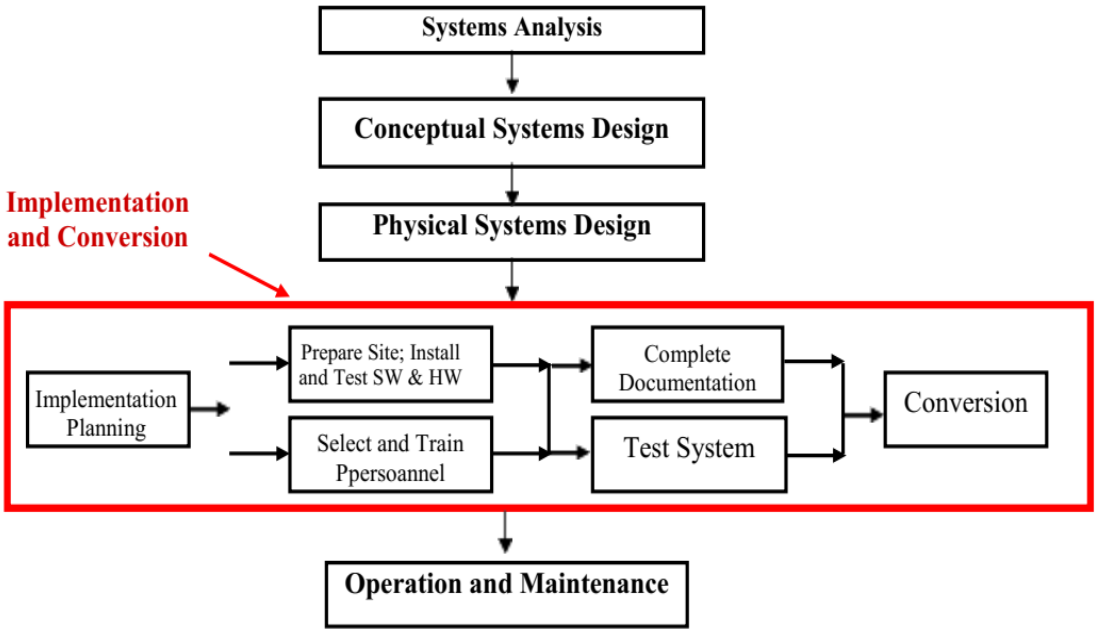
The implementation and conversion phase is the capstone phase during which all the elements and activities of the system come together. Because of this phase's complexity and importance, an implementation and conversion plan is developed and followed. As part of implementation, any new hardware or software is installed and tested. New employees may need to be hired and trained, or existing employees relocated. New processing procedures must be tested and perhaps modified. Standards and controls for the new system must be established and system documentation completed. The organization must convert to the new system and dismantle the old one. After the system is up and running, any fine-tuning adjustments needed are made and a post implementation review is conducted to detect and correct any design deficiencies. The final step in this phase is to deliver the operational system to the organization, at which time the development of the

new system is complete. A final report is prepared and sent to the information systems steering committee.

Systems implementation is the process of installing hardware and software and getting the AIS up and running. Implementation and Conversion includes the following activities. Develop Implementation plan, prepare site and Install hardware and software, Select and Train personnel, test the system, complete documentation and Convert from old to new system Fine-tune and review.

Deliver operational system

The relationship of the items in this phase and the conversion process will be as shown below in a series of activities



1. Implementation Planning

An implementation plan consists of implementation tasks, expected completion dates, cost estimates, and the person or persons responsible for each task. The plan specifies when the project should be complete and operational. The implementation team should identify risk factors that decrease the likelihood of successful implementation, and the plan should contain a strategy for coping with each of the risks. AIS changes may require adjustments to the company's organizational structure, including: Creation of new departments;

Elimination or downsizing of existing departments; and Changes even in the data processing department.

2. Prepare Site and Install and Test Software & Hardware Site Preparation

Site preparation is a lengthy process and should begin well ahead of the installation date. A PC requires little site preparation. A large computer may require changes such as: New electrical outlets, Data communications facilities, Raised floors, Humidity controls, Special lighting, Air-conditioning, Security measures, such as Fire protection and Emergency power supply and Space for equipment, storage, and offices.

Develop and Test Software Programs

Seven steps are followed when developing and testing software programs.

- Determine user needs
- Develop a plan.
- Write program instructions (code)
- Test the program.
- Document the program.
- Train program users.
- Install and use the system.

3. Select and Train Personnel

Employees are hired from outside the company or transferred internally, which often is the less costly alternative because they already understand the firm's business and operations. Transferring employees who are displaced because of the new system could boost employee loyalty and morale. When users are not adequately trained, the company will not achieve the expected benefits and return on its investment. Companies provide insufficient training because it is time consuming and expensive. The hidden cost of inadequate training is that users turn for help to coworkers who have mastered the system, decreasing the productivity of coworkers and increasing company costs. Employees must be trained on the hardware, software, and any new policies and procedures. Training should be scheduled for just before systems testing and conversion. Many training options are available, such as vendor training, self-study manuals, computer-assisted instruction, videotape

presentations, role-playing, case studies, and experimenting with the system under the guidance of experienced users.

4. Complete Documentation

Three types of ***documentation*** must be prepared for new systems.

- Development documentation – it describes the AIS and includes a system description; Copies of output, input, file, and database layouts; Program flowcharts; Test results; and User acceptance forms
- Operations documentation – includes operating schedules; files and databases accessed; and equipment, security, and file retention requirements
- User documentation – this teaches users how to operate the AIS and includes a procedures manual and training materials.

5. Test the System

Inadequate system testing has contributed to the failure of systems. All of the following should be given a trial run in realistic circumstances documents and reports, user input, operating and control procedures, processing procedures, and computer programs. Capacity limits and Backup and recovery procedures should also be tested. There are three common forms of *testing*.

A) **Walk-through**s – is step-by-step reviews of procedures or program logic. It focuses on organization's input, files, outputs, data flows. Subsequently walk-throughs are made by programmers addressing logical and structural aspects of program code.

B) **Processing of test transactions –** determines whether the program operates as designed. It requires both valid and erroneous data. The correct response for each test should be specified in advance.

C) **Acceptance tests** – uses copies of real transactions and files rather than hypothetical ones. Users develop acceptance criteria and then make final decision whether to accept or not.

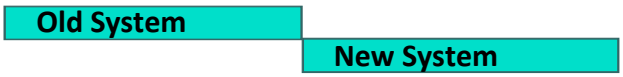
Even software purchased from an outside vendor must be tested thoroughly before installation.

6. Systems Conversion

Conversion is the process of changing from the old AIS to the new. Many elements must be converted, including hardware, software, data files, and procedures. The process is complete when the new AIS has become a routine, ongoing part of the system. Four conversion approaches are used to change from an old to a new system:

A) Direct Conversion Method

Immediately terminates the old AIS when the new one is introduced. Appropriate when ***the old AIS has no value*; or *the new AIS is so different that comparisons between the***



two are meaningless

Advantage – direct conversion is inexpensive

Disadvantage – It provides no backup AIS. There is a high risk of failure unless the new system has been very carefully developed and tested.

B) Parallel Conversion Method

This method operates the old and new systems simultaneously for a period of time. You can process transactions with both systems, compare output, reconcile differences, and make corrections to the new AIS.

- Advantage – it protects the company from errors
- Disadvantage – It is costly and stressful for employees to process all transactions twice.
- Because companies often experience problems during conversion, parallel processing has gained widespread popularity.

C) Phase-in Conversion Method

Gradually replaces elements of the old AIS with the new one. The new system is often phased in a module at a time.

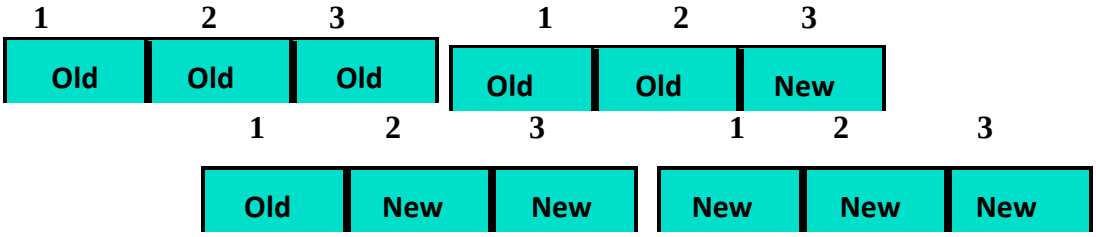
- Advantage – data processing resources can be acquired over time.

- Disadvantages – Costs of creating temporary interfaces between old and new AIS. Large time required to make the complete conversion

D) Pilot Conversion Method

This method implements a system in just one part of the organization, e.g., a branch office or a single store. When problems with the system are resolved, the new system could be implemented at the remaining locations.

- Advantages – localizes conversion problems and allows training in a live environment.
- Disadvantages – long conversion time and need for interfaces between old and new systems.



Data conversion can be time-consuming, tedious, and expensive; its difficulty and magnitude are easily underestimated. Data files may need to be modified in three ways. First, files may be moved to a different storage medium—for example, from tapes to disks. Second, data content may be changed—for example, fields and records may be added or deleted. Third, file or database format may be changed.

The first step in data conversion is to decide which data files need to be converted. Then the data are checked for completeness and errors, and inconsistencies are removed. Following data conversion, the new files are validated to ensure data were not lost during conversion. If data conversion is lengthy, the new files must be updated with the transactions that occurred during data conversion. Once the files and databases have been converted and tested for accuracy, the new system is functional. The system should be

monitored for a time to make sure it runs smoothly and accurately. The final activity is to document the conversion activities.

Phase-5: Operations and maintenance

The last step in the SDLC is to operate and maintain the new system. During its life, the system is periodically reviewed. Modifications are made as problem arise or as new needs become evident, and the organization uses the improved system. This process is referred to as the operations and maintenance phase. Eventually a major modification or system replacement is necessary and the SDLC begins again.

What are some factors to consider during the post implementation review?

- Goals and objectives – Does the system help the organization meet its goals, objectives, and overall mission?
- Satisfaction – Are users satisfied? Do they want changes or improvements?
- Benefits – Were the expected benefits achieved?
- Costs – Are actual costs in line with expected costs?
- Reliability – Has the system failed, and if so, why?
- Documentation – Is documentation complete and accurate?
- Timeliness – Does the system produce timely information?

Controls and security – Are there safeguards against unintentional errors, fraud, and intrusion?

- Errors – Are there adequate error-handling procedures?
- Training – Are systems personnel and users adequately trained?
- Communications – Is the communications system adequate?
- Organizational changes – Are structural changes that resulted from the system beneficial or harmful? If harmful, how can they be resolved?
- Accuracy – Does the system produce accurate and complete data?
- Compatibility – Are hardware, software, data, and procedures compatible with existing systems?

Any problems discovered during the review should be brought to management's attention, and adjustments should be made. When the review is complete, a ***post-implementation***

review report is prepared. User acceptance of that report is the final activity in systems development. Control of the AIS is then passed to the data processing department.

Activity 3.6

1. **What are steps of system analysis phase?**
2. **Describe the steps used in physical system design?**
3. **Discuss the common form of testing?**
4. **Discuss the conversion methods?**

Summary

Accountants use many different types of diagrams to trace the flow of accounting data through an Accounting Information System. A wide variety of software is available for documenting AISs. Documentation includes the narratives (written descriptions), Flowcharts, Diagrams, and Other written material that explain how the system works. One popular means of documenting a system is to develop diagrams, flowcharts, tables, and other graphical representations of information. These documentations are Important for documenting System Development.

A data flow diagram (DFD) graphically describes the flow of data within an organization. It is composed of four basic elements: data sources and destinations, data flows, transformation processes, and data stores. On the other hand, a flowchart is an analytical technique used to describe some aspect of an information system in a clear, concise, and logical manner and uses many symbols to represents system development inputs, process, storage and outputs. Flowcharts can be document flow chart, system flow chart and program flowchart.

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. This change is due to may be changes in user or business needs, technological change, improved business processes, competitive advantage, productivity gains, growth and downsizing. System change and improvement passes and evaluate through systems development life cycle, planning activities during the systems development life cycle, feasibility analysis, behavioral aspects of change and systems analysis.

Self-assessment questions

Choose the correct answer among the given alternatives.

1. Which one of the following is not an importance of documentations?
   A. It depicts how the system works
   B. It is used to give training to users
   C. It is used to establish interpretative narrative
   D. It is used for documenting business processes
   E. None of the above
2. The data flow diagram which has no lower levels is?
   A. Context level data flow diagram
   B. Decomposing level data flow diagram
   C. Physical data flow diagram
   D. Logical data flow diagram
   E. None of the above
3. How a user conceptually organizes and understand data is referred to as the____
   A. Physical view
   B. Logical view
   C. Data model view
   D. Data organization view
4. A data flow diagram is a representation of which of the following?
   A. Relationship among modules, data and programs of an AIS
   B. Flow of data in an organization
   C. Decision rules in a computer program
   D. Computer hardware configuration

5. Which one of the following is true about the differences between Data Flow Diagrams and Flowcharts?
   A. Flowchart emphasizes the flow of data and what is happening in a system, whereas a Data Flow Diagrams emphasizes the flow of documents or records containing data.
   B. A flowchart represents the physical flow of data, whereas a data flow diagram represents the logical flow of data.
   C. Data Flow Diagrams are used primarily to document existing systems, in contrast Flowcharts 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.
   D. All of the above
6. The flowing are states why companies change their systems, except:
   A. The old system is scrapped
   B. Technology advances and becomes less costly
   C. Computers automate clerical and repetitive tasks and significantly increase the performance time of other tasks
   D. Companies outgrow their systems and must either upgrade or replace them entirely
   E. None of the above
7. _____ is behavior intended to destroy, cripple, or weaken the system's effectiveness.
   A. Aggression
   B. Projection
   C. Avoidance
   D. All of the above
8. From five important aspects need to be considered during a feasibility study: "Do we have people who can do it, and will it get used" is?
   A. Scheduling feasibility
   B. Technical feasibility
   C. Economic feasibility
   D. Operational feasibility
   E. None of the above

9. A go-no-go decision is generally made three times during system analysis, which one is not a go no go decision stages?
   A. During the initial investigation
   B. At the end of the feasibility study
   C. Upon completion of the analysis phase
   D. During the system surveys
   E. None of the above
10. Conversion approaches that are appropriate when the old AIS has no value; or the new AIS is so different that comparisons between the two are meaningless is:
   A. Parallel conversion
   B. Phase-in conversion
   C. Pilot conversion
   D. Direct conversion
   E. None of the above

Discussion questions

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

Drawing system flowchart

1. Employees at the sur Construction Company enter the work they perform on job time tickets. Most construction sites have data input terminals that employees use to enter the time they start and stop work and the job code that represents the project they are working on. Every night the job-time ticket data for that day is sent electronically to company headquarters where it is stored until payroll is processed. A few construction sites are so remote that employees still fill out paper job-time tickets. These tickets are express mailed weekly to company headquarters where they are scanned and processed. Payroll is processed weekly. The job-time tickets are used to update the payroll database as well as the work-in-process database. Since all employees are paid electronically, no checks are printed; instead, the payroll system deposits an employee's net pay in the employee's bank account. Payments are made to government tax bodies and the company handling the employee's and the company's pension plan contributions. All disbursements are

accompanied by a report summarizing the disbursement. The system also produces pay stub data that is stored in a payroll transaction file that is accessible to employees over the internet. An electronic summary payroll report is created and sent to the payroll supervisor.

Required: Prepare a system flowchart for Dewey Construction Company's payroll processing.

CHAPTER FOUR

RELATIONAL DATABASES

CHAPTER OBJECTIVES

After studying this chapter, a student should be able to:

- Explain the difference between database and file-based legacy systems
- Describe what a relational database is and how it organizes data
- Explain the difference between logical and physical views of a database
- Create a set of well-structured tables to properly store data in a relational database
- Discuss the steps for designing and implementing a database system.
- Use the REA data model to design an AIS database.
- Draw REA diagram of an AIS database.
- Read REA diagram and explain what it reveals about the business activities and policies of the organization being modeled.
- Integrate separate REA diagrams for individual business cycles into a single, comprehensive organization-wide REA diagram.
- Build a set of tables to implement REA model of an AIS in a relational database.
- Explain how to write queries to retrieve information from an AIS relational database built according to the REA data model.

4.1 Introduction

To appreciate the power of databases, it is important to understand how data are stored in computer systems. Information about the attributes of a customer, such as name and address, are stored in fields. All the fields containing data about one entity (e.g., one customer) form a record. A set of related records, such as all customer records, forms a file (e.g., the customer file). A set of interrelated, centrally coordinated data files that are stored with as little data redundancy as possible forms a database. Under this chapter briefly discussed what is a database and how it differs from a file-oriented system. Then, it also described the structure of a relational database system.

After briefly discussed about the database it is introduces the topic of data modeling. It is demonstrated how to use a tool called the REA (resources, events, and agents) data model to design and document an Accounting Information system (AIS). It is also explaining how the REA data model provides auditors with valuable information about an organization's business activities and policies.

Final sections of the chapter show how to implement a REA diagram in a database. It focuses on relational databases because they are commonly used to support transaction processing systems and are likely to be familiar to most business students. Nevertheless, REA data modeling is not limited for use only in designing relational databases, but can also be used to design object-oriented databases.

4.2 Database system

4.2.1 Files versus Databases

To fully appreciate the power of databases, it is important to understand some basic principles about how data are stored in computer systems. An ***entity*** is anything about which the organization wishes to store data.

Customers				
Customer Number	**Customer Name**	**Address**	**Credit Limit**	**Balance**
1001	XYZ Co.	A.A; P.O.Box 123	30,000	24,750
2121	ABC Co.	A.A; P.O.Box 752	45,000	12,000
4565	QRS Co.	A.A; P.O.Box 741	25,000	24,900

Information about the attributes of an entity (e.g., Customer's Number and address) are stored in **fields**.

Customers				
Customer Number	Customer Name	Address	Credit Limit	Balance
1001	XYZ Co.	A.A; P.O.Box 123	30,000	24,750
2121	ABC Co.	A.A; P.O.Box 752	45,000	12,000
4565	QRS Co.	A.A; P.O.Box 741	25,000	24,900

All the fields containing data about one entity (e.g., one customer) form a record. All the fields that contain data about the same entity form a ***record.***

Customers				
Customer Number	Customer Name	Address	Credit Limit	Balance
1001	XYZ Co.	A.A; P.O.Box 123	30,000	24,750
2121	ABC Co.	A.A; P.O.Box 752	45,000	12,000
4565	QRS Co.	A.A; P.O.Box 741	25,000	24,900

A set of related records are grouped to form *a **file***. For example, all customer receivable records are stored in an account receivable file.

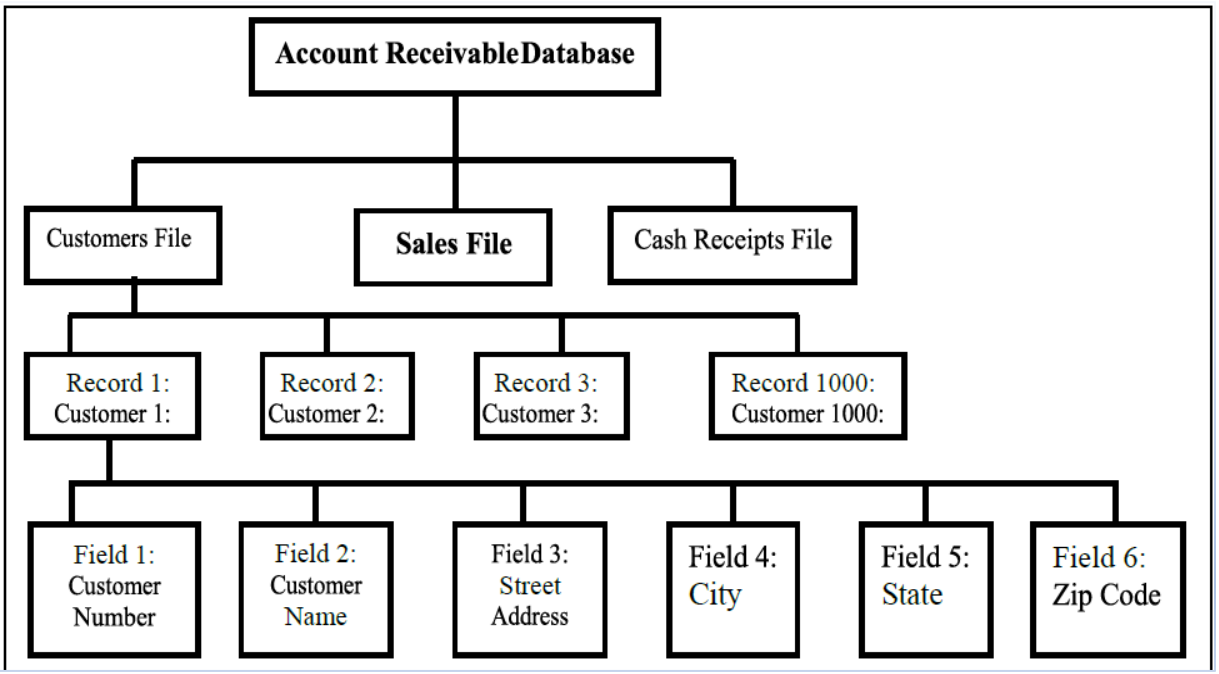
Customers				
Customer Number	Customer Name	Address	Credit Limit	Balance
1001	XYZ Co.	A.A; P.O.Box 123	30,000	24,750
2121	ABC Co.	A.A; P.O.Box 752	45,000	12,000
4565	QRS Co.	A.A; P.O.Box 741	25,000	24,900

A set of interrelated, centrally coordinated files is referred to as ***a database***. **EXAMPLE**: **Accounts Receivable Database** is shown below: it is a combination of Customers File; Sales File; and Cash Receipts File. ***See figure 4.1. Account Receivable database.***

Types of Files

Two basic types of files exist. *A **master file*** is conceptually similar to a ledger in manual AIS. Master files store cumulative information about an organization's resources and the agents with whom it interacts. For example, the inventory and equipment master files store information about important organizational resources. Similarly, the customer, supplier, and employee master files store information about important agents with whom the organization interacts. Master files are permanent; they exist across all periods. Individual records within a master file, however, are frequently changed. The most common type of change made to the records in master files involves updating the data to reflect the effect of specific transactions. Periodically, new records may also be added to the master file and sometimes, individual records may even be deleted.

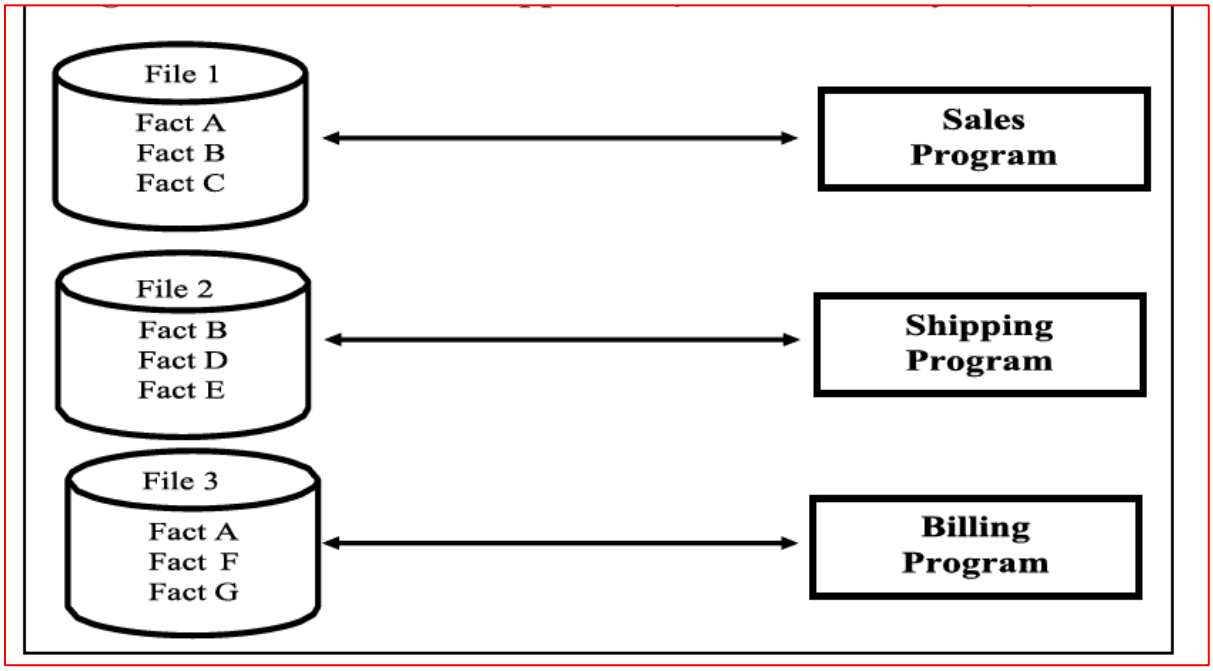
Figure 4.1. Account Receivable database.



The second type of file is called ***a transaction file***, which is conceptually similar to a journal in manual AIS. Transaction files contain records of the individual business transactions (events) that occur during a specific fiscal period. For example, a file containing records of sales events and another file containing records of customer payments. Both of them would be used to update individual customer account balances in

the customers' master file. Transaction files are not permanent, but are usually only maintained on-line for one fiscal period.

For many years companies created new files and programs each time an information need arose. The result was a significant increase in the number of master files that organizations stored. This proliferation of master files created problems. Often, the same data were stored in two or more master files. This made it difficult to effectively integrate data stored in different files and to obtain
an organization-wide view of the data. It also created problems because the specific data values stored in the different files may not have been consistent. For example, new customer address used
to ship merchandise but the old address may be used for billing.



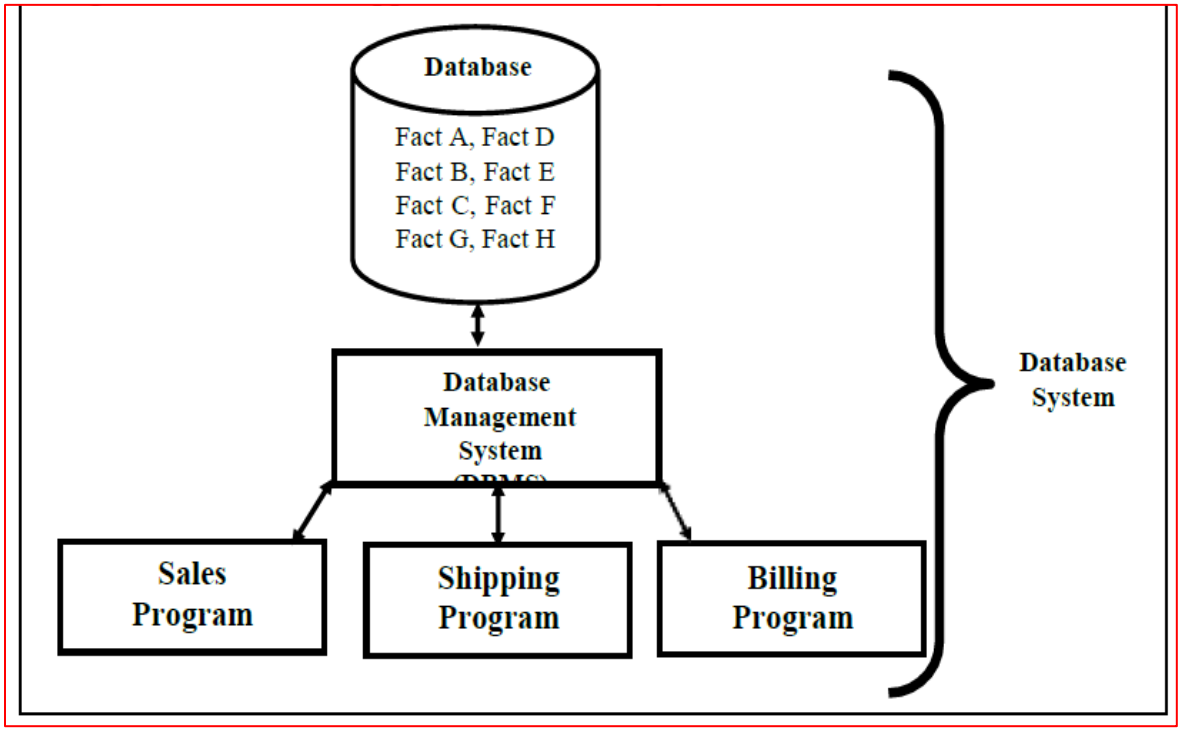
This proliferation (increased in number) of master files created problems:

- Often the same information was stored in multiple master files.
- Made it more difficult to effectively integrate data and obtain an organization-wide view of the data.
- Also, the same information may not have been consistent between files.

- If a customer changed his phone number, it may have been updated in one master file but not another.

Databases system

Database systems were developed to address the problems associated with the proliferation of master files. A database is a set of interrelated, centrally coordinated files. The database approach treats data as an organizational resource that should be used by and managed for the entire organization, not just the originating department or function. The combination of the database; DBMS; and the application programs that access the database through the DBMS is referred to as the ***Database System***. A database management system (DBMS) serves as the interface between the database and the various application programs. The person responsible for the database is referred to as the ***database administrator***. As technology improves, many large companies are developing very large databases called data warehouses.



Importance and Advantages of Database Systems

Virtually all mainframes and servers use database technology, and database use in personal computers is growing rapidly. Most accountants are involved with databases through data

entry, data processing, querying, or auditing. They also develop, manage, or evaluate the controls needed to ensure database integrity. Databases provide organizations with the following benefits

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

Activity 4.1

1. **What is file?**
2. **What are the types of file?**
3. **What is database?**
4. **What are the benefits of database?**

4.2.2 Logical and Physical Views of Data

In file-oriented systems, programmers must know the physical location and layout of records used

by a program. They must reference the location, length, and format of every field they utilize. This

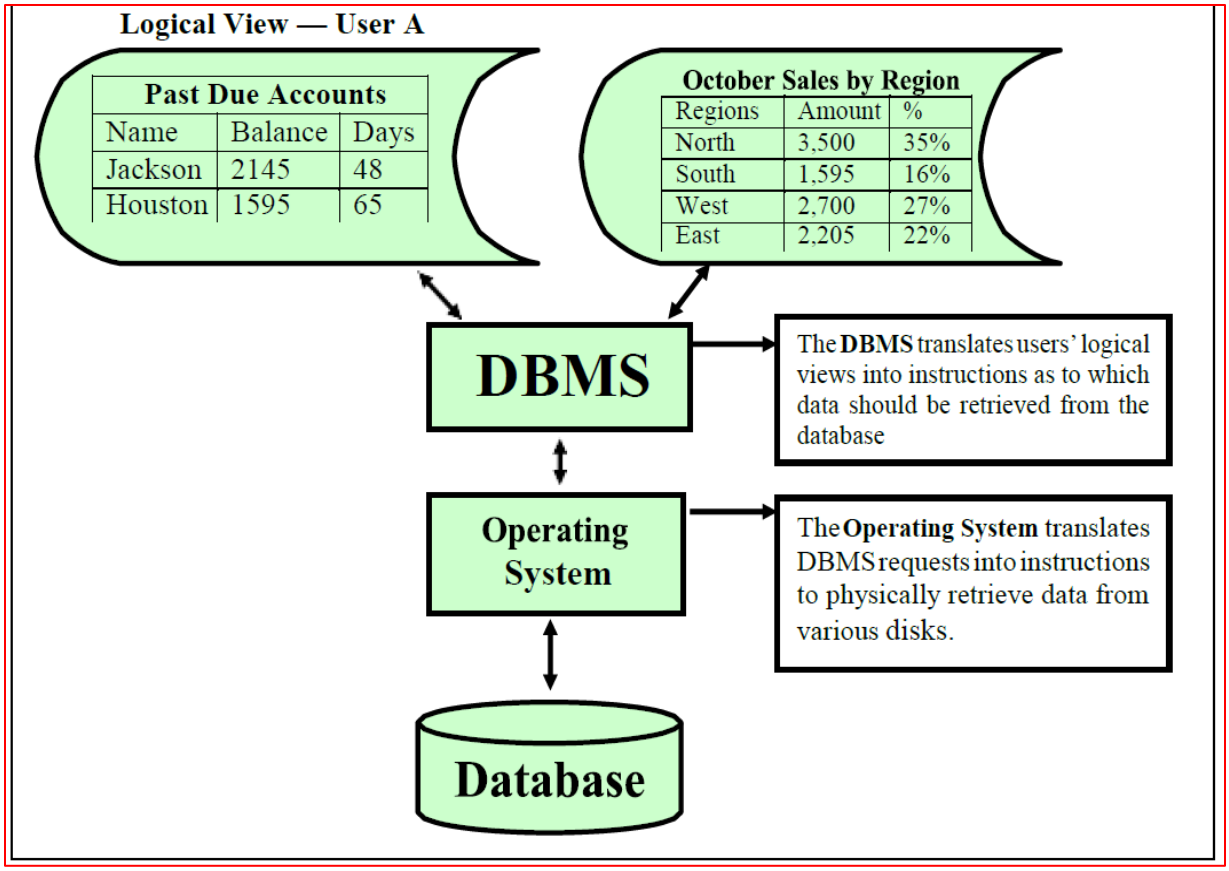
process becomes more complex when data is used from several files. Database systems overcome this problem by separating the storage and use of data elements by providing two separate views of the data. That means, Database Systems separate the **logical** and **physical views** of data.

1. The **logical view** is how the user or programmer conceptually organize and understand the data. It is the manner in which users conceptually organize, view, and understand the relationships among data items. **Example**: a sales manager may conceptualize all information about customers as being stored in form of a table.
2. The **physical view** refers to how and where the data are physically arranged and stored. Example: the way data are physically arranged and stored on disk, tape, CD-ROM, or other media.

Separating the logical and the physical views of data facilitates developing new applications because programmers can concentrate on coding the application logic (what the program will do) and do not need to focus on how and where the various data items are stored or accessed.

The **Database Management System Software** deals with the links between the way the data are physically stored and each user's logical view of the data. Hence, it controls the database so that users can access, query, or update it without reference to how or where the data are physically stored. The user only needs to define the logical data requirements. Separating the logical and the physical views of data also means that users can change their conceptualization about relationships

among data items (their logical view of the task) without making changes in the way those data are physically stored. Likewise, the database administrator can change the physical storage of the data to improve performance, without affecting users or application programs.



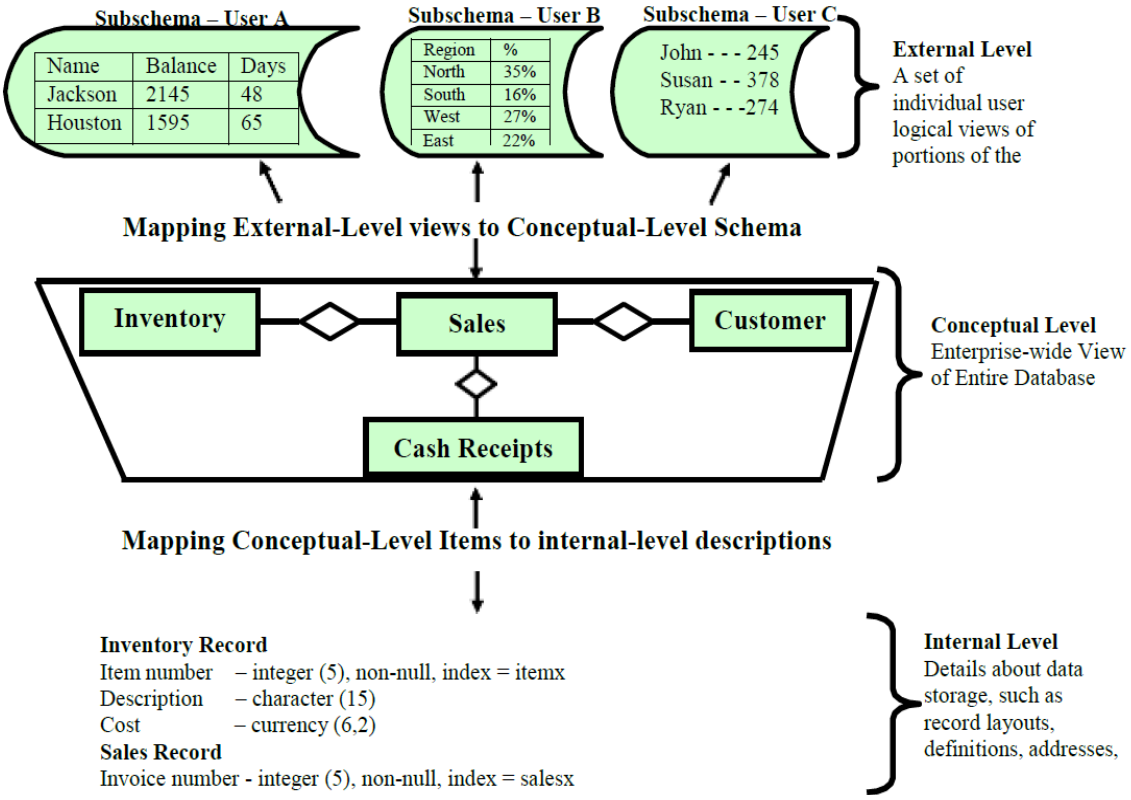
4.2.3 Schemas

A schema describes the logical structure of a database. The database schema is a map or plan of the entire database. Any particular user or application program will be interested in only a subset of the schema, called the subschema. A database schema must be flexible enough to satisfy the required of use of subschema. There are three levels of schemas:

- The conceptual level schema,
- The external level schema, and
- The internal level schema

The **conceptual level schema** is the organization-wide view of the entire database – **i.e.,** the big picture. It lists all data elements and the relationships between them. The **external level schema** consists of a set of individual user views of portions of the database, each of which is also referred to as a **subschema**. The **internal level schema** provides a **low-level**

view of the database. It describes how the data are actually stored and accessed, including information about pointers, record layouts, indexes, record lengths, and so forth.



DBMS uses the mappings to translate a request by a user or program for data (expressed in logical names and relationships) into the indexes and addresses needed to physically access the data. The bidirectional arrows represent mappings between the schemas. **Accountants are frequently involved in developing the conceptual and the external level schemas**. An employee's access to data should be limited to the subschema of data that is relevant to the performance of his job.

4.2.4 The Data Dictionary

A key component of a **DBMS** is the data directory, which contains information about the structure of the database. For each data element stored in the database, such as the customer number, there

is a corresponding record in the data dictionary describing it. Accountants have a very good understanding of the **data elements that exist in a business organization**, where they

originate, and where they are used. Consequently, Accountants should participate in the development of the data dictionary because they have a good understanding of the data elements in a business organization, as well as where those elements originate and how they are used. The DBMS usually maintains the data dictionary. In fact, this is often one of the first applications of a newly implemented database system.

The DBMS maintains the data dictionary, whose inputs include new or deleted data elements and changes in data element names, descriptions, or uses. Outputs include reports for programmers, designers, and users, such as (1) programs or reports using a data item, (2) synonyms for the data elements in a file, and (3) data elements used by a user. These reports are used for system documentation, for database design and implementation, and as part of the audit trail.

Example of a Data Dictionary

Data Element Name	Description	Records in which contained	Source	Field Length	Field Type	Programs in which used	Outputs in which contained	Authorized users	Other Data Names
Customer Number	Unique ID of each customer	A/R Record, Customer Record, Sales Record	Customer Name list	10	Numeric	A/R update, customer file update, sales update	A/R aging report, customer status report, credit report	No Restrictions	None
Credit Limit	Maximum credit that can be extended to customer	Customer Record, A/R Record	Credit Application	8	Numeric	Customer file update, A/R update, credit analysis	Customer status report, A/R aging report, credit Limit	R. David W. Feven H. Heaton	CR_Limit

4.2.5 DBMS Languages

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

to users. The DDL and DML should be restricted to authorized administrators and programmers.

Activity 4.2

1. **Differentiate logical and physical view of data?**
2. **What is the schema?**
3. **Discuss the data dictionary?**
4. **Discuss DBMS languages**

4.3 Relational Databases

Relational Databases underlie most modern integrated AISs. **Relational Databases** are the most popular type of database used for transaction processing. Relational databases are more flexible. Users can define relationships when the database is created or at later points in time. A DBMS is characterized by the type of **logical data model** on which it is based. A data model is an **abstract**

representation of the contents of the database. The majority of new DBMSs are called relational databases because they use ***the relational data model*** developed by Dr E.F.C odd in 1970. ***The relational data model represents everything in the database as being stored in the form of tables*.** Technically, these tables are called relations (hence relational data model), but we will use the two words interchangeably. The data model only describes how the data appear in the conceptual and external level schemas. The data are not actually stored in tables but rather in the manner described in the internal level schema. **Each row** in a relation is called a **tuple**, contains data about specific occurrence of the type of entity represented by that table. For example, each row in the inventory table below contains all the pertinent data about a particular inventory item in the organization. **Each column** in a table contains information about one **specific attribute** about an entity.

Inventory Table			
Item Number	Description	Quantity	List price
2014	19" Monitor	32	Br 1,890
2015	21" Monitor	9	Br 2,890
3054	Color Printer	25	Br 3,900

Inventory Table (Relation): Item No. is the Primary Key

Customers Table							
Customer #	Name	Street	City	State	Zip Code	Credit Limit	Account Balance
11255	G. Hay	299 Main Street	AA	AZ	85281	4,000	875
11266	J. Jak	HG Street	AA	AZ	85281	6,000	3,955

Customer Table (Relation): Customer Number is the Primary Key

Sales Table				
Invoice No.	Date	Sales Person ID.	Customer #	Amount
10001	08-Sep-07	SP101	11255	$8,500
10002	08-Sep-07	SP122	15266	$9,200
10003	08-Sep-07	SP133	13553	$800
10004	08-Sep-07	SP101	13908	$825

Sales Table (Relation): Invoice Number is the Primary Key

Sales-Inventory Line Items Table		
Invoice-Item Number	Quantity	Actual Unit Price
10001-3054	1	399
10002-2015	1	799
10003-2014	1	949

Sales-Inventory Line Items Table (Combination of Invoice Number and Item Number Forms Primary Key)

4.3.1 Types of Attributes (Keys)

Tables in a relational database have three types of attributes:

A **Primary Key**- is the attribute or combination of attributes that uniquely identifies a specific row in a table. For example, the primary key for the inventory table previously is item number. Often, the primary key is a single attribute. In some tables however, two or more attributes jointly form the primary key. For example, in the sales inventory line items table, the primary keys are invoice number and item number.

Primary Key

Inventory Table			
Item Number	Description	Quantity	List price
2014	19" Monitor	32	Br 1,890
2015	21" Monitor	9	Br 2,890
3054	Color Printer	25	Br 3,900

Sales-Inventory Line Items Table		
Invoice-Item Number	Quantity	Actual Unit Price
10001-3054	1	399
10002-2015	1	799
10003-2014	1	949

In some tables, **two or more attributes** may be joined to form the primary key.

A Foreign Key- is an attribute appearing in one table that is a primary key in another table. Foreign keys are used to link tables. Foreign keys enable database records to reference one or more records in other files. For example, the attributes customer number and salesperson number are foreign keys in the sales table; both are used to link the data about a particular sales transaction with information about the sales person and the customer who participated in that event.

Customers Table							
Customer No.	Name	Street	City	State	Zip Code	Credit Limit	Account Balance
11255	G. Hay	299 Main Street	AA	AZ	85281	4,000	875
11266	J. Jak	HG Street	AA	AZ	85281	6,000	3,955

Foreign Keys are used to link tables together

Sales Table				
Invoice No.	Date	Sales Person ID.	Customer #	Amount
10001	08-Sep-07	SP101	11255	$8,500
10002	08-Sep-07	SP122	15266	$9,200
10003	08-Sep-07	SP133	11255	$800
10004	08-Sep-07	SP101	13908	$825

Other Non-Key Attributes- in each table store important information about that entity. For example, in the inventory table, quantity on hand, description and list price are non-key attributes.

Inventory Table			
Item Number	Description	Quantity	List price
2014	19" Monitor	32	Br 1,890
2015	21" Monitor	9	Br 2,890
3054	Color Printer	25	Br 3,900

4.3.2 Alternatives for Storing Data and Its Problems

One possible alternate approach would be to store all data in one uniform table. For example, instead of separate tables for sales and inventory, we could store all data in one table and have a separate line for each ***sales x inventory*** combination. Using the suggested approach, a customer buying three inventory types in a single invoice would need three rows in the table.

Customer No.	Name	Invoice No.	Item No.	State	Permanent Phone No.	Credit Limit	Account Balance
11267	H.D	10008	2014	AZ	333-4521	7,000	4,500
11267	H.D	10008	2015	AZ	333-4521	7,000	4,500
11267	H.D	10008	3054	AZ	333-4521	7,000	4,500
11,255	K.D	10009	2014	NJ	355-2135	8,000	6,300
11,255	K.D	10009	3054	NJ	355-2135	8,000	5,500

In this simplified approach, a number of problems arise.

Problems associated with storing all Data in One table

One problem with trying to store all the data in one table is that it creates a great deal of redundancy. Such redundancy will make file maintenance unnecessarily time consuming and error prone. Three specific types of problems can occur.

The ***first*** is called **update anomaly** because updates or changes to data values are not correctly recorded. For example, changing a customer's address requires searching the entire table and changing every occurrence of that customer's address. Overlooking even

one row **would create inconsistency** in the database and multiple rows with different addresses exist for the same customer. It costs in wrong mailing and error analysis of sales etc.

Customer No.	Name	Invoice No.	Item No.	State	Permanent Phone No.	Credit Limit	Account Balance
11267	H.D	10008	2014	AZ	333-4521	7,000	4,500
11267	H.D	10008	2015	AZ	333-4521	7,000	4,500
11267	H.D	10008	3054	AZ	333-4521	7,000	4,500
11,255	K.D	10009	2014	NJ	355-2135	8,000	6,300
11,255	K.D	10009	3054	NJ	355-2135	8,000	5,500

If customer H.D changes his phone number, you need to make the change in three places. If you

fail to change it in all three places or change it incorrectly in one place, then the records for that

customer will be inconsistent. This problem is referred to as an update anomaly.

The ***second*** one is **insert anomaly**, because there is no way to store information about prospective customers until they actually make the purchase. Until then, the sales invoice number column would be blank. But, the invoice number is part of the primary key and it cannot be blank.

The ***third*** one is **delete anomaly**, because it involves unintended results that arise when ***deleting a row in that table.*** If a customer has made only one purchase, consisting of a single item, deleting that row from the table would result in the loss of all information about that customer.

The Solution: A set of tables

The problem associated with trying to store all the data in one table can be avoided by creating a set of tables in a relational database - one table for each entity of interest. Each entity is stored in a separate table, and separate tables or foreign keys can be used to link the entities together. This is because:

- ***Redundancy*** is greatly reduced- non-key attributes are stored only once. This avoids update anomaly problems. If some attributes are repeated, these are foreign keys and referential integrity rule will ensure update anomaly problems.

- Adding new data to the system is easy- this avoids the insert anomaly
- Improves the deletion of information- deletion of one row will not result in entire loss of information about a specific entity. This will rectify the problem of delete anomaly.

4.3.3 Basic Requirements of the Relational Data Model

The relational data model imposes several requirements on the structure of tables. These requirements are used to develop a well-structured (normalized) database. The requirements include:

1. **Every column in a row must be single valued**- there shall be one and only one value in each cell. Thus, each table is a flat table. This requirement is the reason why there is a table called sales inventory line item. Each sales transaction may involve more than one item and a single item may be sold to different customers with different invoice numbers.
2. **Primary keys can't be null**- the primary key is the attribute or a combination of attributes that uniquely identifies a specific row in a table. For this to be true, the primary key for any row can't be null or blank, for then there would never be a way to uniquely identify that row and retrieve data stored there. A non-null value for primary key indicates that a specific object exists and can be identified by reference to its primary key value. This constraint is referred to as the **entity integrity rule**; because it ensures that every row in every relation must represent data about some specific object in the real world. In general, there should no duplicate primary keys and no null primary keys.
3. **Foreign keys, if null, must have values that correspond to the value of the primary key in another relation**- foreign keys are used to link rows in one table to rows in another table. This is only possible if the values correspond to their values in the row of the original table. This constraint is referred to as the **referential integrity rule** because it ensures the consistency of the database. But foreign keys can contain null values. For example, some customers may pay cash to the seller and the want not to be identified. Hence, the customer number field in the sales

table would be blank.

4. **All non-key attributes in a table should describe a characteristic about the job identified by the primary key-** most tables contain other attributes in addition to the primary and foreign keys. These are other important facts about the entity under consideration.

These four constraints produce a well-structured (normalized) database in which data are consistent and redundancy is minimized and controlled. In a normalized database, attributes appear multiple times only when they function as foreign keys. The referential integrity rule ensures there will be no update anomaly problem with foreign keys. An important feature about relational database is that data about various things of interest (entities) are stored in separate tables.

When data about objects of interest are stored in separate database tables, it is easy to add new data by adding another row to the table. For example, adding a new customer is as simple as adding a new row to the Customer table. Thus, the tables are free from insert anomalies. Relational databases also simplify data deletion. Deleting sales invoice, does not erase all data about that customer, because it is stored in the Customer table. This avoids delete anomalies. Another benefit of the schema is that space is used efficiently. The Sales-Inventory table contains a row for each item sold on each invoice. There are no blank rows, yet all sales data are recorded.

Sales

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

Sales-Inventory

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

Inventory

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

Customer

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

4.3.4 Approaches to Database Design

There are two basic approaches to design a well-structured relational database: Normalization and Semantic Data Modeling

Normalization

It starts with the assumption that everything is initially stored in one large table. A set of rules is then followed to decompose that initial table into a set of normalized tables. The objective is to produce a set of tables what are called **Third Normal Form (3NF)**, because such tables are free of the types of update, insert and delete anomalies (problems described earlier).

Semantic Data Modeling (Conceptual Data Modeling)

An alternative way to design well-structured relational databases involves ***Semantic Data Modeling***. Under this approach, the database designer uses knowledge about how business processes typically work and about the information needs associated with transaction processing to first draw a graphical picture of what should be included in the database. The resulting figure can then be directly used to create a set of relational tables that are in **3NF**. The two data modeling tools that accountants and business systems professionals can use to design transaction processing databases are E-R (Entity-Relationship) Diagramming and the **REA Data Model**. Semantic data modeling has two significant advantages over simply following the rules of normalization.

1. Semantic data modeling uses the designer's knowledge about business processes and practices; it therefore facilitates efficient design of transaction processing databases.
2. The resulting graphical model explicitly represents information about the organization's business processes and policies and facilitates communication with intended users.

Activity 4.3

1. **What is the relational database?**
2. **How relational data model represents everything in the table?**
3. **What are three types of attributes in relational database?**
4. **What are the problems associated with storing all data in one table?**
5. **What are the basic requirements of the relational data model?**

4.4 Database Design Process

A data model is a "description" of both a container for data and a methodology for storing and retrieving data from that container. Actually, a data model is not a “physical thing". Data models are abstractions, oftentimes mathematical algorithms and concepts. You cannot really touch a data model. But nevertheless, they are very useful. The analysis and design of data models has been the cornerstone of the evolution of databases. As models have advanced so has database efficiency.

Design of a database is much more than simply learning the syntax of a how to use a particular DBMS. Building accurate databases requires a great deal of careful planning and design before even sitting down at the computer. The issues of data modeling will be emphasized next. The REA accounting model and the Entity Relationship (E-R) Diagramming and how to use these tools to build a data model of AIS will be seen in the

next discussions. Finally, how to implement the resulting data model in a relational database will be considered.

Steps in database design include the following:

1. **Planning Stage**- involves the initial planning to determine the need for and feasibility of developing the new system. This includes preliminary judgments about the proposal's technological and economic feasibility.
2. **Requirements Analysis Stage**- involves identifying user information needs, defining the scope of the proposed new system, and using information about the expected number of users and transaction volumes to make preliminary decisions about hardware and software requirements.
3. **Design Stage**- involves developing the different schemas for the new system, at the conceptual, external, and internal levels. The requirements analysis and design stages are the stages of data modeling.
4. **Coding**- involves translating the internal level schema into the actual database structures that will be implemented in the new system. This is also the stage when new applications are developed.
5. **Implementation**- this stage includes all activities associated with transferring data from existing systems to the new database AIS, testing the new system, and training employees how to use it.
6. **Operation and Maintenance**- involves using and maintaining the system including *carefully monitoring system performance and user satisfaction* to determine the need for making *system enhancements and modifications*. **Eventually**, changes in business strategies and practices or significant new developments in information technology initiate investigation into the feasibility of developing a new system and the entire process starts again.

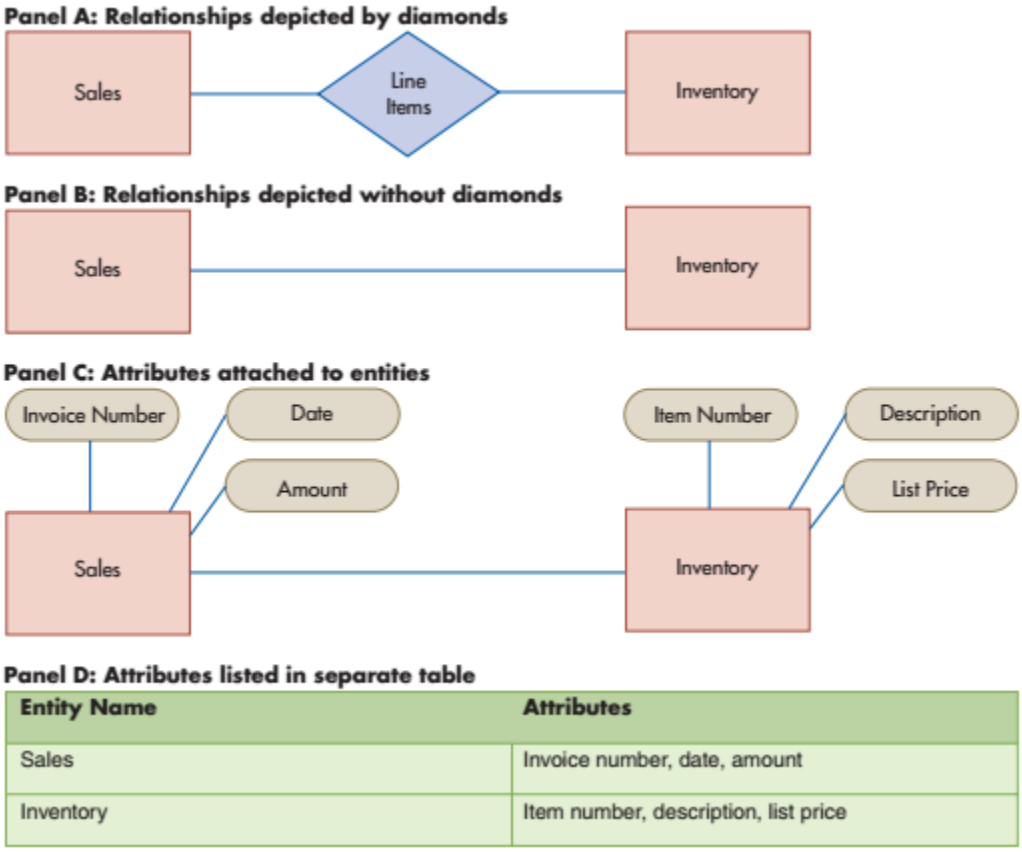
Accountants can and should participate in all stages of the database design process, although the level of their participation in each stage is likely to vary. Accountants may provide the greatest value to their organizations by taking responsibility for **data modeling**. Data modeling is the process of **defining** a database so that it faithfully represents all

aspects of the organization, including its transactions with the external environment. **Data modeling** occurs during both the requirements analysis and design stages of the database design. Two important tools that accountants can use in data modeling are: ***Entity Relationships Diagramming*** *and the* ***REA Data Model***.

4.4.1 Entity Relationship Diagrams

An Entity-Relationship (E-R) Diagram is **a *graphical technique for portraying a database schema***. It graphically depicts a database's contents. ER Diagram shows entities being modeled and the **relationships** among them. An **entity** is anything about which the organization wants to collect and store information. In a relational database, separate tables would be created to store information about each distinct entity; **in an object-oriented database**, separate classes would be created for each distinct entity. In an E-R diagram, entities are depicted as **rectangles.** Unfortunately, however, there are **no industry** standards for other aspects of E-R diagrams. Some data modelers and authors use diamonds to depict relationships (Figure 4-1, panel A) whereas others do not (Figure 4-1, panel B). Sometimes the attributes associated with each entity are depicted as named ovals connected to each rectangle (Figure 4-1, panel C), whereas other times the attributes associated with each entity are listed in a separate table (Figure 4-1, panel D). In this chapter, we will be creating E-R diagrams with a large number of entities and relationships. Therefore, to reduce clutter and improve readability, we omit the **diamonds** for relationships and list the attributes associated with each entity in a separate table. Thus, our diagrams look like a combination of panels B and D in Figure 4-1.

Figure 4-1 E-R Diagram Variations



Entity Name	Attributes
Sales	Invoice number, date, amount
Inventory	Item number, description, list price

E-R Diagram is used to design databases to support an organization's business activities. E-R diagrams depict the contents of a database and graphically model those business processes. Thus, the ER diagrams can be used not only to design databases but also to document and understand existing databases and to reengineer business processes. E-R diagrams can include many different kinds of entities and relationships. An important step in database design is deciding which entities need to be modeled. The REA data model is useful for making that decision.

4.4.2 The REA Data Model

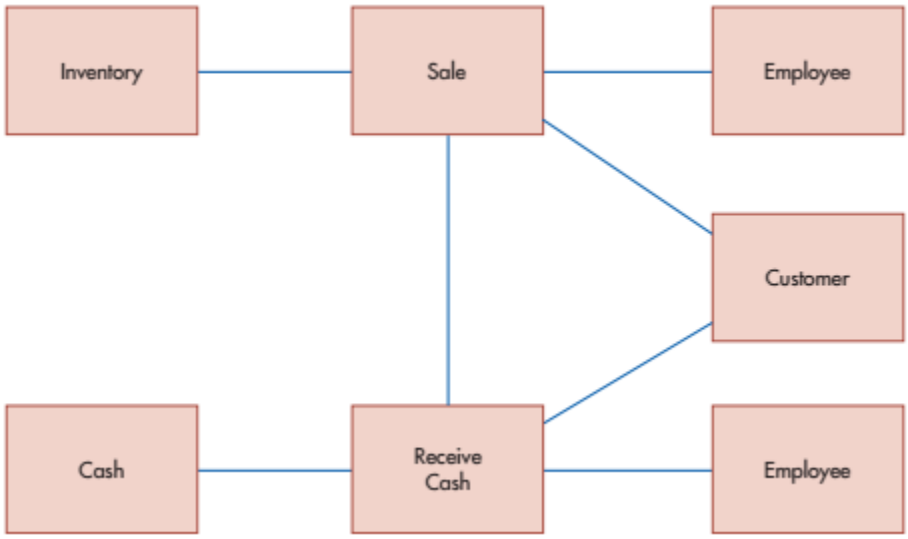
Specifically used for AIS database design, the REA data model is ***conceptual modeling tool that focuses on the business semantics underlying an organization's value chain activities***. The REA data model provides guidance for database design by identifying what entities should be included in the AIS database and how to structure relationships among

the entities in that database. REA data models are usually depicted in the form of E-R Diagrams. Therefore, we refer to E-R diagrams developed with the REA model as **REA Diagrams**

4.4.2.1 Types of Entities: Three Basic Types of Entities

The REA model classifies entities into three distinct categories: the ***resources*** that the organization acquires to use from figure 4-2. Cash and inventory, the ***events*** (business activities) in which the organization engages from figure 4-2. Sale and cash receipt, and the ***agents*** participating in the events from figure 4-2. Employee and customer. Recently, some researchers proposed a fourth type of entity-locations such as stores, warehouses, etc. But they may be considered as resources, or attributes of the event entity. The REA data model is so named because it classifies entities into three distinct categories

Figure 4-2 Basic Elements of a REA Diagram



Resources (R) ***that the organization acquires and uses*** – they are things that have economic value to the organization. These include cash, inventories, equipment and machinery, supplies, warehouses, factories, and land.

Events (E) ***in which the organization engages*** **-** are the various business activities about which management wants to collect information for planning or control purposes. The REA data model helps people design databases that support the management of an organization's

value chain activities. Therefore, most of the events in an REA data model fall into one of the two categories: economic exchanges or commitments.

- ***Economic exchanges***- are the value chain activities that directly affect the quantity of resources. For example, the sales event decreases the quantity of inventory and the cash receipts event increases the amount of cash.
- ***Commitments***- represent promises to engage in future economic exchanges. For example, customer orders are commitments that lead to future sales. Often such commitments are necessary precursors to the subsequent economic exchanges. Moreover, management needs to track commitments for planning purposes. For example, manufacturing firms often use information from customer orders to plan production.

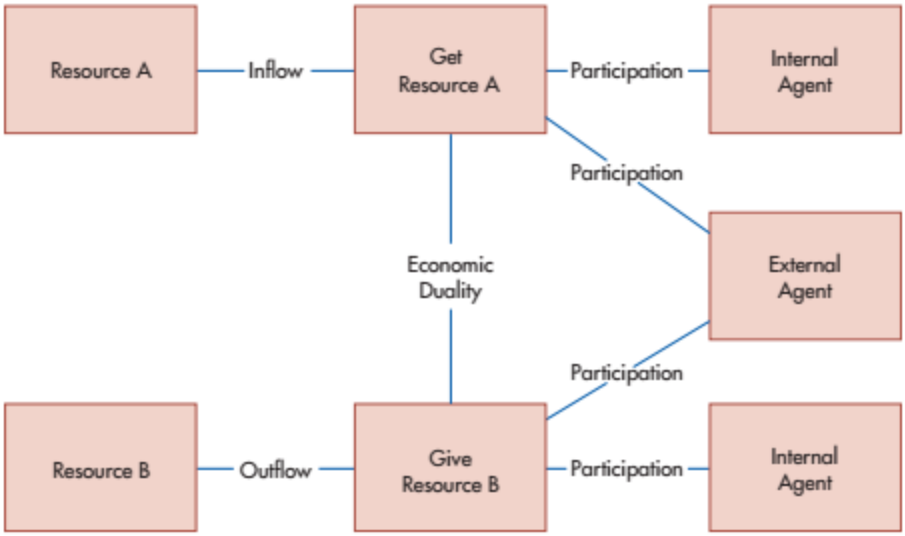
Agents (A) – are people and organizations that participate in the events and about whom information is desired for planning, control, and evaluation purposes. Examples include employees, customers, vendors etc.

In general, the REA is a tool for designing AIS databases. An AIS captures data about an organization's resources, events and agents (REA). Resources are an organization's assets. Events are identifiable activities associated with a business processes. Agents are the people associated with business activities.

4.4.2.2 Structuring Relationships: Basic REA Template

The REA data model prescribes a ***basic pattern*** for how the three types of entities should relate to

one another. Figure 4-3.



The names on the lines describe the nature of the relationship. Agents participate in events. The economic duality relationship between the "get" event and the "give" event reflects the fact that organizations must give up one resource (e.g., cash) in order to get some other resource (e.g., inventory). The stock flow relationships between an event and a resource represent either inflows or outflows of a resource.

Rule 1: Each event is linked to at least one resource that it affects

Events such as the sale of merchandise that change the quantity of a resource are linked to that resource in what is called a ***stock flow relationship***. Other events such as taking a customer order that represent future commitments are linked to resources in what are called ***reserve relationships***.

Every event entity must be linked to at least one resource entity. Events must be linked to at least one resource that they affect. Some events affect the quantity of a resource:

- If they increase the quantity of a resource, they are called a "get" event.
- If they decrease the quantity of a resource they are called a "give" event.

EXAMPLE: If you purchase inventory for cash:

- The get event is that you receive inventory
- The give event is that you pay cash

Relationships that affect the quantity of a resource are sometimes referred to as ***stock flow relationships***. Not every event directly alters the quantity of a resource. If a customer

orders goods but has not paid and has not received goods, this activity is called a **commitment event**. Organizations track the effects of commitments to provide better service and for planning purposes. From the figure 4-3 the resource A linked to get resource A event which the inflow of resource and resource B linked to Give resource which is an outflow.

Rule 2: Each event is linked to at least one other event

Each **economic exchange event** is linked in **a *give to get duality relationship*** with another economic exchange event. These economic duality relationships reflect the basic business principle that organizations typically engage in activities that use up resources only in hopes of acquiring some other resource in exchange. Each accounting cycle can be described in terms of give-to-get economic duality relationships. In revenue cycle, which interacts with customers, for example, the sales event, which requires giving up (decreasing) inventory is related to the cash receipts event which requires getting (increasing) the amount of cash. Not every relationship between two events represents a give-to-get economic duality. **Commitment events** are linked to other events to reflect sequential cause-effect relationships. Example: Customer order is a commitment event that leads to deliver of inventory (give event) and cash receipt (get event). The figure 4-3 shows that the event of get the resource A is linked to the other event give resource B events.

Rule 3: Each event is linked to at least two agents

For accountability, organizations need to be able to track actions of employees. Also need to monitor the status of commitments and exchanges with outside parties. Thus, each event is linked to at least two participating agents: internal agent and external agent. For events that involve transactions with external parties:

- The internal agent is the employee responsible for the affected resource
- The external agent is the outside party to the transaction

For internal events, such as transferring raw materials to the production floor:

- The internal agent is the employee who responsible for the custody of the resource
- The external agent is the one who receives it.

Figure 4-3 shows that get resources A event is linked to two agents which is internal agent and external agent in the same way the give resource B linked to internal agent and external agent.

Activity 4.4

1. **What is data modeling?**
2. **What are the steps in database design?**
3. **What are the tools used in data modeling?**
4. **What are the structuring relationships of REA?**

4.4.3 Developing REA Diagram for One Transaction Cycle

In drawing REA model, the paper is divided into three columns- one for each type of entity:

- The left column is used for resources
- The center column for events, and
- The right column for agents.

Readability is further enhanced if the events entities are drawn from top to bottom corresponding to the sequence in which they occur.

To design REA Diagram for entire AIS, one would develop a model for each transaction cycle and then integrate the separate diagrams into an enterprise-wide model. Developing REA Diagram for a specific transaction cycle consists of the following three steps:

Step-1: Identify the events about which management wants to collect information

Step-2: Identify the resources affected by each economic exchange event and the agents who participate in those events.

Step-3: Determine the cardinalities of each relationship

Step-1: Identify the Events

Identify the events about which management wants to collect information. Events can be Economic Exchange Events or Commitment Events. Identify the pair of economic exchange events that represent the basic give to get economic duality relationship in that

cycle. Then, analyze each economic exchange event to determine whether it should be decomposed into a combination of one or more commitment events and an economic exchange event. If necessary, replace the original economic exchange event with the resulting set of commitment and economic exchange
events.

The basic REA template consists of a pair of events, one that increases some resource and one that decreases some resource. That is, every REA model must include the two events that represent the basic give-to-get economic exchange performed in that transaction cycle. The give event reduces one of the organization's resources. The get event increases a resource. There are also other events (commitment events) that management is interested in planning, controlling, and monitoring. These should be included in the model. Example:

REA Diagram for Revenue Cycle. Revenue
Cycle includes the following typical activities:

- Take customer order - does not involve giving or taking a resource. It is a commitment event
- Fill customer order - involves a reduction in the company's inventory. It is a give event
- Bill customer - involves the exchange of information with an external party but does not affect resources
- Collect payment - results in an increase in cash. It is a get event

In Revenue Cycle, the give-to-get is:

- Fill customer order (often referred to as "sale"); and
- Collect cash (often referred to as "cash receipt")

This step is analyzing each economic exchange event to determine whether it can be decomposed into a combination of one or more commitment and exchange events. It is important for management to get up-to-date information about various orders to reorder various inventory items. It is also important to know which orders have been shipped and when. Then, the single economic

exchange event labeled sales may be replaced with a combination of a commitment event which is labeled customer orders and the economic exchange event that was labeled sales. The cash receipts economic exchange event will not be decomposed because whether payment is received immediately or later by mail, what shall be tracked is actual receipts from customers. Billing as an event is not modeled because it is neither an economic exchange nor a commitment. Printing an invoice and mailing it to the customer doesn't increase or decrease the amount of any resource. It is simply an information processing event that merely retrieves information from the database about previous customer orders and sales events. Organizations build databases to collect, process, and store information about their value chain activities. Printing documents and reports or querying the database are just different ways of retrieving information about those activities for use in making decisions. Such information processing activities do not change the contents of the database and are not modeled as events in an REA diagram.

Take Customer Order

- Taking an order requires that we set resources aside
- That information should be included in our model

Bill Customer

- Printing and mailing invoices does not directly affect an economic resource
- It does not represent a commitment on the part of the company to a future exchange
- It is an information retrieval event and should not alter the contents of the database
- Does not need to be included in the model

Step 2: Identify Resources and Agents

Once the events of interest have been specified, the resources that are affected by those events need to be identified. Involves determining:

- The resource(s) reduced by the give event.
- The resource(s) increased by the get event.
- The resources that are affected by a commitment event

For example, the sales event is translated to giving inventory to customers and the cash receipts event is translated to receiving cash from customers. Hence, the inventory and cash

entities are added in the resource column and the stock flow relationship is drawn between those entities and the events that affected them.

Accounts Receivables

While accounts receivable is an asset in financial reporting, it is not represented as a resource in an REA model. It represents the difference between total sales to a customer and total cash collections from the customer. The information to calculate accounts receivable balance is already there because the sales and cash receipt information is captured. That is, accounts receivable simply represents sales for which customer payments have not yet been received. Consequently, if data about both sales and cash collections are already stored in the database, all the information needed to calculate A/R can be derived from the information stored about those two events. How to extract this information will be discussed later. The following questions must be answered to identify the events and resources affected by the events to incorporate them as an entity in REA Diagram.

- What is the give event?
- What resource is reduced by the give event?
- What is the get event?
- What resource is increased by the get event?
- Is there a commitment event?
- What resource is affected by the commitment event?

The agents who participate in each event should also be identified. After specifying the resources affected by each event, it is necessary to identify the agents who participate in those events. There will always be at least one internal agent (an employee) and in most cases an external agent (the customer or vendor) who participate in each event. For example, customers and salespersons participate in the sale event and customers and cashiers participate in the cash collection event. Hence, in the REA diagram, these three agent entities shall be added: salespersons, customers, and cashiers. Relationships shall be included to indicate which agent participated in which events. Agents can be identified through the following questions for revenue

cycle:

- What agents are involved in the sale?
- What agents are involved in the receipt of cash?
- What agents are involved in taking the order?

It is important to understand that the agents in the REA data model represent functions, not specific people. For example, the salesperson and the cashier are shown as separate entities but the same person may take both roles. The REA data model requires that each event be linked to at least one resource and at least two agents. This information needs to be supplemented by interviews with management to identify other possible relationships of interest. For example, if the organization assigns customers to specific salespeople to provide customized service, then a direct relationship between the two agent entities (salesperson and customer) would be added to the diagram.

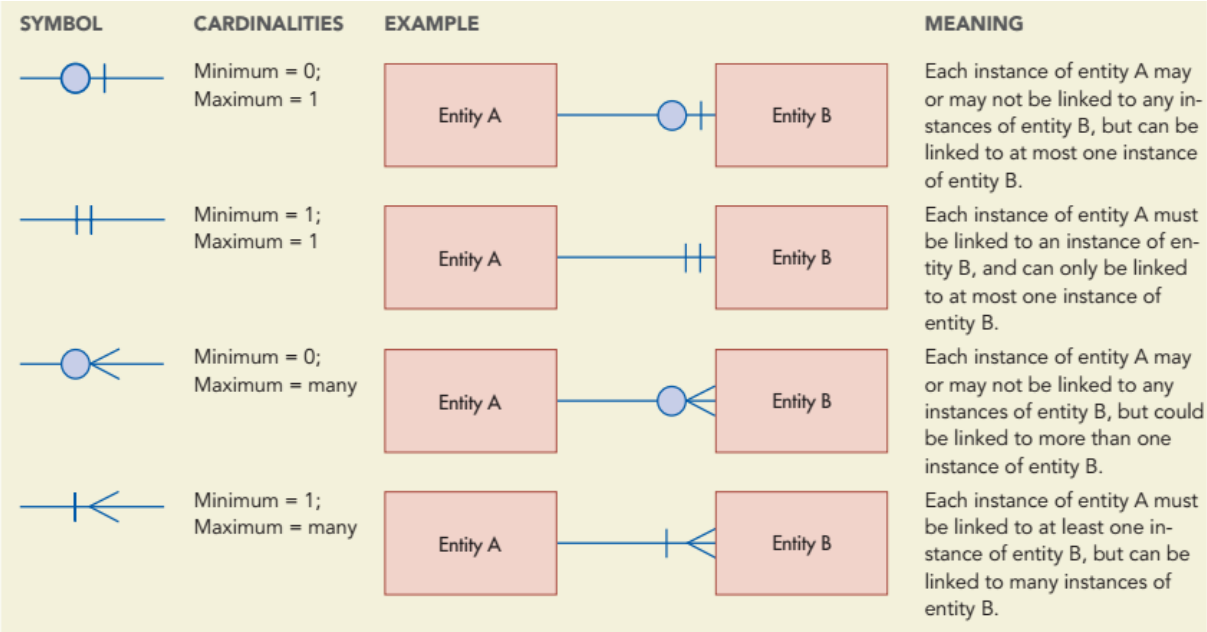
Step 3: Determine Cardinalities of Relationships

The final step in REA Diagram for one transaction cycle is to add information about the cardinality relationship between various entities. **Cardinality** describes the nature of the relationship between two entities. ***Cardinalities indicate how many instances of one entity can be linked to one specific instance of another entity***. Consider the relationship between the Customer agent entity and the Sale event entity. Each entity in a REA diagram represents a set. For example, the Customer entity represents the set of the organization's customers, and the Sale entity represents the set of individual sales transactions that occur during the current fiscal period. Each individual customer or sales transaction represents a specific instance of that entity. Thus, in a relational database, each row in the Customer table would store information about a particular customer, and each row in the Sales table would store information about a specific sales transaction. Cardinalities define how many sales transactions (instances of the Sale entity) can be associated with each customer (instance of the Customer entity) and, conversely, how many customers can be associated with each sales transaction.

No universal standard exists for representing information about cardinalities in REA diagrams. In this chapter, we use the graphical **"crow's feet"** notation style for representing cardinality information because it is becoming increasingly popular and is used by many

software designs tools. Figure 4-4 explains the meaning of the symbols used to represent cardinality information.

Figure 4-4 Graphical Symbols for Representing Cardinality Information



Minimum Cardinality

The first number is the **minimum cardinality in each cardinality pair**. It indicates whether a row in this table must be linked to at least one row in the table on the opposite side of that relationship. **Minimum cardinalities can be either 0 or 1.**

- A minimum cardinality of 0 (Zero) means that a new row can be added to that table without being linked to any specific rows in the table on the other side of the relationship.
- A minimum cardinality of 1 means that each row in that table must be linked to at least one row in the other table.

Maximum Cardinality

It indicates whether one row in that table can be linked to more than one row in the other table. Maximum cardinalities can be either 1 or N.

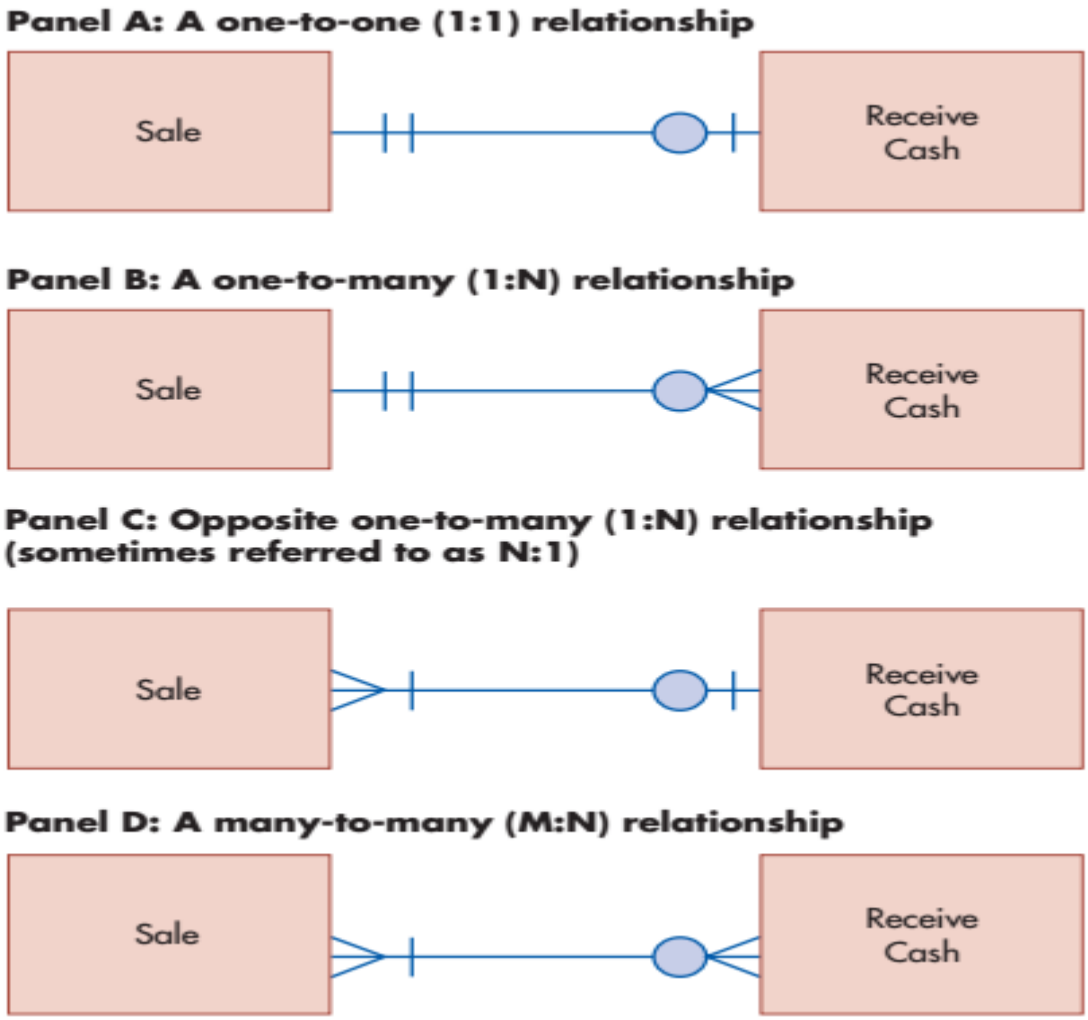
- A maximum cardinality of **N** means that each row in that table may be linked to more than one row in the other table.

- A maximum cardinality of **1** means that each row in that table can be linked to at most only one row in another table.

Types of Relationships

Cardinalities are not arbitrarily chosen by the database designer. They reflect facts about the organization being modeled and its business practices obtained during the requirements analysis stage of the database design process. Three basic types of relationships between entities are possible depending on the **maximum cardinality** associated with each entity. Cardinality of relationships are determined only taking into account the maximum cardinality on each side of a relationship.

Figure; 4-5 Examples of Different Types of Relationships



1. A **one-to-one (1:1)** relationship exists when the maximum cardinality for each entity in that relationship is one. **Example: (see Figure 4-5., panel A)**
2. **A one-to-many (1: N)** relationship exists when the maximum cardinality of one entity in that relationship is 1 and the maximum cardinality of the other entity in that relationship is N

   For one-**to-many (1: N)** relationship **(see Figure 4-5., panels B and C).**

3. **Many-to-many (M: N)** relationship exists when a maximum cardinality for both entities in the relationship is N.

   For many-to-many (M: N) relationship (**Figure 4-5**., panel D)

Figure 4-5. shows that any of these possibilities might describe the relationship between the Sale and Receive Cash events. The data modeler or database designer cannot arbitrarily choose which of these three possibilities to use when depicting various relationships. Instead, the cardinalities must reflect the organization's business policies. Let us now examine what each of the possibilities depicted in Figure 4-5. means. Figure 4-5., panel A, depicts a one-to-one (1:1) relationship between the Sale and Receive Cash events. The maximum cardinality of 1 associated with the Receive Cash entity means that each Sale event (transaction) can be linked to at most one Receive Cash event. This would be appropriate for an organization that had a business policy of not allowing customers to make installment payments. At the same time, the maximum cardinality of 1 associated with each Sale event means that each payment a customer submits is linked to at most one sales event. This would be appropriate for an organization that had a business policy of requiring customers to pay for each sales transaction separately. Thus, the 1:1 relationship depicted in Figure 4-5., panel A, represents the typical revenue cycle relationship for business-to-consumer retail sales: Customers must pay, in full, for each sales transaction before they are allowed to leave the store with the merchandise they purchased. Note that it does not matter how customers pay for each sales transaction (i.e., with cash, check, credit card, or debit card). Regardless of the method used, there is one, and only one, payment linked to each sales transaction and, conversely, every sales transaction is linked to one, and only one, payment from a customer (payments made by debit and credit cards

also involve the card issuer; for simplicity, that transfer agent is not included in Figure 4-6). If management is interested in tracking the frequency of how customers choose to pay, payment method might be recorded as an attribute of the Receive Cash event.

Panels B and C of Figure 4-5 depict two ways that one-to-many (1:N) relationships can occur. Panel B shows that each Sale event may be linked to many Receive Cash events. This indicates that the organization has a business policy that allows customers to make installment payments to the selling organization. If the customer uses a third-party source of credit, the selling organization receives one payment in full from that third party for that particular sales transaction; the customer may be making installment payments to the credit agency, but those payments would not be modeled in an REA diagram for the selling organization. (Think about it: The selling organization has no way of tracking when one of its customers pays a portion of a credit card bill or makes a monthly payment on a bank loan). The situation depicted in Figure 4-5, panel B, does not, however, mean that every sales transaction is paid for in installments: The maximum cardinality of N simply means that some sales transactions may be paid in installments. Panel B of Figure 4-5 also shows that each Receive Cash event is linked to at most one Sale event. This indicates that the organization has a business policy that requires customers to pay for each sales transaction separately and are not allowed to build up an account balance over a period of time. Thus, Figure 4-5, panel B, represents the revenue cycle of an organization that probably sells big-ticket items. Should a customer return and make another purchase, a separate set of installment payments would be created in order to separately track how much has been paid for each sales transaction.

Figure 4-5, panel C, shows another type of 1:N relationship between the Sale and Receive Cash events. In this case, each Sale event can be linked to at most one Receive Cash event. This indicates that the organization has a business policy that does not permit customers to make installment payments. Figure 4-5, panel C, also shows that each Receive Cash event may be linked to many different Sale events. This indicates the existence of a business policy allowing customers to make a number of purchases during a period of time (e.g., a month) and then pay off those purchases with one payment. The situation depicted in

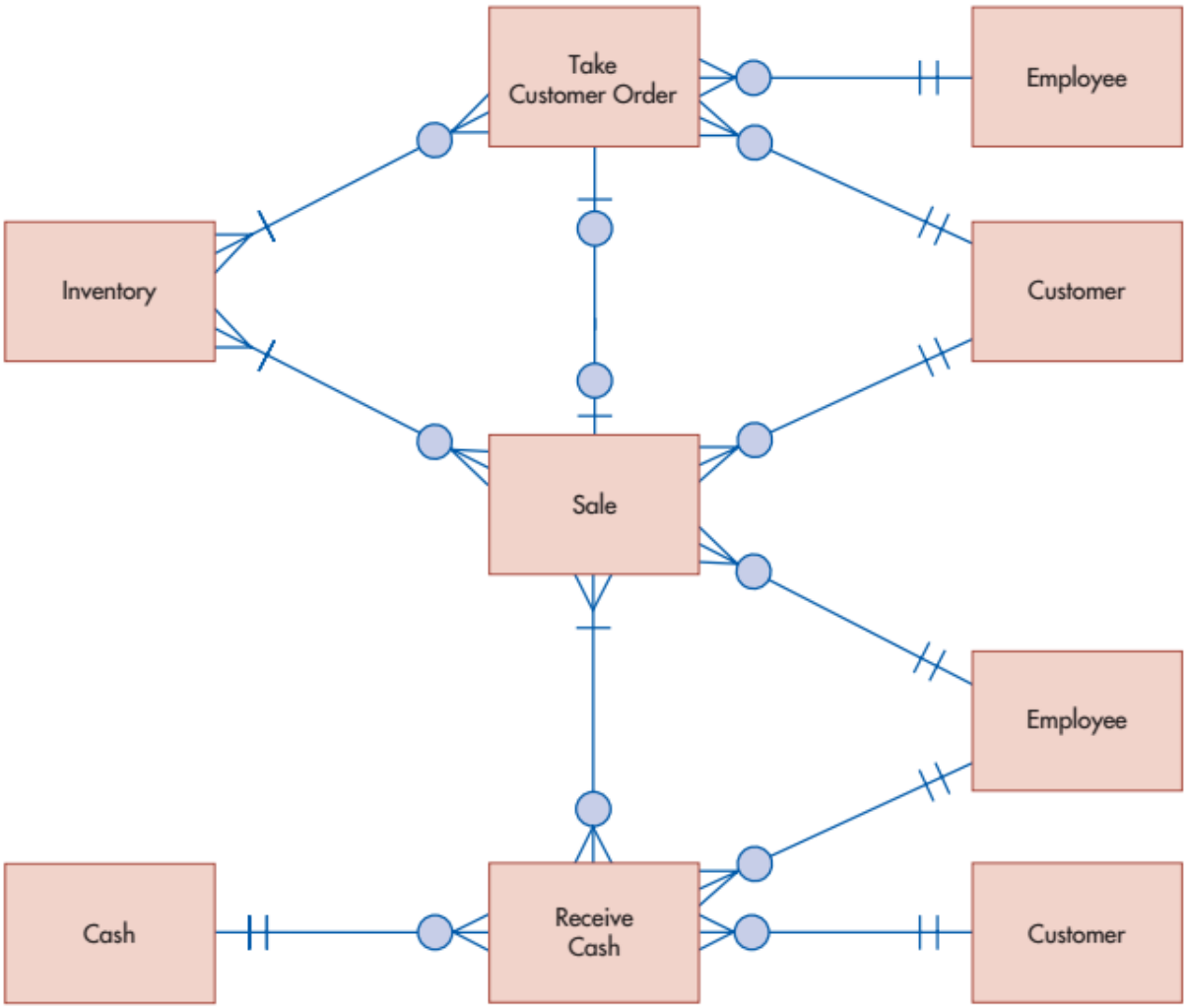
Figure 4-5, panel C, is quite common, especially for business-to-business sales of nondurable goods.

Figure 4-5, panel D, depicts a many-to-many (M:N) relationship between the Sale and Receive Cash events. It shows that each Sale event may be linked to one or more Receive Cash events and that each Receive Cash event may in turn be linked to one or more Sale events. This reflects an organization that has business policies that allow customers to make installment payments and also permits customers to accumulate a balance representing a set of sales transactions over a period of time. Keep in mind, however, that maximum cardinalities of N do not represent mandatory practices: Thus, for the relationship depicted in panel D, some sales transactions may be paid in full in one payment and some customers may pay for each sales transaction separately. The situation depicted in Figure 4-5, panel D, is quite common.

Rules for Specifying Cardinalities

The database designer doesn't arbitrarily choose cardinalities. Instead, cardinalities reflect facts about the organization being modeled and its business practices. This information is obtained during the requirements definition stage of the database design process. Certain general principles can provide a starting point for developing a REA data model for any organization.

Figure 4-6 Partial REA Diagram Revenue Cycle



Let us now examine Figure 4-6 to see what it reveals revenue cycle processes.

1. Cardinality Rules for Agent-Event Relationship

Almost always, the minimum and maximum cardinalities associated with the Event Entity. Every agent-events relationships are both one (1). That is, for each event that occurs, the cardinality between event and agent is typically (1,1). The minimum cardinality associated with the event is 1 because there must be some agent who participates in that event. The maximum cardinality is 1 because the organization wants to be able to hold some specific agent responsible for that event.

For Example: When a sale occurs:

- There is usually one and only one customer

- There is usually one and only one salesperson. This practice makes it more feasible for the organization to establish employee accountability for the event.

There is also a general principle concerning ***cardinalities associated with each Agent Entity in the agent-event relationship***. The ***cardinalities associated with each agent entity in the agent- event relationship*** all have Zero minimums and N maximums. That is, for each agent the cardinality between agent and event is typically (0: N).

The maximum cardinality associated with internal agent entities is almost always N, because organizations expect their employees will participate in numerous events. It is also usually N for external agents, because organizations often engage in repeat transactions with the same suppliers and customers. There are two reasons why the minimum cardinality associated with agent entities in the agent event relationship is usually zero:

- Organizations want to be able to add information about potential customers and suppliers even though those agents may not have participated yet in the business transactions
- Event entities are analogous to transaction files, whereas agent entities are analogous to master files. At the end of the fiscal year, the contents of events tables are archived and the new fiscal year begins with no rows in various event tables. In contrast, information about agents is permanent in nature and is carried over from one fiscal period to the next. Therefore, at the beginning of a new fiscal year customers may not be linked to any current sales.

Example:

For a particular salesperson

- There is typically a minimum of zero sales (allows for inclusion of a new salesperson who has not yet made any sales)
- A salesperson can have a maximum of many sales

For a particular customer:

- There is typically a minimum of zero sales (to allow for the inclusion of prospective customers who haven't bought anything yet) and a maximum of many sales. (see figure 4.6)

2. Cardinality Rules for Resource-Event Relationships

The minimum cardinalities associated with ***Each Resource*** in resource-event relationship are **Zero**. In the cardinality between event and resource, the maximum is typically many (N). This is by the same reasoning as the case for cardinalities associated with agents in agent-event relationship. Reasons:

Minimum cardinality

- A company can have an inventory item for which there has never been a sale
- When the company's cash account is new, there has never been a cash receipt deposited in it

Maximum cardinality

- Most inventory items can be sold many times. (An exception might occur if each inventory item is one unique item, such as a piece of real estate.)
- The company's cash account can have many cash receipts

One exception to this rule is that the maximum cardinality associated with the inventory resource is sometimes **One (1)**. This is when organizations track specific physical inventory items such as original artwork, vehicles, or houses that are identified by a primary key which is some type of serial number. In such cases, a given row in inventory table could be associated with at most one sales transaction and would have maximum cardinality of **1** instead of **N**.

The minimum cardinality associated with ***Event Entities*** in resource-event relationship is usually **1**, because an event can't occur without affecting at least one resource. For example, each sale event must reduce at least one inventory in the inventory table and each Cash Receipt from a customer must be deposited into some cash account. The only exception to this general rule arises if an event potentially can be linked to more than one resource entity. For example, consider a household appliance repair business. Some services may not require parts whereas others may include labor plus parts. Thus, the sale event for such repair business could be linked with inventory entity, or to repair service entity or both types of resources. Consequently, the minimum cardinality for the sales event

would be zero in both of those relationships. ***(In rare situations, an event might be linked to one of several unique agent entities. In such cases, the minimum cardinality associated with the event entity again will be 0 instead of the normal 1.)***

There is **no general principle concerning the maximum cardinality** associated with event entities in resource-event relationship. Instead, the maximum cardinality depends on the nature of the resources affected by that event and by the organizations policies. For example, customers may buy and are encouraged to buy as many products as possible of a company (see figure 4.6). Hence, customer order and sales events can be linked to many rows in inventory table.

3. Cardinality Rules for Event-Event Relationships

Almost any kind of cardinality pair is possible for each event entity in event-event relationships. The organization's business practices and policies must be understood to decide which possibility is correct. For example, collections from customers may be at once (1:1) or in installments (1: N). The only general modeling principle that applies to event-event relationships is that for two temporally ordered events, the minimum cardinality for the first event is 0, because at the time it occurs, the other event has not yet happened. Often, but not always, the minimum cardinality for the event that occurs second is 1, indicating that the first event had already occurred.

When events occur in a sequence, the minimum cardinality between the first event and the second event is always zero, because there is a span of time (although possibly quite short) when the first event has occurred but there are zero occurrences of the second event. Examples:

- When an order is first taken, there have been no deliveries of goods (sale event) to the customer.
- When goods are delivered to the customer, there is a span of time, however brief, in which there is no cash receipt from the customer.

The minimum cardinality between the second event and the first event is typically one, because the second event can't occur without the first event having occurred. An exception could occur if the first event is not required for the second event to occur. **Example:** If a

sale can be made without first taking an order, then the minimum cardinality between sale and take order could be zero. The maximums in the cardinalities between events can be either one or many, and these maximums vary based on business practices. (See figure 4.6) We have seen this when we looked at the four different possibilities for the relationships between sales and cash receipts previously.

Uniqueness of REA Diagrams

Each organization will have its own unique REA diagram. Business practices differ across companies, so cardinalities and relationships will differ. A given organization can change business practices, leading to a change in its REA diagram:

- A change in practice could cause a change in cardinalities.
- Could even lead to the inclusion of different entities on the diagram

Data modeling can be complex and repetitive. Data modelers must discuss their drafts of models with intended users to ensure that:

- Key dimensions are not omitted or misunderstood.
- Terminology is consistent

Activity 4.5

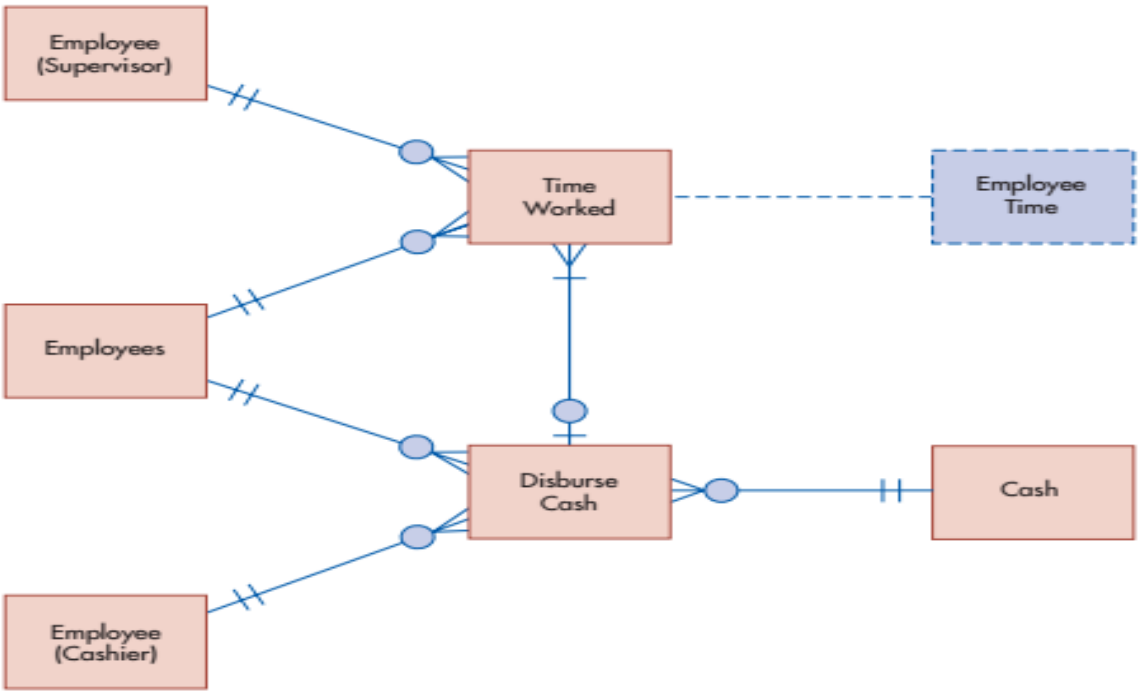
1. **Is the account receivable represent in REA models? If not why?**
2. **What is cardinality?**
3. **What are the possible relationship types based on maximum cardinalities?**
4. **What are the rules for specifying cardinalities?**

4.5 REA data modeling

4.5.1 Integrating REA Diagrams Across Cycles

The separate diagrams for revenue cycle, expenditure cycle, payroll cycle etc. should be integrated to provide a single comprehensive enterprise-wide model of the organization. Doing so requires understanding what the cardinalities in each separate diagram reveal about the organization's business policies and activities. Figure 4-7 depicts the payroll portion of HR/payroll cycle activities. The basic economic exchange involves acquiring the use of each employee's time and skills in exchange for which the employee receives a paycheck. Like many small businesses uses an electronic time clock to record the hours worked by each employee each day. Thus, each Time Worked event records the time an employee began and ended working on a specific day. Each such event must be linked to a particular employee and his or her supervisor; each employee or supervisor, however, may be linked to many different events. Similarly, a paycheck is issued to a particular employee and signed by a particular cashier, but each employee and cashier may be associated with many different Disburse Cash events over time.

Figure 4-7 Payroll Cycle



4.5.2 Rules for Combining REA Diagrams

The integrated diagram merges multiple copies of resource and event entities but retains multiple copies of agent entities. This maximizes the legibility of the comprehensive REA diagram by avoiding the need to have relationship lines cross one another. Let us now examine how to combine redundant resource and event entities.

i. Merging redundant resource entities

Recall that REA diagrams for individual business cycles are built around basic give-to-get economic exchanges. Such economic duality relationships explain why a resource is either acquired or disposed of. They provide only a part of the story about each resource, however. For example, revenue cycle shows that inventory is reduced (the Sales event) in exchange for cash (the Receive Cash event). But revenue cycle does not show how that inventory was initially acquired. Nor does it show how the organization uses the cash it receives from customers. Conversely, expenditure cycle shows how inventory was acquired (the Receive Inventory event) by giving up cash (the Disburse Cash event). Yet, expenditure cycle does not show what the organization does with the inventory or how it acquired the cash used to pay suppliers.

Thus, REA diagrams for individual business cycles provide only partial information about the resources controlled by an organization. The complete picture would show how each resource is acquired and how it is used. As shown in Figure 4-8, this can be done by redrawing an REA diagram to place common resources between the events that affect them. Doing so reflects another important duality that must be depicted in a complete REA model of any organization: Every resource must be connected to at least one event that increases that resource and to at least one event that decreases it.

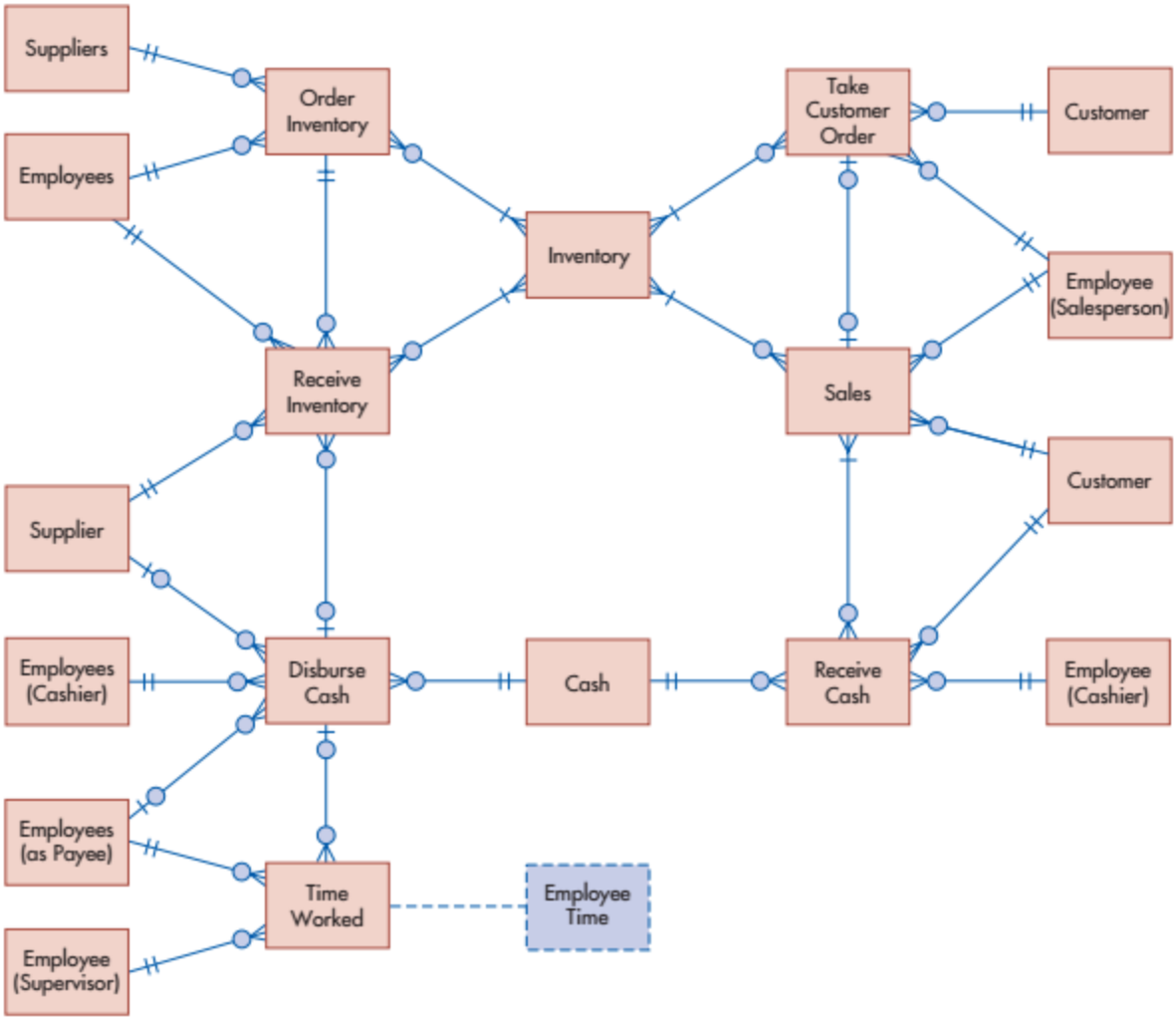


Figure 4-8 Integrated REA Diagram

ii. Merging redundant event entities

REA diagrams for individual business cycles may include some events that also appear in the REA diagrams of another cycle. For example, expenditure cycle and payroll cycle both contain the Disburse Cash event entity. As was the case with resources, merging these multiple occurrences of the same event improves the legibility of the resulting comprehensive REA diagram. Thus, Figure 4-8 shows that the Disburse Cash event is linked to both the Receive Inventory and the Time Worked events.

Close examination of Figure 4-8 reveals an important difference, however, between merging redundant events and merging redundant resources: Merging redundant resources

does not affect any cardinalities, but merging redundant events alters the minimum cardinalities associated with the other events that are related to the merged event.

The reason for this difference lies in the underlying semantics about the nature of the relationship between the merged entity and other entities. The event that appears in both individual business cycle REA diagrams may be linked to either an event that is part of one business cycle or to an event that is part of another cycle but cannot be linked to both events. For example, in Figure 4-8, a particular Disburse Cash event (i.e., a particular check or EFT transaction) could be associated with a prior receipt of inventory from a supplier or with time worked by an employee, but the same check (or EFT transaction) cannot be used both to pay a supplier for receipt of inventory and to pay an employee for working the previous week. Consequently, the minimum cardinality associated with the other events must be 0 in the integrated REA diagram, regardless of what it was in each of the individual transaction cycle REA diagrams.

For similar reasons, the minimum cardinality from the Disburse Cash event to the Receive Inventory event must also be 0. Merging two transaction cycles on a common event may also affect the minimum cardinalities between the merged event and the agents participating in that event.

That is why the minimum cardinality between the Disburse Cash event and the Employee (payee) agent is also 0. Thus, whenever a merged event involves different agents in each of the individual business cycles being merged, the minimum cardinalities between that event and those agents change from the usual 1 to 0, because the event may now be linked to either of the two types of agents, but not both.

iii. Validating the accuracy of Integrated rea diagrams

The, a correctly drawn, integrated REA diagram must satisfy these six rules:

1. Every event must be linked to at least one resource.
2. Every event must be linked to two agents who participate in that event.
3. Every event that involves the disposition of a resource must be linked to an event that involves the acquisition of a resource. (This reflects the economic duality underlying "give-to-get" economic exchanges.)

4. Every resource must be linked to at least one event that increments that resource and to at least one event that decrements that resource.
5. If event A can be linked to more than one other event, but cannot be linked simultaneously to all of those other events, then the REA diagram should show that event A is linked to a minimum of 0 of each of those other events.
6. If an event can be linked to any one of a set of agents, but cannot be simultaneously linked to all those agents, then the REA diagram should show that event is linked to a minimum of 0 of each of those agents.

Notice that these six rules can be used not only to develop an integrated REA diagram but also as "check figures" to validate the accuracy of a completed REA diagram.

4.5.3 Implementing REA Diagram into a Relational Database

Once the REA diagram has been developed, it can be used to design a well-structured relational database. Implementing an REA diagram in a relational database is a three-step process:

1. Create a table for each distinct entity and for each many to many relationships
2. Assign attributes to appropriate tables
3. Use foreign keys to implement one to one and one to many relationships

Recall that even though REA diagrams for different organizations may include the same entities, differences in business policies are likely and will result in differences in relationship cardinalities. For example, the REA diagram for one organization may show a 1:1 relationship between the Sales and Receive Cash events, whereas the REA diagram for another organization may model that same pair of events as being involved in a M: N relationship. Thus, the design of a database (number of tables, placement of attributes) is specific to the organization being modeled.

Step 1: Create Tables for Each Entity and M: N Relationships

A properly designed relational database has a table for each distinct entity and for each many to many relationships in an REA diagram.

Some of the distinct entities include: ***Cash***, ***Inventory***, ***Customer Orders***, ***Sales***, ***Cash Receipts***, ***Employees***, and ***Customers*** assuming that the company does make a call to

customer to buy inventory. The expected many-to-many relationships include ***Customer Order-Inventory***, ***Sales-Inventory***, and ***Sales-Cash Receipts***. (10 Tables from the figure 4.8 REA Diagram).

It is good practice to give each table the same name as the entity that it represents. Tables representing M: N relationships, however, are often titled by **hyphenating** the names of the **two entities** that are linked. For example, Sales-Inventory line table

Step 2: Assign Attributes to Each Table

During the data modeling process, users and management will have identified facts that they want to collect. For example, for inventory items the attributes may include item number, description, cost and selling price.

Assign primary keys- every table in a relational database must have a primary key, consisting of attributes or a combination of attributes. Companies often create numeric identifiers for specific resources, events and agents. These numeric identifiers are good candidates for primary keys. Usually, the primary key of a table representing an entity is a single attribute. The primary key for M: N relationship tables, however, always consists of two attributes that represent the primary keys of each entity linked in that relationship. For example, the primary key of a sales-inventory table consists of both the invoice number (primary key of the sales entity) and item number (primary key of the inventory entity). Such multiple attribute primary keys are called concatenated keys.

Assign other attributes to appropriate tables- additional attributes besides the primary key are included in each table to satisfy transaction processing requirements and management's information needs. Some of the attributes such as the date and amount of each sale are necessary for complete and accurate transaction processing and the production of financial statements and managerial reports. Other attributes are stored because they facilitate the effective management of an organization's resources, events and agents.

Non-key attributes in M: N relationship tables- attributes that help keep the table flat and that can't be stored in separate tables are listed as attributes in M: N relationship tables. For example, quantity sold can't be an attribute in the sales table because a single invoice

may have several values. In addition, a single item may be sold in many different sales transactions. Hence, it may not be an attribute in inventory table. Hence, as it applies to a specific item included in a specific sales transaction, it belongs in the M: N relationship table that links these two entities.

Price data- may be stored in both the inventory and sales-inventory tables. The inventory table lists suggested selling price that remains constant. But the sales inventory table stores actual sales price which varies during the year in relation to promotions.

Cumulative data- includes such information as quantity on hand (in inventory table) and account balance (in the customer table). Theoretically, it is unnecessary to store such information separately in the database because the system can readily compute them when necessary. Explicitly storing cumulative totals and balances, however, may improve response time to queries.

Step 3: Use Foreign Keys to Implement 1:1 and 1: N Relationships

M: N relationships must be implemented as separate tables to have a well-structured relational database. Although 1:1 and 1: N relationships can be implemented as separate tables, it is usually more efficient to implement them by means of **foreign keys**.

One to one Relationships- in a relational database, one to one relationship between entities can be implemented by including the primary key of one entity as a foreign key in the table representing the other entity. The choice is arbitrary. Careful analysis of the minimum cardinalities of the relationship may suggest which approach is likely to be more efficient. For example, in the 1:1 relationship between sales and customer payments,

- the minimum cardinality for the sales event is 0 indicating the existence of credit sales
- the minimum cardinality for the cash receipt event is 1 indicating that customer payments only occur after a sale has been made (assuming no advance collections are made)

In this case including invoice number as foreign key in cash receipts event may be more efficient because then only that one table would have to be accessed and updated to process data about each

customer payment. When events are sequential, including the primary key of the event that occurs first as a foreign key in the event that occurs second may improve internal control.

One to many relationships- As with 1:1 relationship, 1: N relationships also can be implemented in relational databases with foreign keys. To do this, place the primary key of the entity with the maximum cardinality of N as a foreign key in the entity that has maximum cardinality of 1. For example, the primary keys of the salesperson and customer tables are included as foreign keys in the sales table.

A potential exception to this general rule for implementing 1: N relationships may occur if the relationship includes two sequential event entities, and the event that occurs first is also the one that participates many times in that relationship. In that case, implementing the relationship as a

separate table might improve internal control.

REA Diagram for Documenting Business Processes

REA diagrams are especially useful for documenting advanced AIS built using databases, because the cardinalities in REA diagrams provide information about the organization's business practices and the nature of its economic exchanges. Correctly interpreting what the cardinalities in an REA diagram mean requires understanding exactly what the occurrence of each entity represents. This is usually easy for both agent and event entities. Understanding what each occurrence of resource entity represents may be difficult. Consider inventory, for example. An individual occurrence of this entity might represent either a specific physical object or a class of objects depending on the nature of the inventory. In such cases, examining the attributes associated with that entity may indicate what it represents. For example, if there is a column entitled "quantity on hand", each row refers to a specific kind of inventory, not an individual object. In the case of sales-inventory relationship, such column will not exist because

items may be identified by serial number and there could only be one of each item.

Every organization will have its own unique REA diagram at least because business practices and relationship cardinalities differ across companies. Differences in business practices also result in differences in entities being modeled. The cardinalities in REA

diagram also provide information about business controls. For instance, each row in the cash entity represents a specific account. One may be checking account, another payroll account, another money market investment account etc. Cash-cash receipts relationship being modeled as **1: N** ***reflects a sound control practice of depositing all cash collections from*** customers into the company's checking account.

4.5.4 Extracting Information from the AIS

A completed REA diagram also serves as a useful guide for querying an AIS database. Elements such as journals, ledgers and information about receivables as well as payables may seem missing in a database AIS. But they are present though stored in a different format.

Producing journals and ledgers- queries can be used to generate journals and ledgers from a relational database built on the REA model. The information normally found in a journal is stored in the tables used to record data about events. For example, a sales journal can be produced by writing a query that displays the appropriate entries in the sales table for a given period. A query can be written to display every entry in a sales table, to produce a list of all sales events, both cash and credit sales. Traditionally, sales journals are used to record all credit sales. Therefore, the query to produce a credit sales journal would have to include both the sales and cash receipts tables. The logic on the query is would include restricting the output to display only those sales that are not linked to a corresponding customer payment event that occurred on the same day as a sale. The information traditionally contained in **ledgers** is often stored in a relational database in a combination of resources and events tables. For example, accounts receivable doesn't appear as a table. Instead, it is derived by calculating the total amount of sales for which customer payments have not been received.

Providing other financial statement information: A completed REA diagram can also be used to guide the writing of queries to produce the information that would be included in financial statements. Many financial statement accounts, such as Cash, Inventory, and Fixed Assets, are represented as resources in the REA model. An important exception, however, is claims: Figure 4-8 includes neither an entity called Accounts Receivable nor

one called Accounts Payable. Accounts receivable represents sales transactions for which customer payments have not yet been received, and accounts payable represents purchases from suppliers that have not yet been paid for. Therefore, neither accounts receivable nor accounts payable needs to be explicitly stored as separate tables in a REA database. Instead, those claims can be derived from a set of queries against the relevant agent and event tables. For example, three queries can be used to calculate total Accounts Receivable. First, sum the total beginning balances in every customer account. Second, calculate total new sales this period by writing a query against the M:N Sales–Inventory relationship table to sum the product of quantity sold times unit price. Third, determine the total cash received from customers this period by summing the amount column in the Receive Cash table. Total Accounts Receivable equals beginning Accounts Receivable (query 1) plus new sales (query 2) minus cash receipts (query 3). A similar set of queries will produce total Accounts Payable.

Preparing managerial reports- a major advantage of the REA data model is that it integrates non-financial and financial data in the AIS and makes both types of data easily accessible to management. For example, information such as time of sale, returns and allowances etc can be included as attributes in the sales table. New attributes such as credit rating could be added easily. The REA data model can be used to build a database that allows the AIS to change in response to management's changing information requirements. The REA data model shows that accounting need not be limited to the traditional double entry model with its journals, ledgers, and chart of accounts. Instead, the REA data model supports the view that accounting a process or system of collecting and disseminating information about an organization's business transactions. Although the mechanics of accounting may change, the need for the results (managerial reports and financial statements) of accounting remains.

4.6 Database Systems and the Future of Accounting

Database systems may profoundly affect the fundamental nature of accounting. Some of these include:

1. **Database systems may lead to the abandonment of the double entry accounting model.**

The basic rational for the double entry model is that the redundancy of recording the amount of a transaction twice provides a check on the accuracy of data processing. But data redundancy is the antithesis of the database concept. If the amounts associated with a transaction are entered into a database system correctly, then it is necessary to store them only once, not twice. Computer data processing is sufficiently accurate making checks and double checks unnecessary.

2. **Database systems also have the potential to significantly alter the nature of external reporting.**

Considerable time and effort are currently being invested in defining how companies should summarize and report accounting information for external users. A copy of the company's financial database may be simply made available to external users in lieu of the traditional financial statements so that they would be free to manipulate and analyze the raw data in whatever manner they see fit.

3. **The most significant effect of database systems will be in the way that accounting information is used in decision making.**

The difficulty of formulating ad hoc queries in accounting systems based on traditional files or non-relational DBMS meant that accountants act in effect as information gatekeepers. Financial information was readily available only in predefined formats and at specified times. Relational databases, however, provide query languages that are powerful and easy to use. Thus, managers need not get bogged down in procedural details about how to receive information. Instead, they can concentrate solely on specifying what they want. As a result, financial reports can be easily prepared to cover whatever time periods managers want to examine, not just the time frames accountants traditionally use.

4. **Relational DBMSs can also accommodate multiple views of the same underlying phenomenon.**

For example, tables storing information about assets can include columns not only for historical cost, but also for current replacement costs and market values. Thus, managers will no longer be forced to look at data in ways predefined by accountants.

5. **Relational DBMSs provide the capability of integrating financial and operational data.**

For example, data about customer satisfaction, collected by surveys or interviews could be stored in the same table used to store information about current account balances and credit limits. Managers would thus have access to a richer set of data for making tactical and strategic decisions.

In all these ways, relational DBMSs have the potential to increase the use and value of accounting

information for making the tactical and strategic decisions involved in running an organization. Accountants, however, must become knowledgeable about database systems so that they can participate in designing the accounting information systems of the future. Such participation is important for ensuring that adequate controls are included in those systems to safeguard the data and ensure the reliability of the information provided.

Activity 4.6

1. **What are the rules for combining REA diagrams?**
2. **What are the steps used in implementing REA diagram in relational database?**
3. **How information extracted from relational database?**
4. **How database system affects accounting?**

Summary

A database is a set of interrelated, centrally coordinated files. The database approach treats data as an organizational resource that should be used by and managed for the entire organization, not just the originating department or function. Databases provide organizations with the following benefits, data sharing, data independence, cross-functional analysis and, minimal data redundancy and data inconsistencies.

A schema describes the logical structure of a database. The database schema is a map or plan of the entire database.

A key component of a DBMS is the data directory, which contains information about the structure of the database. For each data element stored in the database, such as the customer number, there is a corresponding record in the data dictionary describing it.

The relational data model represents everything in the database as being stored in the form of tables. Technically, these tables are called relations (hence relational data model), but we will use the two words interchangeably. The data model only describes how the data appear in the conceptual and external level schemas. This relational database over comes the problems that we will face while we storing data in one table like delete anomaly, update anomaly and insert anomaly. The basic requirements for the relation is the primary key must not be null, every column in a row must be single valued, foreign keys, if null, must have values that correspond to the value of the primary key in another relation and all non-key attributes in a table should describe a characteristic about the job identified by the primary key.

Data modeling is the process of defining a database so that it faithfully represents all aspects of the organization, including its transactions with the external environment. Data modeling occurs during both the requirements analysis and design stages of the database design. Two important tools that accountants can use in data modeling are: Entity Relationships Diagramming and the REA Data Model.

Self-assessment questions

Choose the correct answer among the given alternatives.

1. _____is conceptually similar to a ledger in manual AIS
   A. Transaction file
   B. Master file
   C. Documents
   D. Reports
   E. All of the above
2. Which of the following is/are benefits that the Database technology provides over the file-based legacy?
   A. Data dissolution
   B. It's easier to share data integrated data
   C. Data dependency
   D. All of the above
3. From the following one is not accountants are frequently involved in developing schemas, which one is it?
   A. The conceptual level schema
   B. The external level schema
   C. The internal level schema
   D. None of the above
4. The database management system language that describes the logical views for each individual user or programmer is?
   A. Creating a database
   B. Changing a database
   C. Querying a database
   D. All of the above
5. Database systems may profoundly affect the fundamental nature of accounting, except:
   A. Relational database management system can also accommodate multiple views of the same underlying phenomenon.
   B. Database systems also have the potential to significantly alter the nature of external reporting
   C. The most significant effect of database systems will be in the way that accounting information is used in decision making
   D. Relational database management system provides the incapability of integrating

financial and operational data.

E. None of the above

6. _____ is not represented as a resource in a REA model.

A. Supplies
B. Account receivable
C. Cash
D. Sales
E. None of the above

7. From the revenue cycle typical activities' which one does not need to be included in the model?

A. Bill customer
B. Take customer order
C. Fill customer order
D. Collect payment

8. In most cases, the relationship between agent entities and event entities is

A. 1:1
B. 1:N
C. M:N
D. 0:N

9. Data modeling occurs during which stages of database design?

A. systems analysis and physical design
B. systems analysis and conceptual design
C. conceptual design and implementation and conversion
D. physical design and implementation and conversion

10. A company has five different cash accounts (checking, money market, petty cash, payroll, and investments). It deposits all payments received from customers into its checking account. Which of the following accurately depicts the relationship between the Cash entity and the Receive Cash event?

A.

B.

C.

D.

Discussion questions

1. Why is it not necessary to model activities such as entering information about customers or suppliers, mailing invoices
2. to customers, and recording invoices received from suppliers as events in a REA diagram?
3. How would accounts payable be reflected in a REA diagram? Why?
4. What is the difference between an Entity-Relationship (E-R) diagram and an REA diagram?

Drawing REA diagram

1. Develop a data model of Fred's Train Shop's expenditure cycle activities related to the acquisition of office equipment and other fixed assets. Fred sometimes orders multiple pieces of equipment. Vendors usually ship the entire order but sometimes are out of stock of some items. In such cases, they immediately ship to Fred what they have in stock and then send a second shipment when they obtain the other items. Conversely, several orders placed within a short time period with the same vendor might be filled with one delivery. Assume that Fred makes installment payments for most fixed-asset acquisitions but occasionally pays for some equipment in full at the time of purchase.

   Required: Draw a REA diagram of your data model. Be sure to include cardinalities

CHAPTER FIVE

TRANSACTION CYCLES AND ACCOUNTING APPLICATIONS

Chapter objectives

After studying this chapter, you should be able to:

- Discuss the organization of accounting applications
- Identify the transaction processing modes
- Explain the procedures in expenditure cycle
- Discuss the procedures in revenue cycle
- Describe general ledger and reporting system

5.1 Introduction

In this chapter and the following chapter, we introduce the fundamentals of business processes and then focus on several core business processes that are common to many businesses. We begin with a brief refresher of the basics of financial accounting. Fundamental elements of accounting are embedded in modern accounting information systems, and they are the basis for a company's annual financial statements. These fundamental elements include journals, ledgers, accounts, trial balances, and financial statements. The nature and types of business processes vary, depending on the information needs of a specific organization. Nevertheless, a number of business processes are common to most organizations. In this chapter, we examine business transactions related to the revenue process (sales and cash collection) and the expenditure process (expenditures for materials and supplies and cash payment).

5.2 Organizing accounting application and business process fundamentals

An accounting cycle can begin in a number of different ways. For instance, accounting personnel can create a transaction from a source document, or a customer may order

products online. Regardless of how the process starts, at the end of the process we issue annual financial reports and close the temporary accounts in preparation for a new cycle.

Overview of the Financial Accounting Cycle

An AIS records each transaction or business event affecting an organization's financial condition in journals or ledgers.

Journals. Accounting personnel record transactions in a journal. Of course, this is rarely an actual paper journal anymore—it's more likely an electronic entry in an accounting information system. In many cases, these entries are made directly into database tables. The journal is a chronological record of business events by account. A journal may be a special journal or a general journal. Special journals capture a specific type of transaction. They are usually reserved for transactions occurring frequently within an organization. In a computerized system, special journals may take the form of special modules with their own files. For example, an accounting clerk would likely record a credit sale in an account's receivable module. In more automated systems, entries into the accounting system may be entirely electronic, such as through scanning a bar code.

Companies can set up a special journal for virtually any type of transaction. Common ones are sales journals, purchase journals, cash receipts journals, and cash disbursements journals. If you think about it, almost all accounting transactions a business organization records fall into one of these categories. Special journals include entries for all but a few types of transactions and adjusting journal entries, such as for depreciation. The general journal records these entries. Ledgers. Journal entries show all aspects of a particular transaction. Each entry shows debit and credit amounts, the transaction date, the affected accounts, and a brief description of the event. Once an AIS records a journal entry, it next posts the entry in the general ledger. Within an AIS, a general ledger is a collection of detailed monetary information about an organization's various assets, liabilities, owners' equity, revenues, and expenses.

The general ledger includes a separate account (often called a T account because of its shape) for each type of monetary item in an organization. While journal entries record all aspects of business transactions, an AIS separately posts the monetary amounts in each account to the various accounts in the general ledger. A company's chart of accounts provides the organizational structure for the general ledger.

Trial Balances and Financial Statements. Once an AIS records journal entries and posts them to the general ledger, it can create a trial balance. The trial balance is a listing of all accounts and their debit and credit balances. After debit and credit dollar amounts in this trial balance are equal, an accountant will record any necessary adjusting journal entries. Adjusting entries include journal entries for depreciation and other unrecorded expenses, prepaid expenses, unearned revenues, and unrecorded revenue. Once the debit and credit amounts in this adjusted trial balance are equal, an AIS is ready to produce financial statements.

Financial statements are the primary output of a financial accounting system. These financial statements include an income statement, balance sheet, statement of owners' equity, and cash flow statement. The accounting cycle does not end when an AIS generates financial statements. The computerized system must close temporary accounts, such as revenue and expense accounts, so that a new cycle can begin. This is necessary because users are interested in income information for a specific period of time. Because balance sheet accounts show financial performance at a specific point in time, they are permanent and need not be closed. Thus, an AIS will carry these amounts forward to the next accounting cycle.

Coding Systems: Accounting information systems depend on codes to record, classify, store, and retrieve financial data. Although it is possible in a manual system to use simple alphabetic descriptions when preparing journal entries, computerized systems use numeric codes (codes that use numbers only) or alphanumeric codes (codes that use numbers and letters) to record accounting transactions systematically. For example, a manual journal entry might include a debit to the ''Direct Materials Inventory'' account. In a computerized

system, the debit might be to account ‘‘12345.’’ Alphanumeric codes are important in computerized systems, as they help to ensure uniformity and consistency. Suppose that a clerk entered a debit to ‘‘Direct Materials Inventory’’ one time and another time entered the debit to ‘‘Dir. Materials Inventory.’’ A computer would set up a new account the second time, rather than recognizing the intended account.

Types of Codes. AISs typically use several types of codes: (1) mnemonic codes, (2) sequence codes, (3) block codes, and (4) group codes. Mnemonic codes help the user remember what they represent. The product codes S, M, L, and XL are examples of mnemonic codes describing apparel sizes. As the name implies, a sequence code is simply a sequential set of numbers used to identify customer accounts, employee payroll checks, customer sales invoices, and so forth. Block codes are sequential codes in which specific blocks of numbers are reserved for particular uses. In a typical application, the lead digit, or two lead digits, in the sequence code acts as the block designator and subsequent digits are identifiers. AISs use block codes to create a chart of accounts. Combining two or more sub codes creates a group code, which is often used as product codes in sales catalogs.

Design Considerations in Coding. There are a number of important factors to consider when designing an accounting code. First, it must serve some useful purpose. For example, if a product code in a manufacturing firm is part of a responsibility accounting system, at least one portion of the code must contain a production department code. Second, it must be consistent. Using Social Security numbers as employee identifiers is a good example of this design consideration. Third, managers must plan for future expansion (e.g., the creation of extra accounts).

Collecting and reporting accounting information

As you might imagine, most of the accounting data collected by an organization ultimately appear on some type of internal and/or external report. Thus, the design of an effective AIS usually begins with the outputs (reports) that users will expect from the system. Although this might seem counterintuitive. Among the outputs of an AIS are: (1) reports to management, (2) reports to investors and creditors, (3) files that retain transaction data, and

(4) files that retain current data about accounts (e.g., inventory records). Perhaps the most important of these outputs are the reports to management because these reports aid decision-making activities. As you might imagine, the formats of these various reports might be very different. These reports might be hard-copy (paper) reports, soft-copy (screen) reports, e-copy (CD and other electronic media) reports, or audio outputs. If a manager queries a database system, the monitor shows the requested data and the system produces a hard-copy report only upon demand.

Designing Reports

Users need many different types of accounting reports—some might be every hour and others not as often. An AIS might issue some reports only when a particular event occurs. For example, an AIS might issue an inventory reorder report only when the inventory for a certain product drops below a specified level. Such an event would probably result in an exception report, which is a list of exceptional conditions. As another example, suppose that a purchase order has an authorization signature but contains some inaccurate or missing information. In this case, the AIS would generate an exception report. The report would include a table that identifies the error or errors and would suggest a possible solution to fix the error. After correcting the error, the purchase order would require a new authorization signature. This signature would clear the exception from the report.

Source Documents: Both manual and computerized AISs use source documents extensively. In many AISs, source documents are still written or printed on paper. However, large companies (such as publicly traded firms) rely heavily on integrated database systems that handle many transactions virtually (i.e., electronically with no paper).

Activity 5.1

1. **What is journal?**
2. **What are types of codes?**

5.3 Transaction cycles

Transaction Processing System applications process financial transactions. A financial transaction was defined in Chapter 1 as: An economic event that affects the assets and equities of the firm, is reflected in its accounts, and is measured in monetary terms. The most common financial transactions are economic exchanges with external parties. These include the sale of goods or services, the purchase of inventory, the discharge of financial obligations, and the receipt of cash on account from customers. Financial transactions also include certain internal events such as the depreciation of fixed assets; the application of labor, raw materials, and overhead to the production process; and the transfer of inventory from one department to another. Financial transactions are common business events that occur regularly. For instance, thousands of transactions of a particular type (sales to customers) may occur daily. To deal efficiently with such volume, business firms group similar types of transactions into transaction cycles.

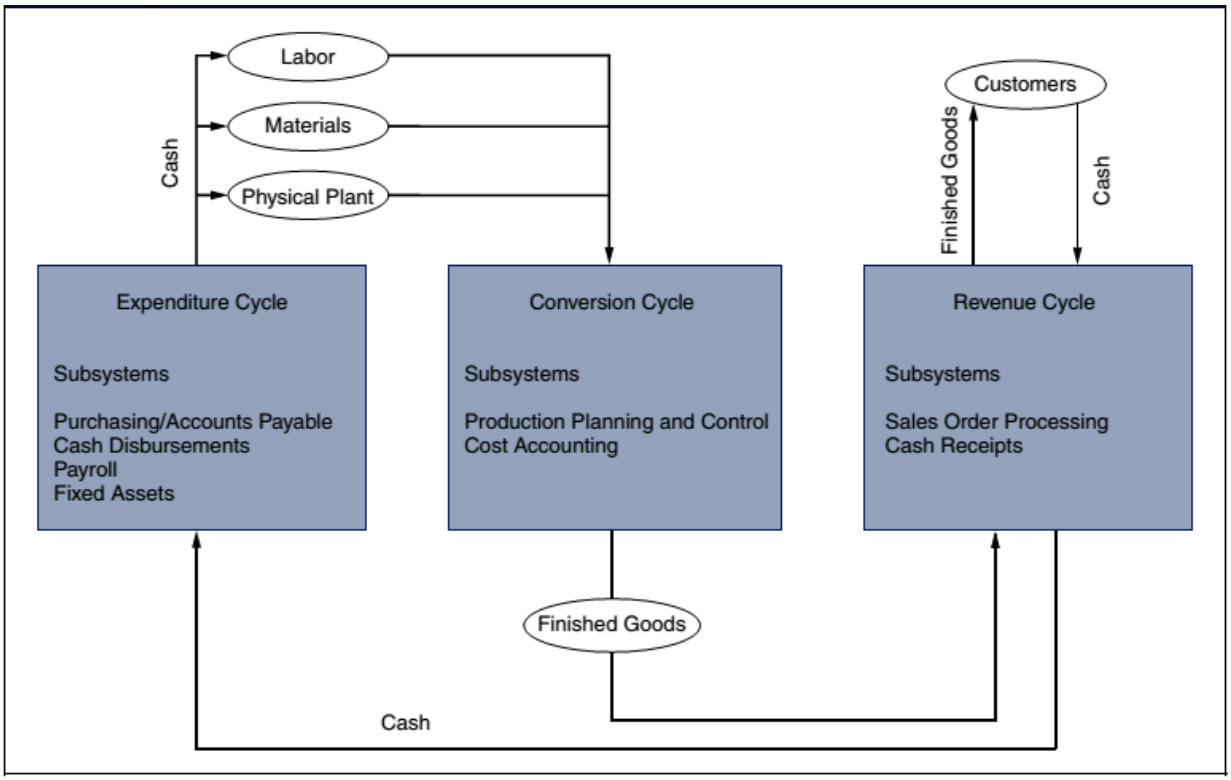
Three transaction cycles process most of the firm's economic activity: the expenditure cycle, the conversion cycle, and the revenue cycle. These cycles exist in all types of businesses—both profit-seeking and not-for-profit types. For instance, every business (1) incurs expenditures in exchange for resources (expenditure cycle), (2) provides value added through its products or services (conversion cycle), and (3) receives revenue from outside sources (revenue cycle). Figure 5-1 shows the relationship of these cycles and the resource flows between them.

5.3.1 The Expenditure Cycle

Business activities begin with the acquisition of materials, property, and labor in exchange for cash—the expenditure cycle. Figure 5-1 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. Days or even weeks may pass between these two events. Thus, from a systems perspective, this transaction has two parts: a physical component (the acquisition of the goods) and a financial component (the cash

disbursement to the supplier). A separate subsystem of the cycle processes each component.

Figure 5-1 Relationship between transaction cycles



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. Conceptually, payroll is a special-

case purchases and cash disbursements system. Because of accounting complexities associated with payroll, most firms have a separate system for payroll processing.

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

Purchases and Cash Disbursements Activities

a) **Purchases Processing Procedures**

Purchases procedures include the tasks involved in identifying inventory needs, placing the order, receiving the inventory, and recognizing the liability. 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). 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.

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 set-up 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.

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. We examine cash disbursements procedures later in this section. 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.

Vouchers Payable System

Rather than using the AP procedures described in the previous section, many firms use a vouchers payable system. Under this system, the AP department uses cash disbursement vouchers and maintains a voucher register. After the AP clerk performs the three-way match, he or she prepares a cash disbursement voucher to approve payment. Vouchers provide improved control over cash disbursements and allow firms to consolidate several payments to the same supplier on a single voucher, thus reducing the number of checks written. Each voucher is recorded in the voucher register. The voucher register reflects the AP liability of the firm. The sum of the unpaid vouchers in the register (those with no check numbers and paid dates) is the firm's total AP balance.

The AP clerk files the cash disbursement voucher, along with supporting source documents, in the **vouchers payable file**. This file is equivalent to the open AP file discussed earlier and also is organized by due date.

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.

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

TABLE 5-1 Summary of Expenditure Cycle Controls

CONTROL POINTS IN THE EXPENDITURE CYCLE		
Control Activity	**Purchases Processing System**	**Cash Disbursements System**
Transactions authorization	Inventory control.	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	Receiving area.	
Accounting records	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 above.	Proper security over cash. Limit access to the accounting records above.
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.

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) 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. The main points are summarized in Table 5-1.

Activity 5.2

1. **What is transaction cycle?**
2. **What are the subsystems under expenditure cycle?**
3. **What is blind copy of the purchase order?**
4. **What is cash disbursement journal under expenditure cycle?**

5.3.2 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. 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. The conversion cycle is not usually formal and observable in service and retailing establishments. Nevertheless, these firms still engage in conversion cycle activities that culminate in the development of a salable product or service. These activities include the readying of products and services for market and the allocation of resources such as depreciation, building amortization, and prepaid expenses to the proper accounting period. However, unlike manufacturing firms, merchandising companies do not process these activities through formal conversion cycle subsystems.

Production Activities: includes,

Production Planning and Control. We first examine the production planning and control function. This consists of two main activities: (1) specifying materials and operations requirements and (2) production scheduling.

Materials and Operations Requirements. The raw materials requirement for a batch of any given product is the difference between what is needed and what is available in the raw material inventory. This information comes from analysis of inventory on hand, the sales forecast, engineering specifications (if any), and the bill of materials (BOM). A product of this activity is the creation of purchase requisitions for additional raw materials. Procedures for preparing purchase orders and acquiring inventories are the same as those described in expenditure cycle. The operations requirements for the batch involve the assembly and/or manufacturing activities that will be applied to the product. This is determined by assessing route sheet specifications.

Production Scheduling. The second activity of the planning and control function is production scheduling. The master schedule for a production run coordinates the production of many different batches. The schedule is influenced by time constraints, batch size, and specifications derived from BOMs and route sheets. The scheduling task also produces work orders, move tickets, and materials requisitions for each batch in the production run.

A copy of each work order is sent to cost accounting to set up a new work-in-process (WIP) account for the batch. The work orders, move tickets, and materials requisitions enter the production process and flow through the various work centers in accordance with the route sheet.

Work Centers and Storekeeping. The actual production operations begin when workers obtain raw materials from storekeeping in exchange for materials requisitions. These materials, as well as the machining and the labor required to manufacture the product, are applied in compliance with the work order. When the task is complete at a particular work center, the supervisor or other authorized person signs the move ticket, which authorizes the batch to proceed to the next work center. To evidence that a stage of production has been completed, a copy of the move ticket is sent back to production planning and control to update the open work order file. Upon receipt of the last move ticket, the open work order file is closed. The finished product along with a copy of the work order is sent to the finished goods (FG) warehouse. Also, a copy of the work order is sent to inventory control to update the FG inventory records.

Work centers also fulfill an important role in recording labor time costs. This task is handled by work center supervisors who, at the end of each work week, send employee time cards and job tickets to the payroll and cost accounting departments, respectively.

Inventory Control. The inventory control function consists of three main activities. First, it provides production planning and control with status reports on finished goods and raw materials inventory. Second, the inventory control function is continually involved in updating the raw material inventory records from materials requisitions, excess materials requisitions, and materials return tickets. Finally, upon receipt of the work order from the last work center, inventory control records the completed production by updating the finished goods inventory records.

An objective of inventory control is to minimize total inventory cost while ensuring that adequate inventories exist to meet current demand. Inventory models used to achieve this objective help answer two fundamental questions:

1. When should inventory be purchased?

2. How much inventory should be purchased?

Cost Accounting Activities

Cost accounting activities of the conversion cycle record the financial effects of the physical events that are occurring in the production process. The cost accounting process for a given production run begins when the production planning and control department sends a copy of the original work order to the cost accounting department. This marks the beginning of the production event by causing a new record to be added to the work-in-process (WIP) file, which is the subsidiary ledger for the WIP control account in the general ledger.

As materials and labor are added throughout the production process, documents reflecting these events flow to the cost accounting department. Inventory control sends copies of materials requisitions, excess materials requisitions, and materials returns. The various work centers send job tickets and completed move tickets. These documents, along with standards provided by the standard cost file, enable cost accounting to update the affected WIP accounts with the standard charges for direct labor, material, and manufacturing overhead (MOH). Deviations from standard usage are recorded to produce material usage, direct labor, and MOH variances.

The receipt of the last move ticket for a particular batch signals the completion of the production process and the transfer of products from WIP to the FG inventory. At this point cost accounting closes the WIP account. Periodically, summary information regarding charges (debits) to WIP, reductions (credits) to WIP, and variances are recorded on journal vouchers and sent to the general ledger (GL) department for posting to the control accounts.

Controls in the Traditional Environment

Recall from previous discussion the six general classes of internal control activities: transaction authorization, segregation of duties, supervision, access control, accounting records, and independent verification. Specific controls as they apply to the conversion cycle are summarized in Table 5-2 and further explained in the following section.

Table 5-2:

Summary of Conversion Cycle Controls	
Control Class	**Control Points in the System**
Transaction authorization	Work orders, move tickets, and materials requisitions.
Segregation of duties	1. Inventory control separate from RM and FG inventory custody.
	2. Cost accounting separate from work centers.
	3. GL separate from other accounting functions.
Supervision	Supervisors oversee usage of RM and timekeeping.
Access	Limit physical access to FG, RM stocks, and production processes. Use formal procedures and documents to release materials into production.
Accounting records	Work orders, cost sheets, move tickets, job tickets, materials requisitions, WIP records, FG inventory file.
Independent verification	Cost accounting function reconciles all cost of production.
	GL reconciles overall system.

Activity 5.3

1. **What are the activities included under production?**
2. **What are the three main activities included under inventory control function?**

5.3.3 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 briefly outlined below.

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

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

Overview of Revenue Cycle Activities

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.

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. When the customer is also a business entity, the order is often a copy of the customer's purchase order. Because the customer order is not in the standard format that the seller's order processing system needs, the first task is to transcribe it into a formal sales order.

The sales order captures vital information such as the customer's name, address, and account number; the name, number, and description of the items sold; and the quantities and unit prices of each item sold. At this point, financial information such as taxes, discounts, and freight charges may or may not be included. After creating the sales order, a copy of it is placed in the customer open order file for future reference. The task of filling an order and getting the product to the customer may take days or even weeks. During this period, customers may contact their suppliers to check the status of their orders. The

customer record in the open order file is updated each time the status of the order changes such as credit approval, on back-order, and shipment. The open order file thus enables customer service employees to respond promptly and accurately to customer questions.

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. Back-ordered items are shipped before new sales are processed.

Finally, the warehouse employee adjusts the **stock records** to reflect the reduction in inventory. These stock records are not the formal accounting records for controlling

inventory assets. They are used for warehouse management purposes only. Assigning asset custody and accounting record-keeping responsibility to the warehouse clerk would violate a key principle of internal control. The inventory control function, discussed later, maintains the formal accounting inventory records.

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. In some systems, the shipping notice is a separate document prepared within the shipping function.

Upon receiving the goods from the warehouse, the shipping clerk reconciles the physical items with the stock release, the packing slip, and the shipping notice to verify that the order is correct. The ship goods function thus serves as an important independent verification control point and is the last opportunity to detect errors before shipment.

The shipping clerk packages the goods, attaches the packing slip, completes the shipping notice, and prepares a **bill of lading**. The bill of lading is a formal contract between the seller and the shipping company (carrier) to transport the goods to the customer. This document establishes legal ownership and responsibility for assets in transit. Once the goods are transferred to the carrier, the shipping clerk records the shipment in the shipping log, forwards the shipping notice to the bill customer function as proof of shipment, and updates the customer's open order file.

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. Upon credit approval, the bill customer function receives the sales order (invoice copy) from the receive order task. This document is placed in an S.O. pending file until receipt of the shipping notice, which describes the products that were actually shipped to the customer. Upon arrival, the items shipped are reconciled with those ordered and unit prices, taxes, and freight charges are added to the invoice copy of the sales order. The completed **sales invoice** is the customer's bill, which formally depicts the charges to the customer. In addition, the billing function performs the following record keeping–related tasks:

- Records the sale in the sales journal.
- Forwards the ledger copy of the sales order to the update accounts receivable task.
- Sends the stock release document to the update inventory records task.

The sales journal is a special journal used for recording completed sales transactions. The details of sales invoices are entered in the journal individually. At the end of the period, these entries are summarized into a sales journal voucher, which is sent to the general ledger task for posting to the account receivable control account and sales account. Each journal voucher represents a general

journal entry and indicates the general ledger accounts affected. Summaries of transactions, adjusting entries, and closing entries are all entered into the general ledger via this method. When properly approved, journal vouchers are an effective control against unauthorized entries to the general ledger. The journal voucher system eliminates the need for a formal general journal, which is replaced by a journal voucher file.

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 containing all attributes of the inventories sold. 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 to these accounts; **Debit to cost of goods sold and credit to inventory control accounts**.

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. Periodically, the individual account balances are summarized in a report that is sent to the general ledger. The purpose for this is discussed next.

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 these accounts; Debit, Accounts Receivable Control and Cost of Goods Sold and Credit, Inventory Control and Sales accounts:

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. We examine this point more fully in a later section dealing with revenue cycle controls.

b. Sales Return Procedures

An organization can expect that a certain percentage of its sales will be returned. When a return is necessary, the buyer requests credit for the unwanted products. This involves reversing the previous transaction in the sales order procedure.

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.

Some systems may actually use a copy of the sales order marked credit memo. 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.

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 these control accounts; Debit, Inventory Control and Sales Returns and Allowances and Credit, Cost of Goods Sold and Accounts Receivable Control accounts.

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. They involve 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.

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. Only the portion above the perforated line is the remittance advice, which the customer removes and returns with the payment. In some systems, the lower portion of the document is a customer statement that the billing department sends out periodically. In other cases, this could be the original customer invoice, which was described in the sales order procedures.

The remittance advice is a form of a turnaround document, as described in Chapter 2. Its importance is most apparent in firms that process large volumes of cash receipts daily. For example, processing a check from John Smith with no supporting details would require a time-consuming and costly search through perhaps thousands of records to find the correct John Smith. This task is greatly simplified when the customer provides necessary account number and posting information. Because of the possibility of transcription errors and omissions, however, sellers do not rely on their customers to provide this information directly on their checks. Errors are avoided and operational efficiency is greatly improved when using remittance advices.

Mail room personnel route the checks and remittance advices to an administrative clerk who endorses the checks "For Deposit Only" and reconciles the amount on each remittance advice with the corresponding check. The clerk then records each check on a form called a remittance list (or cash prelist), where all cash received is logged. In this example, the clerk prepares three copies of the remittance list. The original copy is sent with the checks

to the record and deposit checks function. The second copy goes with the remittance advices to the update AR function. The third goes to a reconciliation task.

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. Next, the clerk prepares a **bank deposit slip** showing the amount of the day's receipts and forwards this along with the checks to the bank. Upon deposit of the funds, the bank teller validates the deposit slip and returns it to the company for reconciliation. 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. DR to Cash and CR to Accounts Receivable Control.

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.

d. Revenue Cycle Controls

We have six classes of internal control activities that guide us in designing and evaluating transaction processing controls. They are transaction authorization, segregation of duties, supervision, accounting records, access control, and independent verification. Table 5-3 summarizes these control activities as they apply in the revenue cycle.

Table 5-3 summary of revenue cycle control

CONTROL POINTS IN THE SYSTEM		
Control Activity	**Sales Processing**	**Cash Receipts**
Transactions authorization	Credit check Return policy	Remittance list (cash prelist)
Segregation of duties	Credit is separate from processing; inventory control 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		Mail room
Accounting records	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	Physical access to inventory; access to accounting records above	Physical access to cash; access to accounting records above
Independent verification	Shipping department, billing department, general ledger	Cash receipts, general ledger, bank reconciliation

5.4 General Ledger and Reporting System

The general ledger and reporting system (GLARS) include the processes in place to update general ledger accounts and prepare reports that summarize results of the organization's activities.

One of the primary functions of GLARS is to collect and organize data from:

- Each of the accounting cycle subsystems, which provide summary entries related to the routine activities in those cycles.
- The treasurer, who provides entries with respect to non-routine activities such as transactions with creditors and investors.
- The budget department, which provides budget numbers.
- The controller, who provides adjusting entries.

The information must be organized to meet the needs of internal and external users. The system must be designed to produce regular periodic reports and to support real-time inquiries.

The basic activities in the GLARS are:

- Update the general ledger

- Post adjusting entries
- Prepare financial statements
- Produce managerial reports

The first three represent the basic steps in the accounting cycle

control: objectives, threats, and procedures

In the general ledger and reporting system (or any cycle), a well-designed AIS should provide adequate controls to ensure that the following objectives are met:

- All transactions are properly authorized
- All recorded transactions are valid
- All valid and authorized transactions are recorded
- All transactions are recorded accurately
- Assets are safeguarded from loss or theft
- Business activities are performed efficiently and effectively
- The company is in compliance with all applicable laws and regulations
- All disclosures are full and fair

There are several actions a company can take with respect to any cycle to reduce threats of errors or irregularities. These include:

- Using simple, easy-to-complete documents with clear instructions (enhances accuracy and reliability).
- Using appropriate application controls, such as validity checks and field checks (enhances accuracy and reliability).
- Providing space on forms to record who completed and who reviewed the form (encourages proper authorizations and accountability).
- Pre-numbering documents (encourages recording of valid and only valid transactions).
- Restricting access to blank documents (reduces risk of unauthorized transaction).

In the following sections, we'll discuss the threats that may arise in the general ledger and reporting system, as well as the controls that can prevent those threats.

The primary threats in the general ledger and reporting system are:

Threat 1: Errors in Updating the General Ledger and Generating Reports

Why is this a problem? Can lead to poor decisions based on incorrect information

Controls: Input edit and processing controls

Checking that the summary journal entries from the accounting cycles represent activity for the most recent time period.

For non-routine entries from the treasurer and controller:

- Validity checks on the general ledger account numbers.
- Field checks for numeric data in the amount fields.
- Zero balance checks (debits = credits).
- Completeness tests to ensure all data is entered.
- Closed-loop verification matching account numbers with account descriptions.
- Standard adjusting entry file for recurring adjusting entries.
- Sign checks on the ledger account balance.
- Run-to-run totals to verify the accuracy of journal voucher batch processing, i.e., account balance before entries, adjusted for total debits and credits entered, should equal balance after adjustments.

Reconciliations and control report

- Trial balances.
- Checking that clearing and suspense accounts have zero balances.
- Checking balances in control accounts against totals of subsidiary accounts.
- Examining transactions near year end for proper timing.

Listings of:

- Journal vouchers by account number to identify cause of errors in a particular account.
- Journal voucher by sequence to look for missing entries.
- General journal to check that total debits to the ledger = total credits.

Audit trail

- Depicts the path of a transaction through the accounting system. Facilitates:
- Tracing transaction from origin to any reports or documents produced.

- Tracing any item in a report back to its origin.
- Tracing all account changes from beginning balance to ending balance.
- The journal voucher file provides information about the source of all entries to the general ledger.
- Various master files can also help verify accuracy of general ledger.
- Usefulness of the audit trail depends on its integrity, so you need to: Make periodic backups and Control access.

Threat 2: Loss, Alteration, or Unauthorized Disclosure of Financial Data

Why is this a problem?

Can result in leaks of confidential data.

Can conceal a theft of assets.

Controls:

- Backup and recovery procedures:
  - At least one backup of general ledger on site and one offsite.
  - Disaster recovery plan should be developed and practiced.
- All disks and tapes should have external and internal file labels to reduce chance of accidentally erasing important data.
- Access controls should be utilized
  - User IDs and passwords.
  - Compatibility matrices.
  - Controls for individual terminals (e.g., so the receiving dock can't enter a sales order).
  - Logs of all activities, particularly those requiring specific authorizations, should be maintained.
- Default settings on ERP systems usually allow users far too much access to data, so these systems must be modified to enforce proper segregation of duties.
- Sensitive data should be encrypted in storage and in transmission.
- Parity checks, acknowledgment messages, and control totals should be used to ensure transmission accuracy.

Threat 3: Poor Performance

Why is this a problem?

- The company might provide tainted or late information to government agencies, regulatory bodies, investors, creditors, etc.
- May not get internal reports on a timely basis.
- Reduces profitability.

Controls:

- Prepare and review performance reports.
- Redesign business processes

Activity 5.4

1. **Describe the process of shipping in revenue cycle**
2. **Discuss the sales return procedures in revenue cycle**
3. **What are the primary threats in general ledger and reporting system?**

Summary

Fundamental elements of accounting are embedded in modern accounting information systems, and they are the basis for a company's annual financial statements. An accounting cycle can begin in a number of different ways. For instance, accounting personnel can create a transaction from a source document, or a customer may order products online.

Transaction Processing System applications process financial transactions. 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.

Three transaction cycles process most of the firm's economic activity: the expenditure cycle, the conversion cycle, and the revenue cycle. These cycles exist in all types of businesses both profit-seeking and not-for-profit types.

Self-assessment questions

Choose the correct answer among the given alternatives.

1. What are the outputs of an AIS?
   A. Reports to management
   B. Reports to investors and creditors
   C. Files that retain transaction data
   D. All of the above
2. Which document is used to establish a contract for the purchase of goods or services from a supplier?
   A. vendor invoice
   B. purchase requisition
   C. purchase order
   D. disbursement voucher
3. Which document captures information about labor used in production?
   A. Move ticket
   B. Job-time ticket
   C. Operations list
   D. Bill of materials
4. What are the segregation duties for cash disbursement system?
   A. Inventory control separate from purchasing and inventory custody
   B. Separate accounting payable subsidiary ledger, cash disbursement and general ledger functions
   C. Account payable reconciles source documents
   D. All of the above
5. Which document often accompanies merchandise shipped to a customer?
   A. Picking ticket
   B. Packing slip
   C. Credit memo
   D. Sales order

6. _____is formal contract between the seller and the shipping company (carrier) to transport the goods to the customer.
   A. Bill of lading
   B. Bill customer
   C. Bill of vendor
   D. All of the above
7. For good internal control, who should approve credit memos?
   A. Credit manager
   B. Sales manager
   C. Billing manager
   D. Controller
8. Which document is used to authorize the release of merchandise from inventory control (warehouse) to shipping?
   A. Picking ticket
   B. Packing slip
   C. Shipping order
   D. Sales invoice

Discussion questions

1. What are the basic activities in the General Ledger and Reporting System?

CHAPTER SIX

CONTROL AND ACCOUNTING INFORMATION SYSTEMS

Chapter objective

After studying this chapter, you should be able to:

- Describe basic internal control concepts, and the computer control and security
- Differentiate between the COBIT, COSO, and ERM control frameworks
- Identify major elements in the internal environment of a company
- Explain Enterprise Risk Management model that used to assess and respond to risk
- Explain how security affect systems reliability
- Discuss the types of preventive, detective, and corrective controls are used to provide information security

6.1 Introduction

In most years, more than 60% of organizations experience a major failure in controlling the security and integrity of their computer systems. Reasons for the failures include the following:

- Information is available to an unprecedented number of workers. Chevron, for example, has over 35,000 PCs.
- Information on distributed computer networks is hard to control. At Chevron, information is distributed among many systems and thousands of employees worldwide. Each system and each employee represent a potential control vulnerability point.
- Customers and suppliers have access to each other's systems and data. For example, Walmart allows vendors to access their databases. Imagine the confidentiality problems as these vendor's form alliances with Walmart competitors.

Organizations have not adequately protected data for several reasons:

- Some companies view the loss of crucial information as a distant, unlikely threat.

- The control implications of moving from centralized computer systems to Internet-based systems are not fully understood.
- Many companies do not realize that information is a strategic resource and that protecting it must be a strategic requirement. For example, one company lost millions of dollars because it did not protect data transmissions. A competitor tapped into its phone lines and obtained faxes of new product designs.
- Productivity and cost pressures motivate management to forgo time-consuming control measures.

Any potential adverse occurrence is called a threat or an event. The potential dollar loss from a threat is called the exposure or impact. The probability that it will happen is called the likelihood or risk of the threat.

Today, every organization relies on information technology (IT). Many organizations are also moving at least portions of their information systems to the cloud. Management wants assurance that the information produced by the organization's own accounting system is reliable and also about the reliability of the cloud service providers with whom it contracts. In addition, management also wants assurance that the organization is compliant with an ever-increasing array of regulatory and industry requirements including Sarbanes-Oxley (SOX), the Health Insurance Portability and Accountability Act (HIPAA), and the Payment Card Industry Data Security Standards (PCI-DSS)

6.2 Overview of Control Concepts

Why AIS Threats Are Increasing--Control risks have increased in the last few years because there is a proliferation of computers, servers, and users, and because distributed and wide-area networks make data widely available.

Some vocabulary terms for this chapter:

The general ledger and reporting system (GLARS) include the processes in place to update general ledger accounts and prepare reports that summarize results of the organization's activities.

- A ***threat*** is any potential adverse occurrence or unwanted event that could injure the AIS or the organization.
- The ***exposure*** or ***impact*** of the threat is the potential dollar loss that would occur if the threat became a reality.
- The ***likelihood*** is the probability that the threat will occur.

Companies are now recognizing control risks and taking positive steps to achieve better control, including security staffs, education, enforcement, secure environments, and building control into the development process. Accountants must understand how to protect systems from threats, have a good understanding of IT and its capabilities and risks. Management must make security and control a top priority.

Control objectives are the same regardless of the data processing method, but a computer-based AIS requires different policies and procedures to achieve that control.

In today's dynamic business environment, companies must balance the need for innovation and creativity with the need for control systems to avoid excessive risks or harmful behaviors.

Internal control is the process implemented by the board of directors, management, and those under their direction to provide reasonable assurance that the following control objectives are achieved: (1) assets (including data) are safeguarded; (2) records are maintained in sufficient detail to accurately and fairly reflect company assets; (3) accurate and reliable information is provided; (4) there is reasonable assurance that financial reports are prepared in accordance with GAAP; (5) operational efficiency is promoted and improved (6) adherence to prescribed managerial policies is encouraged; and (7) the organization complies with applicable laws and regulations.

Internal control is a ***process*** that permeates and organization's activities and provides ***reasonable***, rather than absolute, assurance. Internal control systems are susceptible to errors, poor decisions, and override; and internal control objectives are often ad odds with each other, e.g., controls to safeguard assets may also reduce operational efficiency.

Internal controls perform three important functions:

- ***Preventive controls*** deter problems before they arise.

- ***Detective controls*** discover problems quickly when they do arise.
- ***Corrective controls*** remedy problems by identifying cause, correcting errors, and modifying the system to prevent recurrences.

- Internal controls are often classified as:
  - ***General controls*** to ensure the environment is stable and well-managed.
  - ***Application controls*** to prevent, detect, and correct transaction errors and fraud

Activity 6.1

Define internal control?

6.2.1 SOX and the foreign corrupt practices act

In 1977, Congress passed the ***Foreign Corrupt Practices*** Act. Its primary purpose was to prevent the bribery of foreign officials to obtain business. A significant effect was to require that corporations maintain good systems of internal accounting control.

In the late 1990s and early 2000s, a series of multi-million-dollar accounting frauds made headlines. Congress responded with passage of the ***Sarbanes-Oxley Act of 2002*** (SOX). SOX applies to publicly held companies and their auditors.

Important aspects of SOX include: (1) creation of the Public Company Accounting Oversight Board (PCAOB) to oversee the auditing profession; (2) new rules for auditors, audit committees, and management; and (3) new internal control requirements, requiring that management attest to the adequacy of internal controls. The auditor must attest to and report on management's assessment on internal controls.

The SEC further mandated that management must base its evaluation of internal control on a recognized control framework. The most likely framework is the COSO model discussed later.

Levers of Control--Many people feel there is a basic conflict between creativity and controls. Robert Simons has espoused four levers of controls to help companies reconcile this conflict:

- A concise ***belief system*** to communicate core values to employees.
- A ***boundary system*** to set limits.
- A ***diagnostic control system*** to ensure efficient and effective achievement of important controls.
- An ***interactive control system*** to help top-management with high-level activities that demand regular attention, such as strategic development.

6.2.2 Control frameworks

A number of frameworks have been developed to help companies develop good internal control systems. Three of the most important are: the COBIT framework; the COSO internal control framework; and COSO's Enterprise Risk Management framework (ERM). The ***COBIT Framework***, also known as the ***Control Objectives for Information and Related Technology*** framework was developed by the Information Systems Audit and Control Foundation (ISACF) as a foundation for IT control. COBIT consolidates standards from 36 different sources into a single framework and is having a big impact on the IS profession.

COSO's *Internal Control Framework* was created by the Committee of Sponsoring Organizations (COSO), a private-sector group consisting of the AAA, the AICPA, the IIA, the IMA, and the FEI. In 1992, COSO issued the ***Internal Control Integrated Framework*** to define internal controls and provide guidance for evaluating and enhancing them. It was widely accepted as the authority on internal controls and was incorporated into policies, rules, and regulations used to control business activities. COSO's internal control model has five crucial components: control environment; control activities; risk assessment; information and communication; and monitoring.

Nine years later, COSO began investigating how to effectively identify, assess, and manage risk so organizations could improve the risk management process. The result was the ***Enterprise Risk Manage Integrated Framework (ERM)***. It is an enhanced corporate

governance document that expands on elements of the preceding framework and focuses on the broader subject of enterprise risk management.

The intent of ERM is to achieve all goals of the previous framework and help the organization:

- Provide reasonable assurance that company objectives and goals are achieved and problems and surprises are minimized.
- Achieve its financial and performance targets.
- Assess risks continuously and identify steps to take and resources to allocate to overcome or mitigate risk.
- Avoid adverse publicity and damage to the entity's reputation.

ERM defines risk management as a process effected by an entity's board of directors, management, and other personnel, applied in strategy setting and across the enterprise, to identify potential events that may affect the entity and manage risk to be within its risk appetite in order to provide reasonable assurance of the achievement of entity objectives.

The basic principles behind ERM are:

- Companies are formed to create value for owners and that management must decide how much uncertainty they will accept. Uncertainty can result in risk (the possibility that something negative will happen to value) and opportunity (the possibility that something positive will happen to value).
- The framework should help management manage uncertainty and its associated risk to build and preserve value.
- To maximize value, a company must balance its growth and return objectives and risks with efficient and effective use of company resources.

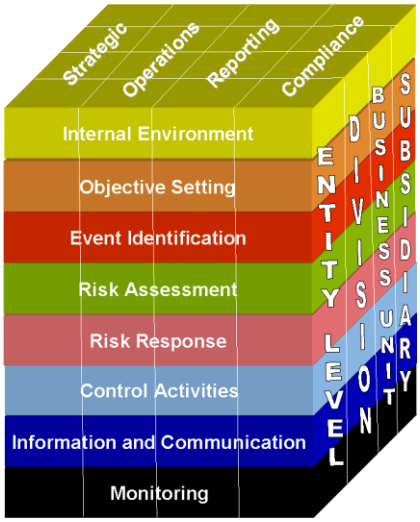


Figure 6.1: COSO's Enterprise Risk Management Model

COSO developed a graphical model to illustrate the elements of ERM. Columns at the top represent the four types of ***objectives*** that management must meet to achieve company goals.

- ***Strategic objectives***—high-level goals aligned with mission.
- ***Operations objectives***—deal with effectiveness and efficiency of company operations, such as profitability goals and safeguarding assets.
- ***Reporting objectives***—to ensure accuracy, completeness and reliability of reports.
- ***Compliance objectives***—with laws and regulations.

Columns on the right represent the company's units: entire company; division; business unit; or subsidiary.

The horizontal rows are eight related risk and control components, including:

- ***Internal environment***—the tone or culture of the company.
- ***Objective setting***—ensures a process in place to set objectives consistent with the company's risk tolerance.
- ***Event identification***—requires management to identify potential events that pose risks and opportunities.

- ***Risk assessment***—to determine their potential impact.
- ***Risk response***—involves determining whether to avoid, reduce, share or accept each risk.
- ***Control activities***—to implement management's risk responses.
- ***Information and communication***—to identify, capture, and communicate information about the ERM's components.
- ***Monitoring***—involves reporting and acting on deficiencies.

Each of the eight risk and control elements are applied to the four objectives in the entire company and/or one of its subunits.

ERM Framework Vs. the Internal Control Framework—COSO's internal control framework has been widely adopted as the principal way to evaluate internal controls as required by SOX. However, it has too narrow of a focus and has an inherent bias toward focusing on past problems and concerns. The ERM framework takes a risk-based, rather than controls-based, approach to the organization, oriented toward future and constant change. It incorporates rather than replaces COSO's internal control framework and contains three additional elements. Over time, ERM will probably become the most widely adopted risk and control model.

Activity 6.2

1. **What is the difference between the COBIT, COSO, and ERM control frameworks?**

6.2.2.1 Internal environment

The most critical component of the ERM and the internal control framework is the internal environment.

Internal environment consists of the following components: (1) management's philosophy, operating style, and risk appetite; (2) the board of directors; (3) commitment to integrity, ethical values, and competence; (4) organizational structure; (5) methods of assigning authority and responsibility; (6) human resource standards; and (7) external influences.

Management's Philosophy, Operating Style, and Risk Appetite--An organization's management has shared beliefs and attitudes about risk. That philosophy affects everything the organization does, long- and short-term, and affects their communications. Companies also have a ***risk appetite***, the amount of risk they are willing to accept to achieve their goals and objectives. That appetite needs to be aligned with company strategy. This philosophy must be clearly communicated to all employees and backed up with actions. This component can be assessed by asking whether management takes undue business risks, attempts to manipulate performance measures or pressures employees to achieve results regardless of methods.

The Board of Directors—The organization should have an active and involved board of directors that oversees management; scrutinizes their plans, performance, and activities; approves strategy; reviews financial results and security policies; and interacts with auditors. They should possess sufficient knowledge and independence.

Public companies must have an ***audit committee***, composed entirely of independent, outside directors. They oversee the internal control structure, the financial reporting process, and compliance with laws and regulations. They also hire and work with the auditors to provide an independent review of management actions.

Commitment to Integrity, Ethical Values, and Competence--Management must create an organizational culture that stresses integrity and commitment to both ethical values and competence. Management should reward and encourage honesty and give labels to honest and dishonest acts. Codes of conduct can help specify permissible and forbidden acts. Employees should be required to report violations. The levers of control can be helpful in creating a commitment to integrity.

Organizational Structure--A company's organizational structure defines its lines of authority, responsibility, and reporting. It provides the overall framework for planning,

directing, executing, controlling, and monitoring its operations. In today's business world, the hierarchical organizations with many layers of management are giving way to flatter organizations with self-directed work teams. These changes have a significant impact on the nature and type of controls needed.

Methods of Assigning Authority and Responsibility--Management should make sure employees understand the entity's objectives and that authority and responsibility for achieving those objectives is assigned to specific departments and individuals. Ownership of responsibility encourages employees to take initiative in solving problems and holds them accountable. Management must be sure to identify who is responsible for the IS security policy and should monitor results so decisions can be reviewed and, if necessary, overruled. Authority and responsibility are assigned through job descriptions; employee training; operating plans, schedules, and budgets; codes of conduct; and written policies and procedures manuals.

Human Resources Standards--Employees are both the company's greatest control strength and weakness. Organizations can implement human resource policies and practices with respect to hiring, training, compensating, evaluating, counseling, promoting, and discharging employees that send messages about the level of competence and ethical behavior required. Policies on working conditions, incentives, and career advancement can encourage efficiency and loyalty. Policies with respect to the following issues are particularly important:

- ***Hiring***—Should be based on the candidates match to the job requirements. Formal interviews should be conducted, and reference and background checks should be done.
- ***Compensating***—Employees should be paid a fair wage.
- ***Training***—Employees should have ongoing training related to their responsibilities, company policies and expectations, and fraud awareness. Employees should be made aware of consequences of bad behavior.

- ***Evaluating and promoting***—Periodic performance appraisals help employees understand their strengths and weaknesses and should be an important basis for promotions.
- ***Discharging***—Terminated employees should be removed from sensitive jobs immediately and denied system access.
- ***Managing disgruntled employees***--Disgruntled employees are much likelier fraud candidates than satisfied employees. The organization can try to reduce the employee's pressures through grievance channels and counseling.
- ***Vacations and rotation of duties***--Some fraud schemes cannot continue without the constant attention of the perpetrator. Mandatory vacations or rotation of duties can prevent these frauds or lead to early detection.
- ***Confidentiality agreements and fidelity bond insurance***--Employees, suppliers, and contractors should be required to sign and abide by nondisclosure or confidentiality agreements. Key employees should have fidelity bond insurance coverage to protect the company against losses from fraudulent acts.
- In addition to the preceding policies, the company should seek prosecution and incarceration of hackers and fraud perpetrators

External influences--External influences that affect the control environment include requirements imposed by FASB, the PCAOB, the SEC, insurance commissions, and regulatory agencies for banks, utilities, etc.

6.2.2.2 objective setting

Objective setting is the second ERM component. It must precede many of the other six components, i.e., you must set objectives before you can define events that affect your ability to achieve objectives. Top management, with board approval, must articulate why the company exists and what it hopes to achieve (the corporate vision or mission). They use the mission statement as a base from which to set corporate objectives. The objectives

need to be easy to understand and measure, prioritized, and aligned with the company's risk appetite.

Objectives set at the corporate level are linked to and integrated with a cascading series of sub-objectives in the various sub-units. For each set of objectives, critical success factors (what has to go right) must be defined and performance measures should be established.

Objective-setting process goes as follows. First, set strategic objectives--the high-level goals that support the company's mission and create value for shareholders. To meet these objectives, identify alternative ways of accomplishing them. For each alternative, identify and assess risks and implications. Formulate a corporate strategy, and then set operations, compliance, and reporting objectives.

6.2.2.3 Event identification

Events are incidents or occurrences that emanate from internal or external sources that affect implementation of strategy or achievement of objectives. Their impact can be positive, negative, or both. Events can range from obvious to obscure and from inconsequential to highly significant.

Management must do its best to anticipate all possible events. COSO identified many internal and external factors that could influence events and affect a company's ability to implement strategy and achieve objectives.

External factors include economic factors, natural environment, political factors, social factors, and technological factors. Internal factors include infrastructure, personnel, process, and technology. Companies usually use two or more of the following techniques together to identify events: comprehensive lists of potential events; internal analysis; monitoring of leading events and trigger points; workshops and interviews; data mining and analysis; and process analysis.

6.2.2.4 Risk assessment and risk response

COSO indicates there are two types of risk: Inherent risk is the risk that exists before management takes any control steps. Residual risk is the risk that still remains after control steps. Companies should assess inherent risk, develop a response, and then assess residual risk. The steps in risk assessment and response are:

- Identify the events or threats that confront the company.
- Estimate the likelihood of each event occurring.
- Estimate the potential loss from each threat.
- Identify controls to guard against the threat.
- Estimate costs and benefits of implementing such controls.
- If it's cost beneficial, then reduce the risk by implementing controls; otherwise, avoid, share, or accept the risk.

6.2.2.5 Control activities

Control activities are policies, procedures, and rules that provide reasonable assurance that management's control objectives are met and their risk responses are carried out. They generally fall into one of the following categories: (1) proper authorization of transactions and activities; (2) segregation of duties; (3) project development and acquisition controls; (4) change management controls; (5) design and use of documents and records; (6) safeguard assets, records, and data; and (7) independent checks on performance.

Proper Authorization of Transactions and Activities--Management must establish policies and empower employees to perform activities within policy. This empowerment is called ***authorization***. There are typically at least two levels of authorization. With ***general authorization***, management authorizes employees to handle routine transactions without special approval. ***Special authorization*** is required for transactions that are of significant consequences; management review and approval is required.

Segregation of Duties--Segregation of duties in the accounting function means that no two employees should have responsibility for more than one of the following with respect to related assets:

- ***Authorization***—approving transactions and decisions.
- ***Recording***—Preparing source documents; maintaining journals, ledgers, or other files; preparing reconciliations; and preparing performance reports.
- ***Custody***—Handling cash, maintaining an inventory storeroom, receiving incoming customer checks, writing checks on the organization's bank account.

If two or more employees work together to override these controls, there is ***collusion***.

Within the systems function, procedures once performed by separate individuals are combined. Therefore, anyone who has unrestricted access to the computer, its programs, and live data could have the opportunity to perpetrate and conceal fraud. To combat this threat, organizations must implement effective segregation of duties within the IS function. Authority and responsibility must be divided clearly among the following functions: systems administration; network management; security management; change management; users; systems analysts; programming; computer operations; information systems library; and data control.

Project Development and Acquisition Controls—Involves a formal, appropriate, and proven methodology to govern the development, acquisition, implementation, and maintenance of information systems and related technologies. This approach should contain appropriate controls for management review and approval, user involvement, analysis, design, testing, implementation, and conversion. The following basic control principles should be applied to systems development: develop a strategic master plan; incorporate project controls; create a data processing schedule; utilize a steering committee; and use system performance measurements and post-implementation review.

Change Management Controls--Change management is the process of making sure that system changes do not negatively affect systems reliability, security, confidentiality, integrity, or availability.

Design and Use of Adequate Documents and Records--Proper design and use of documents and records helps ensure accurate and complete recording of all relevant transaction data. Form and content should be kept as simple as possible. Documents that initiate a transaction should contain a space for authorization. Those used to transfer assets should have a space for the receiving party's signature. Documents should be sequentially pre-numbered and should provide an audit trail.

Safeguard Assets, Records, and Data—Cash, inventory, information, and other assets all need to be protected. Insiders pose the greatest risk to information. It is important to

maintain accurate records of all assets, periodically reconcile recorded amounts to physical counts, restrict access to assets, and protect records and documents.

Independent Checks on Performance--Internal checks to ensure that transactions are processed accurately are an important control element. These checks should be performed by someone independent of the party responsible for the activities. They typically include: top-level reviews, analytical reviews, reconciliation of independently maintained sets of records, comparison of actual quantities with recorded amounts, double-entry accounting, and independent review.

6.2.2.6 Information and Communication

Information and communication are the seventh component of COSO's ERM model. The primary purpose of the AIS is to gather, record, process, store, summarize, and communicate information about an organization. So, accountants must understand how transactions are initiated, data are captured in or converted to machine-readable form, computer files are accessed and updated, data are processed, and information is reported to internal and external parties. Accountants must also understand the accounting records and procedures, supporting documents, and specific financial statement accounts involved in processing and reporting transactions. The preceding items facilitate an audit trail which allows for transactions to be traced from origin to financial statements and vice versa.

6.2.2.7 Monitoring

Monitoring is the eighth component of COSO's ERM model. It can be accomplished with a series of ongoing events or by separate evaluations. Key methods of monitoring performance include: performing ERM evaluation, implementing effective supervision, using responsibility accounting, monitoring system activities, tracking purchased software, conducting periodic audits, employing a computer security officer and security consultants, engaging forensic specialists, installing fraud detection software, and implementing a fraud hotline.

6.3 Information System Control

The Trust Services Framework organizes IT-related controls into five principles that jointly contribute to systems reliability:

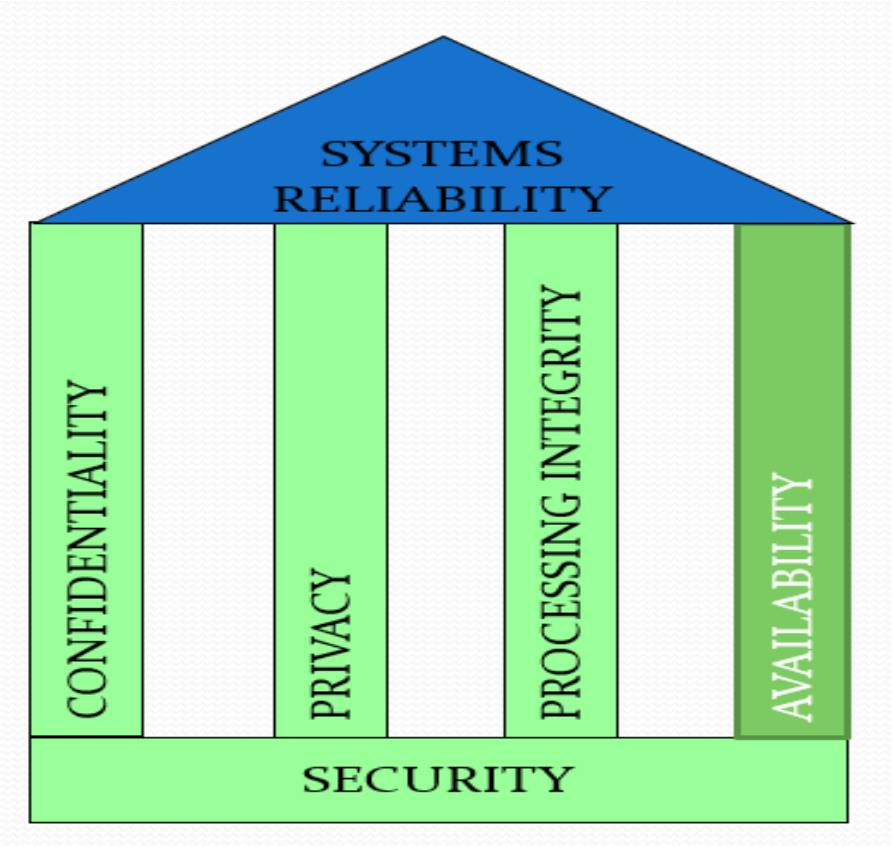


Figure 6.2: Five Trust Services Principles for Systems Reliability

1. ***Security***—access (both physical and logical) to the system and its data is controlled and restricted to legitimate users.

2. ***Confidentiality***—sensitive organizational information (e.g., marketing plans, trade secrets) is protected from unauthorized disclosure. about information security. He writes down the following questions that will guide his investigation:

What controls does Northwest Industries employ to prevent unauthorized access to its accounting system?
How can successful and unsuccessful attempts to compromise the company's accounting system be detected in a timely manner?

What procedures are in place to respond to security incidents?

3. ***Privacy***—personal information about customers, employees, suppliers, or business partners is collected, used, disclosed, and maintained only in compliance with internal policies and external regulatory requirements and is protected from unauthorized disclosure.

4. ***Processing Integrity***—data are processed accurately, completely, in a timely manner, and only with proper authorization.

5. ***Availability***—the system and its information are available to meet operational and contractual obligations.

Activity 6.3

1. **Why information system control?**
2. **Why system reliability and what are basic principles?**

Fundamental Information Security Concepts

Security as a management issue

- Security is a top management issue—not an IT issue. Management is responsible for the accuracy of various internal reports and financial statements produced by the organization's IS. Management must certify the accuracy of the financial statements and maintain effective internal controls.
- The Trust Services framework identifies four essential criteria for successfully implementing the five principles of systems reliability:
  - Develop and document policies.
  - Effectively communicate those policies to all authorized users.

- Design and employ appropriate control procedures to implement those policies.
- Monitor the system, and take corrective action to maintain compliance with the policies.

- Top management involvement and support is necessary to satisfy each of the preceding criteria.
- ***Policy Development***--A comprehensive set of security policies should be developed before designing and implementing specific control procedures. This process begins with taking an inventory of information systems hardware, software, and databases. Once the resources have been identified, they need to be valued in order to select the most cost-effective control procedures.
- ***Effective Communication of Policies***--Security policies must be communicated to and understood by employees, customers, suppliers, and other authorized users. Regular reminders and compliance training should be employed. Management must actively support these policies, and sanctions should apply to violators.
- ***Design and Employ Appropriate Control Procedures***--Control frameworks such as COBIT and Trust Services identify a variety of specific control procedures and tools that can be used to mitigate various security threats. Determining the optimal level of investment in security involves evaluating cost-benefit trade-offs.
- ***Monitor and Take Remedial Action***--Technology advances create new threats and alter the risks associated with existing threats. Effective control involves a continuous cycle of developing policies to address identified threats; communicating those policies to employees; implementing specific control procedures to mitigate risk; monitoring performance; and taking corrective action in response to problems.

The time-based model of security

- Given enough time and resources, any preventive control can be circumvented. Detection and correction must be timely, especially for information security,

because once preventive controls have been breached, it takes little time to compromise the organization's economic and information resources.

- The time-based model evaluates the effectiveness of an organization's security by measuring and comparing the relationships among three variables:
  - P = Time it takes an attacker to break through the organization's preventive controls
  - D = Time it takes to detect that an attack is in progress
  - C = Time to respond to the attack
- If P > (D + C), then security procedures are deemed effective. Otherwise, security is ineffective.

Defense in depth

Defense-in-depth involves using multiple layers of controls to avoid having a single point of failure. Computer security involves using a combination of firewalls, passwords, and other preventive procedures to restrict access. Redundancy also applies to detective and corrective controls.

Major types of preventive controls used for defense in depth include:

- ***Authentication controls*** to identify the person or device attempting access.
- ***Authorization controls*** to restrict access to authorized users. These controls are implemented with an access control matrix and compatibility tests.
- ***Training*** to teach employees why security measures are important and teach them to use safe computing practices.
- ***Physical access controls*** to protect entry points to the building, to rooms housing computer equipment, to wiring, and to devices such as laptops, cell phones, and PDAs.
- ***Remote access controls*** include routers, firewalls, and intrusion prevention systems to prevent unauthorized access from remote locations.
  - A ***border router*** connects the IS to the Internet.
  - Behind the router is the main ***firewall***. It works with the border router to filter information trying to enter or leave the organization.

- Data is transmitted over the Internet in packets through a protocol called TCP/IP. A set of rules called an ***access control list*** (ACL) determines which packets are allowed in and which are dropped. ***Stateful packet filtering*** examines the header of each packet in isolation. ***Deep packet filtering*** examines the data in the body of a packet to provide more effective access control. Deep packet filtering is the heart of a new type of filter called ***intrusion prevention systems***.
- ***Internal firewalls*** can be used to segment different departments within an organization.
- Web servers and email servers are placed in a separate network outside the corporate network referred to as the ***demilitarized zone***.
- Special attention must be paid to use of rogue modems by employees. Wireless access and dial-up modems require special security procedures.

Host and application hardening procedures involve the use of supplemental preventive controls on workstations, servers, printers, and other devices. Special attention should be paid to host configuration, user accounts, and software design.

Encryption provides the final barrier. It involves transforming normal text, called ***plaintext***, into unreadable gibberish, called ***ciphertext***. Decryption reverses the process.

- The factors that determine the strength of an encryption system are the length of the key, key management policies, and the nature of the encryption algorithm.
- There are both symmetric and asymmetric encryption systems. Symmetric systems use the same key to encrypt and decrypt. Asymmetric systems use both a public and a private key. E-business uses symmetric encryption to encode most data, since it is faster, and uses asymmetric encryption to safely send the symmetric key to the recipient.
- ***Hashing*** transforms plaintext into a short code called a ***hash***.

- A ***digital signature*** is a hashed document that has been encrypted with the sender's private key.
- A ***digital certificate*** certifies the owner of a particular public key.
- An organization that issues public and private keys and records the public key in a digital certificate is a ***certificate authority***.

Preventive controls are never 100% effective, so organizations implement controls to enhance security by monitoring the effectiveness of preventive controls and detecting incidents in which they have been circumvented. Detective controls include:

Log analysis—the process of examining logs which record who accesses the system and the actions they take.

Intrusion detection systems (IDS) automate the monitoring of logs of network traffic permitted to pass the firewall. The most common analysis is to compare the logs to a database containing patterns of known attacks.

Managerial reports can be created to disclose the organization's performance with respect to the COBIT objectives. Key performance indicators include downtime caused by security incidents, number of systems with IDS installed, and the time needed to react to security incidents once they are reported.

Security testing includes

- ***Vulnerability scans***, which use automated tools designed to identify whether a system contains any well-known vulnerabilities.
- ***Penetration testing*** which involves an authorized attempt by either an internal audit team or external security consulting firm to break into the organization's IS.

Corrective controls include the following:

- A ***computer emergency response teams*** (CERT), consisting of technical specialists and senior operations management, to deal with major incidents. The CERT leads the organization's incident response process through four steps, which must be practiced regularly:
    - ✓ Recognizing that a problem exists.
    - ✓ Containing the problem.

- ✓ Recovery.
- ✓ Follow up.

A ***chief security officer*** is a designated individual with organization-wide responsibility for security. This individual should report to the COO or CEO and be independent of the IS function. The CSO must understand the technology; disseminate information about fraud, security breaches, and consequences; work with the person in charge of building security; and impartially assess the IT environment. Patch management involves fixing known vulnerabilities and installing the latest updates to anti-virus software, firewalls, operating systems, and application programs.

6.4 Computer Controls and Security

Computer security, also known as **cybersecurity** or **IT security**, is the protection of information systems from theft or damage to the hardware, the software, and to the information on them, as well as from disruption or misdirection of the services they provide. It includes controlling physical access to the hardware, as well as protecting against harm that may come via network access, data and code injection, and due to malpractice by operators, whether intentional, accidental, or due to them being tricked into deviating from secure procedures.

What are the concerns of computer security?

Computer Security is concerned with four main areas:

1. Confidentiality: - Only authorized users can access the data resources and information.
2. Integrity: - Only authorized users should be able to modify the data when needed.
3. Availability: - Data should be available to users when needed.
4. Authentication: - are you really communicating with whom you think you are communicating with

6.4.1 Confidentiality

- Reliable systems protect confidential information from unauthorized disclosure. Confidential information includes sensitive data produced internally as well as that shared by business partners. Each organization will develop its own definitions, which usually include: business plans, pricing strategies, client and customer lists, and legal documents.
- Encryption is a fundamental control procedure for protecting the confidentiality of sensitive information. Confidential information should be encrypted while stored and during transmission to trusted parties.
- The internet provides inexpensive transmission, but data is easily intercepted. Encryption solves the interception issue. If data is encrypted before sending it, a ***virtual private network (VPN)*** is created.
- It is critical to encrypt any sensitive information stored in devices that are easily lost or stolen, such as laptops, PDAs, cell phones, and other portable devices. Many organizations have policies against storing sensitive information on these devices, but 81% of users do so anyway.
- Encryption alone is not sufficient to protect confidentiality. Access controls and strong authentication techniques are also needed. Strong controls should be used to limit the actions (read, write, change, delete, copy, etc.) that authorized users can perform when accessing confidential information. Access to system outputs should also be controlled.
- It is especially important to control disposal of information resources. Special procedures are needed for information stored on magnetic and optical media.
- Controls to protect confidentiality must be continuously reviewed and modified to respond to new threats created by technological advances. Many organizations now prohibit visitors from using cell phones while touring their facilities because of the threat caused by cell-cams. Phone conversations routed over the Internet are also vulnerable.

- Employee use of email and instant messaging (IM) probably represents two of the greatest threats to the confidentiality of sensitive information.

6.4.2 Privacy

- In the Trust Services framework, the privacy principle is closely related to the confidentiality principle. The primary difference is that privacy focuses on protecting personal information about customers rather than organizational data. Key controls for privacy are the same that were previously listed for confidentiality.
- Federal and some state regulations require organizations to protect the privacy of customer information.
- The Trust Services privacy framework of the AICPA and CICA lists ten internationally recognized best practices for protecting the privacy of customers' personal information:
  - ***Management***—Establish policies and procedures to protect privacy of personal information collected. Assign responsibility to a particular person or group.
  - ***Notice***—Notify individuals when their information is collected.
  - ***Choice and consent***—Give customers a choice to opt out (U.S.) or opt in (Europe) to the collection of their personal information.
  - ***Collection***—Means collect only what is needed.
  - ***Use and retention***—Means retain only as long as needed.
  - ***Access***—Allow customers to access, review, and delete their information.
  - ***Disclosure to Third Parties***—Provide to third parties only per policy and require the same protection.
  - ***Security***—Take reasonable steps to protect the information from loss or unauthorized disclosure.
  - ***Quality***—Maintain the integrity of the information.
  - ***Monitoring and enforcement***—Assign a third party to assure and verify compliance.

- A related concern involves the overwhelming volume of spam--unsolicited email that contains either advertising or offensive content. A 2003 Congressional Act, ***CAN-SPAM***, provides criminal and civil penalties for violation of the law, applies to commercial email, and covers most legitimate email sent by organizations to customers, suppliers, or donors to non-profits. CAN-SPAM guidelines include:
  - The sender's identity must be clearly displayed in the message header.
  - The subject field in the header must clearly identify the message as an advertisement or solicitation.
  - The body must provide recipients with a working link that can be used to "opt out" of future email.
  - The body must include the sender's valid postal address.
- Organizations should not send email to randomly generated addresses or set up websites designed to harvest email addresses of potential customers.
- Organizations need to train employees on how to manage personal information collected from customers. One privacy-related issue is identity theft. Organizations have an ethical and moral obligation to implement controls to protect databases that contain their customers' personal information.

6.4.3 Processing integrity

A reliable system produces information that is accurate, timely, reflects results of only authorized transactions, and includes outcomes of all activities engaged in by the organization during a given period of time. Reliability requires controls over both data input quality and the processing of the data.

Five categories of integrity controls are designed to meet the preceding objectives:

- ***Source data controls***--Companies must establish control procedures to ensure that all source documents are authorized, accurate, complete, properly accounted for, and entered into the system or sent to their intended destination in a timely manner. Source data controls include forms design; pre-numbered forms sequence tests; turnaround documents; cancellation and storage of

documents; authorization and segregation of duties; visual scanning; check digit verification; and RFID security.

- ***Data entry controls***--Once data is collected, data entry control procedures are needed to ensure that it's entered correctly. Common tests to validate input include: field checks, sign checks, limit checks, range checks, size checks, completeness checks, validity checks, and reasonableness tests.
- In addition to the preceding controls, when using batch processing, the following data entry controls should be incorporated: sequence checks, error logs, and batch totals. Online data entry controls include: automatic entry of data; prompting; pre-formatting; closed-loop verification; transaction logs; and error messages.
- ***Processing Controls***—Controls to ensure that data is processed correctly include:
  - ***Data Matching***—Involves matching two or more items before processing can proceed.
  - ***File Labels***—External and internal labels to ensure that the correct and most current files are being updated.
  - ***Recalculation of batch totals***
  - ***Cross-footing balance test***
  - ***Write-protection mechanisms***
  - ***Database processing integrity measures***—include database administrators, data dictionaries, and concurrent update controls.
  - ***Data conversion controls***
- ***Data transmission controls***--Organizations need controls to minimize the risk of data transmission errors. When the receiving unit detects a data transmission error, it asks the sending unit to re-send. This action is usually done automatically. Sometimes, the system may not be able to accomplish automatic resubmission and will ask the sender to re-transmit the data. There are two basic types of data transmission controls:

- ✓ ***Parity checking***—adds an additional bit to the digit being transmitted. The receiving device performs parity checking to verify that the proper number of bits is received (odd or even) for each character.
- ✓ ***Message acknowledgment techniques*** include:
  - ***Echo checks***—The sending unit calculates a summary statistic, and the receiving unit recalculates it to see that they match.
  - ***Trailer records***—The sending unit stores control totals in a trailer record, and the receiving unit uses that information to verify the entire message was received.
  - ***Numbered batches***—Batches being transmitted are numbered sequentially. The receiving unit uses those numbers to properly assemble the batches.

☞ ***Output controls***—Careful checking of system output provides additional control over processing integrity. Output controls include:

- ***User review of output*** for reasonableness, completeness, and to be sure they are the intended recipient.
- ***Reconciliation procedures*** involve reconciling all transactions and system updates to control reports, etc., and reconciling control account balances to totals of subsidiary accounts.
- ***External data reconciliation*** involves reconciling stored data with data from outside the system.

6.4.4 Availability

Reliable systems are available for use whenever needed. Threats to system availability originate from many sources, including hardware and software failures; natural and man-made disasters; human error; worms and viruses; and denial-of-service attacks and other sabotage. Organizations must develop disaster recovery and business continuity plans to enable them to quickly resume normal operations after such an event.

Steps to minimize the risk of system downtime include: physical and logical access controls good computer security to minimize risk of theft or sabotage; preventive maintenance; use of redundant components to provide fault tolerance; surge protection devices; and an uninterruptible power supply.

Risks associated with natural and man-made disasters can be reduced with proper location and design of rooms housing mission-critical servers and databases.

Training is especially important. Well-trained operators are less likely to make mistakes and more able to recover if they do. Security awareness training, particularly concerning safe email and web-browsing practices, can reduce risk of virus and worm infection.

Anti-virus software should be installed, run, and kept current. Email should be scanned for viruses at both the server and desktop levels. Newly acquired software and disks, CDs, or DVDs should be scanned and tested first on a machine that is isolated from the main network.

Disaster recovery and business continuity plans are essential if an organization hopes to survive a major catastrophe. The objectives of a disaster recovery and business continuity plan are to: minimize the extent of the disruption, damage, and loss; temporarily establish an alternative means of processing information; resume normal operations as soon as possible; and train and familiarize personnel with emergency operations. Key components of effective disaster recovery and business continuity plans include: data backup procedures; provisions for access to replacement infrastructure (equipment, facilities, phone lines, etc.); thorough documentation; periodic testing; and adequate insurance.

change management controls

Organizations constantly modify their information systems to reflect new business practices and to take advantage of advances in IT. Controls are needed to ensure such changes don't negatively impact reliability. Existing controls related to security, confidentiality, privacy, processing integrity, and availability should be modified to maintain their effectiveness after the change. Change management controls need to ensure adequate segregation of duties is maintained in light of the modifications to the organizational structure and adoption of new software.

Important change management controls include: documentation of change requests in a standard format; approval of change requests at various levels of management; thorough testing; updated program, system, and procedure documentation; procedures for emergency changes; back-out plans; and monitoring of user rights and privileges.

6.5 Overview of Auditing of Computer Based IS

6.5.1 Information system

An Information System (IS) is any combination of information technology and people's activities using that technology to support operations, management, and decision-making. In a very broad sense, the term information system is frequently used to refer to the interaction between people, algorithmic processes, data and technology. In this sense, the term is used to refer not only to the information and communication technology (ICT) an organization uses, but also to the way in which people interact with this technology in support of business processes.

Some make a clear distinction between information systems, ICT and business processes. Information systems are distinct from information technology in that an information system is typically seen as having an ICT component. Information systems are also different from business processes. Information systems help to control the performance of business processes.

6.5.2 Information System Auditing

An information systems audit, is an examination of the controls within an information technology infrastructure. An IS audit is the process of collecting and evaluating evidence of an organization's information systems, practices, and operations. The evaluation of obtained evidence determines if the information systems are safeguarding assets, maintaining data integrity, and operating effectively to achieve the organization's goals or objectives. These reviews may be performed in conjunction with a financial statement audit, internal audit, or other form of attestation engagement.

An IS audit is defined as an audit that encompasses a whole or partial review and evaluation of automated information processing systems, related non-automated processes and the interfaces between them. This definition provides a very broad ambit for an IS audit and covers a review of all or any aspect of the information and communication technology environment from development to deployment, from planning to monitoring and from acquisition to delivery. IS audit has defined by Ron Weber as "the process of collecting and evaluating the evidence to determine whether a computer system (information system) safeguards assets, maintains data integrity, achieves organizational goals effectively and consumes resources efficiently". IS audits are also known as automated data processing (ADP) audits and computer audits. They were formerly called electronic data processing (EDP) audits.

6.5.3 Need for Control and Audit of Information Systems

The role of information technology (IT) control and audit has become a critical mechanism for ensuring the integrity of information systems (IS) and the reporting of organization finances to avoid and hopefully prevent future financial fiascos such as Enron and WorldCom. Global economies are more interdependent than ever and geopolitical risks impact everyone. Electronic infrastructure and commerce are integrated in business processes around the globe. The need to control and audit never been greater.

Initially, IT auditing (formerly called electronic data processing [EDP], computer information systems [CIC], and IS auditing) evolved as extension of traditional auditing. At that time, the need for an IT audit function came from several directions: Auditors realized that computers had impacted their ability to perform the attestation function. Corporate and information processing management recognized that computers werekey resources for competing in business environment and similar to other valuable business resource within the organization, and therefore, the need for control and audit is critical.

IS auditing is an integral part of the audit function because it supports the auditor's judgment on the quality of the information processed by computer systems. The IS

auditor's role has evolved to provide assurance that adequate and appropriate controls are in place. Of course, the responsibility for ensuring that adequate internal controls are in places rests with the management. The auditor's primary role, except in areas of management advisory services, is to provide a statement of assurance as to whether adequate and reliable internal controls are in place and are operating in an efficient and effective manner. Therefore, whereas management is to ensure, auditors are to assure.

As we know that computers play vital part in assisting us to process data and to make decisions, it is important that their use be controlled. Therefore, pointed underneath some of the factors that demand for the audit and control: -

6.5.3.1 Organizational Costs of Data Loss

Data make up a critical resource necessary for an organization's continuing/ operations. In this regard, Everest (1985) proposes that data provides the organization with an image of itself, its environment, its history, and its future. If this image is accurate, the organization increases its abilities to adapt and survive in a changing environment. If this image is inaccurate or lost, the organization can incur substantial losses.

For example, consider a large department store whose accounts receivable file has been destroyed. Unless its customers are honest and also remember what, they have purchased from the store, the firm can suffer a major loss in cash receipts through customers failing to pay their debts. The department store's long-run survival could be affected. Consider, also, a department store that loses its accounts payable file. Most likely it will be unable to pay its debts on time. As a result, it could suffer a loss of credit rating as well as any discounts available for early payment. If it contacts creditors requesting their assistance, the department store has to rely on the honesty of its creditors in notifying it of the amounts it owes. Furthermore, creditors might now begin to question the competence of the department store's management. As a result, they might be unwilling to extend credit to the department store in the future. Such losses can occur when existing controls over computers are lax. For example, 'management might not provide adequate backup for computer files. Thus, the loss of a file through computer program error sabotage or natural

disaster means the file cannot be recovered and the organization's continuing operations are thereby impaired.

6.5.3.2 Incorrect Decision Making

Making high-quality decisions depends in part on the quality of the data and the quality of the decision rules that exist within computer-based information system. The importance of accurate data in a computer system depends on the types of decisions made by persons having some interest in an organization. For example, if managers are making strategic planning decisions, they will probably tolerate some errors in the data, given the long-run nature of strategic planning decisions and the inherent uncertainty surrounding these types of decisions. If managers are making

management control and operational control decisions, however, they will probably require highly accurate data. These types of decisions involve detection, investigation, and correction of out-of-control processes. Thus, in accurate data can cause costly, unnecessary investigations to be undertaken or out-of-control processes to remain undetected. Besides management, incorrect data can also have an impact on other parties who have an interest in an organization.

The importance of having accurate decision rules in a computer system also depends on the types of decisions made by persons having some interest in an organization. In some cases, an incorrect decision rule can have minor consequences. For example, a small, inconsequential error can occur in the calculation of depreciation on a low value asset. In other cases, however, the consequences can be significant. For example, if the algorithm that determines the interest rate to be paid to customers of a bank is incorrect, the bank might make substantial overpayments to its customers. It might not be able to recover these monies without substantial losses of goodwill. Similarly, if a decision rule in an expert system that supports medical diagnosis is incorrect, doctors could prescribe inappropriate treatments for patients, some of which could be fatal.

6.5.3.3 Costs of Computer Abuse

The major stimulus for development of the information systems audit function within organizations often seems to have been computer abuse. Computer abuse is defined to be "any incident associated with computer technology in which a victim suffered or could have suffered loss and a perpetrator by intention made or could have made gain.

TYPES OF COMPUTER ABUSE	
Type of Abuse	Explanation
Hacking	A person gains unauthorized access to a computer system to read, modify or delete programs or data or to disrupt services.
Viruses	Viruses are programs that attach themselves to executable files, system areas on diskettes or data files that contain macros to cause disruption to computer operations or damage to data and programs. They are designed to achieve two objectives: to replicate themselves and to deliver a payload that causes disruption of some kind.
Illegal physical Access	A person gains unauthorized physical access to' computer facilities (e.g., they gain illegal entry to a computer room or a terminal). As a result, they are able to cause physical damage to hardware or make unauthorized copies of programs of data.
Abuse of Privileges	A person uses the privileges they have been assigned for unauthorized purposes (e.g., they make unauthorized copies of sensitive data they are permitted to access).

Table 6.1: Types of computer abuse that an organization

CONSEQUENCES OF COMPUTER ABUSE	
Consequences of Abuse	Explanation
Destruction of asset	Hardware, software, data, facilities, documentation or supplies can be destroyed.
Theft of asset	Hardware, software, data, documentation or supplies can be illegally removed.
Modification of asset	Hardware, software, data or documentation can be modified in an unauthorized way.
Privacy violation	The privacy of data pertaining to a person or an organization can be compromised.
Disruption of operation	The day-to-day operations of the information systems function can cease temporarily.
Unauthorized use of asset	Hardware, software, data, facilities, documentation, or supplies are used for unauthorized purposes (e.g., computer time is used for private consulting purposes).
Physical harm to personnel	Personnel can suffer physical harm.

Table 6.2 CONSEQUENCES OF COMPUTER ABUSE

6.6 Objective of IS Auditing

An IS audit is different from a financial statement audit. While a financial audit's purpose is to evaluate whether an organization is adhering to standard accounting practices, the purposes of an IS audit are to evaluate the system's internal control design and effectiveness. This includes but is not limited to efficiency and security protocols,

development processes, and IS governance or oversight. The goal is to evaluate the organization's ability to protect its information assets and properly dispense information to authorized parties.

6.6.1 Asset Safeguarding Objectives

The information system assets of an organization include hardware, software, facilities, people (knowledge), data files, system documentation and supplies. Like all assets, they must be protected by a system of internal control. Hardware can be damaged maliciously. Proprietary software and the contents of data files can be stolen or destroyed. Supplies of negotiable forms can be used for unauthorized purposes. These assets are often concentrated in one or a small number of locations, such as a single disk. As a result, asset safeguarding becomes an especially important objective for many organizations to achieve.

6.6.2 Data Integrity Objectives

Data integrity is a fundamental concept in information systems auditing. It is a state implying data has certain attributes: completeness, soundness, purity, and veracity. If data integrity is not maintained, an organization no longer has a true representation of itself or of events. Moreover, if the integrity of an organization's data is low, it could suffer from a loss of competitive advantage. Nonetheless, maintaining data integrity can be achieved only at a cost. The benefits obtained should exceed the cost of the control procedures needed.

Three major factors affect the value of a data item to an organization and thus the importance of maintaining the integrity of that data item: - The value of the informational content of the data item for individual decision makers: The informational content of a data item depend on its ability to change the revel of uncertainty surrounding a decision and as a result, to change the expected payoffs of the decisions that might be made. These notions have been wet developed within statistical decision theory. The extent to which the data item is shared among decision makers: If data is shared, corruption of data integrity affects not just one user but many. The value of a data item is some aggregate function or the value

of the data item to the individual users of the data item. Thus, maintenance of data integrity becomes more critical in a shared data environment.

The value of the data item to competitors: If a data item is valuable to a competitor, its loss might undermine an organization's position in the marketplace. Competitors could exploit the informational content of the data item to reduce the profitability of the organization and to bring about bankruptcy, liquidation, takeover or merger.

Summary

Maintain a strong control environment, there are at least six control-related structures that management should develop and maintain. These are enterprise risk management (ERS), code of ethics, a set of internal controls, a set of IT controls, a corporate governance structure, and an IT governance structure.

Threats and risks that interrupt or stop computer operations can be severely damaging to the organization. Not only can they disrupt or shut down normal operations, but they also can lead to incorrect or incomplete accounting information. There are three important areas of knowledge regarding threats and risks to IT systems: The first is the description of the general controls and application controls that should exist in IT systems. The second is the type and nature of risks in IT systems. Third, and most important, is the recognition of how these controls can be used to reduce the risks to IT systems.

The AICPA Trust Services Principles define five objectives for IT controls: security, availability, processing integrity, confidentiality, and online privacy. Security means that the system is protected against unauthorized (physical and logical) access. Availability means the system is available for operation and use as committed or agreed. Processing integrity means that the system processing is complete, accurate, timely, and authorized. Online privacy means that personal information obtained as a result of e-commerce is collected, used, disclosed, and retained as committed or agreed. Confidentiality means that information designated as confidential is protected as committed or agreed.

Self-Assessment Questions

1. COSO identified five interrelated components of internal control. Which of the following is NOT one of those five?

   A. risk assessment
   B. internal control policies
   C. monitoring
   D. information and communication

2. All other things being equal, which of the following is true?

   A. Detective controls are superior to preventive controls.
   B. Corrective controls are superior to preventive controls.
   C. Preventive controls are equivalent to detective controls.
   D. Preventive controls are superior to detective controls.

3. Which of the following statements about the control environment is false?

   A. Management's attitudes toward internal control and ethical behavior have little impact on employee beliefs or actions.
   B. An overly complex or unclear organizational structure may be indicative of problems that are more serious.
   C. A written policy and procedures manual is an important tool for assigning authority and responsibility.
   D. Supervision is especially important in organizations that cannot afford elaborate responsibility reporting or are too small to have an adequate separation of duties.

4. Which of the following statements is true?

   A. Encryption and hashing are both reversible (can be decoded).
   B. Encryption is reversible, but hashing is not.

C. Hashing is reversible, but encryption is not.

D. Neither hashing nor encryption is reversible.

5. To achieve effective segregation of duties, certain functions must be separated. Which of the following is the correct listing of the accounting-related functions that must be segregated?

   A. control, recording, and monitoring

   B. authorization, recording, and custody

   C. control, custody, and authorization

   D. monitoring, recording, and planning

Matching

"A"	"B"
1. Vulnerability	**A)** A device that provides perimeter security by filtering packets.
2. Exploit	**B)** An attack that involves deception to obtain access.
3. Authentication	**C)** Software code that can be used to take advantage of a flaw and compromise a system.
4. Authorization	**D)** A flaw or weakness in a program
5. firewall	**E)** Verification of claimed identity.
	F) Restricting the actions that a user is permitted to perform.

Discussion

1. What is the relationship between COSO, COBIT, and the AICPA's Trust Services frameworks?

Self-assessment Answer key

Chapter one

Multiple Choice

1. B
2. C
3. C
4. B
5. A
6. B
7. C
8. B
9. A
10. B

Discussion answer

1. These questions involve traditional economic cost/benefit issues and less well-defined ethical
issues.
a. To what extent should management monitor employees' e-mail?

Generally, the courts have held that organizations have the right to monitor employees' email.
Such monitoring can have disastrous effects on employee morale, however. On the other hand,
it might provide legitimate information about group members' individual contributions and productivity.
b. To what extent should management monitor which Web sites employees visit?

Students are likely to argue whether or not this should be done. One potential benefit that could
be argued is the likelihood that if employees are aware that they will be monitored they will be
less prone to surf the Web for non-work-related uses.

c. To what extent should management monitor employee performance by, for example, using software to track keystrokes per hour or some other unit of time? If such information is collected, how should it be used?

Arguments pro and con can be generated about the effects of such monitoring on performance
and on morale. Clearly, the specifics of any incentive schemes tied to such metrics are

important.
d. Should companies use software to electronically "shred" all traces of e-mail? Arguments can be raised on both sides of this issue. Try to get students to go beyond the legal
ramifications of recent news stories and to explore the ethical implications of destroying different kinds of email.

e. Under what circumstances and to whom is it appropriate for a company to distribute information it collects about the people who visit its Web site?

Direct students to the guidelines followed by organizations that certify how various web sites
use the information they collect. Students are likely to make the argument that personal information is inherently private and sacrosanct. To challenge that view, ask them about the
legitimacy of developing and maintaining a reputation. Doesn't that involve the divulgence and
sharing of personal information among strangers? Ask the class if it is feasible (or undesirable)
to totally prevent or prohibit such sharing of information.

The instructor should also refer the students to Generally Accepted Privacy Principles (GAPP),
as one of its criteria concerns sharing information with 3rd parties. The instructor and the students could read the GAPP criterion about sharing data together, and then discuss what they
think. Remind the students that GAPP is not regulatory law – just recommended best practice.

Chapter Two

Multiple Choice

1. A
2. B
3. B
4. A
5. C
6. C
7. D
8. D
9. A

10. B

Discussion

1. **What kinds of documents are most likely to be turnaround documents? Do an**
   internet search to find the answer and to find example turnaround documents.
   Documents that are commonly used as turnaround documents include the following:
   · Utility bills
   · Meter cards for collecting readings from gas meters, photocopiers, water meters etc
   · Subscription renewal notices
   · Inventory stock cards
   · Invoices
   · Checks (banks encode account info on the bottom of checks)
   · Annual emissions inventory forms

Chapter 3

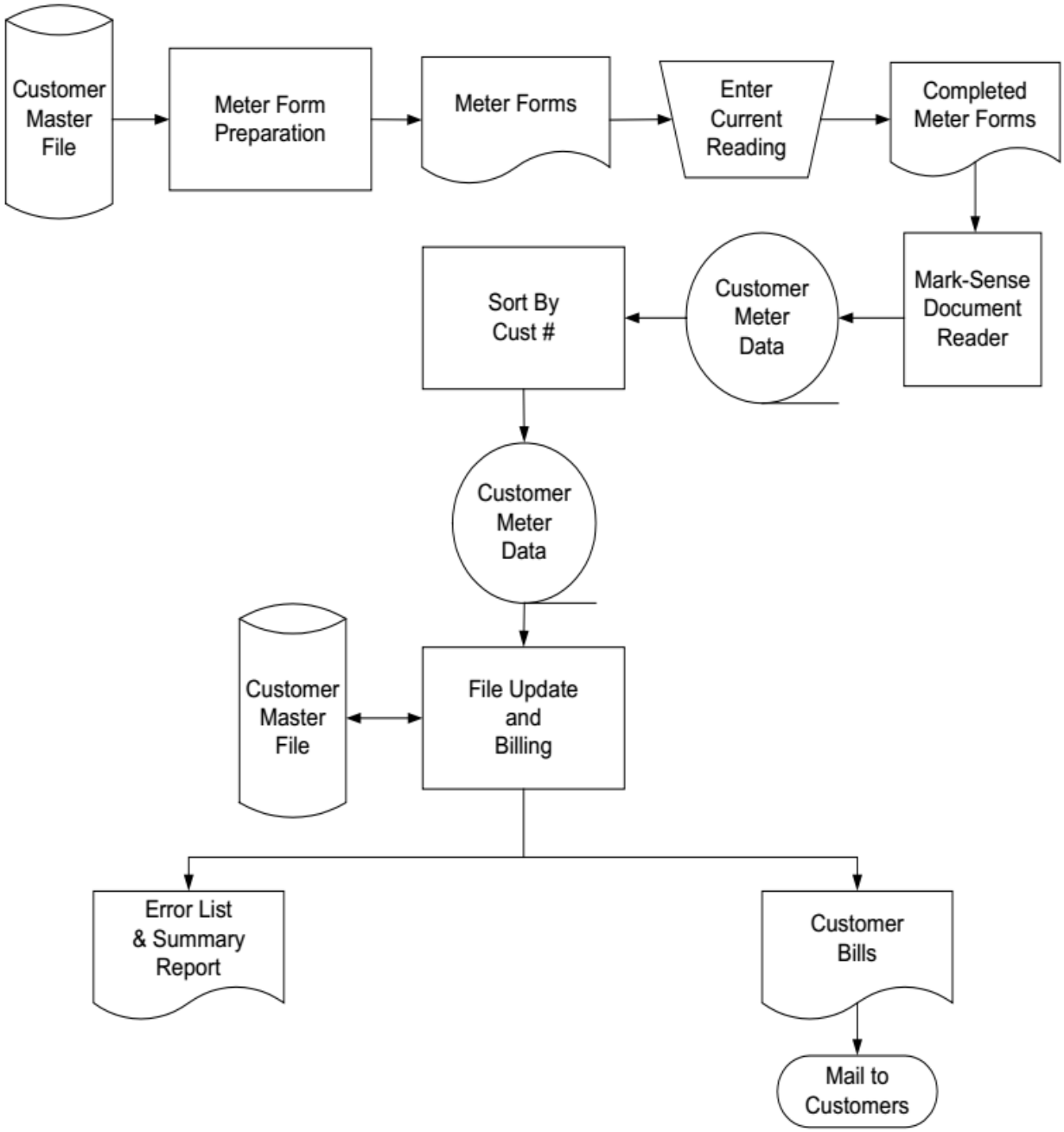
Multiple Choice

1. C
2. C
3. B
4. B
5. B
6. C
7. A
8. D
9. D
10. D

Discussion

1. It is usually not sufficient to use just one documentation tool. Every tool document a uniquely important aspect of a given information system. For example, system flowcharts are employed to understand physical system activities including inputs, outputs, and processing. In contrast, data flow diagrams provide a graphic picture of the logical flow of data within an organization.

   Each alternative is appropriate for a given aspect of the system. As a result, they work together to fully document the nature and function of the information system.



Chapter four

Multiple Choice

1. B
2. B
3. C

4. A
5. D
6. B
7. A
8. B
9. B
10. D

Discussion

1. The REA data model is used to develop databases that can meet both transaction processing and management analysis needs. Only events that either (1) directly change the quantities of resources, (2) represent commitments to future exchange events, or (3) that provide new information about activities that management wants to plan, evaluate, and control need to be included in such databases. None of the activities listed in the question satisfy these requirements.

   Customer information is stored in rows in the customer table and supplier data is stored in rows in the supplier table. The bulk of this would have been entered when the database was initially created and the customer and supplier tables created and populated. Subsequently, new rows would be entered in these tables as a by-product of other events that management does want to plan, evaluate, and control – such as a sales call, the receipt of an order from a new customer, or placing an initial order with a new supplier.

   Data processing activities, such as preparing reports or transcribing data from a form, are not explicitly modeled because they do not change information about any resources nor are they fundamental activities which management wants to control. (Consider: How often are managers concerned about how many reports a given employee prints in one day?) Indeed, all the information contained in a vendor invoice is already in the purchasing company's database before the vendor invoice arrives: the quantity ordered is known when the order is placed, as is the quoted price and terms of payment, and the quantity received in good condition is known when the receiving report is stored. Consequently, there is no need to explicitly model activities such as mailing or recording invoices as events in an REA data

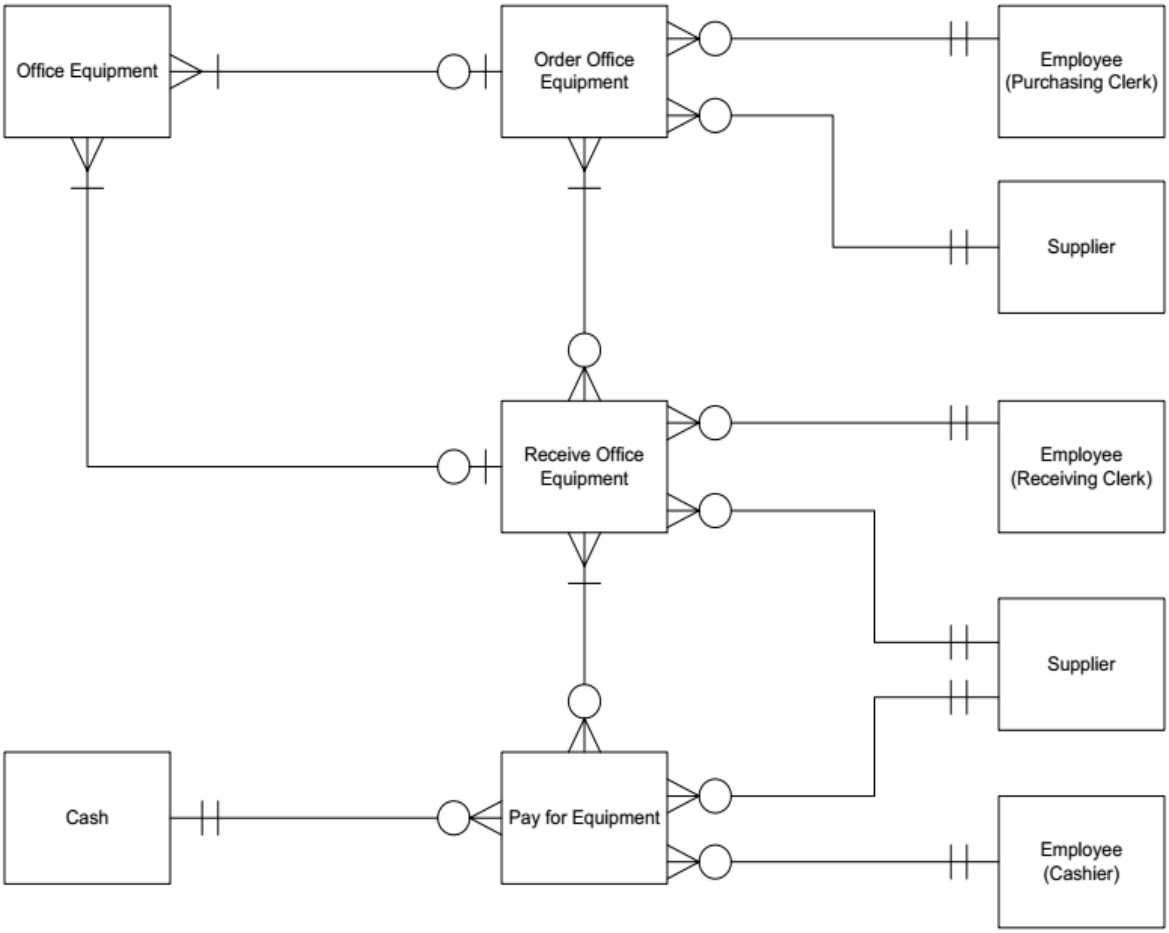
model. In fact, many administrative data processing activities are not even necessary steps in the value chain. For example, with the advent of sophisticated AIS, particularly ERP systems, many companies are requesting their suppliers not to send them any invoices

2. Accounts payable is not represented on an REA diagram. Accounts payable represents purchases for which the organization has not yet paid the supplier. Thus, at any point in time, accounts payable can be calculated by comparing two events: purchases and cash disbursements for those purchases. However, this difference must be recorded in financial statements as a liability at a particular point in time. Since the payable recorded in the financial statements is an artifact of reporting time periods, it is not a resource, event, nor an agent. Therefore, it will not appear on an REA diagram.
3. An entity-relationship (E-R) diagram is a graphical representation of a database that depicts the entities of interest and the important relationships among those entities. The entities are represented as rectangles; the relationships are represented as lines that connect entities.

   An REA diagram is an E-R diagram that is designed using the REA data model to identity the three basic kinds of entities relevant to transaction processing systems: the resources controlled by the organizations, the events (business activities) that managers want to plan, control, and evaluate, and the agents who participate in those events.

   Drawing REA Diagram

   1. Draw a REA Diagram of your data model. Be sure to include cardinalities.



Chapter five

Multiple Choice

1. D
2. C
3. B
4. B
5. B
6. A
7. A
8. A

Discussion

- Update the general ledger
- Post adjusting entries
- Prepare financial statements
- Produce managerial reports

Chapter Six

Multiple choice

1. B
2. D
3. A
4. B
5. B

Matching answer

1. D
2. C
3. E
4. F
5. A

Discussion question

1. **What is the relationship between COSO, COBIT, and the AICPA's Trust Services frameworks?**
   COSO is a broad framework that describes the various components of internal control. It
   does not, however, provide any details about IT controls.
   COBIT is a framework for IT governance and control.
   The AICPA's Trust Services framework is narrower in scope than COBIT, focusing only on those IT controls (security, confidentiality, privacy, processing integrity, and availability) that relate directly to systems reliability.

Reference

Romney, Marshall B, 2016 Accounting information system 13th and 14thed, New York: Pearson.

James A. Hall: Accounting Information Systems, 9thed, South-Western Cengage Learning

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CONTINUING AND DISTANCE EDUCATION PROGRAM

Name…….……..… Center……...……

ID No……..…… Term ……

Program…… Date …….

Assignment for Accounting Information Systems (AcFn 3181)

- This assignment is to be completed and send to the institute for evaluation. Its maximum load is **30%.**
- Do not try to complete the assignment until you have covered all the lessons and have reviewed the study guide and your self-test exercises.
- In addition to this, your tutor will clarify the assignment for you.
- After successfully completing this assignment, be certain that to write your **Name, ID No., Term and Center** on the cover page of your assignment and also your Name **and ID No.** on the other pages.

Multiple Choice

1. Which one of the following is odd?

   A) Service B) Marketing C) sales D) Purchasing E) C&D F) non

2. Documents that are sent to customers or suppliers and then sent back to the company in the course of a business transaction are known as

   A) Output documents.

   B) Turnaround documents

   C) Input documents.

   D) Transaction documents. E) All

3. The manager was working one weekend and needed to find some information about production requests for a certain customer. He was able to find the report on the company's network; this scenario indicates;

   A) Accessible B) Reliable C) Complete D) Timely E) A & D

4. A set of two or more interrelated components that interact to achieve a goal is:

   A) System B) An accounting information system c) Data d) Mandatory information

5. From the following information output, which one is provide specific piece of information by the request user?

A) Report B) Document C) Queries D) A&C E) All

6. A DFD created at the highest-level or summary view is referred to as a

   A) Process diagram. B) Overview diagram.

   C) Content diagram. D) Context diagram

7. A data flow diagram

   A) is a graphical description of the flow of documents and information between departments or areas of responsibility.

   B) is a graphical description of the relationship among the input, processing, and output in an information system.

C) is a graphical description of the source and destination of data that shows how data flow within an organization.

D) is a graphical description of the sequence of logical operations that a computer performs as it executes a program.

E) All

8. _____is the set of formal procedures by which data are collected, processed into information, and distributed to users?

A) Information technology B) information C) data D) System E) Information System

9. An information system used by 3F furniture maker took 48 hours to process an order received over the internet. After upgrading the system, processing time was reduced to sixty seconds. This is an example of

A) a competitive advantage.

B) a technological change.

C) an improved business processes.

D) growth

10. Helen Fume is a recruiter with The Ladders in Nome, Alaska. The Ladders success is largely attributable to its accounting information system. When a client is hired by an employer, Helen creates a record that identifies the employment relationship. Helen follows up on placements by surveying both employers and clients about the employment experience and then entering the results into the AIS. Clients are uniquely identified by social security number. In records that contain client survey data, the social security number is likely to be:

A. the primary key.

B. a foreign key.

C. combined with other data fields to form a primary key.

D. null.

11. Suppose a relational database contained two linked tables. Assuming the organization wants the database to be normalized, which of the following items represents a problem to normalization?

    A. The database contains only one primary key.

    B. The database contains two foreign keys

    C. The database contains two primary keys.

    D. The database contains only one foreign key.

12. Ato zegeye has been hired by Arba Minch textile factory as a staff accountant in the internal audit department. He has been asked to thoroughly document the existing accounting information system in preparation for making recommendations for improvements. He decides to begin by meeting with the information technology staff in order to develop an understanding of the computer operation used by the system. The documentation tool that he should employ for this purpose is a?

    A) Data flow diagram. B) Document flowchart.

    C) System flowchart. D) Program flowchart

13. The Director of Information Technology for the city of Tampa, Florida formed a company to sell computer supplies and software. All purchases made on behalf of the City were made from her company. She was later charged with fraud for overcharging the City, but was not convicted by a jury. The control issue in this case arose because the Director had both _____ and _____ duties.

    A) custody; authorization C) recording; authorization

    B) custody; recording D) management; custody

14. Personnel policies such as background checks, mandatory vacations, and rotation of duties tend to deter

A) unintentional errors.
B) employee fraud or embezzlement.
C) fraud by outsiders.
D) disgruntled employees

15. Why did COSO develop the Enterprise Risk Management framework?

A) to improve the audit process
B) to improve the risk management process
C) to improve the financial reporting process
D) to improve the manufacturing process

True or false

Write true if the statement is correct and false if the statement is incorrect and justify why it is false

1. An understanding of documentation tools like document flow diagram and system charts is required only for auditors to understand the client's system of internal controls before conducting an audit.
2. Including for data flows into or out of data stores, data elements should be given unique and descriptive names representing what is known about them in data flow diagrams.
3. Documentation is not that important in the system development life cycle model chosen or devised for any application, but is usually done in parallel with the development process.
4. Conceptual design translates the broad, user-oriented requirements of the system analysis into detailed specifications that are used to code and test the computer programs.
5. The combination of the database; Database management system; and the application programs that access the database through the Database management system is referred to as the Database administration.

6. A key component of a Database management system is the data storage, which contains information about the structure of the database; there is a corresponding record in the data dictionary describing it.
7. Data modeling is the process of defining a database so that it faithfully represents all aspects of the organization, including its transactions with the external environment and occurs during both the implementation and evaluation stages.
8. The sales employee evaluates the circumstances of the sales return of goods and makes a judgment to grant (or disapprove) credit on the credit memo.
9. Internal control is the process implemented and limited to the board of directors and management to provide reasonable assurance that control objectives like safeguarding assets are met.
10. Operational audit reviews the control of an AIS to assess compliance with internal control policies and procedures and the effectiveness of safeguarding assets.

Essay and drawing diagram

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

3. An audit trail enables a person to trace a source document to its ultimate effect on the financial statements or work back from financial statement amounts to source documents. Describe in detail the audit trail for the following:

    a. Purchases of inventory

    b. Sales of inventory

    c. Employee payroll

4. Describe the differences between general and specific authorization.
5. Prepare flowcharting segments for each of the following operations:
   a) processing transactions stored on magnetic tape to update a master file stored on magnetic tape
   b) processing transactions stored on magnetic tape to update a database stored on a magnetic disk
   c) converting source documents to magnetic tape using a computer-based optical character reader (OCR)
   d) processing OCR documents online to update a database on magnetic disk
   e) reading data from a magnetic disk into the computer to be printed on a report
   f) using a computer or terminal to key data from source documents to a file stored on a magnetic disk
   g) manually sorting and filing invoices numerically
6. Sue's Gallery sells original paintings by local artists. All sales occur in the store. Sometimes customers purchase more than one painting. Individual customers must pay for purchases in full at the time of sale. Corporate customers, such as hotels, however, may pay in installments if they purchase more than 10 paintings. Although Sue's Gallery has several bank accounts, all sales monies are deposited intact into the main checking account.

   Required: Draw a REA diagram for the gallery's revenue cycle. Be sure to include cardinalities.