DCAM-05

Vardhaman Mahaveer Open University, Kota

Accounting Information System

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Vardhaman Mahaveer Open University, Kota

Accounting Information System

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Editing and Course Writing

Editor
Dr. M.L Gupta
Sr. Lecturer, ABST
Govt. J.D.B. Girls College, Kota

Writers

1. **Dr. Anju Gupta**
   HOD, Business Administration,
   SS Jain Subodh College, Jaipur
2. **Dr. Priyanka Bhatt**
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   Udipur
8. **Dr. R.K. Jain**
   Assistant Professor of Management
   Vardhaman Mahaveer Open University, Kota

Academic and Administrative Management

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Vice-Chancellor
Vardhaman Mahaveer Open University,
Kota

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Director (Academic)
Vardhaman Mahaveer Open University,
Kota

Mr. Yogendra Goyal
Incharge
Material Production and
Distribution Departmant

Course Material Production

Mr. Yogendra Goyal
Assistant Production Officer,
Vardhaman Mahaveer Open University,
Kota

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INTRODUCTION

In the era of Information Teachnology Computers in commercial application has brought about revolutionary change by the accounting information system in business organisations.

In accounting a lot of monotonus work, which is required to be done mannually for example, making journal, ledger, writing day book, preparing vouchers etc. All the activities are performed by the computer.

This book has been written to cover the course prescribed for the paper accounting information systems for course code CCA-04.

In this book first ten chapters provides the knowledge of accounting and information technology, Designing, Double Entry System, Transactions flow Components, Transactions Processing Cycles, Coding System for Transactions Processing, Productions and Finance Cycles, Introductions to Data Base Management, Application of DOS and Windows and System Development. Last six chapters ample light on the Electroni spread sheet and Data Bases, Important features of MS-Excel, Graphics in Excel, Working with MS-Access credit data base and its manupulation in accounts and MS-Access create data base in marketing, Finance and personal areas.

The subject matter has been designed in such a manner that will effectively communicate the desired study material in a lucid and simple language.

Unit-1

Accounting Information System

Outline of the Unit:

1.0 Objectives

1.1 Introduction

1.2 Evolution

- 1.2.1 Ancient Accounting
- 1.2.2 Middle Ages Accounting
- 1.2.3 Accounting during Industrial Revolution
- 1.2.4 Accounting and Information Age
- 1.2.5 AIS as Major Component of Management Information System (MIS)

1.3 Meaning of Accounting Information System (AIS)

- 1.3.1 System
- 1.3.2 Information
- 1.3.3 Information System
- 1.3.4 Accounting Information System

1.4 Information and Decision Making

- 1.4.1 Financial and Non-Financial Information
- 1.4.2 Qualities of Information
- 1.4.3 Value of Information for Decision Making

1.5 Users of AIS

- 1.5.1 Internal users
- 1.5.2 External users

1.6 Purpose of Accounting Information and AIS

1.7 Enterprise Resource Planning (ERP) System

1.8 Role of Accountants in AIS

- 1.8.1 Accountant as Designer
- 1.8.2 Accountant as User
- 1.8.3 Accountant as an Auditor

1.9 Components of AIS

- 1.9.1 General Ledger System Component
- 1.9.2 Objectives of the General Ledger System
- 1.9.3 Application Controls Pertaining To the General Ledger Processing and Output
- 1.9.4 System Flowchart Showing Period-End Preparation of Outputs Relating to the General Ledger

1.9.5 Management Reporting System Component
1.9.6 Transaction Processing System Component
1.10 Summary
1.11 KeyWords
1.12 Abbreviations Used
1.13 Hints/Key to Activities or SAQs
1.14 Questions for Practice
1.15 Reference/Suggested Books

1.0 Objectives

After studying this unit, you will be able to:

- Explain what an AIS is and how the system has been evolved.
- Identify the role of information in decision-making and various internal and external users of this information.
- Describe the role played by an accountant in AIS and how it has been changed in the era of information age.
- Discuss the purpose which accounting information and AIS fulfills.
- Identify various sub-systems of AIS and their respective areas.

1.1 Introduction

We begin this unit by explaining the evolution of AIS in its present form. The evolution part emphasizes on the basic accounting, role of information age in bringing the present form of AIS and lastly AIS has been explained as a part of MIS. The unit also explains the meaning of AIS by detail analysis of each part of the word AIS and how the whole thing is being integrated into one system i.e. accounting information system. Then we describe how accounting information is used in the process of decision making and various courses of action and result. The section continues with detail of various persons interested in this accounting information mainly classified into internal users and external users. The role of accounting information and AIS has also been explained.

Explaining AIS is incomplete without talking about enterprise resource planning (ERP) which facilitates company-wide integrated information system, covering all functional areas including AIS. We conclude by describing the various sub-systems of accounting information system. This unit also examines the objectives, features and control issues involved in general ledger system. Finally the management reporting system is examined. The management reporting system is distinguishable from the financial reporting system in one key respect: financial reporting is mandatory while management reporting is discretionary. Organization management implements MRS applications at their discretion, based on internal user needs.

1.2 Evolution

As the lifeblood of any competitive business, accounting information is a critical resource for all enterprises. The concept of accounting information system (AIS) is quite well established and

numerous commercial packages have been developed. AIS has evolved from the general ledge machine to the setting which may be multi-media or distributed. Now-a-days an increasing number of accounting software packages are available for different kinds of computers. Some accounting software packages offer sophisticated features, such as multi-companies and multi-currencies, to meet the requirement of different organizations.

The double entry book keeping concept was introduced by Luca Pacioli five hundred years ago, accountants have used the framework of double-entry book keeping as the basic tool for gathering and aggregating accounting data. In order to verify the correctness of data entries, a trail balance is needed before an income statement and balance sheet can be produced. Some rules are also introduced to help identify data entry mistakes if a trial balance has problems. This procedure has been accepted as a traditionally necessary accounting practice.

Accounting has been called as the language of business. Accounting is the system which measures business activities. It processes activities in business into reports and communicates the results to top management. Let us now look through the advancement of accounting.

1.2.1 Ancient Accounting:

As early as 8500 B.C., accounting has already existed. Archaeologists have found clay tokens as old as 8500 B.C. found in Mesopotamia which were usually cones, disks, spheres and pellets. These tokens correspond to such commodities like sheep, clothing or bread. They were used in the Middle West in keeping records. After some time, the tokens were replaced by wet clay tablets. During such time, experts concluded this to be the starts of the art of writing. Examples of ancient civilizations keeping account records are China, Babylonia, Greece and Egypt. Like in Babylonia during 3600 B.C., payments of salaries were recorded in clay tablets. In addition, the rulers of these civilizations keep track of labor and material costs used in building structures using accounting. A good example is the case of the Egyptian pharaohs in building their magnificent pyramids.

1.2.2 Middle Ages Accounting:

During the thirteenth to the fifteenth centuries, trade flourished places such as Florence, Venice and Genoa, thus, there was advancement in account keeping methods, thanks to the merchants and the bankers of such time. During the 1211 A.D., one of the systems in accounting was kept by a Florentine banker. However, the system was primitive as the concept of equality for entries was absent. Double entry records first came out during 1340 A.D. in Genoa. In 1494, the first systematic record keeping was formulated by Fra Luca Pacioli, a Franciscan monk and one of the most celebrated mathematicians to this day. Pacioli is considered as the father of accounting.

1.2.3 Accounting during Industrial Revolution:

The industrial revolution which was characterized by great changes in working and business transactions paved way to the specialized field of accounting called cost accounting in order to meet the need for the analysis of various costs. In addition, since there was a development of the corporate form of organization, there was a need for a separate and independent report to assure the management's financial representations are reliable.

1.2.4 Accounting and Information Age:

At present, there have been tremendous advancements in accounting to meet the needs brought about by information technology (IT). Those duties that required manual, tedious and time -consuming methods can now be done using the computers which make work faster, more reliable, accurate and

precise. True enough, business transactions have changed and evolved. Businesses can now be transacted virtually making it faster and hassle free. Businessmen transact their businesses without even facing one another has become possible all because of information technology. With the advancement of businesses, accounting has also advanced to meet the needs of businesses at this day. There has been a great quantity of applications and elements of accounting that meet up the various needs of businesses. As they often point out, as a smart businessman, one must breathe in information technology to keep up with the trend and stay competitive.

Accounting information system covers all business functions from backbone accounting transaction processing systems to sophisticated financial management planning and processing systems. Financial reporting starts at the operational levels of the organization, where the transaction processing systems captures the important business events such as normal production, purchasing and selling activities. These events and transactions are classified and summarized for internal decision making and for external financial reporting. Cost accounting systems are used in manufacturing and service environments. These allow organizations to track the cost associated with production of goods and services.

In addition, the accounting information system can provide advanced analysis for improved resource allocation and performance tracking. Management accounting systems are used to allow organizational planning, monitoring and control for a variety of activities. This allows managerial level employees to have access to advanced reporting and analysis. The systems can be used to gather information, to develop various scenarios, and to choose an optimal answer among alternate scenarios. The management accountants within AIS were viewed as involving the design and operation of financial advisory and information systems in organizational settings. Three factors influence quality of management accounting:

- Compliance – it focuses on the design and operations of the systems concerned with technical compliance regarding external regulations and reporting requirements.
- Control – it is the systems to support resource management and control including standard costing and variance analysis, flexible budgeting, responsibility accounting and accounting performance measures.
- Competitive support – it is the provision of financial services to the management team in order to enhance the firm's competitiveness. The accounting function is seen as one of producing financial services, which add value and the management team is seen as a consumer of those services.

The importance of AIS to improve decision making has been well proved. Financial and production records have long been used as an instrument to measure and evaluate the success of business. However, when computer technology became more widely available in the late 1950s and early 1960s, there was an increased enthusiasm for information systems to enhance decision processes.

1.2.5 AIS as Major Component of MIS:

AIS is actually one major component of a management information system (MIS). Whereas AIS accumulates, classifies, processes, analyses and communicates relevant financial information, MIS performs these functions for all types of information affecting a company's operations, such as marketing subsystem performing an analysis of customer product preferences, and production subsystem experimenting a new production method.

Accounting information system is considered as a sub system of MIS. To regard accounting

as an information system, perhaps is the latest definition of accounting. For the first time in 1966, the American Institute of Certified Public Accountants (AICPA) stated that:

"Accounting actually is information system and if we be more precise, accounting is the practice of general theories of information in the field of effective economic activities and consists of a major part of the information which is presented in the quantitative form".In the above definition, accounting is a part of general information system of an economic entity. Thus, accounting information system is system that operates functions of data gathering, processing, categorizing and reporting financial events with the aim of providing relevant information for the purpose of score keeping, attention directing and decision-making. Accounting information system is considered as important organizational mechanism that is critical for effectiveness of decision management and control in organizations. Successful implementation of accounting systems requires a fit between three factors:

- A fit must be achieved with dominant view in the organization or perception of the situation.
- The accounting system must fit when problems are normally solved, i.e. the technology of the organization.
- The accounting system must fit with the culture, i.e. the norms and the value system that characterize the organization.

Today's products cost is mainly made up of R & D, intellectual assets and services. Paciolis accounting system has not changed practically for the last 500 years, and as long as our wealth was physical and our costs included mostly material and labour, this system was adequate. The double-entry accounting system relied on historical information and has traditionally provided financial reports and statements two weeks after month-end but now-a-days because of accounting information system, activities and indices of performance are available at the push of a button or a key. The trends in information age are to conceptualize and implement accounting as a data base information system gathering all quantitative and qualitative events of all the areas of the company. Oracle, PeopleSoft and SAP are world player in this reconceptualization of accounting as a data base information system. There are many excellent accounting software packages available for the companies such as Pacioli 2000 for Windows, Peachtree Complete Accounting and Quick books Pro.

To briefly summarize the historical developments, there have been significant efforts devoted to improving the accounting information system from the early computerized activities forty years earlier. The decision aids available have grown in number and they are more sophisticated. There has been some movement toward integration of the data oriented systems and the model oriented systems.

Activity 1.1

1. Approach a nearest company in your town and Conduct a research on the expansion of the role of accountant into areas such as non-financial information; assurance s ervices etc. also discuss positive and negative effects of this expansion.

1.3 Meaning of AIS

Effective AIS is essential to any organization's long-run success. To better understand the term 'Accounting Information System', the three words constituting AIS needs to be elaborated separately as follows:

1.3.1 System:

A system is basically a set of interdependent elements that together accomplish specific objectives. Thus, a system may be defined literally as "a complex or organized whole, an assemblage or combination of things or parts forming a complex or unitary whole."

1.3.2 Information:

By information, we mean the data presented in a form that is useful in a decision making activity. Data are facts or figures in a raw form. Activities mainly involve three types of data, i.e.

- Facts about the event itself,
- Resources affected by that event,
- The agents who participated in that event.

For example consider the selling activity. Data is collected regarding date of sale, amount (facts about the event), identifying goods or services, the quantity sold, unit price (data regarding resources) and data regarding customers and sales persons (data regarding agents).

To become useful to a decision maker, data must be transformed into information. The information has value to the decision maker because it reduces uncertainty and increase knowledge about a particular area of concern.

1.3.3 Information System:

Information system (IS) is a man-made system that generally consist of an integrated set of computer based components and manual components established to collect, store and manage data and to provide output information to users. The Information System facilitates various operational functions and supports management decision making by providing information that managers can use to plan and control the activities of the firm. The Information System may have advanced elements such as a database for storage and can use decision models to present output information for decision making. The goal of an information system is to support:

- The stewardship function of management
- Management decision making
- The firm's day-to-day operations

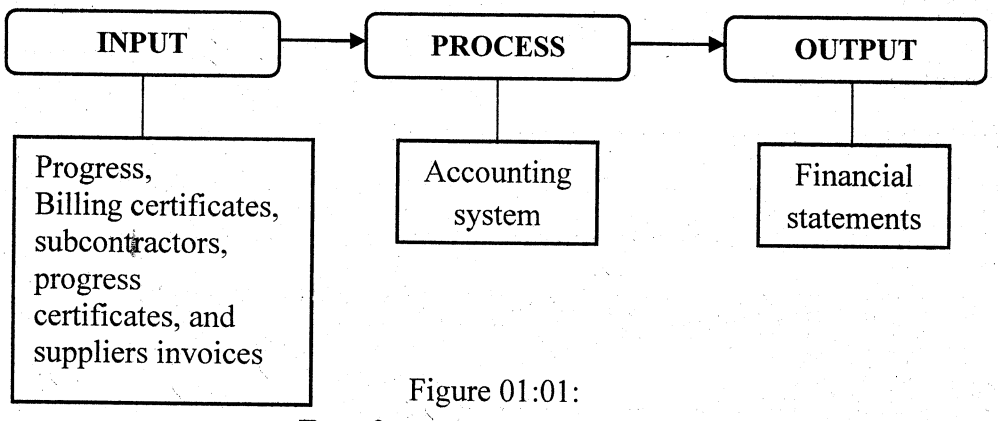


Figure 01:01:
Transformation Process of AIS
Source: Compiled from www.articlesnatch.com

1.3.4 Accounting Information System:

AIS is a specialized sub-system of Information System. The purpose of this separate AIS is to collect, process and report information related to mainly financial aspects of business events.

AIS is the system of records a business keeps maintaining its accounting system. This includes the purchase, sales and other financial processes of the business. The purpose of AIS is to accumulate data and provide decision makers with information. While this was previously a paper based process, most business now uses accounting software. In an electronic financial accounting system, the steps in the accounting cycle are dependent upon the system itself. For example, some systems allow direct journal posting to the various ledgers and others do not. Not all AIS's are computerized.

AIS combines the study and practice of accounting with the design, implementation and monitoring of information system. Such system use modern information technology resources together with traditional accounting controls and methods to provide users the financial information necessary to manage their organization.

To be more precise, AIS can be regarded as an integration of resources, techniques and practices which are used for accounting functions. Thus, AIS consists of business operations which generate raw data, management which provides knowledge and requirements for transforming the data into meaningful information and utilizing it for other business functions, and information system which include software and hardware and development people.

1.4 Information And Decision Making

Generally, accounting information system provides financial reports on a daily and weekly basis and also provides useful information for monitoring decision-making process and performance of the organization. Accounting information system provides primary data for decision making. Information technology has caused many changes in reporting information. Thus, the characteristics of information currently prepared can help decision-makers seeks more alternatives to the solution of the problem in hand. Accessibility to information related to the main transaction of an organization leads to a categorized detailed information which facilitates decision making in any difficult situation. Accounting based system is computer based system that increases the control and enhances the cooperation inside the organization. Management is engaged with different types of activities which require good quality and reliable information. They also need non-financial information such as production statistics, quality of production and so on. However, quality of information generated from AIS is very important for management. Effectiveness of AIS can be analyzes on three bases:

- information scope
- timeliness
- aggregation

Information scope is considered as financial and non-financial information, internal and external information that is useful in prediction of future events. Timeliness is related to the ability of accounting information system to satisfy information needs by providing systematic reports to the user. Aggregation of information is considered as means of collecting and summarizing information within a given time period.

1.4.1 Financial and Non-Financial Information:

AIS sub-system process financial and non-financial transactions that directly affect the processing of financial transactions. For example, changes to customers name and addresses are

processed by the AIS to keep the customers file current. Although not technically financially transactions, these changes provide vital information for processing future sales to the customer.

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

Non-financial transactions are those events which are not financial in character like adding a new supplier of raw material to the list of valid suppliers is an event that may be processed by the enterprises information system as a transaction.

Financial transactions and non-financial transactions are closely related and are often processed by the same physical system. For example in a financial portfolio management system which collects and tracks stock prices (non-financial transaction), when stock reaches a threshold price, the system places an automatic buy and sell order (financial transaction). Once the buy or sell order is placed, however the processing of this financial transaction must comply with legal and professional guidelines.

1.4.2 Qualities of Information:

Regardless of physical form or technology, useful information has the following characteristics:

- Understandability
- Timeliness (no older than the time period of the action it supports)
- Predictive value and feedback
- Neutrality (freedom from bias)
- Comparability
- Relevance (serves a purpose)
- Reliability (Information reliability requires accounting independence)
- Accessibility
- Accuracy (free from material errors)
- Completeness (all information essential to a decision or task is present)
- Consistent
- Summarization (aggregated in accordance with the user's needs)

1.4.3 Value of Information for Decision Making:

AIS can improve decision-making by providing accurate and timely information. The importance of information for decision-making can be gauged from following points:

- Reduction in uncertainty – decisions are required where there are uncertainties. Thus, information provides a basis for choosing among alternate actions. For example, accounting information helps in setting prices and determining credit policies.
- Need for management action – information helps in identification of situations which requires management action. For example, large deviations of actual cost from set standards in cost management require management to investigate and take corrective action, if required.
- Improvement in future decisions – information about the results of previous decisions provides valuable feedback that can be used to improve future decisions.

Although, information is required for decision making, but it is important to recognize that there are cost associated with producing these information. Time and resources are the main cost involved. Time and resources are spend in collecting, processing, storing the data and in distributing the resulting information to decision makers. It is not possible for every organization to spend unlimited resources in improving the information systems. Therefore, another important decision involves identifying which potential AIS improvements are likely to yield the greatest result. Making this decision wisely requires proper understanding between accountants and information system professionals.

Self Assessment Questions 1.1

1. Distinguish between financial and non-financial transactions. Give three examples of each.
2. What do you mean by information system?
3. How valuable is the information for the purpose of decision-making.

1.5 Users of Ais

Systems will be useful when information provided by them is used effectively in decision-making process by users. Therefore, the effectiveness of accounting information system not only depends on the purpose of such systems but also depends on contingency factors of each organization. Accounting information system are said to be effective when the information provided by them serves widely the requirements of the system users. Effective systems should systematically provide information which has potential effects on decision making process. Accounting information usually is categorized under two groups;

- Information that influences decision-making and mainly used for the purpose controlling the organization.
- Information that facilitates decision-making process and mostly used for coordination within an organization which in turn increases the quality of decisions.

1.5.1 Internal Users:

Internal information is mostly discretionary information and such information should have positive value. The internal users have unlimited and direct access to information in the organization. Information is available to management on demand to support strategic, tactical and operational decisions.

- **Management** - decisions concerning the running of the business and strategic planning for the future. The management of an enterprise has the primary responsibility for the preparation and presentation of the financial statements of the enterprise. Management is also interested in the information contained in the financial statements even though it has access to additional management and financial information that helps it carry out its planning, decision-making and control responsibilities. Management has the ability to determine the form and content of such additional information in order to meet its own needs.
- **Employees** - Employees and their representative groups are interested in information about the stability and profitability of their employers. They are also interested in information which enables them to assess the ability of the enterprise to provide remuneration, retirement benefits and employment opportunities.

1.5.2 External Users: External users primarily use information that is either mandatory or essential. Focus of such information is mainly on minimizing costs, meeting regulatory requirements, meeting minimum standards of reliability and usefulness. The external users of financial information have limited and indirect access to information and is usually reliant on the information contained in the financial reports and reported in the press. Following are common users categorized as external to the organization:

- **Investors** - The providers of risk capital and their advisers are concerned with the risk inherent in, and return provided by, their investments. They need information to help them determine whether they should buy, hold or sell. Shareholders are also interested in information which enables them to assess the ability of the enterprise to pay dividends.
- **Lenders** - Lenders are interested in information that enables them to determine whether their loans, and the interest attaching to them, will be paid when due.
- **Suppliers and other trade creditors** - Suppliers and other creditors are interested in information that enables them to determine whether amounts owing to them will be paid when due. Trade creditors are likely to be interested in an enterprise over a shorter period than lenders unless they are dependent upon the continuation of the enterprise as a major customer.
- **Customers** - customers have an interest in information about the continuance of an enterprise, especially when they have a long-term involvement with or are dependent on the enterprise.
- **Governments and their agencies** - Governments and their agencies are interested in the allocation of resources and, therefore, the activities of enterprises. They also require information in order to regulate the activities of enterprise determine taxation policies and as the basis for national income and similar statistics.
- **Public** - Enterprises affect members of the public in a variety of ways. For example, enterprises may make a substantial contribution to the local economy in many ways including the number of people they employ and their patronage of local suppliers.

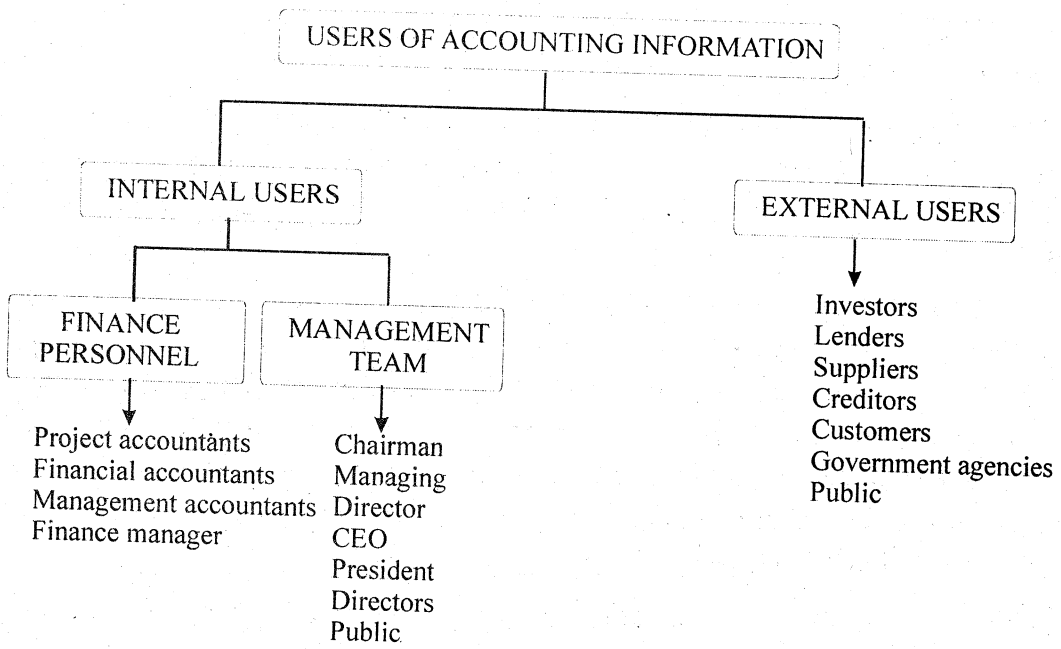


Figure 1.2
Users of Accounting Information
Source : Compiled from the website www.ehow.com

1.6 Purpose of Accounting Information And AIS

The product of accounting is accounting information. Accounting information is used in the process of decision making and various courses of action and result. Decisions are made for the future and present where there is great uncertainties involved. This uncertainty is reduced with the help of information. This implies that the greater the uncertainty, the more accounting information is required. Events and transactions are to be recognized, measured, processed and are to be compiled in the form of corporate reports which forms the part of accounting information that are communicated to users.

These are then interpreted, decoded and used by management and other user groups. Thus, providing information useful in the decision making process is the main purpose of accounting information. Decision usefulness as the main objective of accounting information cannot remain static, however, but will evolve and change over time. It will be influenced by political, social, economic and technological changes in the environment. Changes in the environment may influence not only the nature and objectives of accounting information but also the needs of its users. This calls for accounting information system, to be flexible enough to adapt the changing demand of its users. The following uses of AIS can be listed out:

- Producing external reports
- Supporting routine activities
- Decision support
- Planning and control
- Implementing internal control

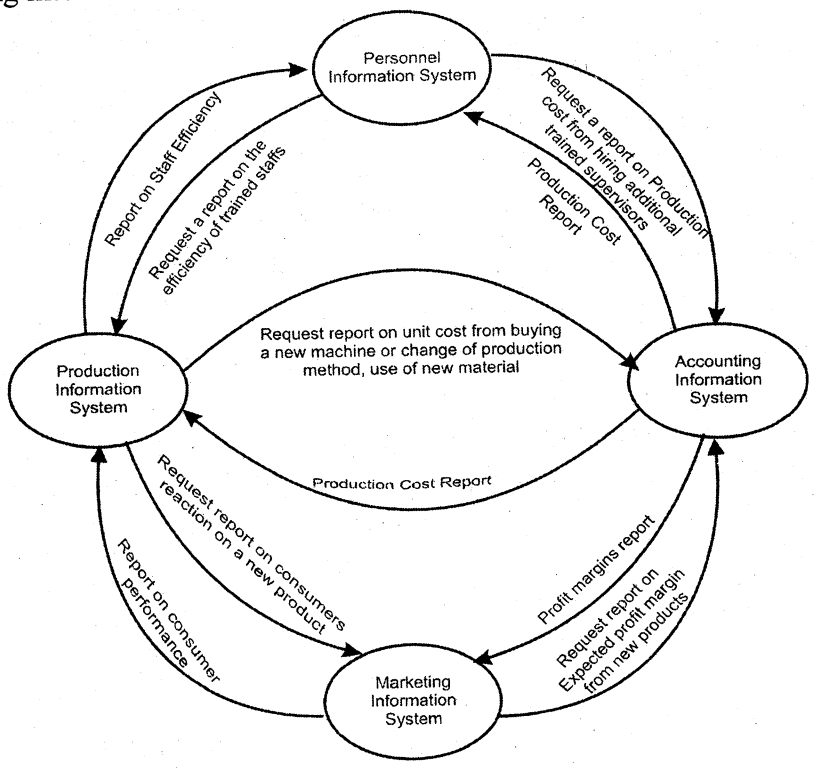


Figure 01:03: Role of AIS

Source: Compiled from article on "Issues in AIS for the Year 2000" by Chuk Yau and Pak K. Auyeung, Griffith University.

Thus, a generally accepted purpose of AIS within an organization is to perform the service function of transforming quantifiable financial data into useful information that efficiently and effectively aids management and outside users in making decisions about the allocation of scarce economic resources. The Figure below depicts the role of AIS within an organization.

Traditionally, the AIS have been referred to as a transaction processing system as it was concerned only with financial and accounting transactions. Non-financial transactions or information was generally collected and processed outside the AIS. Thus, these non-financial information were not the part of AIS and consequently, many organizations developed additional information system to collect, process, store and report information not contained in the AIS. But the very existence of multiple systems created numerous problems and inefficiencies. Often the same data was captured and stored by more than one system, which not only resulted in redundancy across systems, but also lead to discrepancies if data was changed in one system. In addition, it was also difficult to efficiently integrate data from various systems.

Activity 1.2

1. Using internet resources, locate opening for at least three jobs, other than traditional public accounting positions, which requires strong accounting and technology skills. Select one of these jobs and develop a plan to get you from your current level of knowledge to a point where you will qualify for the job.

1.7 Enterprise Resource Planning (ERP) System

ERP are designed to overcome the problems which are discussed in the last part of "purpose of accounting information and AIS" as they integrate all aspects of company's operations with its traditional AIS. A key feature of ERP systems is the integration of financial with other non-financial operating data.Traditional AISs recorded financial information and produced financial statements on a periodic basis according to Generally Accepted Accounting Principles (GAAP) pronouncements. Modern ERP systems provide a broader view of organization information, enabling the use of advanced accounting techniques and improved managerial reporting using a variety of analytical techniques.

ERP is a solution which facilitates company-wide integrated information system, covering all functional areas and performs core corporate activities and increases customer services. ERP systems permit an integration of data and applications. Both financial and non-financial data can be integrated. ERP systems also facilitate access to data that are within the firm but outside the ERP system. Standardization of worldwide systems, consistent and accessible data, and on-line processing of data result in firm-wide data availability. It is a system which integrates information and business processes to enable information entered once to be shared throughout the organization.

1.8 Role of Accountants In Ais:

Technology is rapidly changing the nature of the work of most accountants and auditors with the aid of special software packages, accountants summarize transactions in standard formats of financial records and organize data in special formats employed in financial analysis. There accounting packages greatly reduce the tedious work associated with data management and record keeping. Computers enable accountants to be more mobile and to use their client's computer system to extract information from databases and the internet. Thus, technology is making information available to improve decision for all decision makers.

Historically, the accountant has performed functions which determined the reliability of financial information. This role is expanding to induce the following:

- Non-financial information (example – accountants might help determine occupancy rates for hotels or apartment complexes).
- Use of IT to create or summarize information from databases.
- Information interpretation to determine the quality and relevance of information to be used for decision making (e.g. evaluating information for the assessment of risk).

Thus, today's accountants act as an information management and business measurement specialist. Regarding the AIS, the accountant can assume three roles which are as follows:

1.8.1 Accountant as Designer:

As a designer, the accountant brings knowledge of accounting principles, auditing principles, information, and system technique and system development methods. In an organization accountant act as controller, treasurer, tax specialist, financial analyst, cost accountant, general accounting and budgeting specialist. In all cases, accountant use the AIS to perform their functions. Example – while performing the function of financial analyst, to analyze financial information, he must know what data are stored in AIS, how to access them, what analysis tools exist, how to use them and present the information using available report writing facilities. Thus as a system designer:

- Accountants must be able to clearly convey their needs to the systems professionals who design the system.
- The accountant should actively participate in systems development projects to ensure appropriate systems design.
- The accounting function is responsible for the conceptual system, while the computer function is responsible for the physical system.
- The conceptual system determines the nature of the information required, its sources, its destination, and the accounting rules that must be applied.

1.8.2 Accountant as User:

As a user, accountant participates in the AIS design process to make sure that the system contains required features. To be effective in the design process, the user must know how systems are developed and the techniques used in the same.

1.8.3 Accountant as an Auditor:

As an auditor, accountants are concerned regarding the reliability of the accounting data and of the reports produced by the system. They may test the system controls, access the systems efficiency and effectiveness. As an auditor, accountant can be:

- External Auditors

  Attest to fairness of financial statements

  Assurance service: broader in scope than traditional attestation audit
- IT Auditors

  Evaluate IT, often as part of external audit
- Internal Auditors

  In-house IS and IT appraisal services

1.9 Components of AIS

The AIS is composed of three major sub-systems:

- Transaction processing system (TPS) – which supports daily business operations with numerous reports, documents and message for users throughout the organization.
- Financial Reporting System (FRS) – which produces the traditional financial statements such as the balance sheet, income statement, cash flows, tax returns and other reports required by law.
- 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.

Together there sub-systems enable an AIS to fulfill three important financial in any organization.

- Collecting and storing data about the activities performed by the organization, the resources affected by those events and the agent who participate in the various activities so that management, employees and interested outsides can review what has happened.
- Facilitate decision making by transforming data into useful information to enable decision makers to plan, executive and control activities.
- Facilitate data availability with accuracy and reliability by providing adequate controls to safeguard the organization assets.

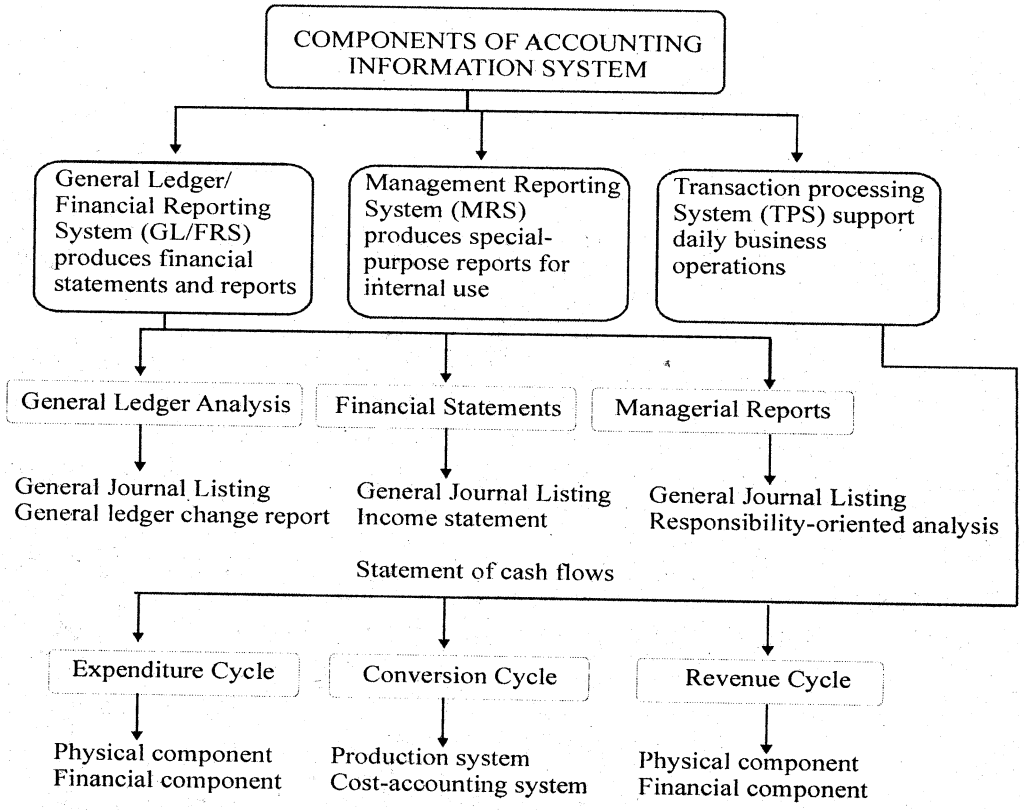


Figure 1.4
Sub-Systems of AIS
Source: Compiled from various sources

1.9.1 General Ledger System Component:

The main inputs to the general ledger and financial reporting cycle are the outputs of all the

other cycles. The general ledger provides the chart of accounts structure, which combines the financial and managerial sides of accounting. The general ledger system and the financial reporting are two closely related subsystems. However because of their operational inter dependency; they are generally viewed as a single integrated system. The bulk of the input to the general ledger portion of the system comes from the transaction cycles. Summaries of transaction cycle activity are processed by the general ledger system to update the general ledger control accounts. Other less frequent events such as stock transactions, mergers and lawsuits settlements for which there may be no formal processing cycle in place also enters the general ledger system through alternate sources. The financial reporting systems measures and reports the status of financial resources and the changes in those resources. The financial reporting system communicates this information primarily to external users. This type of reporting is called nondiscretionary because the organization has few or no choices in the information it provides. Much of this information consists of traditional financial statements, tax returns and other legal documents.

General ledger is an interacting structure of people, equipment, activities and controls that is designed to accomplish both operations and information systems functions. The general ledger system mainly focuses on information functions. Thus, the general ledger system comprises the following:

- Accumulating data, classifying data by general ledger accounts and recording data in those accounts.
- Fueling the financial reporting, business reporting and other reporting subsystems by providing the information needed to prepare external and internal reports. In servicing the information needs of managerial reporting, the general ledger interacts with the budgeting modules.

Objectives of the General Ledger System:

- To record all accounting transactions promptly and accurately.
- To post these transactions to the proper accounts.
- To maintain an equality of debit and credit balances among the accounts.
- To accommodate needed adjusting journal entries.
- To generate reliable and timely financial reports pertaining to each accounting period.

Application Controls Pertaining To the General Ledger Processing and Output:

- Posting journal entries to the general ledger accounts with a variety of program checks performed before and after posting.
- Summing the amounts posted to the general ledger accounts and then comparing the posted totals to the pre-computed batch control totals.
- Establishing and maintaining an adequate audit trail.
- Preparing frequent trial balances, with any differences between total debits and credits being investigated.
- Maintaining a log or file of journal vouchers by number and periodically checking to make certain that the sequence of numbers is complete.
- Printing period-end listings and change reports for review by accountants before the financial statements are prepared.
- Reviewing financial reports and other outputs for correctness and reasonableness.

- Auditing general ledger procedures.

System Flowchart Showing Period-End Preparation of Outputs Relating to the General Ledger:

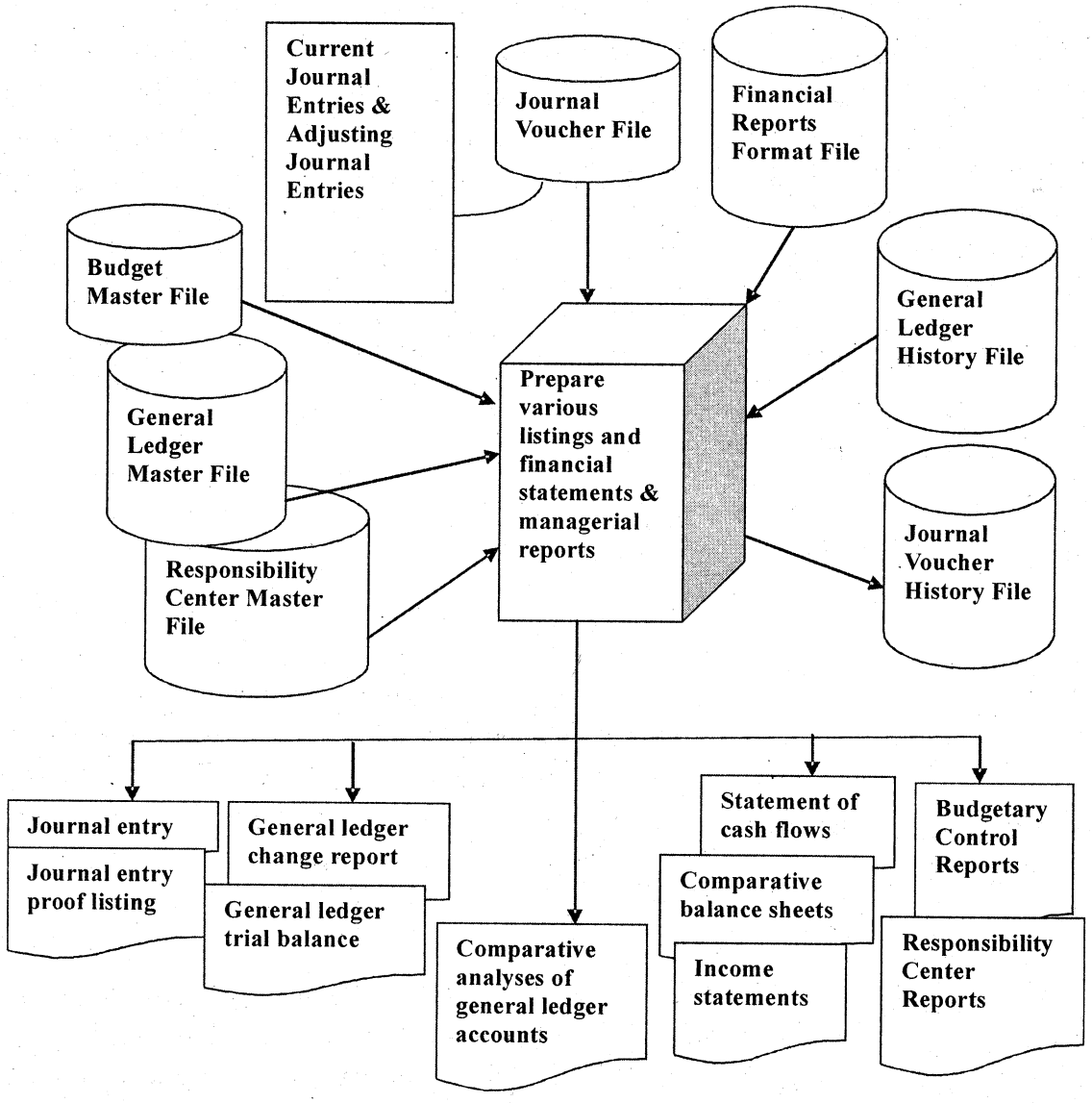


Figure-1.5

Source: Compiled from www.articlesnatch.com

Activity - 1.3

1. Contact a chartered accountant (CA) firm to find out about their current expectations regarding your technical knowledge as an entry-level accountant and draft a report for the same.

1.9.2 Management Reporting System Component:

Management reporting system provides the internal financial information needed to manage a business. Managers must deal immediately with day-to-day business problems as well as plan and control their operations. Managers require different information for the various kinds of decisions they must make. Typical reports produced by the management information system include budgets,

variance reports, cost volume-profit analysis and reports using current cost data. This type of reporting is called discretionary reporting because the organization can choose what information to report and how to present it.

1.9.3 Transaction Processing System Component:

The transaction processing system is central to the overall functions of the information system by converting economic events into financial transactions, recording financial transactions in the accounting records (journal and ledger) and distributing essential financial information to operations personnel to support their daily operations.

The transaction processing system deals with business events that occur frequently. In a given day, a firm may conversion cycle process thousands of transactions. To deal efficiently with such volume, similar types of transactions are grouped together into transaction cycles. The transaction cycle consists of three cycles: Revenue cycle, Expenditure cycle and Conversion cycle.

Each cycle captures and processes different types of information transactions. These three cycles has been explained in detail in unit II.

1.10 Summary

AIS has evolved from the general ledge machine to the setting which may be multi-media or distributed. Now-a-days an increasing number of accounting software packages are available for different kinds of computers. Accounting is mainly based on double entry book keeping. Traditional accounting included balancing of trail balance and preparation of final accounts which took many days of accounts personnel. So, the need was felt to do accounting through push of key, which can save time and reduce the tedious work of accountants, thus the concept of AIS emerged. At present, there have been tremendous advancements in accounting to meet the needs brought about by information technology. Those duties that required manual, tedious and time -consuming methods can now be done using the computers which make work faster, more reliable, accurate and precise.

An accounting information system is a collection of resources designed to transform data into information. This information is communicated to a wide variety of decision makers which are mainly categorized into internal and external users. Internal users include: management and employees while external users include: investors, lenders, suppliers and other trade creditors, customers, governments and their agencies and public. AIS sub-system process both financial and non-financial transactions. 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. Non-financial transactions are those events which are not financial in character like adding a new supplier of raw material to the list of valid suppliers. Financial transactions and non-financial transactions are closely related and are often processed by the same physical system. The main aim of AIS is to provide information useful in the decision making process.

To solve the problem of existence of many systems like AIS, the concept of ERP system developed which facilitates company-wide integrated information system, covering all functional areas and performs core corporate activities and increases customer services. The AIS is composed of three major sub-systems: Transaction processing system (TPS), Financial Reporting System (FRS) and Management Reporting System (MRS).TPS supports daily business operations with numerous reports, documents and message for users throughout the organization. FRS produces the traditional financial statements such as the balance sheet, income statement, cash flows, tax returns and other

reports required by law. While MRS provides internal management with special purpose financial reports and information needed for decision making such as budgets, variance reports and responsibility reports.

1.11 Key Words

- Information Age - The Information Age, also known as the Computer Age, is an idea that the current age will be characterized by the ability of individuals to transfer information freely, and to have instant access to knowledge that would have been difficult or impossible to find previously.
- Accounting Software Packages - Accounting software is application software that records and processes accounting transactions within functional modules such as accounts payable, accounts receivable, payroll, and trial balance.
- Double Entry Book Keeping - An accounting technique which records each transaction as both a credit and a debit. Credit entries represent the sources of financing, and the debit entries represent the uses of that financing.
- Financial Reporting - is a formal record of the financial activities of a business, person, or other entity.
- Cost Accounting Systems - refers to the process of collecting and presenting information (costs as well as advantages) for each proposed alternative when a decision is necessary.
- Management Accounting - concerned with the provisions and use of accounting information to managers within organizations, to provide them with the basis to make informed business decisions that will allow them to be better equipped in their management and control functions.
- Database - A collection of information organized in such a way that a computer program can quickly select desired pieces of data.
- Decision Models - develop insight into the decision and determine a clear course of action.
- Software - is the collection of computer programs and related data that provide the instructions telling a computer what to do.
- Hardware - physical components of a computer system.
- Enterprise Resource Planning - a business management system that integrates all facets of the business, including planning, manufacturing, sales, and marketing.
- Technology - whatever can be said at any particular historical period, concerning the state of the art in the whole general field of practical know-how and tool use.
- Accounting Principles - standard framework of guidelines for financial accounting used in any given jurisdiction.
- Financial Analyst - *Financial analysts* help people decide how to invest their money. They work for banks, insurance companies, mutual funds, and securities firms.
- Budgets - A budget is a detailed plan of operations that is predetermined for a particular period. Budgets are quantitative or financial statements prepared for the purpose of attaining a particular objective.
- Cost Volume-Profit Analysis - Analysis that deals with how profits and costs change with a

change in volume. More specifically, it looks at the effects on profits of changes in such factors as variable costs, fixed costs, selling prices, volume, and mix of products sold.

1.12 Abbreviations Used

AICPA	:	American Institute of Certified Public Accountants
AIS	:	Accounting Information System
ERP	:	Enterprise Resource Planning
FRS	:	Financial Reporting System
GAAP	:	Generally Accepted Accounting Principles
IS	:	Information System
IT	:	Information Technology
MIS	:	Management Information System
MRS	:	Management Reporting System
R&D	:	Research and Development
SAQs	:	Self Assessment Questions
TPS	:	Transaction Processing System

1.13 Hints/Key To Activities Or Saqs

Hints to activity 1.1

Answer 1: Collect information regarding accounting skills needed especially in the area of information technology.

Hints to self assessment questions 1.2

Answer 1: There major difference is the measurement of event in financial terms.

Answer 2: It an integrated set of computer based components and manual components which collects, store and manage data.

Hints to activity 1.3

Answer 1: Search out on internet websites like www.timesjobs.com, www.naukri.com etc.

Hints to activity 1.4

Answer 1: Report should cover both the required knowledge of basic accounting and recent development in accounting.

1.14 Questions For Practice

1. Which of the following is not a financial transaction?
   a) Purchase of products
   b) Cash receipts
   c) Update valid vendor file
   d) Sale of inventory.

2. Which is not an accountant's primary role in information system?
   a) System user b) System auditor
   c) System designer d) System programmer
3. Classify the following users of information as either internal users or external users:
   a) Internal revenue service
   b) Inventory control manager
   c) Board of directors
   d) Lending institutes
   e) Securities and Exchange Commission
4. Classify the following items as TPS, FRS or MRS.
   a) Variance reports
   b) Sales order capture
   c) Balance sheet
   d) Tax returns
   e) Cost-volume-profit analysis.
5. "To be a good accountant in today's world, one needs to have knowledge of technology also". Comment.
6. If accountants are viewed as providers of information, then why are they consulted as system users in the systems development process?
7. Distinguish between AIS and MIS.
8. What is discretionary reporting? Give examples
9. What are the qualities of information? Explain them in your own words with examples.
10. State the basic difference between data and information.
11. Why is the information system important to the organization?
12. What three roles can an accountant fill in relation to the AIS? Describe them.
13. Do you think your accounting education is preparing you efficiently to practice accounting? Why or why not? Discuss from both a short term (i.e., immediately upon graduation) and a long-term (i.e., 5 to 10 years after beginning your career) standpoint.
14. Discuss the differences between internal and external users of information and their information needs.

Key to questions:

Answer 1: (c)

Answer 2: (d)

Answer 3: internal users (a, b, c) and external users (d, e)

Answer 4: TPS (b), FRS (c), MRS (a, d, e)

1.15 Reference/Suggested Books

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Unit - 2

Transaction Processing System

Outline of the unit:

2.0 Objectives

2.1 Introduction

2.2 Transaction Processing System (TPS)

2.3 Characteristics of TPC

2.4 Revenue Cycle

- 2.4.1 Sales order entry
- 2.4.2 Shipping
- 2.4.3 Billing and accounts receivable
- 2.4.4 Cash collections

2.5 Expenditure Cycle

- 2.5.1 Order Goods
- 2.5.2 Receiving the Goods
- 2.5.3 Paying for the Goods

2.6 Production Cycle

- 2.6.1 Product Design
- 2.6.2 Planning and Scheduling
- 2.6.3 Production Operations
- 2.6.4 Cost Accounting

2.7 REA (Resource-Entity-Agent) Data Models for Various Cycles

- 2.7.1 Identify Economic Exchange Events:
- 2.7.2 Identify Resources and Agents
- 2.7.3 Include Commitment Events
- 2.7.4 Determine Cardinalities of Relationships

2.8 AIS and Information Technology

- 2.8.1 Computer Based Accounting Systems
- 2.8.2 Batch Processing
- 2.8.3 Real Time Processing
- 2.8.4 Merits of Computerized AIS
- 2.8.5 De-merits of Computerized AIS
- 2.8.6 Information Technologies and Related Terms

2.9 Summary

2.10 Keywords

2.11 Abbreviations Used
2.12 Hints/Key to Activities or SAQs
2.13 Questions for Practice
2.14 Reference/Suggested Books

2.0 Objectives

After studying this unit, you will be able to:

- Identify the broad objectives of transaction cycles.
- To recognize the fundamental tasks that must be performed in the various cycles regardless of the level of technology in place.
- Explain the basic accounting records used in TPS.
- Compare the traditional accounting records and their magnetic equivalents.
- Explain the documentation techniques used in each cycle of TPS.
- Understand the batch and real-time processing and the impact of these technologies on transaction processing.

2.1 Introduction

In this unit, transaction processing system has been defined as an activity consisting of three major subsystems called cycles i.e. revenue cycle, the expenditure cycle and the production cycle. While each cycle performs different specific tasks, they may also share common characteristics.

A transaction cycle produces raw data for various management reports and financial statements. They are of much importance to accountant professionals because of their financial impact on the firm. The unit is organized into various sections. The first is an overview of transaction processing. The section defines broad objectives of three transaction cycles and specifies their respective roles. The unit also examines documentation techniques used to represent systems. Then the three cycles are explained in detail. Last section of the unit explains the AIS and use of information technology.

2.2 Transaction Processing System (Tps)

Transaction processing system (TPS) processes financial transactions. A financial transaction was defined in unit I as:

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

Financial transactions are common business events that occur regularly. For example there may be many transactions involved regarding sale to customer daily. To deal efficiently with such volume, business firms group similar type of transactions into transaction cycles.

TPS is defined as one of the basic processing functions and transaction records are described as one of the outputs of an information system. The TPS is vital to the operations of an organization. Without it bills would not be paid, sales order would not be filled, manufacturing parts would not be ordered and many more. Prior to computers, transaction processing was performed manually or with mechanical machines. Computer based data processing has altered the speed and complexity of transaction processing, but not the basic function.

The TPS begins with the transaction which may be recorded in hand written form or on computer through online terminal. Data from the transaction is frequently required for updating of master files. This updating may be performed concurrently with the processing of transaction documents or by a subsequent computer run. Data validation is the testing of input data records to determine if they are correct and complete. This cannot be accomplished with complete assurance, but reasonable validation is usually possible. When input data items have been validated, the valid records are processed. Subsequently two major activities occur during transaction processing: updating of machine-readable stored data (master file) related to or affected by the transaction and preparation of outputs such as transaction documents and reports. In both of these activities, control information is also produced. Methods of processing transactions:

Transaction processing systems (TPS) is an Information system that processes data arising from the occurrence of business transactions.

- Transaction processing systems (TPS) are aimed at improving the routine business activities on which all organizations depend.
- A transaction is any event or activity that affects the organization which occur as part of doing business, such as sales, purchases, deposit, withdrawals, refunds and payments.
- Common transactions include placing orders, billing customers, hiring employees, and depositing cheques.
- The types of transactions that occur vary from organization to organization.
- Transaction processing, the set of procedures for handling the transactions, often includes the activities like calculation, storage and retrieval, classification, summarization, sorting.
- Transaction processing procedures are often called standard operating procedures.

There are three major approaches to processing transactions:

- Periodic data preparation and periodic processing of batches of data (batch processing).
- Online data entry and immediate processing of individual transactions (online processing).
- Online data entry with periodic processing of batches of data.

Although no two firms are identical but most of them experience similar economic events which may be grouped into following categories which have been explained in detail in following section of the unit:

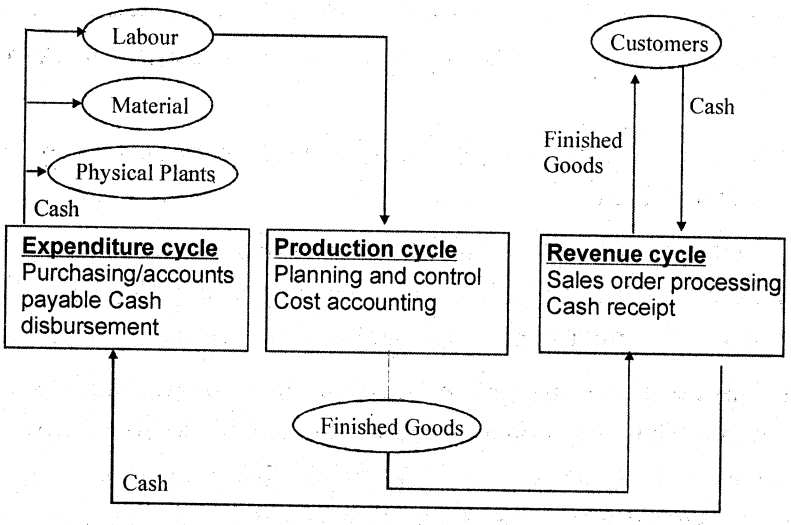


Figure 2.1: Relationship between Transaction Cycles

Source: Complied from the website ehow.com

- Revenue cycle – events related to distribution of goods and services and collection of related payments.
- Expenditure cycle – events related to acquisition of goods and services from other entities and settlement of obligations.
- Production cycle – events related to transformation of resources into goods and services.

2.3 Characteristics of Tpc

- The objective of grouping like transaction is to cluster these transactions together in a way that simplifies information processing.
- Information processing within TPC require Recording, Maintaining & Reporting (keyword: RMR) on the business activities that make up a business process.
- TPC consists of one or more applications.
- The concept of TPC provides a frame-work for analyzing organizational activities.
- Generate statistical data for AIS.
- It provides a basis for categorizing flow of economic events that are common to all organizations.
- Helps analyze the entity's business activities.

2.4 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. The revenue cycle is a recurring set of business activities and related information processing operations associated with providing goods and services to customers and collecting cash in payment for those sales.

There are the four basic revenue cycle business activities:

- Sales order entry
- Shipping
- Billing and accounts receivable
- Cash collections

2.4.1 Sales order entry:

The revenue cycle begins with the receipt of orders from customers. Entering sales order includes three activities: taking the customer order, customer credit and lastly checking inventory levels. With the use of IT, the efficiency and effectiveness of taking the orders from customers has improved. The sales order contains information item numbers, quantities, prices and other terms of sales. There are many ways through which sales order may be taken. They are as follows:

- Optical Character Recognition (OCR) – many retail stores have customers mark item numbers and quantities on preprinted order forms that an OCR device can read.
- Choice boards – these are the interactive sales order entry systems where customers can choose the product features which they need at a price they can afford.
- Electronic Data Interchange (EDI) – it directly links company with the customers. It includes vendor-managed inventory (VMI). With VMI, the customer provides the supplier with access

to data from the customer's point-of-sale (POS) system. The supplier uses this data to monitor inventory levels.

Most of the business caters to credit sales. Credit sales should be approved before they are processed. So our next step in sales order entry is credit approval. It includes two types of customers: old customers and new customers. Credit approvals in case of old customers includes checking customer master file, identifying customer credit limits and verifying that the amount of order plus any current account balance does not exceed this limit. New customer's needs specific authorization by credit manager, especially when the customer has outstanding part due balances.

The last step is to determine if there is sufficient inventory available to fill the order. It is important for the company to deliver the product on time to customers. There are two possibilities in this condition: availability of sufficient inventory and non- availability of sufficient inventory. In case of sufficient inventory, shipping, inventory control and billing departments are informed and acknowledgement may be sent to the customer. But if inventory is not sufficient, a back order for those items needs to be created. Production department is requested for the production of the items. Once the inventory is available, the system then creates a picking ticket that lists the items and quantities that customer ordered.

Besides processing customer orders, the sales order entry process also includes responding to customer inquiries. In order to serve customers better, now-a-days, companies are using special software packages, called customer relationship management (CRM). CRM systems help organize detained data about customers so that data can be used for more personalized services. For example the data about customer preferences and transaction history can be used to suggest other products customer may want to consider.

2.4.2 Shipping:

The second basic activity in the revenue cycle is filling the customer orders and shipping the desired merchandise. It entails two steps:

- Picking and packing the order
- Shipping the order

Warehouse workers are responsible for filling customer orders by removing items from inventory. The picking ticket printed by the sales order entry triggers the shipping process and is used to identify which products to remove from inventory. A physical count is compared with the quantities on the picking ticket and packing slip. The packing slip list the quantity and description of each item included in the shipment. Some spot checks are made and a bill of lading is prepared. The bill of lading is a legal contract that defines responsibility for the goods in transit. Here the automated warehouse systems consisting of computers, bar code scanners, conveyer belts and forklifts helps in reducing the time and cost of moving inventory into and out of the warehouse. The shipping activity also includes the choice of delivery method. Increasingly, many customers are asking suppliers to deliver products only when needed. Thus, companies must use logistic software tools to identify the optimal location to store inventory.

2.4.3 Billing and accounts receivable:

The function of billing and maintaining accounts receivable are performed by two separate functional departments within accounting department. Two activities are performed at this stage of the revenue cycle: Invoicing customers and maintaining customer accounts. Accurate billing is crucial

and requires information identifying the items and quantities shipped, prices, and special sales terms. The sales invoice notifies customers of the amount to be paid and where to send payment. Sending these invoices trough EDI is faster and cheaper. A monthly statement summarizes transactions that occurred and informs customers of their current account balance. A credit memo authorizes the billing department to credit a customer's account. There are two types of billing systems: post billing system (invoices are prepared after confirmation that the items were shipped) and pre billing system (invoices are prepared as soon as the order is approved).The inventory, accounts receivable, and general ledger files are updated at this time.

There are two methods for maintaining accounts receivable: open invoice method and balance-forward method. In open invoice method, customer pays according to each invoice while in balance-forward method they pay according to amount shown on monthly statements. To obtain a more uniform flow of cash receipts, many companies use a process called cycle billing. In cycle billing monthly statements are prepared for subsets of customers at different times. Here the image processing technology can improve the efficiency and effectiveness of managing customer accounts.

2.4.4 Cash collections

The final step in the revenue cycle is cash collection. Two areas are involved in this activity: The cashier and the accounts receivable function. At this stage, reduction of cash theft is essential. The billing/accounts receivable function should not have physical access to cash or checks. The accounts receivable function must be able to identify the source of any remittances and the applicable invoices that should be credited. Checks are received and deposited. A remittance list is prepared and entered on-line showing the customer, invoice number, and the amount of each payment. The system performs a number of on-line edit checks to verify the accuracy of data entry. The company can arrange the system of lockbox with bank. It is a postal address to which customers can send their remittances. The remittances can also be send by using electronic fund transfer (EFT). Integrating EFT with EDI, a process referred to as financial electronic data interchange (FEDI), completes the automation of both billing and cash collections.

Self Assessment Questions 2.1

1. Which cycle includes the set of transactions involving interactions between an organization and its customers?
   a) Revenue cycle b) Expenditure cycle
   c) General ledger d) Production cycle
2. Discuss the ways in which sales order of the company may be taken.
3. List out the name of various departments involved in revenue cycle of the business. Also explain their respective functions.

2.5 Expenditure Cycle

Business activities begin with the acquisition of material, property and labour in exchange for cash. Most expenditure transactions are based on a credit relationship between the trading parties. In expenditure cycle, the external agency involved is suppliers. The expenditure cycle is a recurring set of business and related information processing operations associated with the purchase of and payment for goods and services. The first function of the AIS is to support the effective performance of the organization's business activities. The primary objective of the expenditure cycle is to minimize

the total cost of acquiring and maintaining inventories, supplies, and the various services necessary for the organization to function. This section examines the three basic activities involved in expenditure cycle: ordering goods, supplies and services; receiving them and finally paying for the same. These are discussed in detail below:

2.5.1 Order Goods:

The first major business activity in the expenditure cycle involves the request to purchase inventory or supplies. The activity involves deciding on the inventory control methods. The traditional inventory control method, often called economic order quantity (EOQ).This approach is based on calculating an optimal order size so as to minimize the sum of ordering, carrying, and stockout costs. But now-a-days there are many alternative inventory control methods available, which are as follows:

- MRP (material requirement planning) - This approach seeks to reduce required inventory levels by scheduling production, rather than estimating needs.
- JIT (just in time) - JIT systems attempt to minimize both carrying and stockout costs.

MRP systems schedule production to meet estimated sales need, thereby creating a stock of finished goods inventory. Whereas JIT systems schedule production to meet customer demands, thereby virtually eliminating finished goods inventory.

The need for the goods results in preparation of purchase requisition. The purchase requisition is a document that identifies the following:

- Requisitioner and item number.
- Specifies the delivery location and date needed.
- Specifies descriptions, quantity, and price of each item requested.

After receiving the requisition slip, the purchase order is prepared. The purchase order is a document that formally requests a vendor to sell and deliver specified products at designated prices. It is also a promise to pay and becomes a contract once it is accepted by the vendor. Frequently, several purchase orders are generated to fill one purchase requisition. In this stage, the use of EDI, internet based trading exchanges, vendor-managed inventory programs and reverse auctions can help reduce inventory cost. In selecting suppliers following factors should be considered:

- Price
- Quality of materials
- Dependability in making deliveries.

2.5.2 Receiving the Goods:

The second major business activity involves the receipt and storage of ordered items. Here the major work is of receiving department which reports to the warehouse manager and inventory stores department is responsible for storage of goods. The receiving department has two major responsibilities: Deciding whether to accept a delivery and verifying quantity and quality. Information from purchasing function is collected in order to accept goods. The receiving report documents details about each delivery, including the date received, shipper, vendor, and purchase order number. For each item received, it shows the item number, description, unit of measure, and count of the quantity received. While checking the goods these problems need to be checked:

- Quantity different from order quantity
- Receiving damaged goods

- Receiving goods of inferior quality

The adjustments in the purchase is being recorded in debit memo and sent to the supplier who sends credit memo in acknowledgement. The whole process of receiving goods is a labor-intensive task. Suppliers can be requested to use bar codes which can be scanned and thus much time is saved.

2.5.3 Paying For the Goods:

The third activity entails approving vendor invoices for payments. The objective of accounts payable is to authorize payment only for goods and services that were ordered and actually received. This requires internally generated information from both the purchasing and receiving function. There are two basic ways to process vendor invoices: Nonvoucher system and voucher system. In nonvoucher system, each approved invoice is posted to individual supplier records in accounts payable file. While in voucher system, disbursement voucher is prepared which summarizes the information of vendor invoices and specifies the general ledger accounts to be debited. These invoices can be submitted through EDI or internet. Another approach is invoiceless approach called evaluated receipt settlement (ERS) which reduces the number of documents that need to be matched. ERS requires that supplies quote accurate prices at the time of orders.

The final activity is the payment of approved invoices considering vendor discounts. A short-term cash flow budget is useful for making this decision. The cashier receives and reviews each voucher package which authorizes disbursement of funds by check or EFT to suppliers.

The system uses the voucher file to update the accounts payable, open invoice, and the general ledger files.

2.6 Production Cycle

The production cycle is a recurring set of business activities and related data processing operations associated with the manufacturing of products. Accurate and timely cost accounting information is essential input to decisions about: Product mix, Product pricing, Cost management, Resource allocation and planning.

There are four basic activities in the production cycle:

- Product design
- Planning and scheduling
- Production operations
- Cost accounting

2.6.1 Product Design:

The first step in the production cycle is product design. The objective of this activity is to design a product that meets customer requirements for quality, durability, and functionality while simultaneously minimizing production costs. The product design activity creates two main documents: Bill of materials and operations list. Bill of materials describe the component's requirements while operations list specifies the labor and machine requirements. The role of AIS in this stage is as follows:

- by showing how various design trade-offs affect production costs and thereby profitability
- by ensuring that the system is designed to collect and provide information about the machine setup and materials handling costs associated with alternative product designs

- by providing data about repair and warranty costs associated with existing products.

2.6.2 Planning and Scheduling:

The second step in the production cycle is planning and scheduling. The objective of this step is to ensure that production plan is efficient enough to meet existing orders and anticipate short-term demand without creating excess finished goods inventories. These are the two common methods of production planning:

- Manufacturing resource planning (MRP-II) - MRP-II is an extension of materials resource planning that seeks to match existing production capacity and raw materials needs with forecasted sales demands.
- A just-in-time (JIT) manufacturing system - The goal of JIT is to minimize inventories of raw materials, work in process, and finished goods.

The master production schedule (MPS) specifies how much of each product is to be produced during the planning period and when that production should occur. A materials requisition authorizes removal of materials from the storeroom to the factory. Subsequent transfers of these materials are documented on move tickets. The AIS can be involved in planning and scheduling in the following way:

- by ensuring that the system collects and reports costs in a manner consistent with the production planning techniques used by the company
- by helping to choose whether MRP-II or JIT is more appropriate

2.6.3 Production Operations:

The third step in the production cycle is the actual manufacture of products. The manner in which this activity is accomplished varies greatly across companies. In this stage, computer-integrated manufacturing (CIM) is of special relevance. It is the use of information technology in the production process. Computer-Integrated Manufacturing (CIM) is the use of various forms of IT in the production process, such as robots and computer-controlled machinery, to reduce production costs. Every firm needs to collect data about the following four facets of its production operations:

- Raw materials used
- Labor-hours expended
- Machine operations performed
- Other manufacturing overhead costs incurred

2.6.4 Cost Accounting:

The final step in the production cycle is cost accounting. The cost accounting encompasses three principal objectives:

- To provide information for planning, controlling, and evaluating the performance of production operations
- To provide accurate cost data about products for use in pricing and product mix decisions
- To collect and process the information used to calculate the inventory and cost of goods sold values.

In the production cycle, there are two types of cost accounting systems:

- Job-order costing - Job-order costing assigns costs to specific production batches or to individual jobs.

- Process costing - Process costing assigns costs to each process, and then calculates the average cost for all units produced.

The choice of job-order or process costing affects only the method used to assign costs to products, not the method used for data collection. There are five types of cost, regarding which a data is to be collected: raw materials, labor, machinery & equipments, manufacturing overheads and accounting for fixed assets. These are explained below in nutshell:

- Raw Materials - When production is initiated, the issuance of a materials requisition triggers the journal entry. Most raw materials are bar-coded. Inventory clerks use online terminals to enter usage data for those items that are not bar-coded. For example when raw material worth Rs. 150000 are issued, following journal entry is passed to record issuance of raw materials:

Work in Process	15,000
Raw Materials Inventory	15,000

Assume that Rs.10000 of raw materials was returned to inventory. The journal entry to record return of raw materials to inventory will be:

Raw Materials Inventory	1,000
Work in Process	1,000

- Direct Labor - A job-time ticket is a paper document used to collect data about labor activity. This document records the amount of time a worker spent on each specific job task. Workers can enter this data using online terminals at each factory workstation.
- Machinery and Equipment - As companies implement CIM to automate the production process, an even larger proportion of product cost relate to the machinery and equipment used to make the product.
- Manufacturing Overhead - all manufacturing costs that are not economically feasible to trace directly to specific jobs or processes. Example – cost of water.
- Accounting for Fixed Assets - The AIS also needs to collect and process information about investment in the property, plant, and equipment used in the production cycle. Fixed assets should be bar-coded. Following information should be kept by organizations about their fixed assets:
  - identification number
  - location
  - date of acquisition
  - expected life
  - depreciation method
  - improvements
  - serial number
  - cost
  - vendor name and address
  - expected salvage value
  - depreciation charges to date
  - maintenance services performed

Activity -2.2

1. Prepare a report on how an ATM works.

2.7 REA Data Models For Various Cycles

REA data model is a conceptual modeling tool used for AIS database that focuses on the business semantics underlying an organization's value chain activities. It identifies what entities should be included in AIS and prescribes how to structure relationships among the entities in that database. The entities are divided into three categories:

- Resources – things having economic value to the organization. Example-cash, inventory etc.
- Events – business activities regarding which information is collected for planning and control purposes. For example-sales, cash receipt etc. They are of two types: economic exchanges and commitments. Economic exchanges are the value chain activities that directly affect the quantity of resources. Example-sales event decreases inventory. Commitments on the other hand represent promises to engage in future economic exchange. For example customer orders are commitments that lead to future sales.
- Agents – people and organizations that participate in events and about whom information is collected.

Developing a REA model for any cycle involves following four steps:

- Identify economic exchange events
- Identify resources and agents
- Include commitment events
- Determine cardinalities of relationships

Here is the REA model explained taking an example of revenue cycle. Once the REA concept is clear, we can apply the same to any event and also to remaining two cycles.

2.7.1 Identify Economic Exchange Events:

In drawing REA model, left column is used for resources, center column for events and right column for agents. The basic economic exchange in the revenue cycle involves the sale of goods or services and the subsequent receipt of cash in payment for those sales.

2.7.2 Identify Resources and Agents:

Next step is to identify the resources affected by these events. To continue our example, sales event translates to giving inventory to customers and that the cash receipt leads to receiving cash from customers. Thus inventory and cash are the resources identified here. Then we drew the stock flow relationships between these entities and events that affected them. After specifying the resources affected agents are identified. Customers and salespersons participate in sales event. Customers and cashier are involved in cash receipt event. The REA model requires that each event be linked to at least one resource and two agents. The main rules are:

- Every Event is connected to at least one Source from which it differs.
- Every Event is connected to at least one other Event.
- Every Event is connected to at least two Agents (The economic duality principle).

2.7.3 Include Commitment Events:

In stage involves analyzing each economic exchange event to decompose it into one or more

commitment and exchange event. To continue our example, company can receive orders from customers in three ways: over the internet, by phone and by mail. It is important to have up-to-date information about these orders for maintaining proper inventory levels. Thus customer order can be a commitment attached with sales event. However, billing and printing documents will not form a part of REA model as they do not change the content of database.

2.7.4 Determine Cardinalities of Relationships:

The final step in REA model is to add information about the nature of relationships between the various entities. Entities represent a class or set of objects. For example the customer entity represents all the organizations customers and sales entity represents all the individual sales transactions. Each individual customer or sale transaction represents specific instance of that entity. Cardinalities indicate hoe many instances of one entity can be linked to one specific instance of another entity. For example, how many sales transactions can be linked to each individual customer and at the same time how many customers can be linked to each individual sales transaction?

The pair of letters and numbers next to each entity represents minimum and maximum cardinalities. For example the minimum cardinality of 0 next to customer entity in customer-sales relationship indicates that information about new customer can be added to customer table without linking it to any specific sales transaction. Minimum cardinality of 1 means information about a new sales transaction can be added only if it is linked to a customer table. The second number in each cardinality pair is the maximum cardinality. Maximum cardinality of 1 means each sale transaction can be linked to only one specific customer. Maximum cardinality of N (which means many) means that each customer can be linked to more than one sales transaction.

There are three types of relationship:

- A one-to-one (1:1) relationship exists when maximum cardinality for each entity in that relationship is one.
- A one-to-many relationship exist when maximum cardinality of one entity ion the relationship is 1 and for other entity it is N.
- A many-to-many relationship exists when the maximum cardinality for both entities in the relationship is N.

For example (1:1) relationship between sales and cash receipt event s indicates maximum cardinality of 1 associated with sales entity means each sales event can be linked to at most one cash receipt event. This would reflect a policy that customers are not allowed to make installment payments. On the other hand, maximum cardinality of 1 with cash receipt means each payment a customer submits is linked to at most one sales event. This indicates that customers must pay for each sales transaction separately. The REA model for revenue, expenditure and production cycles of transaction processing system has been explained through Figure number 02:02, 02:03 and 02:04 respectively. In this REA model, the box represents resources, an event or an agent. Diamonds in model represents relationship of interest.

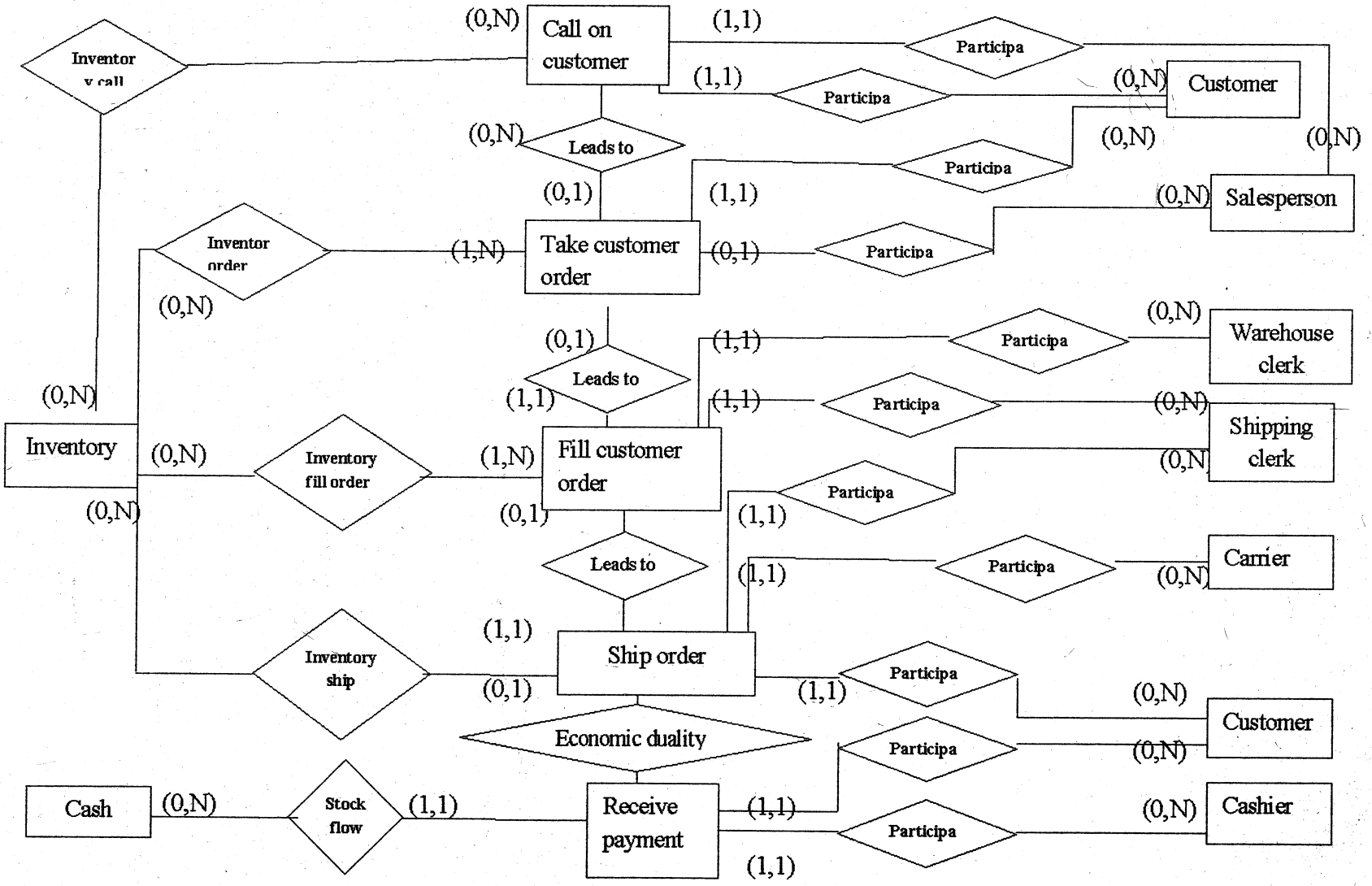


Diagram 02:02: Revenue Cycle REA Model
Source: Romney, M.B. & Steinbart, P.J. (2009), "Accounting Information Systems", Prentice Hall.

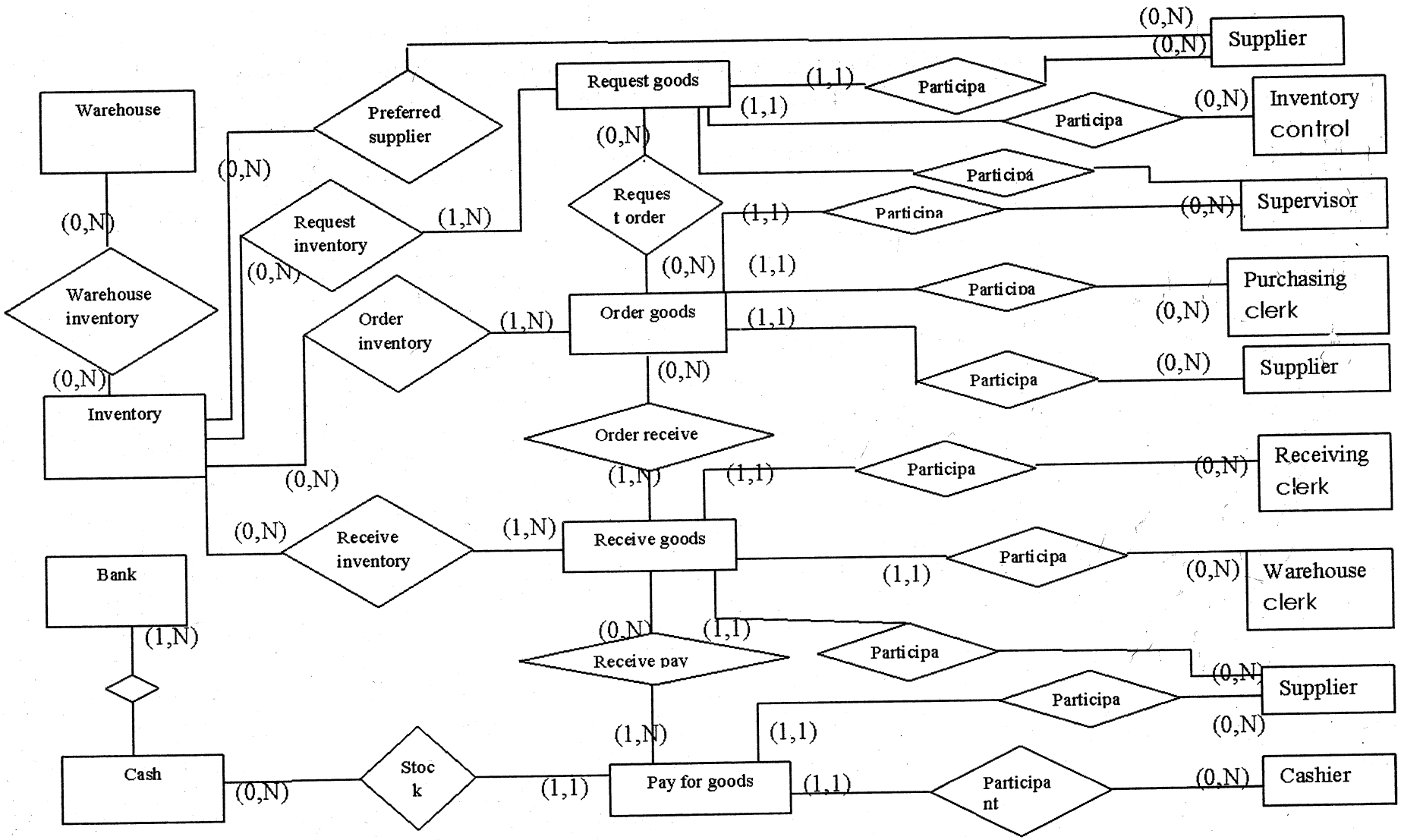


Diagram 2.3: Expenditure Cycle REA Model
Source: Romney, M.B. & Steinhart, P.J. (2009), "Accounting Information Systems", Prentice Hall.

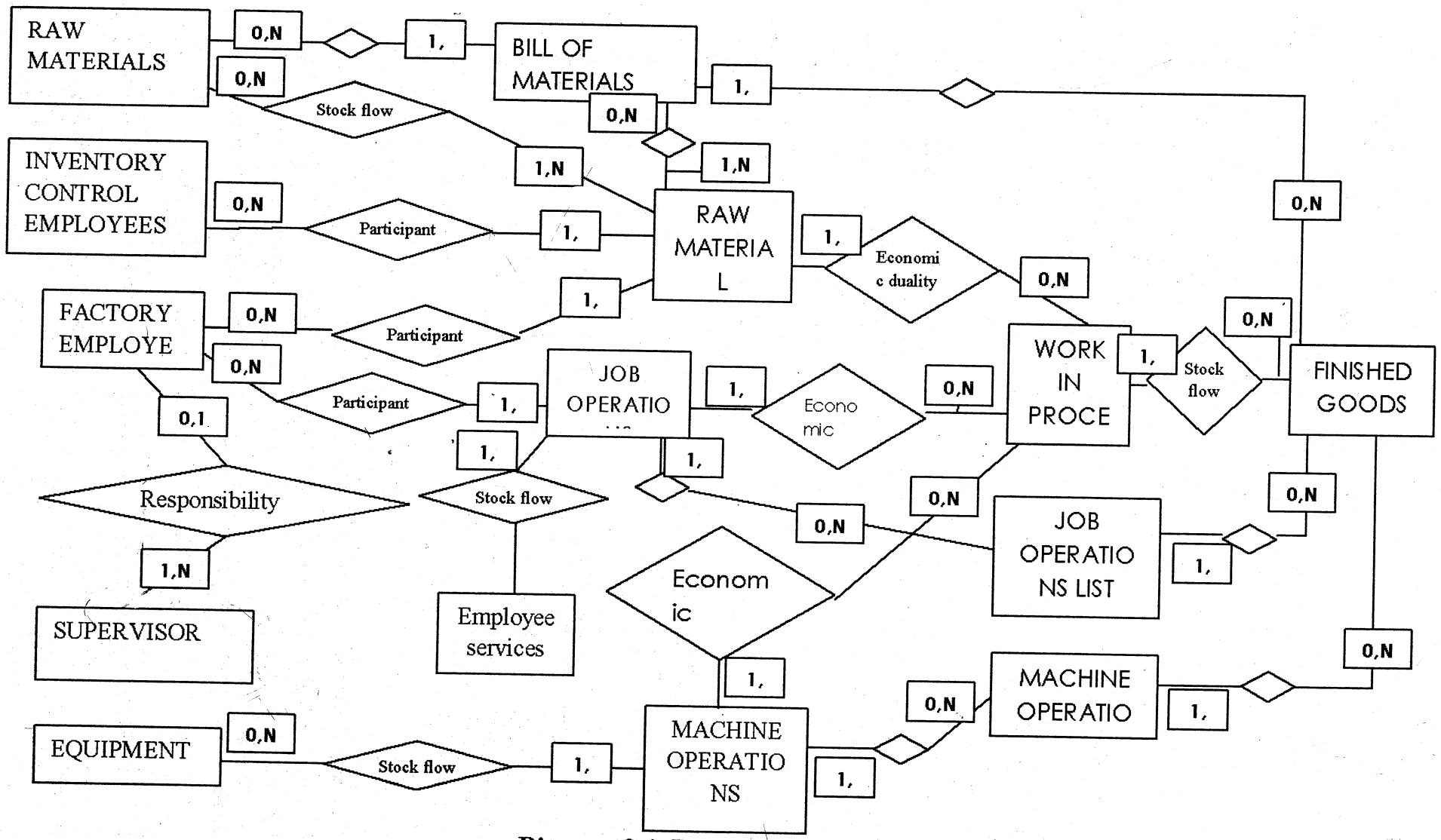


Diagram 2.4: Production Cycle REA Model
Source: Romney, M.B. & Steinhart, P.J. (2009), "Accounting Information Systems", Prentice Hall.

Activity 2.2

1. The data models for both revenue and expenditure cycles presented in this unit contain some common elements such as inventory and cash. Sketch a combined R E A Figure to integrate both cycles.
2. Explain the REA model for expenditure and production cycle in your own words, on the same pattern as explained for revenue cycle in the unit.

2.8 Ais And Information Technology

Over the last few years, accounting information technology has been malformed at a tremendous pace. Earlier the accounting process was controlled by costly mainframe computers. These computers were programmed by specialized information system staff, but today it has now been changed to accessible and incorporated internet-based systems. Today the skills and abilities essential for the accountant include the proper knowledge of application and combination of I.T. into the accounting process. Adding to this, these days many companies are looking for accountants who also have a proper knowledge of managerial and financial accounting principles. In fact, today every organization is looking for accountants who are familiar with today's systems.

2.8.1 Computer Based Accounting Systems:

There are two broad classes of systems

- Batch systems
- Real time systems

2.8.2 Batch Processing:

A batch is a group of similar transactions that are accumulated over time and then processed together. The transactions must be independent of one another during the time period over which the transactions are accumulated in order for batch processing to be appropriate. A time lag exists between the event and the processing. Organizations can increase efficiency by grouping large numbers of transactions into batches rather than processing each event separately. Batch processing provides control over the transaction process via control figures.

AIS processing is characterized by high-volume, independent transactions, such as recording cash receipts checks received in the mail. The processing of such high-volume checks can be done during an off-peak computer time. This is one reason for the preference of batch processing in the AIS. Batch processing involves:

- Gathering source documents originated by business transactions, such as sales orders and invoices, into group called batches.
- Recording transaction data on an input medium, such as magnetic disks or magnetic tapes.
- Sorting the transactions in a transaction file in the same sequence as records in a sequential master file.
- Processing transaction data and creating an updated master file and a variety of documents (such as customer invoices or pay cheques and reports)
- Capturing and storing batches of transactions data at remote sites, and then transmitting it periodically to central computers for processing. This is called remote job entry or RJE.

2.8.3 Real Time Processing:

Process transactions individually at the moment the economic event occurs. There exists no time lag between the economic event and the processing generally require greater resources than batch processing since they require dedicated processing capacity; however, these cost differentials are decreasing oftentimes have longer systems development time. Real time processing involves:

- Real-time processing systems process transaction data immediately after they are generated and can provide immediate output to end users.
- In full-fledged real-time processing systems, data is processed as soon as it is originated or recorded, without waiting to accumulate batches of data.
- Data is fed directly into the computer system from online terminals, without being sorted, and it is always stored online in direct access files.
- Files and databases are always up to data since they are updated as and whenever data is originated, regardless of its frequency.
- Responses to end users' inquiries are immediate, since information stored on direct access devices can be retrieved almost instantaneously.
- Real-time processing depends on telecommunication networks of online terminals and computers.

2.8.4 Merits of Computerized AIS:

- Faster and efficient in processing of information.
- Automatic generation of accounting documents like invoices, cheques and statements of account.
- With the larger reduction in the cost of hardware and software and availability of user-friendly accounting software package, it is relatively cheaper.
- Mere timely information can be produced.
- No more manual processing of the data. All the data automatically been posted to the various ledgers.
- Various types of useful reports can be generated for management.

2.8.5 De-merits of Computerized AIS:

- Power failure, computer viruses and hackers are the inherent problems of using computerized system.
- Once data been input into the system, automatically the outputted are obtained. Hence the data being inputted needs to be validated for accuracy and completeness.
- Accounting system not properly set up to meet the requirement of the business due to badly programmed or inappropriate software or hardware or personnel problems can cause more havoc.
- Danger of computer fraud if proper level of control and security, whether internal or external are not properly been instituted.

2.8.6 Information Technologies and Related Terms:

Information technology not only includes computers but also use of various technologies to process information like machine-readable bar codes, scanning devices and communications protocols.

- Data processing - Refers to a class of programs that organize and manipulate data, usually large amounts of numeric data. Accounting programs are the prototypical examples of data processing applications.
- Office automation (OA) – the use of information technology in office place. It is an electronic technology which allows processing of variety of messages and documents. OA includes text processing, message processing and image processing.
- Quick response technology - Quick response is a method that allows manufacturers or retailers to communicate inventory needs for their shelves or assembly lines in near-real time. These companies have traditionally communicated with business partners about inventory replenishment via electronic data interchange (EDI) systems, faxes or phone calls. But with the advent of the Internet, a growing number of organizations have been turning to Web-based systems.
- Just-in-Time (JIT) - An inventory strategy companies employ to increase efficiency and decrease waste by receiving goods only as they are needed in the production process, thereby reducing inventory costs.
- Electronic Data Interchange (EDI) - The electronic data interchange process is the computer-to-computer exchange of business documents between companies. EDI replaces the faxing and mailing of paper documents. EDI documents use specific computer record formats that are based on widely accepted standards.
- Computer-Integrated Manufacturing (CIM) - A system in which individual engineering, production, and marketing and support functions of a manufacturing enterprise are organized into a computer-integrated system. Its objective is to streamline the manufacturing processes and to integrate them with other business functions (such as accounting, financing, distributing, marketing).
- Electronic Fund Transfer (EFT) - Transfer of funds between accounts by electronic means rather than conventional paper-based payment methods. EFT refers to any transfer of funds initiated through an electronic terminal, including credit card, ATM, Fed wire and point-of-sale (POS) transactions. It is used for both credit transfers, such as payroll payments, and for debit transfers, such as mortgage payments.

2.9 Summary

Most organizations experience similar types of economic events. These events generate transactions that may be grouped according to three common cycles of business activity: revenue cycle, expenditure cycle and production 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. There are the four basic revenue cycle business activities: sales order entry, shipping, cash collections and billing & accounts receivable. The expenditure cycle is a recurring set of business and related information processing operations associated with the purchase of and payment for goods and services. The primary objective of the expenditure cycle is to minimize the total cost of acquiring and maintaining inventories, supplies, and the various services necessary for the organization to function. It examines the three basic activities: ordering goods, supplies and services; receiving them and finally paying for the same. The third step in the production cycle is the actual manufacture of products. In this stage, computer-integrated manufacturing (CIM) is of special relevance. Computer-

Integrated Manufacturing (CIM) is the use of various forms of IT in the production process, such as robots and computer-controlled machinery, to reduce production costs. The four basic activities performed in this stage are: product design, planning and scheduling, production operations and cost accounting.

One way to perform the activities of requirements definition and conceptual design is to build a data model of the AIS. The REA accounting data model is developed specifically for building a database AIS. The REA model classifies data into three basic categories: resources, events and agents. Developing an REA model requires four steps: identify the basic economic exchange, identify the resources and agents, determine if any of the economic exchange can be decomposed into a set of commitment and exchange events and lastly, use knowledge about the organization's business practices to add relationship cardinality information to the Figure.

Today the skills and abilities essential for the accountant include the proper knowledge of application and combination of I.T. information technology not only includes use of computers but also involves use of various technologies like: data processing, Office automation (OA), Quick response technology, Just-in-Time (JIT), Electronic Data Interchange (EDI), Computer-Integrated Manufacturing (CIM), and Electronic Fund Transfer (EFT).

2.10 Key Words

- Transaction Processing System - Transaction processing is a computer-based group of logical operations.
- Data Validation - Data validation guarantees to your application that every data value is correct and accurate. It is the process of ensuring that a program operates on clean, correct and useful data.
- Master File - A collection of records pertaining to one of the main subjects of an information system, such as customers, employees, products and vendors. Master files contain descriptive data, such as name and address, as well as summary information, such as amount due and year-to-date sales.
- Optical Character Recognition - is the mechanical or electronic translation of scanned images of handwritten, typewritten or printed text into machine-encoded text.
- Choice Boards - these are the interactive sales order entry systems where customers can choose the product features which they need at a price they can afford.
- Electronic Data Interchange - It is a set of standards which creates a cohesive system within which all parties are able to electronically exchange data information within a set of protocols.
- Point-Of-Sale - Point of sale (POS) or checkout is the location where a transaction occurs. A "checkout" refers to a POS terminal or more generally to the hardware and software used for checkouts, the equivalent of an electronic cash register. A POS terminal manages the selling process by a salesperson accessible interface.
- Customer Relationship Management - is a broadly recognized, widely-implemented strategy for managing and nurturing a company's interactions with customers, clients and sales prospects.
- Accounts Receivable - Money which is owed to a company by a customer for products and services provided on credit. This is treated as a current asset on a balance sheet.

- Electronic Fund Transfer - computer-based systems used to perform financial transactions electronically.
- Financial Electronic Data Interchange - is the computer-to-computer exchange of payment and payment-related information between companies using a standard format.
- Economic Order Quantity - The amount of orders that minimizes total variable costs required to order and hold inventory.
- Material Requirement Planning - is a production planning and inventory control system used to manage manufacturing processes.
- Just In Time – also known as zero-inventory level. Goods are ordered, just when they are required.
- Voucher System - Type of internal system used to control the cash (checks) being spent (written).
- Evaluated Receipt Settlement - is a procedure for the automatic settlement of goods receipts. It is a business process between trading partners that conduct commerce without invoices.
- Manufacturing Resource Planning - a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning in dollars, and has a simulation capability to answer "what-if" questions and extension of closed-loop MRP.
- Master Production Schedule - the plan that the company has developed for production, staffing, inventory, etc.
- Materials Requisition - A materials requisition is a source document used by materials managers of a manufacturing company to order raw materials from suppliers.
- Direct Labor - Cost of personnel that can be identified in the product, such as the salary of the person who works at the production machine.
- Overhead - The ongoing administrative expenses of a business which cannot be attributed to any specific business activity, but are still necessary for the business to function.
- Manufacturing Overhead - refers to indirect factory-related costs that are incurred when a product is manufactured.
- Batch Processing - is execution of a series of programs ("jobs") on a computer without manual intervention.
- Real Time Processing - Data is processed in a small stipulated time period.
- Data Processing - conversion of raw data to machine-readable form, flow of data through the CPU and memory to output devices, and formatting or transformation of output.
- Office Automation - refers to the varied computer machinery and software used to digitally create, collect, store, manipulate, and relay office information needed for accomplishing basic tasks and goals.

2.11 Abbreviations

TPS	:	Transaction Processing System
REA	:	Resource-Entity-Agent

IT	:	Information Technology
OCR	:	Optical Character Recognition
EDI	:	Electronic Data Interchange
VMI	:	Vendor-Managed Inventory
POS	:	Point-Of-Sale
CRM	:	Customer Relationship Management
EFT	:	Electronic Fund Transfer
FEDI	:	Financial Electronic Data Interchange
EOQ	:	Economic Order Quantity
MRP	:	Material Requirement Planning
JIT	:	Just In Time
ERS	:	Evaluated Receipt Settlement
MRP-II	:	Manufacturing Resource Planning
MPS	:	Master Production Schedule
CIM	:	Computer-Integrated Manufacturing
DP	:	Data Processing
OA	:	Office Automation
RJE	:	Remote Job Entry

2.12 Hints/Key To Activities

Hints to self assessment questions 2.1

Answer 1: (a)

Answer 2: Explain the departments involved, machine used in processing the documents, various documents and inventory details.

Answer 3: All departments involved directly as well as indirectly are to be explained.

Hints to activity 2.2

Answer 1: Explain it with the help of following steps: data entry, data validation, processing and revalidation, storage, information and reporting.

Hints to activity 2.3

Answer 1: Identify common resources, entities, agents and establish relationship between them.

Answer 2: Start the activity by explaining agents involved, resources affected by entities and deriving the relationship among them. Use REA model of expenditure and production for explain the same.

2.13 Questions For Practice

1. Which of the following inventory control methods is most likely to be used by a company that purchases inventory in response to customer orders?

   (a) JIT (b) MRP (c) MRP-II (d) EOQ

2. Most costs are locked in at which stage in the production cycle?

   a) Product design b) Production planning

   c) Production operations d) Cost accounting

3. What do you mean by transaction processing system? Explain its approaches.
4. What is a major difference between MRP and JIT?
5. Explain briefly various technologies used in processing transactions of the business.
6. Explain electronic data interchange.
7. What are the various methods of processing accounting data in computers? Also list out the merits and demerits of computerized accounting system.
8. Write down a brief note on computer-integrated manufacturing (CIM).
9. You have been hired to design a production information system for a new company that will manufacture automobile wheels. List all the documents, paper as well as electronic that should be included in the system and specify the purpose they serve.

Key to Questions:

Answer 1: (a)

Answer 2: (a)

2.14 Reference/Suggested Books

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Unit - 3

Transaction Flows, Components

Outline of The Unit:

3.0 Objectives

3.1 Introduction

3.2 Transaction Flows: An Overview

3.3 Computerized Accounting

- 3.3.1 Need and Requirements
- 3.3.2 Differences between Manual Accounting and Computerized Accounting
- 3.3.3 Types of Files in AIS

3.4 Major Components

- 3.4.1 Data Input Function
- 3.4.2 Data Processing
- 3.4.3 Data Storage
- 3.4.4 Information Output

3.5 Designing Double-Entry System

3.6 Coding Systems for Transaction Processing

- 3.6.1 Coding In Accounting Systems
- 3.6.2 Uses of Data Coding in AIS
- 3.6.3 Design Considerations in Coding

3.7 Summary

3.8 Key Words

3.9 Abbreviations

3.10 Hints/Key to Activities

3.11 Questions for Practice

3.12 Reference/Suggested Books

3.0 Objectives

After studying this unit, you will be able to:

- Provide an overview description of the flow of transactions in accounting information system.
- Be familiar with the computerized accounting system.
- Explain the major process of input-process-output.
- Describe the working and use of various tools as input devices & output devices in processing accounting information.
- Understand how double-entry system is being designed and implemented in accounting information system.

- To understand the use of different codes and discuss common coding system that is used in transaction processing.
- Describe the basic functions of computerized AIS.

3.1 Introduction

The term "transaction processing" includes combination of various activities which an organization must undertake to support its day-today operations. It involves activities like record keeping, planning the activities, monitoring physical operations and activities related to controlling the same. This unit illustrates how the data that result from transaction processing activities are recorded and processed to maintain financial records. The unit also examines the basic computer processing system of input-process-output with special reference to accounting transactions. The last part of the unit deals with relevance of using coding system in AIS and a detail analysis of various codes being used in system.

3.2 Transaction Flows: An Overview

In recent years information technology has had a significant impact on the practice of accounting. Computers have replaced paper, pencils and ten-key adding machines as the primary means of recording, classifying, analyzing and presenting financial information. This change has freed the accountant from performing many mundane record-keeping activities and has enabled him to devote more of his energies toward assisting management in identifying opportunities and resolving problems. Information technology has extended the accountant's capabilities in providing relevant and reliable information to both internal and external users on a timely basis. Thus it has become essential to understand the flow of transactions in today's information era.

A computerized accounting system saves a great deal of time and effort, considerably reduces (if not eliminates) mathematical errors, and allows for much more timely information than does a manual system. In a real-time environment, accounts are accessed and updated immediately to reflect activity, thus combining steps 2 and 3 as discussed in the preceding section. The need to test for equality of debits and credits through trial balances is usually not required in a computerized system accounting since most systems test for equality of debit and credit amounts as they are entered. If someone were to attempt to input data containing an inequality, the system would not accept the input. Since the computer is programmed to post amounts to the various accounts and calculate the new balances as new entries are made, the possibility of mathematical error is markedly reduced.

Computers may also be programmed to record some adjustments automatically at the end of the period. Most software programs are also able to prepare the financial statement once it has been determined the account balances are correct. The closing process at the end of the period can also be done automatically by the computer. Human judgment is still required to analyze the data for entry into the computer system correctly. Additionally, the accountant's knowledge and judgment are frequently required to determine the adjustments that are needed at the end of the reporting period. The mechanics of the system, however, can easily be handled by the computer.

3.3 Computerized Accounting

The most popular system of recording of accounting transactions is manual which requires maintaining books of accounts such as Journal, Cash Book, Special purpose books, ledger and so on. The accountant is required to prepare summary of transactions and financial statements manually.

The advanced technology involves various machines capable of performing different accounting functions, for example, a billing machine. This machine is capable of computing discount, adding net total and posting the requisite data to the relevant accounts. With substantial increase in the number of transactions, a machine was developed which could store and process accounting data in no time. Such advancement leads to number of growing successful organizations. A newer version of machine is evolved with increased speed, storage, and processing capacity. A computer to which they were connected operated these machines. As a result, the maintenance of accounting data on a real-time basis became almost essential. Now maintaining accounting records become more convenient with the computerized accounting. The computerized accounting uses the concept of databases. For this purpose an accounting software is used to implement a computerized accounting system. It does away the necessity to create and maintain journals, ledgers, etc., which are essential part of manual accounting. Some of the commonly used accounting softwares are Tally, Cash Manager, Best Books, etc. The computerized accounting is based on the concept of database. It is basic software which allows access to the data contained in the data base. It is a system to manage collection of data insuring at the same time that it remains reliable and confidential. Following are its components:

- **Preparation of accounting documents -** Computer helps in preparing accounting documents like Cash Memo, Bills and invoices etc., and preparing accounting vouchers.
- **Recording of transactions -** Every day business transactions are recorded with the help of computer software. Logical scheme is implied for codification of account and transaction. Every account and transaction is assigned a unique code. The grouping of accounts is done from the first stage. This process simplifies the work of recording the transactions.
- **Preparation of Trial Balance and Financial Statements -** After recording of transaction, the data is transferred into Ledger account automatically by the computer. Trial Balance is prepared by the computer to check accuracy of the records. With the help of trial balance the computer can be programmed to prepare Trading, Profit and Loss account and Balance Sheet.

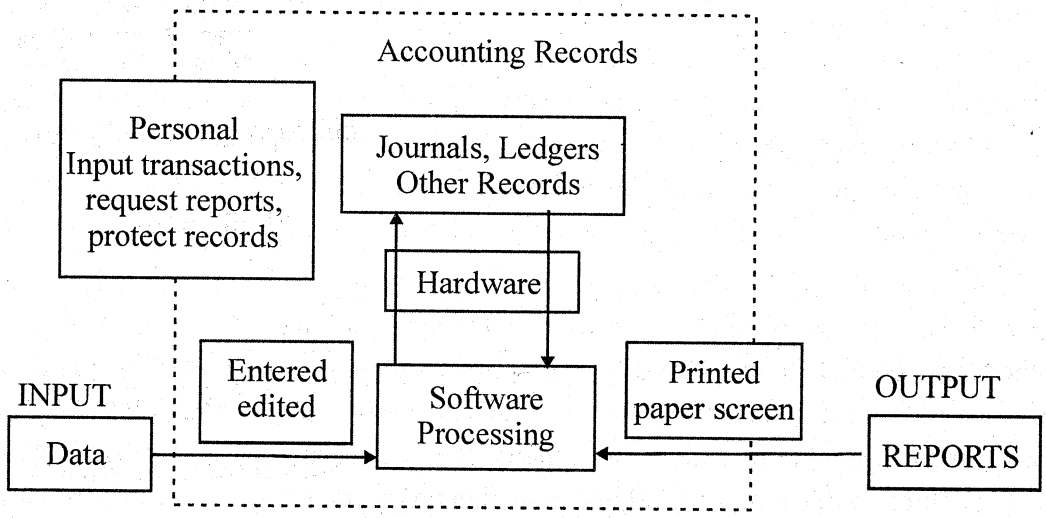


Figure 3.1 : Computerized Accounting System

Source: Complied from the website ehow.com

Transaction processing system (TPS) is the first stage of computerized accounting system. The purpose of any TPS is to record, process, validate and store transactions that occur in various functional areas of a business for subsequent retrieval and usage. TPS involves following steps in

processing a transaction: Data Entry, Data Validation, Processing and Revalidation, Storage, Information and Reporting. It is one of the transaction processing systems which is concerned with financial transactions only. When a system contains only human resources it is called manual system; when it uses only computer resources, it is called computerized system and when it uses both human and computer resources, it is called computer-based system.

3.3.1 Need and Requirements

The basic requirements of any accounting information system are the followings:

- **Accounting framework** - It is the application environment of the accounting information system. A healthy accounting framework in terms of accounting principles, coding and grouping structure is a pre-condition for any AIS.
- **Operating procedure** - A well-conceived and designed operating procedure blended with suitable operating environment of the enterprise is necessary to work with the accounting information system. The accounting information system is one of the database-oriented applications wherein the transaction data is stored in well- organized database. The user operates on such database using the required interface and also takes the required reports by suitable transformations of stored data into information. Therefore, the fundamentals of accounting include all the basic requirements of any database-oriented application in computers.

3.3.2 Differences between Manual Accounting and Computerized Accounting

Shifting from manual to computerized accounting information system is a sign of advancement in accounting profession. Manual accounting implies that employees perform the whole accounting cycle manually on a periodic basis: they calculate trial balances, journalize transactions, and prepare financial statement reports and other routines. Of course it takes much time, resources and effort in large organizations. Computerized accounting implies that the only thing that employees do is recording transactions into the computer which processes the other steps of accounting cycle automatically or by a request. On the basis of the above discussions, there are the following differences between manual accounting and computerized accounting:

- **Recording** - manual accounting involves the process of recording transaction in the books of original entry, posting them in the ledger accounts, performing mathematical functions adding subtraction and totaling. In the computerized process, transactions are recorded in the books of accounts and the remaining functions are performed without any further process or command being carried out manually.
- **Classification** - In the manual process, the transactions are recorded in the book of original entry and are posted into the ledger accounts. It means that, after recording the transaction, another process of posting is performed. In computerized accounting the posting process is carried out by internal sorting of data, with the help of utility or application software, without any further process.
- **Summarizing** - In the manual system of accounting, the data under each ledger is summarized and a balance of each account is ascertained to prepare a Trail Balance. As a result, preparing ledger accounts is essential to prepare a Trail Balance. In the computerized process, a transaction or event, once recorded, is stored in the database and can be processed to produce a Trail Balance directly.

- **Adjustments Entries** - Adjustment entries are passed to rectify an error or to follow the matching adjustment entries can be equated with the recording process. These entries are identified and recorded in the books of accounts. The remaining process is the same as discussed above.
- **Grouping of Accounts**: One of the basics of correct accounting is determining whether a transaction is capital or revenue in nature and, accordingly, which account head is to be debited or credited. Once this decision is taken, the account is grouped as an asset, a liability, an income or an expense at the same time of preparing the financial statements. The above process is followed when the manual system of accounting is adopted. However, in computerized accounting, whether an account head is an asset, a liability, an income or an expense, is decided at the time the transaction takes place, as in the case of manual accounting. It is also defined whether the particular head of account shall be shown as an asset or liability, or an income or expense.
- **Financial Statements** - In the manual process, availability of the Trail Balance is essential to prepare the financial statements. In the computerized process, financial statements are generated from the system itself and, hence, there is no need to have a Trail Balance.

3.3.3 Type of Files in AIS:

There are mainly four types of files used in accounting information system. They are as follows:

- **Master File** - generally contains account data (e.g., general ledger and subsidiary file). These contain permanent data (records) pertaining to entities (people, things).
- **Transaction File** - a temporary file containing transactions since the last update. These contain records pertaining to events currently being processed, such as sales, receipt of goods. Transaction data are periodically posted to master files.
- **Reference File** - contains relatively constant information used in processing (e.g., tax tables, customer addresses). They contain tables or list of data needed for making calculations or for checking the accuracy of input data e.g. product price tables, customer list.
- **Archive File** - contains past transactions for reference purposes. They are also known as history files as they contain records pertaining to completed transactions such as past sales.
- **Open File** - these records incomplete transactions.

3.4 Major Components

Along with the improvements in the technology, information systems have been computerized. Improvements in this technology have replaced manual bookkeeping systems with computerized ones. The revolution in the information systems, which started in the early 1950s when the first business computers became available, is still in progress. Large mainframe computers have been replaced by small and fast personal computers at lower costs. As a result, accounting information systems that were previously performed manually are now performed by computers in most companies. Companies can now capture, process, store, and transmit data with the help of computers. Whereas data collections and processing were performed manually in historical systems, on-line collection and processing of data are performed by computerized systems. In manual accounting information systems, processing of data is slow and subject to error. Fortunately, improvements in the technology have enabled companies to collect, process, and retrieve data quickly. In addition, there is less

likelihood for error when data are processed with computers. In this case, functions of accounting can be explained for computerized AIS as follows:

3.4.1 Data Input Function:

In computerized AIS, after data are captured, they should be converted into machine-readable form. In most computerized AIS, source data automation devices that capture data at the time and place of their origins are used. For example, bar code scanners used in retail stores can record the sale transaction just as scanning devices read the codes located on the products. In addition to the data scanned into the computer, there are existing data bases that contain stored data for future processing. A database includes information about entities. An entity is something about which information is stored. For example, information about existing customers is stored in databases. In this case, customers represent entities. Information about customers such as account number, credit limit, and current balance of the customer can be stored in the database. Master files are used to store data about entities in databases in computerized AIS. Master files have replaced the subsidiary ledgers that are used in manual systems. For example, records in accounts receivable master file include customer name, customer account number, address, and balance due. Master files are frequently updated as transactions are taking place. For example, as sales are made or receivables are collected, accounts receivable master files are changed. In addition to the accounts receivable master file, master files are kept for all other balance sheet and income statement items such as accounts payable, fixed assets and expenses. In computerized AIS, relational tables can be used to establish master files. Another concept in accounting is relational tables which are the tables that include detailed information for every entity. For example, following table represents a relational table for sales which show details for every entity. For example, sales file shows customer (account) numbers, invoice total, and date of sale.

Table 3.1: Relational Table for Sales

SALES				
Sales Invoice #	Date	Salesperson	Customer Number	Invoice Total (Rs.)
101	2/8/2009	Ravi	156	2000
102	3/8/2009	Ram	157	1000
103	9/8/2009	Raman	158	1500

3.4.2 Data Processing:

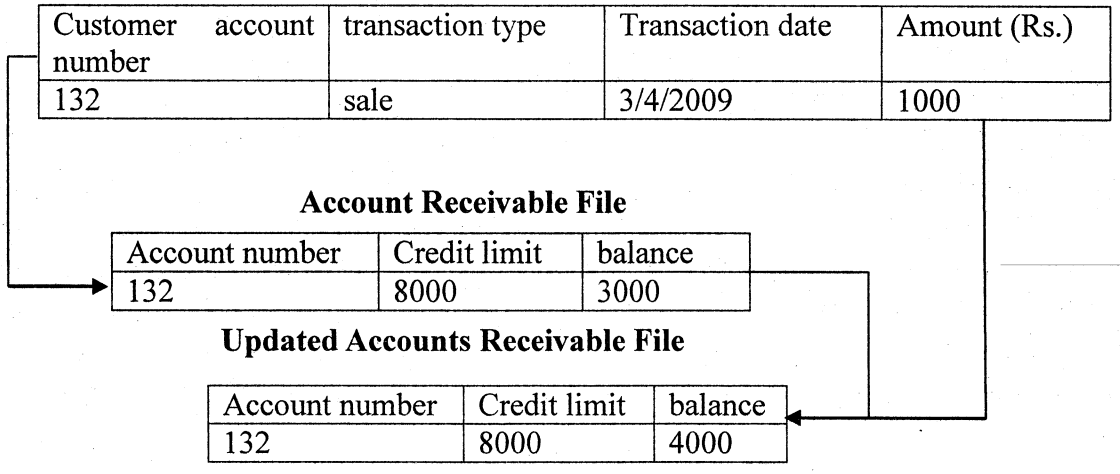


Figure 3.2: Process by Which AIS Updates Customer File as a Result Of Sale Transaction Data

Source: Jones and Rama (2007), "Accounting Information System: A Business Process Approach", 2nd ed. New Delhi, Tata McGraw-Hill.

After the data are collected and entered into computers, they are processed. The most common data processing activity is data maintenance. Data maintenance is the processing of transactions to update stored data. For example, when sales transaction takes place, data are entered into the computer. In turn, computer immediately updates sales and accounts receivable files. In computerized systems, records are updated by using primary keys that uniquely identifies each record. For example, when a sales transaction takes place, related customer file should be updated. In order to find related customer master file, customer account number can be used as the primary key because every customer has unique customer account number. In other words, it is not possible that two or more customers have common customer account number. Figure 03:02 shows how a customer file is updated as a result of a credit sale transaction.

As seen above, when a credit sale is made to a customer, computer searches for the related customer in the accounts receivable file via customer account number. In this case, there is no chance to go to wrong customer because every customer has unique customer account number. When the desired customer is found, amount in the current balance column is updated. It involves use of journals and registers to provide a permanent and chronological record of input. The common special journals are:

- Sales journal: - to summarize sales on A/c.
- Purchase journal: - to summarize purchase on A/c.
- Cash receipt journal: - to summarize receipt on A/c.
- Cash payment journal: - to summarize payment on A/c.

3.4.3 Data Storage:

For easy and efficient access to AIS, the data should be organized properly. Something for which information is stored is termed as entity. For example customer. Each entity has attributes, which needs to be stored e.g. Customer address. The specific data values for these attributes will differ among entities. The physical space, where these data values are stored is called as field. The set of fields about various attributes for same entity is termed as record. Related records are grouped to form file. For example, all customer receivable records are stored in an accounts receivable file. Finally a set of these interrelated centrally coordinated files is referred to as database. To continue our example, the account receivable file might be combined with customer, sales analysis and related files to form customer database.

In the AIS, the files used to store information about resources and agents are called ledgers. The general ledger contains the data for main headings while subsidiary ledger records all the detail data for any general ledger. For example, the general ledger containing total amount owed to the company by all customers has subsidiary accounts receivable ledger which keeps separate record for each individual customer. The general ledger account corresponding to each subsidiary ledger is called a control account. The relationship between general ledger control account and the individual account balances in subsidiary ledger helps in maintaining the accuracy of data stored in AIS. The list of all general ledger accounts an organization uses is termed as chart of accounts. The structure of chart of accounts is important aspect of AIS as it affects the preparation of final statements and reports.

3.4.4 Information Output:

After the data are entered into the computer and processed, information output is produced to meet the needs of the users. Information is presented in three forms: a document, a report, or a

response to a query. Documents are records of transactions or company data such as invoices. These documents can be printed out using printers. In addition, they can be stored as electronic images in the computer databases. Reports are prepared for internal and external users. For example, to meet the needs of external users such as creditors, financial statements should be prepared. In addition, computers can be programmed to display financial information automatically in a required form such as spreadsheets.

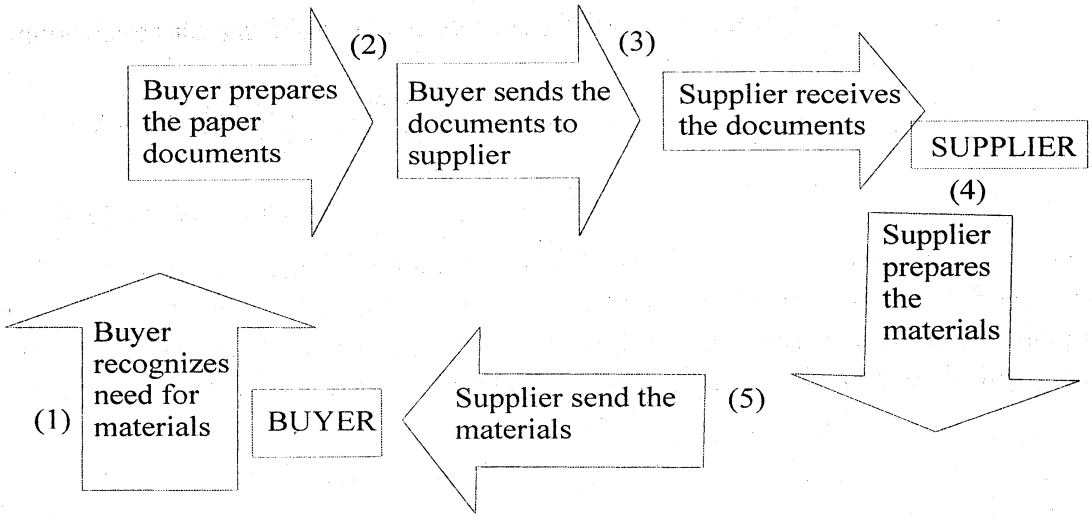
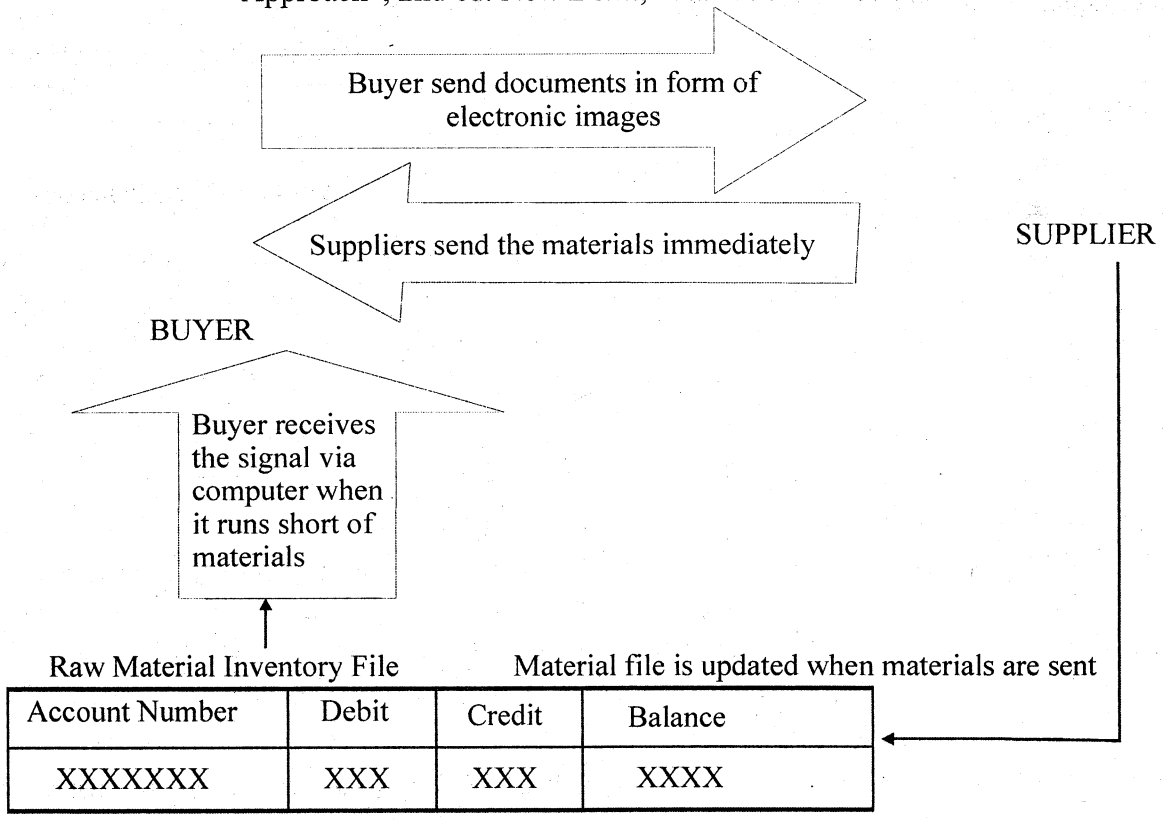


Figure 03:03: Procurement of Materials without Computerized AIS

Source: Jones and Rama (2007), " Accounting Information System: A Business Process Approach", 2nd ed. New Delhi, Tata McGraw-Hill.



Account Number	Debit	Credit	Balance
XXXXXXX	XXX	XXX	XXXX

Figure 03:04: Procurement of Materials with Computerized AIS

Source: Jones and Rama (2007), " Accounting Information System: A Business Process Approach", 2nd ed. New Delhi, Tata McGraw-Hill.

Today, electronic communication systems enable companies to transmit financial reports to the users electronically. This, of course, eliminates paper work and reduces costs. In addition to the reports produced for the needs of external users, reports can also be produced to meet the needs of the internal users such as managers. Sometimes, documents and periodic reports may not be enough to meet the needs of the users. If unexpected problems arise, managers can enter the system and query the information they need. A user enters a request into the computer to get the information, and the computer performs necessary tasks to solicit the required information. Once found, the information is retrieved and analyzed by the user. In manual AIS, transactions are first recorded in journals and then they are posted to ledger accounts. At the end of each accounting period, financial statements are prepared by using the ending balances of ledger accounts. On the other hand in computerized AIS, all the information is gathered in relational tables. In this case, financial statements can be prepared at any time by entering necessary commands into the computer.

Self Assessment Questions3.1

1. All the information (name, etc.) about a particular student is stored in which of the following?
   a) File
   b) Record
   c) Attribute
   d) field
2. The..... cannot make a decision itself like human beings.
3. The computerized accounting uses the concept of.....

3.5 Designing Double-Entry System

Accounting is structured to reflect the dual nature of business transactions. The two sides of every transaction, whether it is a sacrifice and reward, effort and benefit, or source and use must be in balance. This is what we call in accounting terminology "double-entry system". Accounting information technology is rooted in double entry accounting. Double entry accounting provides a platform for understanding the workings of virtually all accounting information systems. Computerized accounting systems automatically and accurately process transactions with minimal human intervention. The accountant should be in command of the system, not the system in command of the accountant. Accounting software packages are not and should not be treated as "black boxes" that produce analyses and financial statements. Even though debits and credits are not formally used in most computerized accounting systems, software developers are cognizant of double accounting and the traditional systems used by organizations to accumulate, analyze, and present financial information. Accountants are the designers and the managers of the system and, therefore, must understand its theoretical underpinnings. Accounting software must be adapted to meet the information needs of the organization. To accomplish this accountant must have an understanding of the theory of double entry accounting coupled with the workings of the software. Double entry accounting is not an artificial construct but is a natural representation of business events. The fundamentals of accounting are the same whether a manual or computerized system is used. A amount is assigned to each impacted account; the processing system aggregates all those transactions that affect particular accounts. When processing is complete, balances are determined and presented as financial statements.

Rather than using debits and credits computerized systems use binary (1,0) representation to accumulate transactions.

To implement a double-entry accounting system, forms and business paper must be designed, a technology must be selected and operating procedure must be designed with due care for internal control consideration. There are pre-determined steps which are essential for designing double-entry system. These are essential steps regardless of whether the data processing system is manual or computerized. The difference arises in complexity of these steps when one moves from a manual to a computerized accoun ting. Whatever may be an accounting system, it must fit a particular organisation. An organisational structure plays important role in designing double-entry system. Figure 03:05 illustrates a hierarchical structure of an organisation. The process begins with a determination of desired outputs of the accounting system. The basic objective of an accounting is to record, process and report financial information. This objective is reflected through organizations financial statements and other reports. All the activities are identified through the transaction cycle to which they belong. Once activities within each transaction cycle has been identified, they are grouped into application system which processes a logically set of transactions.these operating activities must be summarized in the form of standard journal entry. They are the entries that are expected to occur in normal operation of a system. They should indicate the accounts affected by them, their source (journal, department, computer run etc.) and the date & period of entry. They forms the basis for designing special journals. In computerized accounting, standard jornal entry specify the desired output from specific applications such as payroll system and indicates how these outputs enter the general ledger (master file). In a traditiopnal accounting system, the flow of processing is from sorce documents to journals, journals to ledgers and from ledgers to financial statements.

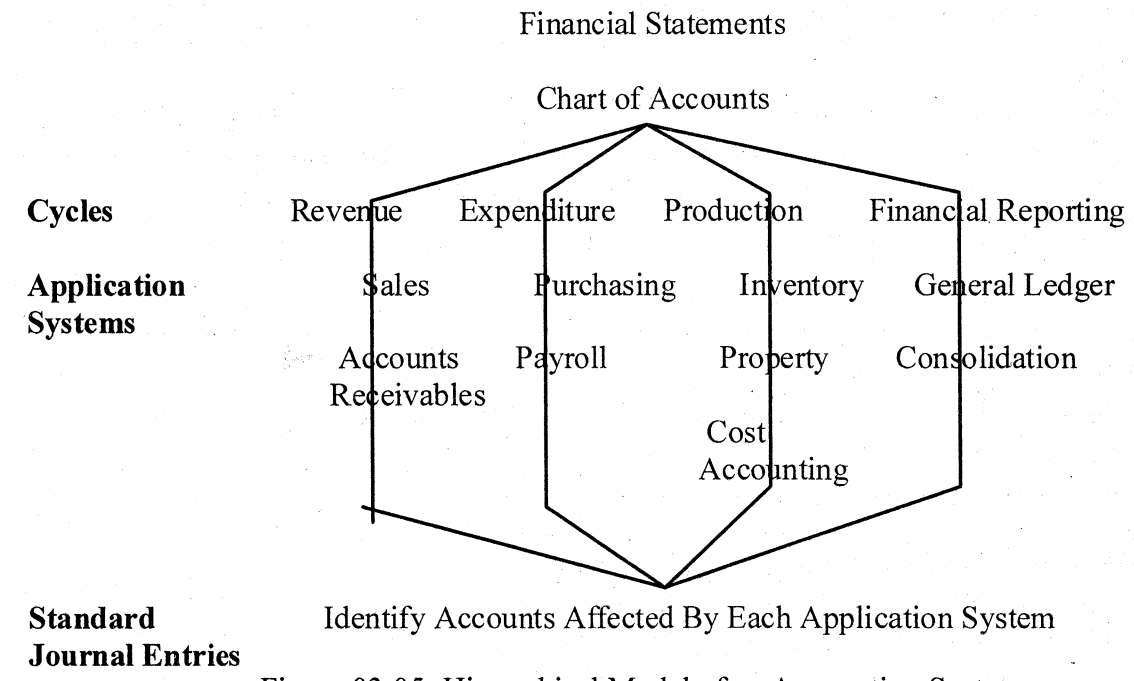


Figure 03:05: Hierarchical Model of an Accounting System

Source: Romney, M.B. & Steinbart, P.J. (2009), "Accounting Information Systems", ch.4, Prentice Hall.

Multiple transaction techniques – it is useful in the case of large volume of transactions. It reduces the clerical function of journalizing and posting. It includes one-write systems, where a writing board is designed to allow simultaneous recording on several documents. For example in recording a payroll, a current earning statement is prepared checking for each employee, payroll register is prepared and earning to each employee is updated. A writing board performs all the three functions

by writing the same only once. Other documents are automatically updated by using a carbon paper.

Ledgerless bookkeeping – in this sytem, the source documents are filed rather than posting them to other media. The file of source document serves as seperate ledger. It involves no posting. Like a statement of account will not be periodically mailed to customers. In ledgerless bookkeeping, numerical control of documents, pre-listing and batch controls ans subdivision of files to keep batch sizes reasonable are essential steps to compensate for lack of second record of transactions.

Coputer processing – computers can process the transactions by using two different modes. These are – batch processing and direct processing. In direct processing individual transactions rather than batches of batches of transactions are posted to ledgers. The need for seperate journals prior to posting to ledgers is eliminated.

Data validation – the accuracy and completeness during the input stage of computer processing is reviewed by the use of data validation. Computer is based on the concept of "Garbage in, Garbage out", thus the accuracy of financial reports depends on the accuracy of input to the accounting system.

In order to design financial statements and other reports, a **chart of accounts** has to be designed. An account is a place where data relevant to a particular activity are recordede and summarized. It contains three accounts – assets, liabilities and capital. Revenue and expenditure accounts forms the part of capital. Each of these three accounts are further divided into sub parts. A chart of accounts must be responsive to both the external as well as internal information users. Ledgers are sub-divided into two parts – general ledger and subsidiary ledger. General ledger contains accounts for assests, liabilities and capital. It summarizes trhe chart of accounts for the entire organization. Subsidiary ledgers are supporting ledgers and are used to tabulate and centralize information pertaining to specific accounts such as fixed assets, accounts payable etc. In large organizations, they are maintained by departments.

Documentation forms the essential part of double-entry system, which is facilitated by accounts manual. An account manual is a form of procedural documentation. Complete documentation of the organization and procedure of accounting system would include a detail description of job titles, chart of accounts and standard jornal entries and related procedures. They also help formalize internal control procedures.

Activity 3.2

1. What do you know about a coding system? List all the codes you know which are used in companies.

3.6 Coding Systems For Transaction Processing

A coding system consists of a character set which is a set of pre-defined symbols that are used to identify an object. It can be a numeric code (like 101,201) or an alphanumeric code which uses letters of alphabet and other specific symbols (like *, #), finally special machine-readable codes exist like bar codes. Coding system is built around individual character. Rules specify the manner in which characters are interpreted, they also specifies the value given to them and position of characters. The various numeric and alphanumeric coding can be as follows:

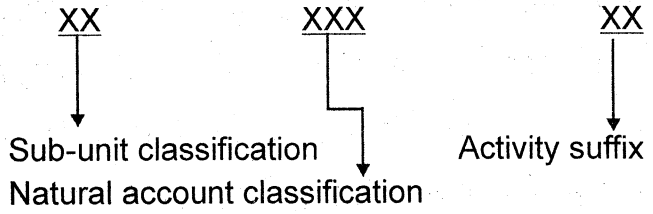
- **Block Codes** – it represents whole classes of items by restricting each class to a specific range within the coding scheme. A common application of block coding is the construction

of the chart of accounts, which is the basis of general ledger. Each account type is represented by a unique range of codes. In this example, each of the accounts consists of 3-digit code. The 1st digit is the blocking digit and represents the account classification for e.g. current assets, liability or operating expenses. The other digits in the code are sequentially assigned. It allows for insertion of new codes within a block without disturbing the entire series.

- **Sequential Codes** – represents items in some sequence like ascending or descending. A common application of numeric sequential codes is the pre-numbering of source documents. At printing, hard-copy documents are each given a unique sequential code number. It supports the reconciliation of batch of transactions. It alerts management to the possibility of a missing transaction. Management can even determine the cause and effect of error. But sequential codes do not carry information beyond their order in the sequence. For example a sequential code assigned to a raw material inventory tells nothing about its attributes like size, warehouse location etc. also it is difficult to change the codes once they are allotted.
- **Group or Hierarchical Codes** – these implies several sub classifications within each major block of data. Certain characters are reserved for each classification desired. Such codes generally consist of several blocks called fields.
- **Decimal Code** – it is a special variation of hierarchical codes. It differs from block codes as it allows for unlimited expansion to the right of decimal point. Major classifications are represented by fields to the left of the decimal point, while digits to the right of the point are not standardized and are used to provide sub-classifications. The major advantage of decimal codes is the capacity for unlimited easy expansion.

3.6.1 Coding In Accounting Systems:

Accounting system uses the codes to a wide extent. For TPS to process data efficiently, accounting data are often coded. We can have a common understanding of these through an example of chart of accounts. It is a hierarchical coding system. After selecting the accounts, they must be organized properly. Each account is given a multidigit code in which each digit denotes a particular classification. Below is an example of coding system given for a chart of accounts:



The first two digits of the seven-digit code are used to identify a division, department, profit or cost center. These sub units are numbered from 01 to 99. E.g. 01 (accounting department), 02 (research division). The next three digits represent specific categories: major account classification, financial statement classification and detail account classification. Major account classification can be numbered 100 to 900 (in hundreds). Financial statement classifications are the account titles used on a company's financial statements. These can be numbered 10 to 90 (in tens). Detailed account classifications are the transaction level accounts into which information is posted. They can be numbered 1 to 9. The rightmost two digits (activity suffix) may be used to denote a company's products or activities within sub-units.

Code should facilitate the desired presentation of information. The desired outputs must be identified before a chart of accounts is constructed. Here is the example of coding system for a chart of accounts:

05 211 04

In this code, the numbers represents the following:

- 05 - Production department.
- 211 - Here 200th item is asset, 10th item in the asset category is cash and 1 for checking bank account within that cash heading.
- 04 – Represents product number fourth.

3.6.2 Uses of Data Coding in AIS:

The company derives the following benefits by using coding system in presenting accounting information:

- Concisely represent large amount of complex information that would otherwise be unmanageable.
- Provide a means of accountability over the completeness of the transactions processed.
- Identify unique transactions and accounts with a file.
- Support the audit function by providing an effective audit trail.
- Provides a brief identification.
- Gives meaning to data in subsequent processing.

3.6.3 Design Consideration in Coding:

Choice of the code and the way they are constructed is determined by the code's use

- The need for consistency;
- Consideration of design efficiency;
- An allowance for growth;
- The desire to use standard code throughout a company;
- They should serve some useful purpose.

3.7 Summary

The most popular system of recording of accounting transactions is manual which requires maintaining books of accounts such as Journal, Cash Book, Special purpose books, ledger and so on. The accountant is required to prepare summary of transactions and financial statements manually. Now maintaining accounting records has become more convenient with the computerized accounting. The computerized accounting uses the concept of databases. For this purpose an accounting software is used to implement a computerized accounting system. Following are its components: Preparation of accounting documents, recording of transactions, preparation of trial balance and financial statements. Transaction processing system (TPS) is the first stage of computerized accounting system. TPS involves following steps in processing a transaction: Data Entry, Data Validation, Processing and Revalidation, Storage, Information and Reporting.

Shifting from manual to computerized accounting information system is a sign of advancement

in accounting profession. Manual accounting is differentiated from computerized accounting on the basis of recording, classification, summarizing, adjustment entries, grouping of accounts and preparation of financial statements. There are mainly four types of files used in computerized accounting information system. They are: master file, reference file, transaction file and lastly archive file.

In computerized AIS, after data are captured, they should be converted into machine-readable form. In most computerized AIS, source data automation devices that capture data at the time and place of their origins are used. In addition to the data scanned into the computer, there are existing data bases that contain stored data for future processing. A database includes information about entities. An entity is something about which information is stored. After the data are collected and entered into computers, they are processed. The most common data processing activity is data maintenance. Data maintenance is the processing of transactions to update stored data.

For easy and efficient access to AIS, the data should be organized properly. Something for which information is stored is termed as entity. Each entity has attributes, which needs to be stored In the AIS, the files used to store information about resources and agents are called ledgers. The general ledger contains the data for main headings while subsidiary ledger records all the detail data for any general ledger. The general ledger account corresponding to each subsidiary ledger is called a control account. The relationship between general ledger control account and the individual account balances in subsidiary ledger helps in maintaining the accuracy of data stored in AIS. After the data are entered into the computer and processed, information output is produced to meet the needs of the users. Information is presented in three forms: a document, a report, or a response to a query. Today, electronic communication systems enable companies to transmit financial reports to the users electronically. Once the information is retrieved and analyzed by the user, all the information is gathered in relational tables. Thus financial statements can be prepared at any time by entering necessary commands into the computer.

Accounting is structured to reflect the dual nature of business transactions. The two sides of every transaction, whether it is a sacrifice and reward, effort and benefit, or source and use must be in balance. This is what we call in accounting terminology "double-entry system". Accounting information technology is rooted in double entry accounting. Computerized accounting systems automatically and accurately process transactions with minimal human intervention. Rather than using debits and credits computerized systems use binary (1,0) representation to accumulate transactions. Thus computerized AIS mainly depend on coding system.

A coding system consists of a character set which is a set of pre-defined symbols that are used to identify an object. It can be a numeric code or an alphanumeric code which uses letters of alphabet and other specific symbols. The codes in accounting can be of following types: block codes, sequential codes, group or hierarchical codes and decimal code.

3.8 Key Words

- Information Technology - information technology is the use of computers and software to manage information.
- Accounting - Accounting is the method in which financial information is gathered, processed, and summarized into financial statements and reports.
- Computers - A computer is a machine for manipulating data according to a list of instructions.

- Computerized Accounting System - Computerized accounting is a beneficial use of current technological advances. Companies now create entire accounting information systems that integrate all business operations, including external suppliers and vendors in the value chain.
- Accounting software is a computer program that allows accountants to record and process financial transactions electronically.
- Manual System - A manual system usually means done by hand. That could be typing all your information into Notepad.
- Financial Statement - For a business enterprise, all the relevant financial information, presented in a structured manner and in a form easy to understand, are called the financial statements. They typically include Balance sheet, Income statement, Statement of retained earnings and Statement of cash flows.
- Accounting Transactions - Accounting transactions are the components of a system that keeps track of money. Each accounting detail when it is recorded is called a transaction. Accounting transactions are recorded according to the principle of a debit and credit.
- Database - A database consists of an organized collection of data for one or more uses, typically in digital form. It is a collection of information that is organized so that it can easily be accessed, managed, and updated.
- Transaction Processing System - A Transaction Processing System is a set of information which processes the data transaction in database system that monitors transaction programs.
- Data Entry - The process of entering data into a computerized database or spreadsheet.
- Data Validation - A process used to determine if data are accurate, complete, or meet specified criteria.
- Accounting Cycle - The Accounting Cycle is a series of steps which are repeated every reporting period. The process starts with making accounting entries for each transaction and goes through closing the books.
- Application Software - Application software is a subclass of computer software that employs the capabilities of a computer directly and thoroughly to a task that the user wishes to perform. It is a computer software designed to help the user to perform singular or multiple related specific tasks.
- Master File - A collection of records pertaining to one of the main subjects of an information system, such as customers, employees, products and vendors.
- Double-Entry System - The double entry system is the nearly universal practice in bookkeeping and accounting, by which each transaction causes at least two changes in the accounts. A credit entry in one account causes a corresponding debit entry in another account, thereby maintaining the accounting equation: Assets = Liabilities + Owners' Equity.
- Coding - A coding system consists of a character set which is a set of pre-defined symbols that are used to identify an object.

3.9 Abbreviations

Transaction Processing System (TPS)

Accounting Information System (AIS)

3.10 Hints/Key to Activities

Hints to self assessment questions 03:A:

Answer 1: (d)

Answer 2: Computer

Answer 3: Database

Answer 4: (a)

Hints to activity 03:A:

Answer 1: Try to find out the codes used in companies trough their published reports and financial statements.

3.11 Questions For Practice

1. Tally, Cash Manager, Best Books etc are all examples of
   a) Accounting software
   b) Accounting hardware
   c) Transaction processing system
   d) Transaction processing cycle
2. Which file in AIS contains past transactions for reference purposes
   a) Master file
   b) Reference file
   c) History file
   d) Transaction file
3. A database includes information about
   a) Resources
   b) Entity
   c) Ledgers
   d) Cardinalities
4. In the code "08 345 02", "02" represents
   a) Product
   b) Department
   c) Asset
   d) Liability
5. Explain the role of Computers in Accounting.
6. Differentiate between Manual accounting and computerized accounting system.
7. Enumerate the basic requirements of any computerized accounting system.
8. Explain various type of files used in AIS. Also give examples.
9. What do you mean by coding system? Explain various types of codes.

10. Explain the relevance of coding in accounting system. Is accounting possible without the use of codes. Explain why or why not.
11. How codes can be of immense help to an accountant.
12. What are the basic points which are to be considered while designing the codes?
13. Discuss the double-entry system used in AIS? How it differs from traditional accounting.

Key to questions:

Answer 1: (a)

Answer 2: (c)

Answer 3: (b)

Answer 4: (a)

3.12 Reference/Suggested Books

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UNIT-4

Coding System of Transaction Processing and Internal Control System

Outline of the unit

4.0 Objectives

4.1 Introductions

4.2 Purpose of Transaction Processing

4.3 Terminologies

4.4 Features of Transaction Processing System

4.5 Transaction Processing Qualifies

4.6 Coding System for Transaction Processing

4.7 Internal-Control Structure

4.8 Four Purpose of Internal Controls

4.9 Five Components of Internal Controls

4.10 Five key Internal Control Activities

4.11 Management Responsibility

4.12 Checklist for Managers

4.13 Framework for establishing and maintaining effective internal control

4.14 Self assessment questions

4.0 Objectives

After completing this unit, you will be able to:

- Discuss the features and qualifiers of Transaction Processing System.
- Understand the coding system for Transaction Processing.
- Describe the internal Control Structure and its components.
- Explain the key Internal Control Activities

4.1 Introduction

The value of information lies solely in its ability to affect a behavior, decision, or outcome. Information systems are implemented within an organization for the purpose of improving the effectiveness and efficiency of that organization. Capabilities of the information system and characteristics of the organization, its work systems, its people, and its development and implementation methodologies together determine the extent to which that purpose is achieved

Pyramid of systems that reflected the hierarchy of the organization, usually Transaction processing systems at the bottom of the pyramid, followed by Management information systems, Decision support systems and ending with Executive information systems at the top.

Different Organizations require different types of information systems to meet their needs. Information systems and computers function at the core of industries, such as automobiles, communications, education, entertainment, medical, space and sports. An increasing number of managerial personnel rely on computers and information system to make decisions.

4.2 Purpose of Transaction Processing

The primary purpose of transaction processing is to record, process, validate, and store transactions that take place in various functional areas of business for future retrieval and use.

Transaction processing is designed to maintain a computer system (typically a database or some modern file systems) in a known, consistent state, by ensuring that any operations carried out on the system that are interdependent are either all completed successfully or all canceled successfully.

For example, consider a typical banking transaction that involves moving $1000 from a customer's savings account to a customer's checking account. This transaction is a single operation in the eyes of the bank, but it involves at least two separate operations in computer terms: debiting the savings account by $1000, and crediting the checking account by $1000. If the debit operation succeeds but the credit does not (or *vice versa),* the books of the bank will not balance at the end of the day. There must therefore be a way to ensure that either both operations succeed or both fail, so that there is never any inconsistency in the bank's database as a whole. Transaction processing is designed to provide this.

In short, objectives of TPS are:

- Increase labor efficiency
- Capture, process and store transactions and produce output
- Maintain error-free data input and processing
- Ensure data and information integrit
- Produce timely documents and reports

4.3 Terminologies

Transaction: A transaction is an agreement, communication, or movement carried out between separate entities or objects, often involving the exchange of items of value, such as information, goods, services, and money.

Transaction Processing: In computer science, **transaction processing** is information processing that is divided into individual, indivisible operations, called transactions. Each transaction must succeed or fail as a complete unit; it cannot remain in an intermediate state.

Transaction Processing System: A transaction processing system is a type of information system. **TPSs** collect, store, modify, and retrieve the transactions of an organization. A transaction is an event that generates or modifies data that is eventually stored in an information system. To be considered a transaction processing system the computer must pass the **ACID** test. The essence of a transaction program is that it manages data that must be left in a consistent state.

For Example: If an electronic payment is made, the amount must be both withdrawn from one account and added to the other; it cannot complete only one of those steps. Either both must occur, or neither. In case of a failure preventing transaction completion, the partially executed transaction must be

'rolled back' by the TPS. While this type of integrity must be provided also for batch transaction processing, it is particularly important for online processing: if e.g. an airline seat reservation system is accessed by multiple operators, after an empty seat inquiry, the seat reservation data must be locked until the reservation is made, otherwise another user may get the impression a seat is still free while it is actually being booked at the time. Without proper transaction monitoring, double bookings may occur. Other transaction monitor functions include deadlock detection and resolution (deadlocks may be inevitable in certain cases of cross-dependence on data),

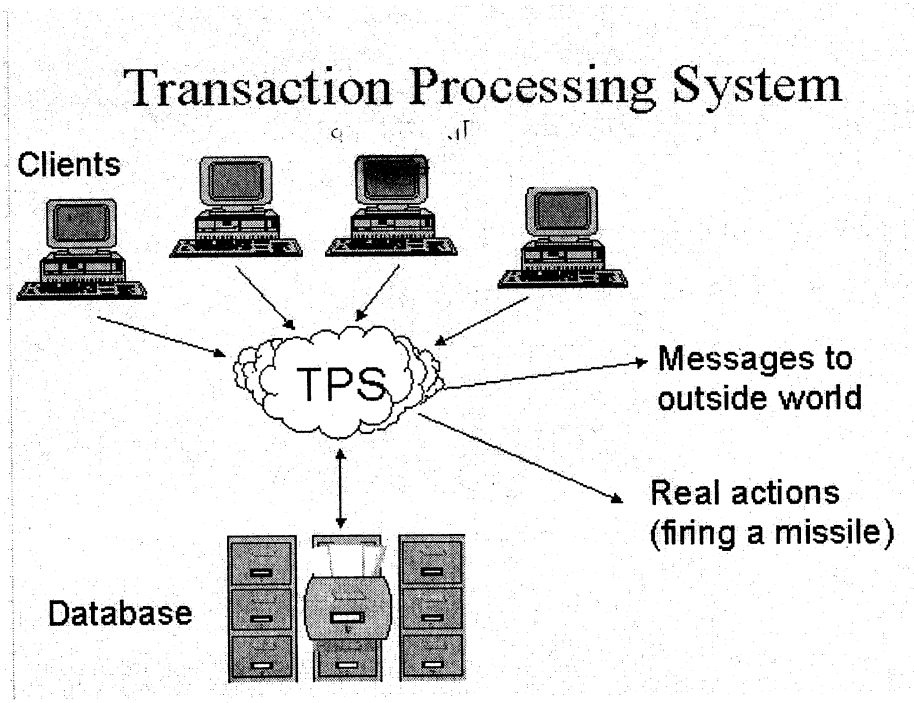
Rollback: In database technologies, a **rollback** is an operation which returns the database to some previous state. They are crucial for recovering from database server crashes; by rolling back any transaction which was active at the time of the crash, the database is restored to a consistent state.

Deadlock: A **deadlock** is a situation where in two or more competing actions are each waiting for the other to finish, and thus neither ever does. It is often seen in a paradox like the "chicken or the egg".

In computer science, deadlock refers to a specific condition when two or more processes are each waiting for each other to release a resource, or more than two processes are waiting for resources in a circular chain.

Data integrity is data that has a complete or whole structure. All characteristics of the data including business rules, rules for how pieces of data relate dates, definitions and lineage must be correct for data to be complete.

In terms of a database data integrity refers to the process of ensuring that a database remains an accurate reflection of the universe of discourse it is modeling or representing.



4.4 Features of Transaction Processing Systems

The success of commercial enterprises depends on the reliable processing of transactions to ensure that customer orders are met on time, and that partners and suppliers are paid and can make payment.

Transaction processing systems offer enterprises the means to rapidly process transactions to ensure the smooth flow of data and the progression of processes throughout the enterprise. Typically, a TPS will exhibit the following **characteristics**:

Rapid Processing: The rapid processing of transactions is vital to the success of any enterprise – now more than ever, in the face of advancing technology and customer demand for immediate action. TPS systems are designed to process transactions virtually instantly to ensure that customer data is available to the processes that require it.

Reliability: Similarly, customers will not tolerate mistakes. TPS systems must be designed to ensure that not only do transactions never slip past the net, but that the systems themselves remain operational permanently. TPS systems are therefore designed to incorporate comprehensive safeguards and disaster recovery systems. These measures keep the failure rate well within tolerance levels.

Standardization: Transactions must be processed in the same way each time to maximize efficiency. To ensure this, TPS interfaces are designed to acquire identical data for each transaction, regardless of the customer.

Controlled Access: Since TPS systems can be such a powerful business tool, access must be restricted to only those employees who require their use. Restricted access to the system ensures that employees who lack the skills and ability to control it cannot influence the transaction process.

4.5 Transactions Processing Qualifiers

In order to qualify as a TPS, transactions made by the system must pass the ACID test. The ACID tests refers to the following four prerequisites:

Atomicity: Atomicity means that a transaction is either completed in full or not at all. For example, if funds are transferred from one account to another, this only counts as a bone fide transaction if both the withdrawal and deposit take place. If one account is debited and the other is not credited, it does not qualify as a transaction. TPS systems ensure that transactions take place in their entirety.

Consistency: TPS systems exist within a set of operating rules (or integrity constraints). If an integrity constraint states that all transactions in a database must have a positive value, any transaction with a negative value would be refused.

Isolation: Transactions must appear to take place in isolation. For example, when a fund transfer is made between two accounts the debiting of one and the crediting of another must appear to take place simultaneously. The funds cannot be credited to an account before they are debited from another.

Durability: Once transactions are completed they cannot be undone. To ensure that this is the case even if the TPS suffers failure, a log will be created to document all completed transactions.

These four conditions ensure that TPS systems carry out their transactions in a methodical, standardized and reliable manner.

4.6 Coding Systems for Transaction Processing

A coding system consists of a character set; that is, a set of admissible predefined symbols that are used to identify the object of interest.

Two purposes of a code are -

- It provides a brief identification.
- It gives meaning to data in subsequent processing.

Some examples of codes are -

- numeric codes
- alphanumeric codes
- machine-readable codes

The Universal Product Code is an example of a bar code.

Coding Systems

- **Mnemonic Codes** give visible clues concerning the objects they represent
- **Sequence Codes** are the simplest type of coding scheme that assign numbers or letters in consecutive order
- **Block Codes** assign a series of numbers within a sequence to entities or events having common features
- **Group Codes** reveal two or more dimensions or facets pertaining to an object

Design Considerations in Coding

- Codes should serve some **useful purpose**
- Codes should be **consistent**
- Codes should be **standardized** throughout the organization
- Codes should **plan** for future expansion.

4.7 Internal Control structure

Internal control is focused on the achievement of the organization's mission. Therefore, it is essential that an organization have a clearly stated mission that is known and understood by everyone in the organization. It is also important to understand that, while good internal control will provide "reasonable assurance" goals and objectives are met, good internal control cannot guarantee organizational success. However, goals and objectives are much less likely to be met if internal control is poor.

Internal control is defined as follows:

Internal control is the integration of the activities, plans, attitudes, policies, and efforts of the people of an organization working together to provide reasonable assurance that the organization will achieve its objectives and mission.

Why are Internal Controls Important?

- Internal control, or management control, helps to provide reasonable assurance that the organization
- adheres to laws, regulations, and management directives;
- promotes orderly, economical, efficient, and effective operations and achieves planned outcomes;
- safeguards resources against fraud, waste, abuse, and mismanagement;
- provides quality products and services consistent with the organization's mission; and
- develops and maintains reliable financial and management information and fairly discloses that data through timely reporting.

Therefore, it is essential that all managers in an organization understand the importance of establishing and maintaining effective internal control. For this reason, the Internal Control Standards Committee of the International Organization of Supreme Audit Institutions (INTOSAI) has prepared this booklet to:

- provide an overall framework for establishing and maintaining effective internal controls,
- describe internal control roles and responsibilities for government managers and auditors,
- describe common internal control practices,
- provide a simple checklist to help you begin thinking about whether your organization has taken appropriate steps to ensure effective internal control, and
- provide a list of references for further information.

4.8 Four Purposes of Internal Control

While the overall purpose of internal control is to help an organization achieve its mission, internal control also helps an organization to:

1. Promote orderly, economical, efficient and effective operations, and produce quality products and services consistent with the organization's mission.
2. Safeguard resources against loss due to waste, abuse, mismanagement, errors and fraud.
3. Promote adherence to laws, regulations, contracts and management directives.
4. Develop and maintain reliable financial and management data, and accurately present that data in timely reports.

4.9 Five Components of Internal Control

- Control Environment
- Communication
- Assessing And Managing Risk
- Control Activities
- Monitoring

- **Control Environment** Control environment is the attitude toward internal control and control consciousness established and maintained by the management and employees of an organization. It is a product of management's governance, that is, its philosophy, style and supportive attitude, as well as the competence, ethical values, integrity and morale of the people of the organization. The control environment is further affected by the organization's structure and accountability relationships.

The control environment has a pervasive influence on the decisions and activities of an organization, and provides the foundation for the overall system of internal control.

- **Communication** Communication is the exchange of useful information between and among people and organizations to support decisions and coordinate activities. Information should be communicated to management and other employees who need it in a form and within a time frame that helps them to carry out their responsibilities. Communication with customers, suppliers, regulators and other outside parties is also essential to effective internal control. Information can be communicated verbally, in writing and electronically. While verbal communication may be sufficient for many day-

to-day activities, it is best to document important information. This provides a more permanent record and enables managers and others to review the information. Information should travel in all directions to ensure that all members of the organization are informed and that decisions and actions of different units are communicated and coordinated. A good system of communication is essential for an organization to maintain an effective system of internal control. Information is useful when it is timely, sufficiently detailed and appropriate to the user.

Communication is not an isolated internal control component. It affects every aspect of an organization's operations and helps support its system of internal control. The feedback from this communication network can help management evaluate how well the various components of the system of internal control are working.

- **Assessing and Managing Risk:** Risk should be assessed and managed through an organization-wide effort to identify, evaluate and monitor those events that threaten the accomplishment of the organization's mission. For each risk that is identified, management should decide whether to accept the risk, reduce the risk to an acceptable level, or avoid the risk.

- **Control Activities** Control activities are tools - both manual and automated - that help identify, prevent or reduce the risks that can impede accomplishment of the organization's objectives. Management should establish control activities that are effective and efficient.

When designing and implementing control activities, management should try to get the maximum benefit at the lowest possible cost.

- **Control Activities for Information Technology:** While some of the control activities relating to information technology (IT) are the responsibility of specialized IT personnel, other IT control activities are the responsibility of all employees who use computers in their work. For example, any employee may use:
  - Encryption tools, protocols, or similar features of software applications that protect confidential or sensitive information from unauthorized individuals;
  - back-up and restore features of software applications that reduce the risk of lost data;
  - Virus protection software; and
  - Passwords that restrict user access to networks, data and applications.

- **Monitoring:** Monitoring is the review of an organization's activities and transactions to assess the quality of performance over time and to determine whether controls are effective. Management should focus monitoring efforts on internal control and achievement of the organization's mission. For monitoring to be most effective, all employees need to understand the organization's mission, objectives, risk tolerance levels and their own responsibilities. Everyone within an organization has some responsibility for monitoring. The position a person holds in the organization helps to determine the focus and extent of these responsibilities.

4.10 Five Key Internal Control Activities

1. Separation of Duties

- Divide responsibilities between different employees so one individual doesn't control all aspects of a transaction.
- Reduce the opportunity for an employee to commit and conceal errors (intentional or unintentional) or perpetrate fraud.

2. **Documentation**

Document & preserve evidence to substantiate:

- Critical decisions and significant events...typically involving the use, commitment, or transfer of resources.
- Transactions enables a transaction to be traced from its inception to completion.
- Policies & Procedures documents which set forth the fundamental principles and methods that employees rely on to do their jobs.

3. **Authorization & Approvals**

- Management documents and communicates which activities require approval, and by whom, based on the level of risk to the organization.
- Ensure that transactions are approved and executed only by employees acting within the scope of their authority granted by management.

4. **Security of Assets**

- Secure and restrict access to equipment, cash, inventory, confidential information, etc. to reduce the risk of loss or unauthorized use.
- Perform periodic physical inventories to verify existence, quantities, location, condition, and utilization.
- Base the level of security on the vulnerability of items being secured, the likelihood of loss, and the potential impact should a loss occur.

5. **Reconciliation & Review**

- Examine transactions, information, and events to verify accuracy, completeness, appropriateness, and compliance.
- Base level of review on materiality, risk, and overall importance to organization's objectives.
- Ensure frequency is adequate enough to detect and act upon questionable activities in a timely manner.

4.11 Management Responsibility

Managers should realize that a strong internal control structure is fundamental to control of an organization and its purpose, operations, and resources.

Management has an obligation to ensure that internal control processes are cost-effective and consistent with agency operational needs, and recognize changing operational requirements. To achieve this goal, management should:

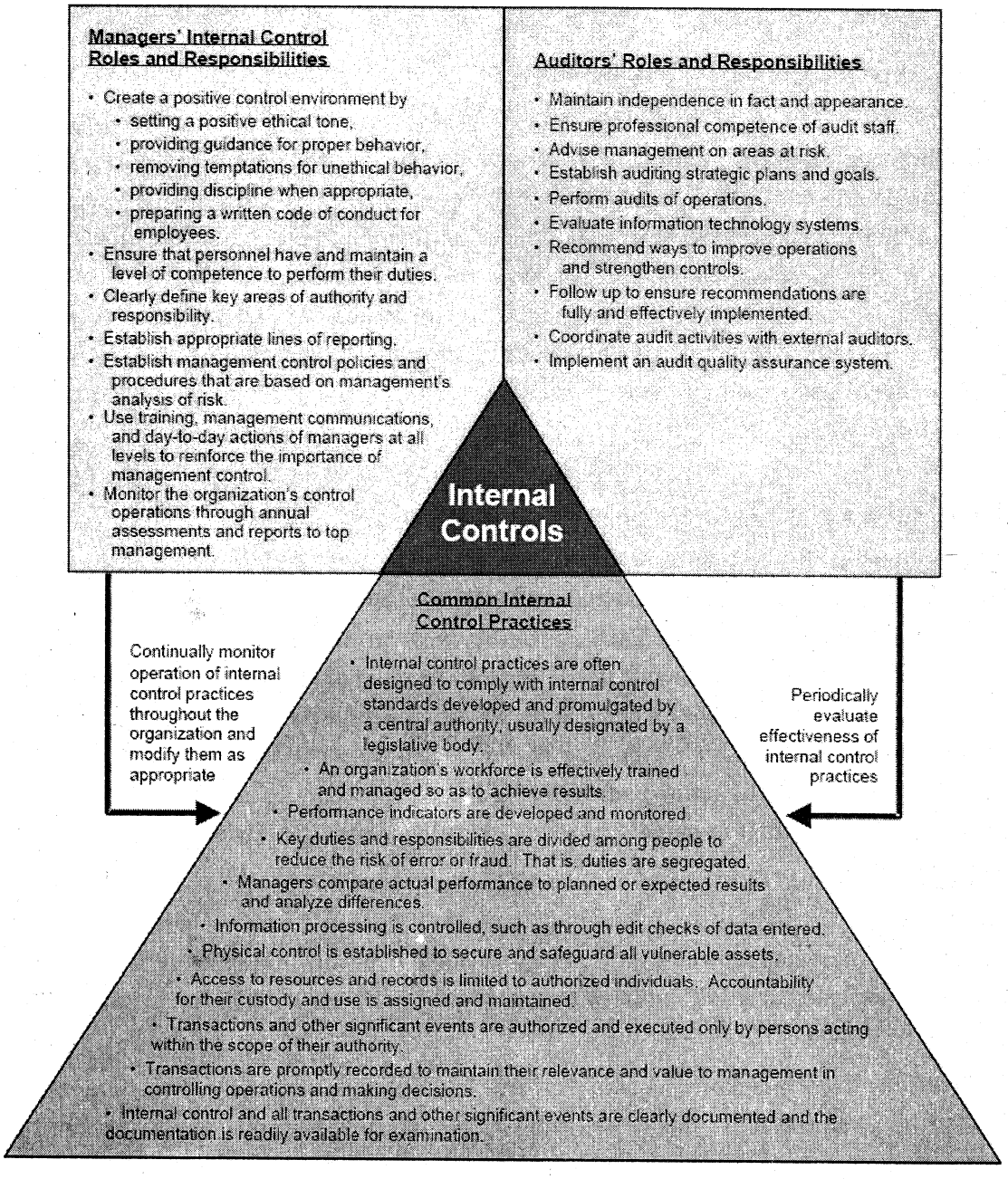
- recruit staff with skills sufficient to deliver agency objectives
- provide appropriate training to staff
- undertake regular reviews to ensure that internal controls are continuing to achieve the stated objectives cost-effectively
- implement mechanisms to review existing processes, or implement new processes, resulting from ongoing operational and risk assessment reviews.
- ensure financial management practice manuals and other agency-specific documentation are up to date and reflect current agency operations and objectives.

4.12 Checklist For Managers

For implementing internal control

- Adopted effective internal control throughout the organization?
- Based the organization's internal control on sound internal control standards?
- Included in the organization's internal control structure appropriatand cost-effective control practices?
- Prescribed control practices through management directives, plans, and policies?
- Established a means of continually monitoring the operation of the organization's internal control practices?

4.13 Framework for Establishing and Maintaining Effective Internal Control



Supporting Activities: Evaluation, strategic planning and internal audit are all activities that support a good system of internal control. They provide management with additional tools to help ensure that the mission of the organization will be achieved.

Evaluation : Evaluation is the process management uses to determine whether:

- the organization will likely achieve its goals and objectives;
- the elements of the organization's system of internal control are functioning effectively;
- risks to the organization and opportunities for improvement are being identified.

It is important to note the distinction between evaluation and monitoring. Monitoring involves performing daily or routine procedures - like supervision, transaction review and problem resolution - that help to ensure operations are in compliance with the organization's system of internal control. Evaluation, on the other hand, involves doing periodic assessments of the organization's performance compared to established expectations or measurement standards.

Evaluation can be accomplished through **self-assessment** and **independent review**. Self assessment should be the primary basis for evaluation. Regular self-assessment helps management detect problems early, and thus minimizes the costs of these problems. Self assessments should be scheduled regularly, and should be performed throughout the organization.

Strategic Planning: Strategic plans are the courses of action that will enable an organization to achieve its objectives and goals. Planning should begin at the top levels of management with a strategic plan that focuses on the long-range direction of the organization. The strategic planning process should include establishing the organization's broad organizational objectives and developing the strategies that should be followed to achieve them. Based on the direction provided by the organization's strategic plan, management should develop plans for each major organizational division with a long-range focus specific to that division. The division plans guide managers in developing shorter-range operational plans for each of the major functions performed within their respective divisions.

Internal Audit: Internal audit functions add value to an organization's internal control system by bringing a systematic, disciplined approach to the evaluation of risk and by making recommendations to increase the effectiveness of risk management efforts, improve the internal control structure and promote good corporate governance. The Legislature, in passing the Internal Control Act, recognized the internal audit function's key role in supporting the internal control system and, as such, made the Division of the Budget responsible for designating which State agencies would be required to maintain internal audit units. The Division of the Budget makes this determination based in part on the size, nature and/or complexity of agency operations. Other entities may choose to establish an internal audit function as part of their management of risks and resources.

Continuing Professional Education : To be effective in a changing world, all audit staff need to maintain and enhance their technical competence through a program of continuing education. Professional audit standards, as well as various professional licensing programs including the Certified Internal Auditor and the Certified Public Accountant are all subject to periodic continuing education requirements.

Communication: Communication is also a critical factor in ensuring that internal audit operations provide maximum value to the organization. Professional standards require periodic meetings between the internal auditor, executive management and any governing board or audit committee that may

exist. These meetings are essential to ensure the independence, effectiveness and accountability of the internal audit activity and should be held at least quarterly. The timely distribution of internal audit reports is another integral way that communication supports the independence, effectiveness and credibility of the internal audit organization.

Maintaining Audit Documentation: Internal audit units should maintain documentation for each audit and subsequent follow-up. This documentation should contain sufficient information to enable an experienced auditor who has no previous connection with the audit to ascertain the evidence that supports the auditors' significant judgments and conclusions. Each internal audit unit should establish a formal policy that clearly delineates who is responsible for reviewing audit documentation prepared by various staff levels and when that review should occur.

Audit documentation is the auditors' property and should be kept under their control. The auditors should know exactly where all pieces of documentation are at all times during the conduct of the audit.

4.14 Self Assessment Questions

1. Define Transaction processing system. Explain its Qualifiers.
2. What are the two types of transaction? Write down steps involved in processing a transaction.
3. Define internal control. Explain in brief purposes and five components of internal control.
4. Explain importance of Internal Control System.
5. Name five key internal control activities.
6. Describe the management responsibility for Internal Control Activities
7. Discuss features of Transaction processing system
8. Explain coding system for transaction processing.
9. Define :-
   a. Data integrity
   b. Rollback
   c. Deadlock

Unit 5

Revenue and Expenditure Cycles Applications

Outline of the Unit

5.0 Objectives

5.1 Introduction

5.2 Revenue Cycle

- 5.2.1 Objectives of the Revenue Cycle
- 5.2.2 Revenue Cycle Subsystems

5.3 Accounts Reciveble Systems

- 5.3.1 Methods of Maintenance of Accounts Receivable
- 5.3.2 Sales Returns and Allownaces
- 5.3.3 Write-off of Accounts Receivable
- 5.3.4 Lapping of Accounts Receivable - a Risk Exposure
- 5.3.5 Functions in the Revenue Cycle
- 5.3.6 Inputs to the Revenue Cycle
- 5.3.7 Outputs of the Revenue Cycle
- 5.3.8 Types of Managerial Decisions Pertaining to the Revenue Cycle
- 5.3.9 Typical Files Associated with the Revenue Cycle

5.4 Expenditure

- 5.4.1 Definition
- 5.4.2 The Expenditure Cycle
- 5.4.3 Objectives of the Expenditure Cycle
- 5.4.4 Functions in the Expenditure Cycle
- 5.4.5 Other Related Functions of the Expenditure Cycle
- 5.4.6 Inputes to the Expenditure Cycle
- 5.4.7 Outputs of the Expenditure Cycle
- 5.4.8 Inventory Control Output Reports of the Expenditure Cycle
- 5.4.9 Internal Controls in the Expenditure Cycle

5.5 Summary

5.0 Objectives

After studying this units you will be able to

- Understand revenue cycle of the business
- Understand Expenditure cycle of the business

5.1 Introduction

Revenue is something that fields a regular financial return or source of income. The amount

of money that a company actually receives during a specific period, including discounts and deductions for returned merchandise. It is the "top line" or "gross income" figure from which costs are subtracted to determine net income. Revenue is calculated by multiplying the price at which goods or services are sold by the number of units or amount sold.

Amount generated from sale of goods or services, or any other use of capital or assets, associated with the main operations of firm before any costs or expenses are deducted. Revenue is shown usually as the top item in an income (profit and loss) statement from which all charges, costs, and expenses are subtracted to arrive at the net income of the firm. Also called sales, or (in the UK) turnover.

For a company, this is the total amount of money received by the company for goods sold or services provided during a certain time period. It also includes all net sales, exchange of assets; interest and any other increase in owner's equity and is calculated before any expenses are subtracted. Net income can be calculated by subtracting expenses from revenue. In terms of reporting revenue in a company's financial statements, different companies consider revenue to be received, or "recognized", different ways. For example, revenue could be recognized when a deal is signed, when the money is received, when the services are provided, or at other times. There are rules specifying when revenue should be recognized in different situations for companies using different accounting methods, such as cash basis and accrual basis.

For the government, the increase in assets of governmental funds that do not increase liability or recovery of expenditure. This revenue is obtained from taxes, licenses and fees.

5.2 Revenue Cycle

The term revenue cycle refers to all of the steps required in the Sales, Operations and Credit & Collections processes to facilitate revenue recognition. This document is an educational tool for professionals in all departments of publisher organizations and addresses every step of the revenue cycle, from the Request for Proposal (RFP) to managing the Days Sales Outstanding (DSO).

The recommendations outlined in this document address two main areas:

Interdepartmental communication between Credit & Collections, Sales and Operations.

Processes and controls that ensure the necessary steps are taken and approvals obtained prior to taking action.

These Best Practices were developed by examining friction within the revenue cycle and determining the underlying causes and possible solutions. The document is organized by each revenue cycle phase (Request for Proposal, Proposal, Insertion Order (IO), Delivery and Optimization, Collections).

5.2.1 Objectives of the Revenue Cycle

- To record sales orders promptly and accurately
- To verify that the customers are worthy of credit
- To ship the products or perform the services by agreed dates
- To bill for products or services in a timely and an accurate manner
- To record and classify cash receipts promptly and accurately
- To post sales and cash receipts to proper customers' accounts in the accounts receivable

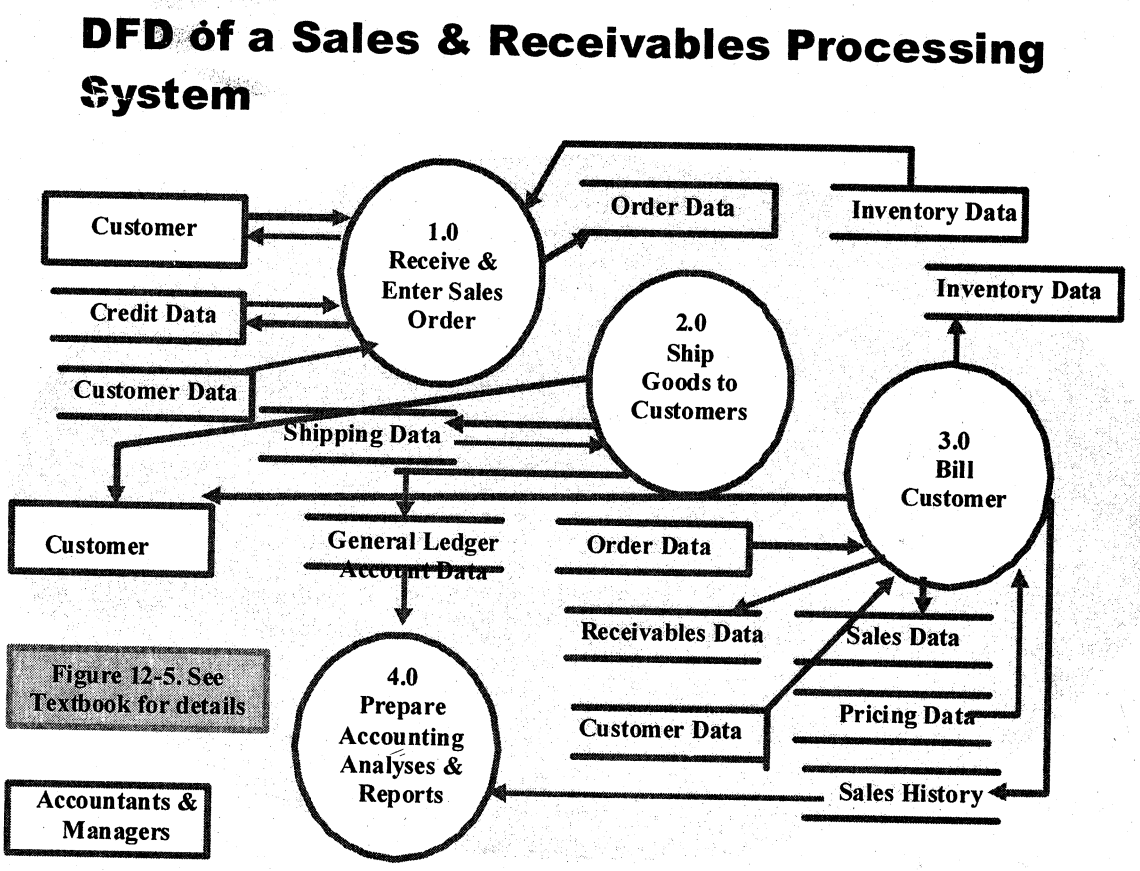
ledger

- To safeguard products until shipped
- To safeguard cash until deposited

5.2.2 Revenue Cycle subsystems

- Sales Order Processing
- Accounts Receivable System
- Web based systems

DFD of a Sales & Receivables Processing System



Sales order processing is an important step in a series of processes that leads directly to revenue for your company. And the way your company handles its sales orders says a lot about it.

Types of Sales Order Systems

- Incomplete pre billing:- the invoice is not completed until the goods are ready for shipment
- Separate order and billing:- both a sales order and an invoice are used in a sales order application system
- Post billing: - the invoice is prepared or completed after shipment.

5.3 Accounts Receivable Systems

An accounts receivable system is a system that is totally integrated and is a consistent sub-system of general ledger systems. It is designed to generate computerized invoices through to the receipting of generated invoices

Factoring of Accounts Receivable

Factoring involves selling accounts receivable at a discount to collection agencies.

- Advantages: avoids accounts receivable recordkeeping costs and speeds up cash collection.
- Disadvantages: fees charged by factoring agencies are unusually large and there could be potential negative effects of factoring on customer relations.

Accounts Receivable Functions

- Cash Receipts
- Billing
- Accounts Receivable
- Credit
- General Ledger

Web-Based Systems

- Electronic commerce
- Larger customer base
- Quicker processing of transactions
- Less paperwork
- Greater efficiency & productivity
- Self-service
- AICPA's Web-Trust and competing services

5.3.1 Methods of Maintenance of Accounts Receivable

- Balance Forward Method - applies a customer payment against the outstanding balance rather than against a specific invoice by merging all invoice amounts of previous months and showing a "balance forward".
- Open invoice Method - matches each payment with a specific invoice, thus disputed invoices are more easily isolated.

5.3.2 Sales Returns and Allowances

- Credit Memorandum: a form used to document reductions to a customer's account due to sales returns or sales allowances.

5.3.3 Write-off of Accounts Receivable

- Numerous techniques are available to collect past due accounts (e.g., follow-up letters, collection agencies), but some accounts are ultimately worthless
- Central feature in a write-off procedure is an analysis of past due accounts, usually done with an aged trial balance.

5.3.4 Lapping of Accounts Receivable-a Risk Exposure

- Lapping is a type of embezzlement that involves the theft of cash and its concealment by a succession of delayed postings to customer accounts.
- The risk exposures include a loss of funds received from customers and overstated accounts receivable balances.

- Using a bank lockbox system and segregation of duties can help reduce exposure.

5.3.5 Functions in the Revenue Cycle

- Sales department obtains customer order and validates.
- Credit department checks customer's credit.
- Sales department determines that products or services are available and prepares a sales order.
- Stores assemble goods for shipment which may involve using a picking ticket to remove goods from the warehouse.
- Shipping department ships ordered goods including a packing slip for customer validation.
- Billing department bills customer upon receipt of a shipping notice from shipping department.
- Cashier receives and deposits cash intact daily using a deposit slip.
- Accounts receivable clerk updates accounts receivable database by reference to the customer remittance advice which accompanies payment.
- Appropriate personnel prepare needed reports.

5.3.6 Inputs to the Revenue Cycle

- Sales Orders - prenumbered and usually prepared in multiple copies.
- Sales Invoices - prepared after shipment of goods or providing of a service.
- Customer Checks - deposited intact daily by cashier.
- Remittance Advices - serve as source document for credits to accounts receivable; advices may be turnaround documents.
- Shipping Notices - copies will serve as packing slips and bills of lading.
- Credit Memos - issued for sales returns and allowances.

5.3.7 Outputs of the Revenue Cycle

- Open Orders Report - lists those sales orders that are not completely shipped and billed.
- Customer Billing Statement - includes customer account activity such as sales, returns, and cash receipts.
- Accounts Receivable Aging Statement - contains data concerning the status of open balances of all active credit customers arranging the overdue amounts by time periods.
- Sales Analysis Reports - captures detailed data about each sale in order to monitor sales activities and plan production and marketing efforts.
- Customer Listing Report - shows customer codes, contacts, shipping and billing addresses, credit limits, and billing terms.

5.3.8 Types of Managerial Decisions Pertaining to the Revenue Cycle

Financial Decisions :-

- What criteria are to be employed in granting credit to potential customers?
- What collection methods are to be employed in minimizing bad debts?

- What accounts receivable records are to be maintained concerning amounts owed by customers?
- What sources, other than receipts from sales, are to be employed in obtaining needed funds for operations?
- What financial plans and cash budgets are to be established for the coming year?

5.3.9 Typical Files Associated with the Revenue Cycle

Master Files :-

- Customer master file
- Accounts receivable master file
- Merchandise inventory master file

Transaction & Open Document Files :-

- Sales order file
- Open sales order file
- Sales invoice transaction file
- Cash receipts transaction file

Other Files :-

- Shipping & Price data reference file
- Credit reference file
- Salesperson file
- Sales history file
- Cash receipts history file
- Accounts receivable report file

5.4 Expenditure

5.4.1 Definition

The act or process of expending, an outlay, a payment, the promise of a future payment.

Actual payment of cash or cash-equivalent for goods or services, or a charge against available funds in settlement of an obligation as evidenced by an invoice, receipt, voucher, or other such document. A revenue expenditure is cash used in payment for goods and services consumed in a short period. A capital expenditure is cash used in purchase of fixed assets that last one year or more.

5.4.2 The Expenditure Cycle

- The purpose of the **Expenditure Cycle** is to facilitate the exchange of cash with vendors for needed goods and services.
- Purchases may be for cash or credit
- The Expenditure Cycle captures information relating to purchases, suppliers, and payables

5.4.3 Objectives of the Expenditure Cycle

- The primary objective of the expenditure cycle is to minimize the total cost of acquiring and maintaining inventory, supplies, and services.

- Ensure goods and services are ordered as needed.
- Receive all ordered goods, verify condition, and safeguard until needed.
- Determine that vendor invoices are valid and correct and paid at the optimal time for cash discounts and avoidance of finance charges for late payment.
- Maintenance of vendor records by the purchasing department, which is responsible for finding reputable vendors who offer quality goods and services at reasonable prices.
- Forecast cash outflows in order to prepare a cash budget.

5.4.4 Functions in the Expenditure Cycle

- Stores recognize the need for goods or services and issue a purchase requisition.
- Purchasing department places an order for goods or services by issuing a legally binding purchase order with a supplier. The purchase order identifies the vendor, confirms the goods ordered, quantity, price, delivery date, and payment terms.
- Receiving department receives goods or accepts services and completes a receiving report after inspecting and counting goods.
- Accounts payable department ascertains validity of the payment obligation by vouching the vendor invoice to supporting documentation.
- Accounts payable prepares the disbursement check on the basis of approved vendor invoices.
- Accounts payable department maintains accounts payable and General ledger department posts transactions to the general ledger.
- Appropriate personnel prepare needed financial reports and other outputs.

5.4.5 Other Related Functions of the Expenditure Cycle

- Payroll disbursements - includes accrual of payroll and employer payroll taxes
- Capital expenditures - includes acquiring, trading, salvaging and depreciating plant assets
- Purchase returns and allowances - arise when the purchasing firm is unsatisfied with ordered goods and a debit memorandum is issued
- Miscellaneous cash disbursements - i.e., discharge bank loans, acquire investments and repurchase stock
- Petty cash disbursements - in order to control these small expenditures an imprest system is normally used.

5.4.6 Inputs to the Expenditure Cycle

- List of Approved Vendors - reflects merchants with whom the company has been authorized to do business
- Purchase Requisition - shows items requested by stores and may indicate the name of the vendor
- Purchase Order - based on purchase requisition but also includes vendor information and payment terms
- Vendor Invoice - includes items shipped by vendors, prices, shipping terms, and discounts provided

- Receiving Report - reflects the count and condition of received goods.

5.4.7 Outputs of the Expenditure Cycle

- Open Purchase Order reports - show all purchases for which invoices have not been approved for payment.
- Open Invoices reports - list all approved invoices that are currently unpaid.
- Inventory Status reports - contain quantities received, shipped, and on hand for each type of inventory.
- Overdue Deliveries reports - reflect purchase transactions which have arrived late from suppliers.
- Payables Aging reports- reflect the status of old unpaid invoices due to unresolved questions or liquidity problems.
- Vendor checks - should be supported by a voucher and signed by a person designated by management.
- Check registers - list all checks issued for a particular period.
- Discrepancy reports - used to identify any differences among quantities on the purchase order, receiving report, and vendor invoice.
- Cash requirement forecasts - predict future payments and payment dates by reference to outstanding purchase order, unbilled receiving reports, and vendor invoices.

5.4.8 Inventory Control Output Reports of the Expenditure Cycle

- Price lists - maintained to show prices charged for raw materials and to determine standard costs for budgeting production costs
- Periodic Usage reports - provide managerial information about how various production departments are using raw materials
- Inventory Status reports show inventory levels for purchasing and production purposes
- Inventory Reconciliation reports note discrepancies between the physical inventory count and book balances

Check Kiting - a Risk Exposure

- **Kiting** is a type of embezzlement that involves transfers of checks among bank accounts.
- The purpose is generally to cover cash shortages or to inflate assets.
- The risk of kiting can be reduced if bank reconciliations are prepared and compared with respect to all bank accounts as of the same date.

Voucher System of Cash Disbursements

- Before payment to a vendor an accounts payable clerk matches together the purchase requisition, purchase order, and receiving report with the vendor invoice and prepares a **voucher**.
- The voucher serves as a control over cash disbursements to vendors by avoiding duplicate payments.

5.4.9 Internal Controls in the Expenditure Cycle

- Purchase requisitions should originate and be approved outside the purchasing department.

- Purchasing should implement competitive bidding procedures.
- Receiving should be separate from stores and should perform a blind count of shipments received.
- Written authorization should accompany the movement of inventory.
- Accounts payable should employ a voucher system.
- Cashier should sign checks.
- A physical count of inventory should be taken and compared to inventory records.

Payroll

- Personnel
- Timekeeping
- Payroll

Personnel

- Responsible for placing people on the company's payroll, specifying rates of pay, and authorizing all deductions from pay.

Timekeeping

- Timekeeping is responsible for the preparation and control of time reports and job time tickets.
- Timekeeping reconciles employee hours to job time summary reports received from production.

Payroll

- The payroll department is responsible for the actual computation and preparation of payroll.
- It should be noted that payroll is independent of timekeeping and personnel

Payroll Register

- Details the computation of net pay (gross pay less deductions from pay).

Payroll Controls

- Paychecks are sent to cash disbursements for signature, review, and distribution.
- The use of a separate imprest payroll account for paychecks to facilitate reconciliation.
- An independent reconciliation of the payroll account bank statement independent paymaster.
- The person who distributes pay is independent of the payroll preparation process.

Payroll Processing Requirements

- Federal old-age, survivors', disability, and hospital insurance (F.I.C.A.)
- Federal unemployment insurance.
- State unemployment insurance.
- Income taxes withheld.

Tax Forms

- Form 941 – Quarterly filing summarizing federal withholding, social security, and medicare taxes.

- Form W-2 – On or before Jan 31 an employee must provide employees with this wage and tax statement.
- Form W-3 – Summary form that accompanies copies of Forms W-2 sent to the federal government on or before Feb. 28.
- Form 1099 Misc – Documents contract services over a certain amount in a given year.
- Earnings statement – Statement summarizing payroll computations for an employees pay check.

IV. The Payroll Application System

- The Role of Personnel
- Payroll Processing
- Internal Audit and the Bank Reconciliation

A. The Role of Personnel

- The authorization for placing people on the payroll should be separated from the record keeping that payroll performs.

C. Internal Audit and the Bank Reconciliation

- Internal audit received information directly from the bank and performs an independent reconciliation of the payroll bank account.

Web Security Procedures

- Authentication
- Authorization
- Use of an Access Control List
- Accountability
- Data Transmission
- Disaster Contingency & Recovery Plan

5.5 Summary

- Forms used in the expenditure cycle
- Steps of the expenditure cycle
- Payroll duties
- Possible Payroll Features
- Payroll Forms
- Steps in the payroll cycle

Unit -6

Introduction to Database Management

Outline of The Unit:

6.0 Objectives

6.1 Introduction

6.2 Concepts and definition of DBMS

6.3 Structure of DBMS

6.3.1 Data Models

6.3.2 Internal Schema

6.4 Types of DBMS

6.5 Database Organization and Development

6.6 Relational database management system

6.6.1 Relational Algebra

6.6.2 Normalization

6.6.3 Functional Dependencies

6.7 Summary

6.8 Keywords

6.9 Abbreviations Used

6.10 Hint/Key to activities or SAQ

6.11 Question for Practice

6.12 Reference/suggested Books

6.0 Objectives

After studying this unit, you will be able to:

- understand the concept ,meaning, Definitions of database management system ,
- know the structure and types of databases
- comprehend the database organization

6.1 Introduction

The non-technical dictionary meaning of database is "a store of a large amount of information, especially in a form that can be handled by a computer". A database is a collection or set of related data arranged-logically in a structured form designed to meet the information requirement on non redundant operational data which are sharable between different application systems. The advantage with a database is that the data remains independent of the application programs that use them. Further the data is accessible to any programme with a legitimate need for them, regardless of where the data is physically located. It is also accessible to any programme regardless of the language in which the programme is written. Data are not duplicated in different locations. A database basically comprise data elements or fields each of which contains a data value about an attribute of a particular entity.

i. Data Definition Language (DDL), a mechanism for organizing and structuring the database and defining the data elements.
ii. Data Manipulation Language (DML), used by programmers to manipulate data, often used
iii. in conjunction with a high level language.
iv. Query Language, for users of the database who need answers to their question.
v. a report writer for producing printed customized report.
vi. a data input system.
vii. a communication system to support a number of on-line areas.

- **Advantages of a DBMS :**

A complete database management system separates the definition of data from the programme that accesses it. This concept of data independence is one of the key advantages of a database management system. The lack of data independence from traditional approaches to progarmming also creates a significant maintenance problem. As programmes are changed to reflect changing conditions or request from users, all the programmes in a system that access the files have to be altered. At a minimum, the record description in the programmes will have to be changed. It may also be necessary to make modifications in the programme themselves to process added data. With a database management system only programmes that access the actual fields altered are generally affected by a change. Programmes that do not use the red fields do not usually have to be changed. As a result, we have gained some independence between the data and the programmes that access those data This kind of data independence is the essence of the database concept.

The main functions and the design objectives and benefits of the database management system are: (i) Integration, (ii) data independence, (iii) data retrieval, analysis, modification and storage, (iv) privacy, (v) integrity controls and recovery methods, (vi) compatibility, (vii) concurrency support, (viii) support of complex file structure and access paths.

The overview of the database management system is given below

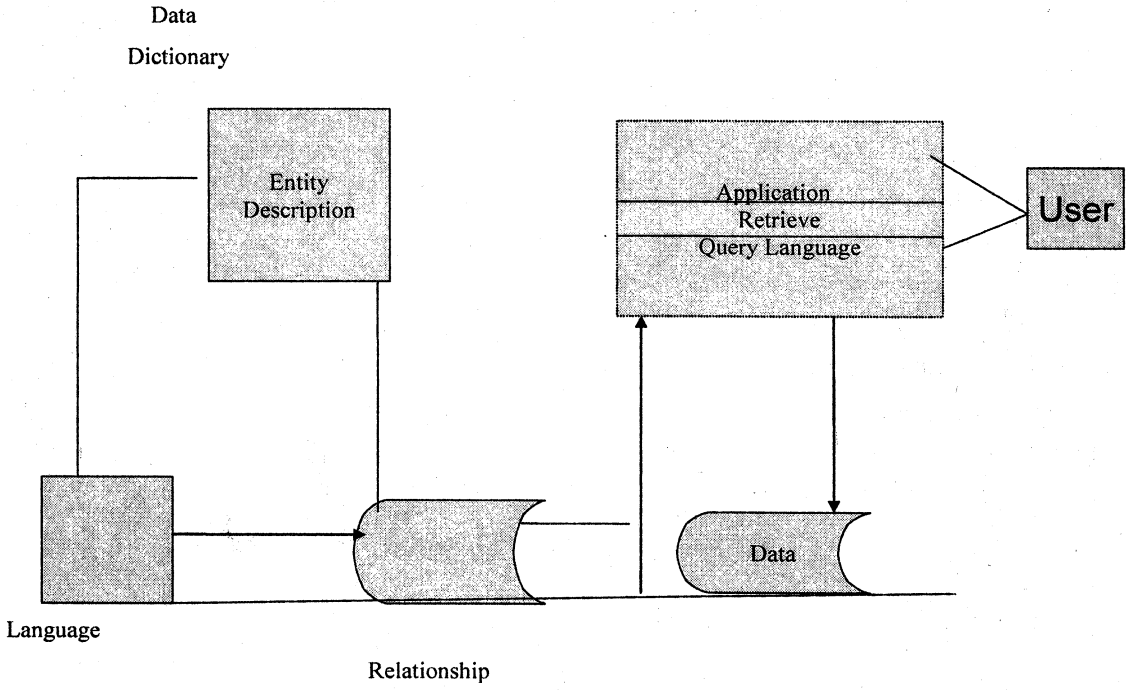


Figure 6:2
Source: Complied from the website codeproject.com

Self Assesment 6.1

Define the important components of DBMS?

6.3 Structure of DBMS

The conceptualization of the database management system starts with the definition of the schema. A schema is a formulation of the schema in the language interface offered by a DBMS. A schema comprises two parts

(i) a logical schema and

(ii) a physical schema.

The logical schema is concerned with exploiting the data structure offered by a DBMS in order to make the schema understandable to a computer. The physical schema, on the other hand, deals with the manner in which the conceptual database shall get represented in the computer as a stored database. It can be said that there is no straight forward step by step procedure to be followed in arriving at the conceptual schema. It is not surprising, therefore, that two different people looking at the same universe of discourse may end up with different conceptual schema or even the same person looking at a given universe at two different times may produce two different schema.

The conceptual schema should have the following properties :

- It should correspond well with the real world of which it is a model.
- It should capture as precisely as possible the information content of the real world.
- It should be complete .
- It showed be possible for the conceptual schema to support different external
- schema as per the requirements of the users of the information system.
- The representation of conceptual schema should be stable in order to make the specification of both, the logical schema and the physical.

(i) Schema easy for the DBA. In terms of schema, the DBMS has a three-level architecture. The first level structure of DBMS is the external level which refers to the way the users view the data. The external level is also called sub-schema. A user may be interested in a small portion of the database which will form his external view. The architecture of a DBMS is illustrated in figure 2. The second level conceptual schema represents the total information content of the database. It gives a global or integrated view of the database. The third level of the architecture is the internal schema. The Internal view describes how the data is actually stored and managed on the storage media. It specifies what indexes exist, how fields are represented and the physical sequence of the stored records. The internal schema is built up using the internal DDL. The conceptual/internal mapping statements ensure physical data interdependence. The mapping components between internal schema and secondary storage device, i.e., direct access storage device (DASD) is called access method Thus designing of efficient and effective database structure has led to the identification of three distinct planes or levels of data abstraction and description. These three levels are :

(a) External or users view level.
(b) Conceptual schema level.
(c) Internal or physical level.

The conceptual schema is machine and application software independent description of total database. The term schema is used to mean an overall chart of the entire database. The conceptual schema might be regarded as an overall logical database description. The model of conceptual schema or model base has to be as stable as possible.

6.3.1 Data Models

In a database the data is usually logically and physically organized according to some data model. A data model is a collection of conceptual tools for describing data, data relationship, data semantics and data constraints.

The data base generally structure their data on the basis of one of the following four data models:

(i) Relational data model

(ii) Network data model

(iii) Hierarchical data model

(iv) or a combination of these three or some subsets of these three models.

The hierarchical or network data models have been in use since the early 1960s, whereas the relational model was proposed as a modeling structure in the early 1970s. The difference between these three data models is the way they represent the relationship of entities or their attributes. These models make use of three database constraints-simple sequence relationship, hierarchical relationship and network relationship.

6.3.2 Internal Schema

The physical organization and layout of the database on the storage device is called the internal view. The internal view is represented by means of the internal schema, which not only defines the physical structure of the stored database, but also specifies the methods that may be used to locate the logically related data records, insert new record and delete records.

6.4 Types of DBMS

The DBMS can be classified from different perspectives. But the DBMS is classified according to the way they present data to the user. But it is important to stress that the way data are presented to the user does not bear any resemblance to the way the DBMS are generally of three types

(i) Hierarchical DBMS

(ii) Network DBMS

(iii) Relational DBMS

The hierarchical DBMS is the oldest of the three types. In this the data is structured in such a manner that each element is subordinate to another in a strict hire genus-species, parent-child relationships. The relationship between the two data elements or records in a hierarchical relationship is therefore one of super and subordinate relationship. The advantage of such DBMS is simplicity.

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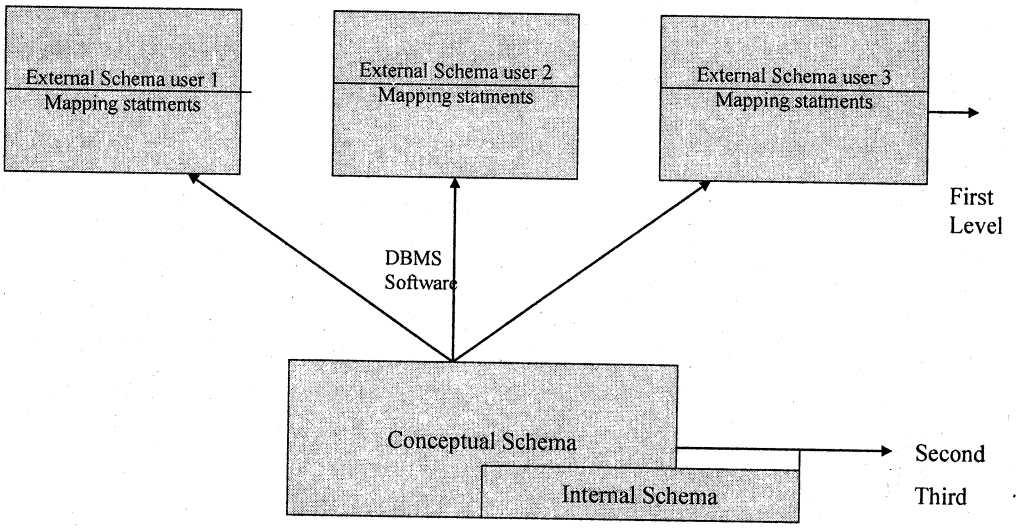


Figure - 6.3

Source: Complied from the website codeproject.com

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ii) Network data model

iii) Hierarchical data model

A set of similarly constructed records constitute a file which contains data records about an entity type. Ultimately a set of related files stored together in a logical fashion comprise a database. Data are raw facts or intangible ideas about something and include numbers words, symbols, ideas, concepts and oral verbalization the purpose of information systems is to collect, process and store large quantity of data to obtain the information for effective decision making, planning and control.

Moreover, in most organizations for reasons of volume, complexity, timing and computational demand, this collected data must be organized in a manner to serve a variety of user's information request. Data that stored in a database generally fall into a data hierarchy made up of categories: These categories in the hierarchical order are : Fields, Records, Files and Database is

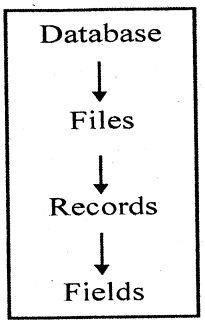


Figure 6.1

Source: Complied from the website codeproject.com

At the lowest level data is organized into fields. A field represents a subject data item, e.g., in case of bibliographic data for books, we have Author Field, Title Field etc. Fields are made up of individual letters, numbers or symbols. Once characters are joined into a field, then the field is treated as a Unit.

e.g. Ashok Kumar Singh = Author Field

Record :- is made up of a set of related fields. A record can contain either one field or a number of fields, for example a record for a book may contain- Author Field, Title Field, Imprint Field, Edition Field, and Collation Field etc. So for each book we may have a separate record.

File:- is a set of related records. A file may contain as few as one or as many as millions of records.

Database :- is the highest in the hierarchy. A database is a collection or set of related files.

Historically, files came before database. Though database represents a step forward from files, they are in fact constructed from files. Due to intrinsic advantages of database as mentioned earlier, the database organizers are willing to pay for the cost of creation and maintenance of database. An organization that uses database rather than files can save time and money in developing the application program. It can exploit the data more efficiently, since they are easier to get it. In a database, the data is organized into Record (logical) and Record (physical). A logical record consists of more than one data elements or fields among which some logical connection exists. The contents of the field represent a set of qualities or attributes about the particular real world entity represented by the record and the logical connection among the data elements or field is maintained by their physical representation or the data structure within the storage medium. The physical record is a basic unit of data which is read from or written on the storage medium by a single input/output command to the computer. One physical record often contains multiple logical records or segments. The data file is a collection of one type of stored records or interrelated data that are treated as unit and kept on a secondary computer storage device. A set of similarly constructed records comprise a

file. Physical storage area containing data could be program or group of data or records managed as a single unit by the operating system of a computer. A given physical file can be accessed in a wide variety of ways.

The records can be located in a storage medium randomly or directly, i.e., independent of the location of any other record in the file. This type of organization is called direct physical file organization or random access file. When a file is maintained on a sequential or random storage device in sequential access mode then it is called a sequential file. The searching of data or data records is generally through an index. The input to the index file from each record is very important. The operation of creating an index file from a master file is referred to as inversion and files with indexes are often called inverted files.

A database concept has traditionally evolved from file-processing or management system. It is a collection of related and cross referred files designed and created to minimize the repetition of data. These integrated files are part of the overall database system including the specialized software called the database management system (DBMS), which allow data records to be created, accessed, updated, deleted and retrieved. With the evolution of the database system and concepts, the same physical data could be viewed in different logical ways by different applications. The database management system bridges the gap between the logical file description and the physical organization of database.

6.2 Concepts and Definition of DBMS

Database management system (DBMS) is a programme, that makes it possible to create, use and maintain a database. When DBMS is used, the users need not be concerned about the way data are organized or retrieved from the direct access storage device or the particular file from which the data are obtained. The database management system (DBMS) can be defined as an integrated set of programmes that serve as interface between application programmes and a set of coordinated integrated physical files called a database. It provides access to the organized group of data or data records for purposes of searching, manipulating and reporting. The management of a database involves both definition of structure for the storage of data and the provision of mechanization for the manipulation of data. Therefore any database management system uses two languages a data definition language (DDL) and a data manipulation language (DML)

The main role of data definition language is to :

- Describe schema and subschema
- Describe the fields in each record
- Indicate key words
- Provide for logical and physical data independence
- Provide means for associating record.

The function of data manipulation language is to provide the machines the information for data manipulation, such as creation, updating, deletion, replacement, retrieval and sorting of data or records. It also enables the user and the application programmes to process the data using logically meaningful data names rather than physical storage location. It also allows the user of the application programmes to be independent of physical data storage and maintenance. The DML also provides for the use of logical relationship among the items. Besides DDL and DML, there is a query language for the users of database. In brief, the DBMS will comprise the following modules to operate on the central database :

iv) or a combination of these three or some subsets of these three models.

The hierarchical or network data models have been in use since the early 1960s, whereas the relational model was proposed as a modeling structure in the early 1970s. The difference between these three data models is the way they represent the relationship of entities or their attributes. These models make use of three database constraints-simple sequence relationship, hierarchical relationship and network relationship.

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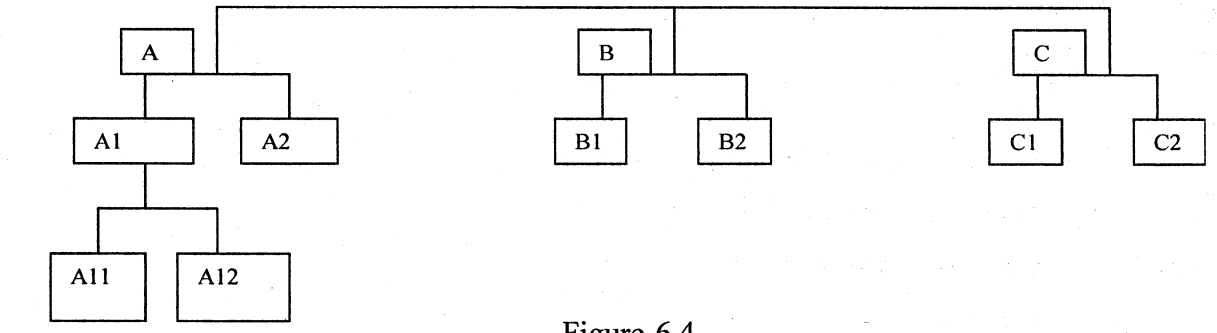


Figure-6.4

Source: Complied from the website codeproject.com

(ii) Network DBMS

In a network DBMS, the network support n:m relationship. A network can be a hierarchy but hierarchy cannot be a network.. Defining a network style of database requires considerable skill and planning and changing such system is difficult.

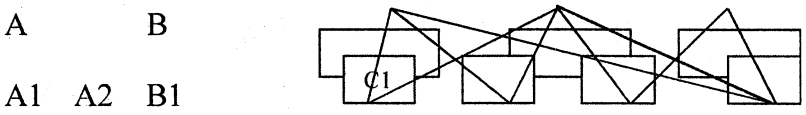


Figure-6.5

Source: Complied from the website codeproject.com

The Network Structure

Further if the original designer who is familiar with the relationship is not available, then maintenance and change can consume a considerable number of man-hours .

(iii) RDBMS

Relational DBMS have been evolving since the relational data model was proposed in 1970 by **Edgar F Codd** of IBM. The relational model is a radically different approach to the problem in that it concentrates on simplifying the view of the database into one made up of flat tables. The data are organized in two dimensional tables as given below. Such tables are easy for a user to develop and understand. The name is derived from the fact that each table represents a relation.

Table 6.1
Example of RDBMS

Name	City	Profession	Income (monthly)
Ashok	Delhi	Medical	40000
Neelam	Varanasi	Legal	15000
Mohan	Calcutta	Scientists	20000
Deepak	Mumbai	Engineer	30000

Source: Complied from the website codeproject.com

Since different users see different sets of data and different relationships among them, it is necessary to extract subsets of the table columns for same users and to join tables together to form larger tables for others. The mathematics provides the basis for extracting some columns from the tables and for joining various columns. This capability to manipulate relations provides flexibility not normally available in a hierarchical or network structure. The relational database management system has many advantages. Most of the DBMS are based on relational model because it is relatively easier for the user to understand.

6.5 Database Organization And Development:

The database design is a step by step procedure. The database design is done usually by a system analyst or database administrator. The overall process of database development and its organization are :

- Planning – The overall scope and objectives of the database is defined. The hardware and software requirements and constraints must be identified
- Survey of Users Needs – The survey/study must be conducted to identify the needs of potential users. An attempt should be made to ascertain present and future needs.
- Conceptual Design – The conceptual design of the database is a two-stageprocess:

(a) The design of a conceptual schema which is an abstraction of the real world situation under consideration.

(b) Design of a logical structure, representing this schema

The designing of a conceptual schema implies the representation of that part of the 'real model' that the database is about. The entities must be identified about which information or data is to be included in the database.

- Physical Database Design – At this stage the conceptual model is translated into physical

database model that conforms to the features of particular DBMS, Every DBMS has its own database structure to store information.

- Design Implementation – The physical model is implemented with the aid of the database management system in establishing information storage and retrieval systems of the organization.
- Testing and Evaluation – The implemented design is tested to ensure whether the system is working as expected. The system must be evaluated/monitored to maintain optimum level of efficiency.

Self Assesment 6.2

Define the Structure of DBMS?

6.6 Relational Database Management System:

The database management system based on the relational model was proposed by **E.F. Codd** of the IBM in 1970 and since then it has become an important concept in DBMS technology. The DBMS for micro-computers are based on relational model because it is relatively easy to understand from the user point of view. The basic concept in the relational model is that of a relation which is a set of theoretic notion.

From the pragmatic points of view, one can look at a relation as a table. The relations expressed in the form of a table has the following characteristics:

(i) Columns in a table are always homogenous. In other words the column of a table always contain items of the same kind whereas items in different columns may not be of the same kind.

(ii) Each item is a simple number or character string.

(iii) All rows of a table are distinct i.e. a table does not contain two row which are identical in every column.

(iv) The ordering of rows within a table is immaterial.

(v) The column of a table are assigned distinct names and the ordering of these columns is immaterial.

Hence each column and rows of a table can be uniquely identified by its content Consequently one can use content addressability as a means for accessing individual rows of the table. So a relational database is a collection of data belonging to a system spread over a number of relations.

6.6.1 Relational Algebra

Let us consider, the relational model formally. This is called relational as relational algebra shall be concerned with the relation as a data structure and with the operations that can be performed on it. The keys (data items) play an important role in relational data base management system. The keys serve two basic purposes:

- Identification of tuples
- Establishing relationship between tables

The keys can be made up of a single attribute called single key attribute or multiple attributes

called multi-key attributes. Keys formed by multiple attributes are also called composite or concatenated key.

The Cartesian product of two set A and B, denoted by A × B is

A × B = {(a,b) : a e A and b e B}

The expanded Cartesian product X of n-set A1, A2,.... An is defined by

That is the concatenation operator applied to two tuples of degree m and n respectively yields a (m+n) tuple.

The unit on which a relation is constructed is known as a domain. They are two kinds of domain –simple and compound. The simple domain is defined as a set of which each element is an integer or each element of which is a character string. A compound domain is the expanded Cartesian product of a finite number, N (N >1) of simple domains. N is called the degree of the compound domain.

Given domain D_1, D2.....D_n we define a relation R as a subset of the expanded

Cartesian product of these domains as follows:

R (D_1, D2.....D_n)CX(D_1 ,D_2.....D_n)

In general, we say that a relation defined over n domain has a degree n or is in n-ary The element of this set are n-tuples. The definition of a relation gives a name to the relation and specifies the components over which it is defined. These components are referred to as relation attributes or attributes for short. A relational schema is defined to be a collection of relation definitions. It should be obvious that the relational schema can be used to represent the data base schema.

Table 6.2

Example of Relation Table for Book

Order No	Author	Title	Supplier	Date
215	William, J	Information Technology	Student Friends	31.3.1999
216	Naveen Prakash	Database Management	Vishwa Vidyalaya Prakashan	1.4.1999
217	Singh, R.K.	Child Psychology	Current Books	2.4.1999
218	Mishra, L.	Organic Chemistry	Popular Book House	3.4.1999
219	T. Lal	Algebra	Vikas	5.4.99

The above table contains information about books: order no, supplier, title, date of order. While constructing the tables of the relational model one has to fulfil the following requirements:

- Each table must be given a unique heading
- Each attribute must be given a name, referred to as keys
- Each entity record or tuple corresponding to a row in the table must have an

Attribute or combination of attributes which serves as unique identifier referred to as a primary key.Within one table, we consider a set of attributes which defines the entity type or a particular facet

of the entity type with which we may be concerned in a given context Each row or tuple in the table represents data for a particular order. An attribute B is said to be functionally dependent on the attribute A if the value of attribute A always determines the value of the attribute B.

A B i.e., A is determinant of B

A functional dependency may involve more than two attributes.

6.6.2 Normalization

The normalization technique is concerned with translating a conceptual design into a set of well designed relational table. The normalization is a major task in designing a relational database. The process of normalization ensures that there will be no problem in updating the database and that operation on the various relations will not lead to inconsistent and incorrect data. During the normalization process, the designer first looks to be sure that the relations are in first normal form, next he or she checks for second normal form and finally for third. The first normal form requires that all occurrences of a record type contain the same number of fields. It may be noted that normalization is primarily aimed at preventing or reducing data maintenance problems rather than improving retrieval efficiency. Normalization of relations removes anomalies in the database. The second and third normal forms require the designer to examine the relationship between key fields and other fields in the record. To conform to second and third normal forms, each non-key field must give us information about the entire key and nothing but the key.

e.g. suppose that one has a relationship as follows:

Order No.	Author	Title	Supplier	Data

If author and title forms a composite key, this relationship is not in second normal form. Note that its author and title would be repeated in each record that stores information about a part in another. If the author changed then every record of a order number would have to be updated. What would happen if there were no order number relating to author or book? Then it is possible that database would like to keep track of the author, since there would be no record having its author. The relations can be made to conform to second normal form by splitting it into two relations.

Order No.	Author	Title	Supplier	Data
No.	Author	Title	Supplier	Data

Order number and Author could be the combined key for the relation and author can be the key for the second.

Thus normalization is a systematic process of transforming initial conceptual design first into a set of relational table in First normal form (1NF) by assigning a unique key to each entity type table and removing repeating group from the tables by splitting each into two or more new entity types or relation tables. The set of relational tables in 1NF may be changed into set of tables in second normal form (2NF) by removing partial functional dependencies within tables. It is accomplished by splitting of these dependencies into new separate tables. The set of tables in 2NF may be converted into a new set of tables in third normal form (3NF) by eliminating transitive dependencies.First normal form (1NF), Second normal form (2NF), Third normal form (3NF), Fourth normal form (4NF), Fifth normal form (5NF), and the highest normal form is called domain/ key normal form (DK/NF).

6.6.3 Functional Dependencies

Dependency refers to the relationship among attributes. These attributes may belong to the same relation or different relations. Dependencies can be of various types viz. functional dependencies, transitive dependencies, multi-level dependencies etc. Functional dependence is a relationship that exists between any two fields or attributes. We may say that a field A of an n-set O is functionally dependent upon field B of O (written B A) if each value of B has precisely one value of A corresponding to it at every instant of time.

It can be represented as

(i) J K

(ii) J L

(iii) K J

(iv) L J

Transitive dependency is a form of intermediate dependency. For example if we have attributes or groups of attributes A, B and C such that A determines B and B determines C, i.e.

A B

B C

In the above example, we can say that there exist transitive dependency between A and O. The multi-valued dependency refers to m:n (many to many) relationships. The multivalued dependency exist between two data items when one value of the first data item gives a collection of values of the second data item i.e., it multi-determines the second data items.

Self Assesment 6.3

What is relational database management system?

6.7 Summary

The use of database management system represents one of the most significant trends in the field of computer-based information systems. A database management system (DBMS) is a collection of software for processing a collection of interrelated data known as 'database'. The objective of a database management system is to facilitate the creation of data structure and relieve the programmer of the problem of setting up complicated files. A complete DBMS separates the definition of data from the programmes that access it. With a DBMS, it is possible to design file structures much more easily and to set up a database that can be used by a number of different application programmes. In modern times RDBMS is being developed and used more and more.

6.8 Keywords

- Data: - Collection of facts made up of numbers, characters, and symbol stored on a computer in such a way that it can be processed by the computer.
- DBMS: - Database management system is a series of programmes that allow the User to easily create and modify databases.

- Database :- A collection of information organized in such a way that a computer Program can quickly select desired pieces of data.
- Decision Models:- Develop insight into the decision and determine a clear course of action.
- Software:-Software is the collection of computer programs and related data that provide the **instructions** telling a computer what to do.

6.9 Abbreviation Used

DBMS	:	Data Base Management System
DDL	:	Data Definition Language
DML	:	Data Manipulation Language
DCL	:	Data Control Language
RDBMS	:	Relational Data base management system
1NF	:	First Normalization Form
2NF	:	Second Normalization Form
3NF	:	Third Normalization Form
4NF	:	Fourth Normalization Form
5NF	:	Fifth Normalization Form
DK	:	Domain Key
NF	:	Normal Form
SAQs	:	Self Assesment Questions

6.10 Hint/Key To SAQ

Self Assesment 6.1

The important components of DBMS are:

(i) Data Definition Language (DDL) it provides the mechanism for organizing and structuring the databases and defining the data elements.

(ii) Data Manipulation Language (DML). It provides the mechanism for data manipulation such as creation, updating, deletion, replacement, retrieval, and storage of data or records.

(iii) Query Language – This provides the mechanism to provide answers to the user queries.

(iv) Data input system – for inputting of data

(v) Communication sub-system - to support a number of on-line users

Self Assesment 6.2

The database management system (DBMS) can be defined as an integrated set of programmes that serves as interface between application programmes and a set of coordinated integrated physical files called a database. A database management system provides the capabilities for creating maintaining and changing a database as well as retrieving information from it..

The main functions of DBMS are:

(i) Integration

(ii) Data independence – logical and physical

(iii) Data retrieval, analysis, modification and storage

(iv) Primary

(v) Integrity controls and recovery methods

(vi) Compatibility

(vii) Concurrency support

(viii) Support of complex file structures and access paths

Self Assesment 6.3

The relational database management system is a DBMS based on the relational model of data organization. It was first propounded by EF Coded of the IBM in 1970. In the relational DBMS the relations between data or entities are expressed in the form of tables.

6.11 Question For Practice

(i) Why would you choose a database system instead of simply storing data in operating system files? When would it make sense not to use a database system?

(ii) What is logical data independence and why is it important?

iii) Explain the difference between logical and physical data independence?

(iv) Explain the difference between external, internal, and conceptual schemas. How are these Different schema layers related to the concepts of logical and physical data independence?

(v) What are the responsibilities of a DBA? If we assume that the DBA is never interested in running his or her own queries, does the DBA still need to understand query optimization? Why?

Project-based Exercises:

(i) Use a Web browser to look at the HTML documentation for Minibus. Try to get a feel for the overall architecture.

6.12 Reference/ Suggested Books

- **Codd, E F**(1982) Relational Database: A Practical Foundation for Productivity" *Comm ACM* 25, 2; 109-17
- **Date, C.J.** (1975). An Introduction to Database System. Reading" Mass: Addison Wesley
- **Korth H and Silber Schatz** A(1986). Database System Concepts" NY : McGraw Hill.
- **Lucas, Henry** C (1990). Information Systems Concept for Management" NY:McGraw Hill

Unit - 7

Application of DOS and Windows based software in creating a data base for accounting information and analysis

Outline of the Unit

7.0 Objectives

7.1 Introduction

7.2 Accounting information systems technology includes

- 7.2.1 Input
- 7.2.2 Process
- 7.2.3 Output

7.3 Management Information Systems (MIS)

- 7.3.1 MIS
- 7.3.2 Financial applications
- 7.3.3 Human resource applications

7.4 Development

- 7.4.1 Planning
- 7.4.2 Analysis
- 7.4.3 Design
- 7.4.4 Implementation
- 7.4.5 Support

7.5 Attestation

7.6 Enterprise Resource Planning (ERP)

7.7 Database Software

- 7.7.1 What Information to Track?
- 7.7.2 How to Organize the Information?
- 7.7.3 Which Database Software to Use?
- 7.7.4 How Will it Work with Other Software We Use?
- 7.7.5 How Much Will it Cost?

7.8 Advance Features of Web Enabled Accounting Information System

7.9 Summary

7.10 Questions

7.0 Objectives of Accounting Information System

1. Develop an understanding of the Accounting System's importance in situating the Organization within the relevant business environment with some emphasis on broad view, long term decision making.

2. Learn some basic Accounting Information relating to accounting cycles, tools for understanding, explaining and designing accounting system. Internal control concepts in both manual and computerized environment and database concepts. These fundamentals are important for understanding, developing and working with all accounting system, whether manual to computer based.
3. Develop an awareness of the intrinsic capabilities and complications using accounting information system.

7.1 Introduction of Accounting Information Systems

7.1.1 Accounting information systems

Accounting information systems widely covers all business functions from backbone accounting transaction processing systems to advance financial management planning and processing systems. All Financial reporting begins at the operational levels of the organization, where the transaction processing systems covers important business transaction such as normal production, purchasing, and selling activities. These transactions are classified and summarized for decision making for internal as well as external financial reporting.

7.1.2 Cost accounting systems

Cost accounting systems are generally followed in the field of manufacturing and service environments. This allow a business firm to track the costs associated with the production of goods and/or performance of services. In addition, the Accounting information systems furnish advanced analysis for improved resource allocation and performance tracking.

7.1.3 Accounting systems

Accounting systems are used to organizational planning, monitoring, and controlling for a variety of tasks. This facilitates managerial-level to have access advanced reporting and statistical analysis. The systems can be used to gather information, to develop various scenarios, and to select an optimal answer among alternative scenarios.

7.2 Accounting Information Systems Technology Includes

7.2.1 Input

The input devices generally include: standard personal computers running applications; scanning devices for standardized data entry; electronic communication devices for electronic data interchange (EDI) and e-commerce. In addition, many financial systems also introduced the feature of "Web-enabled" to allow devices to connect to the World Wide Web e.g. Tally 9.0

7.2.2 Process

Basic processing is achieved through computer systems ranging from individual personal computers to large-scale enterprise servers. However, conceptually, the underlying processing model is still the "double-entry" accounting system initially introduced in the fifteenth century.

7.2.3 Output

The output devices include computer displays, impact and non-impact printers, and electronic communication devices for EDI and e-commerce. The output content may encompasses any type of financial reports from budgets to multinational financial statements.

7.3 Management Information Systems (MIS)

7.3.1 MIS

Interact between human and machine systems that support decision making for users both in and out of organizational boundaries. These systems are used to support an organization's daily operational activities, current and future decisions and overall strategic direction.

7.3.2 Financial applications

Financial applications make up the heart of an Accounting information systems. Modules commonly implemented include: general ledger, payables, procurement/ purchasing, receivables, billing, inventory, assets, projects, and budgeting.

7.3.3 Human resource applications

Human resource applications make up another major part of modern information systems. Modules commonly integrated with the Accounting information systems include: human resources, benefits administration, payroll, and time and labor reporting.

7.4 Development

Accounting information systems development includes basically five phases: planning, analysis, design, implementation, and support.

7.4.1 Planning

The first phase of systems development is the planning of the project. This implies determination of the scope and objectives of the project, the definition of project responsibilities, control requirements, project phases, project budgets, and project deliverables.

7.4.2 Analysis

This is the second phase of the development. This phase is used to both determine and document the accounting and business processes used by the organization. Such processes are redesigned to take advantage of the operating characteristics of modern system solutions.

- **Data Analysis :** is a thorough review of the accounting information that is currently being collected by an organization. Current data are then compared to the data that the organization should be using for managerial purposes.
- **Decision Analysis :** is a thorough review of the decisions, a manager is responsible for making. The primary decisions that managers are responsible for are identified on an individual basis. Then models are created to support the manager in gathering financial and related information to develop and design alternatives, and to make actionable choices. This method is valuable when decision support is the system's primary objective.
- **Process Analysis :** is a thorough review of the organization's business processes. Organizational processes are identified and segmented into a series of events that either add or change data. These processes can then be modified or re-engineered to improve the organization's operations in terms of lowering cost, improving service, improving quality, or improving management information. This method is appropriate when automation or re-engineering is the system's primary objective.

7.4.3 Design

This is the third phase of the development. The design phase takes the conceptual results of the analysis phase and develops detailed, specific designs that can be implemented in subsequent phases. It involves the detailed design of all inputs, processing, storage, and outputs of the proposed accounting system. Inputs may be defined using screen layout tools and application generators. Processing can be shown through the use of flowcharts or business process maps that define the system logic, operations, and work flow. Logical data storage designs are identified by modeling the relationships among the organization's resources, events, and agents through diagrams. Also, entity relationship diagram (ERD) modeling is used to document large scale database relationships. Output designs are documented through the use of a variety of reporting tools such as report writers, data extraction tools, query tools, and on-line analytical processing tools.

- **Report Design :** Reporting process provides the information that helps to drive management decision making. Accounting systems make use of a variety of scheduled and on-demand reports. The reports can be tabular, showing data in a table or tables; graphic, using images to convey information in a picture format; or matrices, to show complex relationships in multiple dimensions. The reports must be accessible through the system's interface. They should convey information in a proactive manner. They must be relevant. Accuracy must be maintained. Lastly, reports must meet the information processing style of the people they are to inform.
- **Reports are of three basic types :** A *filter report* that separates select data from a database, such as a monthly check register; a *responsibility report* to meet the needs of a specific user, such as a weekly sales report for a regional sales manager; a *comparative report* to show period differences, percentage breakdowns and variances between actual and budgeted expenditures. An example would be the financial statement analytics showing the expenses from the current year and prior year as a percentage of sales.
- **Screen designs and system interfaces :** are the primary *data capture devices* of Accounting information systems s and are developed through a variety of tools. *Storage* is achieved through the use of normalized databases that assure functionality and flexibility.
- **Business process maps and flowcharts :** are used to document the operations of the systems. Today's Accounting information systems use specialized databases and processing designed specifically for accounting operations. This means that much of the base processing capabilities come delivered with the accounting or enterprise software.

7.4.4 Implementation

This is the fourth phase of the development. The implementation consists of two primary parts: construction and delivery.

Construction : incorporates the selection of hardware, software and vendors for the implementation; building and testing the network communication systems; building and testing the databases; writing and testing the new program modifications; and installing and testing the total system from a technical standpoint.

Delivery : is the process of conducting final system and user acceptance testing; preparing the conversion plan; installing the production database; training the users; and converting all operations to the new system.

Tool sets are a variety of application development aids that are vendor-specific and used for

customization of delivered systems. They allow the addition of fields and tables to the database, along with ability to create screen and other interfaces for data capture. In addition, they help set accessibility and security levels for adequate internal control within the accounting applications.

Security exists in several forms. Physical security of the system must be addressed. In typical Accounting information systems the equipment is located in a locked room with access granted only to authorized technicians. Software access controls are set at several levels, depending on the size of the Accounting information systems . The first level of security occurs at the network level, which protects the organization's communication systems. Next is the operating system level, which protects the computing environment. Then, database security is enabled to protect organizational data from theft, corruption, or other forms of damage. Lastly, application security is used to keep unauthorized persons from performing operations within the Accounting information systems .

Testing is performed at four levels. Unit testing is used to ensure the proper operation of individual modifications. Program testing involves the interaction between the individual modification and the program it enhances. System testing is used to determine that the program modifications work within the Accounting information systems as a whole. Acceptance testing ensures that the modifications meet user expectations and that the entire Accounting information systems performs as designed.

Conversion entails the method used to change from an old Accounting information systems to a new Accounting information systems . There are several methods for achieving this goal. One is to run the new and old systems in parallel for a specified period. A second method is to directly cut over to the new system at a specified point. A third is to phase in the system, either by location or system function. A fourth is to pilot the new system at a specific site before converting the rest of the organization.

7.4.5 Support

This is the fifth phase of the development. The *support* phase has two objectives. The first is to update and maintain the Accounting information systems . This includes fixing problems and updating the system for business and environmental changes. For example, changes in generally accepted accounting principles (GAAP) or tax laws might necessitate changes to conversion or reference tables used for financial reporting. The second objective of support is to continue development by continuously improving the business through adjustments to the Accounting information systems caused by business and environmental changes. These changes might result in future problems, new opportunities, or management or governmental directives requiring additional system modifications.

7.5 Attestation

Accounting information systems change the way internal controls are implemented and the type of audit trails that exist within a modern organization. The lack of traditional forensic evidence, such as paper, necessitates the involvement of accounting professionals in the design of such systems. Periodic involvement of public auditing firms can be used to make sure the Accounting information systems is in compliance with current internal control and financial reporting standards. After implementation, the focus of attestation is the review and verification of system operation. This requires adherence to standards such as ISO 9000-3 for software design and development as well as standards for control of information technology.

Periodic functional business reviews should be conducted to be sure the Accounting information systems remains in compliance with the intended business functions. Quality standards dictate that this review should be done according to a periodic schedule.

7.6 Enterprise Resource Planning (ERP)

ERP systems are large-scale information systems that impact an organization's Accounting information systems . These systems permeate all aspects of the organization and require technologies such as client/server and relational databases. Other system types that currently impact Accounting information systems are supply chain management (SCM) and customer relationship management (CRM).

Traditional Accounting information systems recorded financial information and produced financial statements on a periodic basis. Modern ERP systems provide a broader view of organizational information, enabling the use of advanced accounting techniques, such as activity- based costing (ABC) and improved managerial reporting using a variety of analytical techniques.

7.7 Database Software

You have kept your customer information on paper, in spreadsheets, in your accounting program and now you want to set up a central database for all your customer information. As you evaluate your options, you face questions like:

The first question about the database you should consider is:

7.7.1 What Information to Track?

This varies dramatically, but there are several frequently used types of business information:

- Contact details
- Customer preferences
- Communications history
- Sales history
- Actions
- Payments

Then there is business-specific customer information. For example, family-oriented organizations track family members. real estate companies - properties, engineering firms - equipment they maintain on behalf of the customers and so on.

7.7.2 How to Organize the Information?

How all this information can be organized for an easy access and use? Should it fit into a single system or multiple systems? How can I fit my data into the database structure?

• **Single vs Multiple Systems :-** Using a single database minimizes the hassle of synchronizing multiple sources of data and improves data accuracy. However, if your business software must incorporate industry-specific logic, you are unlikely to find an integrated system that includes both logic and a full-featured customer database. In that case, the best option is to use your industry-specific software as a primary source of information and copy the customer records from that software into the customer database, where you add more information to them. As much as possible avoid synchronizing the two systems both ways - there should be just one master customer database.

• **Customizing databases to fit your information :-** Now that you decided what information goes into your database and where it comes from, consider how this data can fit into the database. The simplest method of customizing a database is creating extra fields in the customer record. Many database programs make it easy and so you can accommodate business-specific information by adding more and more fields.

When you have hundreds of fields, the system becomes difficult to manage. This is probably because you have put together information about different objects. Re-structuring your data makes it easier to access and manipulate. There are two methods of re-structuring such data:

- Splitting customer records into related record types
- Storing some information in external files

• **Splitting customer records into related record types** :-

Suppose we need to record basic family information:

- Family name
- Husband's name and birthday
- Wife's name and birthday
- Child 1 name and birthday
- Child 2 name and birthday
- Child 3 name and birthday

If you were to add all these details to your customer record, they will occupy eleven fields. Finding a John Smith will be difficult - you need to search four times - for John as the husband, Child 1, Child 2 and Child 3. And the system won't accommodate families with four or more children.

To handle this information, the databases can store it in different record types and relate these records to one another. Because of these ability these databases are called relational (as opposed to flat) databases. In a relational database, you would have family and person information in different records and link persons' records to their family record.

In example, each personal record will then have three fields: name, birthday and the link to the family record. John Smith can be easily found with one search, no matter who he is in the family. The difference in ease of use is even more apparent when you need to store more information, like insurance policies with number, name of the insurer, monthly premium, expiration date etc.

To see if a piece of customer information should be tracked in a separate record type check whether a customer can have more than one of it. Can a customer have multiple policies? family members? air conditioners? Can a customer be included into multiple lists? If the answer is yes, then those objects should be tracked separately and linked to the customer records. If no, they can be incorporated into the customer record.

• **Storing some information in external files** :- There is a natural desire to track all customer information on the database, but is it really required? There are some data types that databases don't handle well, for example, spreadsheets. The databases are designed to work with large number of similar records, while in a spreadsheet each row could be different from the previous one. Spreadsheets' formulas can be easily modified, while in a databases they are programmed.

So if you are used to tracking some customers information in spreadsheets or some other external files (photos, text documents etc), perhaps it is worthwhile to continue doing so, linking those files to the customer records. You will keep your database simple and agile and retain the familiar ways of working with these files, but can still easily access all customer information from a central location.

The down side is that you cannot easily search on or otherwise process the information that is stored externally. If you store customer borrowing power calculations in Excel spreadsheets, you can easily access this data on any customer, but cannot find customers who can borrow in a specified range without going through each and every record.

7.7.3 Which Database Software to Use?

Many people consider one or more of the following choices:

- Microsoft Access
- Popular contact managers
- Accounting program
- Employing a software developer
- A package that is both simple and easily customizable, such as Simply Contacts Database.

• **Microsoft Access :-** Perhaps one of the first programs people turn to when it comes to building customer database is Microsoft Access, probably the single most popular database program. Most already have it as part of Microsoft Office Professional or Premium, making it an easy choice. The system comes with Wizards assisting in setting up new databases, creating tables and basic forms.

However, beyond the basic setup, you are on your own. To add a field, you need to add it first to the database, then to all the forms and reports where you need it. Maintaining lists of values for drop-down lists is not a trivial task. As the number of fields grows, maintaining forms layout quickly becomes a chore.

Access is a great system in the hands of a professional, but developing a functional customer database in it usually requires more expertise and time than a business person can afford.

We can create the MS Access database with the following steps:

Step 1: We select Start à Program à Microsoft Office à Microsoft Access. The following screen will appear. We select the New Blank Database option and provide the name of File. We can also select the customized folder where we can store the database from clicking the folder icon as displayed on the right side of the screen just after the file name. And then click on Create Command button.

Step 2: After clicking on Create button the next screen will appear as shown below : In the above screen we can see that there are two panes Left and Right. In the Left pane we can see the **object available in MS Access like Table, Query, Form, Reports, Pages, Macro & Modules.**

To create a new table : first we select the Table object and then Design View. After selecting the design view we can see that the Right pane display Field Name, Data Type and Description. Here we create the Field Name as per our requirement and define the Data Type of each field in front of him. The Data type means what type of value will store in that field. There are nine Data types as follows:

1. Text

2. Memo
3. Number
4. Date/Time
5. Currency
6. Auto Number
7. Yes/No
8. OLE Object
9. Hyperlink

In the above depicted table, we can see at the lower part the field properties where we can customized the fields as per requirement of each field. There are some common field properties as follows:

1. Format: Indicates how the field's will be displayed
2. Caption: Provides the label that will be attached to the field on a form or report
3. Default Value: specifies values for new entries. Enter the most frequently entered value for the field.
4. Validation Rule: Indicates a range of acceptable entries.
5. Validation Text: Help mesage that appears in the status bar when the field is active.
6. Required: A Yes/No setting that indicates whether the field must have an entry.

The Description entry appears in the status bar during data entry when the insertion point is in that field. It is an optional entry.

Primary Key and Relationship : A relationship ties one table to another by including the primary key from one table in the related table. A table's primary key is the field or fields used to uniquely identify each record in the table. When you include the key field in another table and use it to relate the two tables, the field in the related table is called a foreign key. To relate the two tables, you connect the primary key from the table on the "One" side of a relationship (the primary table) to the foreign key in the "Many" table (the related table).

Form Object : To create a form, first open the form in Design view. The Design window includes horizontal and vertical rulers and Form Design and Formatting toolbars. There is a tool box that will help with adding objects to the form. If the toolbox doesn't appears when you open a form in Design view, click the toolbox button in the Form Design toolbar. In Design view, a form includes three sections and a number of different controls. The three sections are:

1. A Form Header at the beginning of the first page of the form, usually used for titles.
2. A Form Footer at the end of the last page of the form, used for user tips or other miscellaneous information.
3. A Detail section, where each records data is displayed.

Report Object : A report is the printed output of the data in a database. A report can show all or only some of the data related to a record, and it can be based on either a table or a query.

To create a Report in Design View: There are seven sections in a report:

1. Report Header: Appears at the top of the Report and includes the title and other report

information.

2. Page Header: Appears at the top of every printed page of the Report
3. Group Header: Appears at the top of the identified group, there will be a separate group header for each grouping level.
4. Detail: Contains the Data from the tables/ queries.
5. Group Footer: Appears at the bottom of the identified group and contains summaries of group details.
6. Page Footer: Appears at the bottom of every page.
7. Report Footer: Appears on the last page of the report.

Query Object : A query displays records and fields from one or more tables based on criteria you specify. Queries are like filters, but much more flexible. When you create a query, you can choose which tables to draw data from, which fields you want from those tables, and which sets of records you want from those fields.

To create a query object, we click on Create menu à Create query in Design view. In design view the query window is separated into two panes.

The lower pane use one column for each field included in the query. It shows the field name, the table the field comes from, whether the query is sorted based on the field, whether the field is shown in the query result and criteria that have been applied to the field to limit the query results. The upper pane shows the tables included in the query and any relationship between the tables.

• **Popular Contact Managers** :- Many people have heard about ACT and Goldmine. Unlike Access, which is a generic database tool, these programs are business applications designed with customer management in mind. They offer rich contact management functionality out of the box and can be extended by adding extra fields, reports or buying add-on modules.

These are capable systems, but their primary target audience is salespeople. According to the vendor's site, ACT is designed for "individuals and organizations involved in selling and other functions where management of contact details, activities and communications is critical." From customer point of view, ACT is similar to Access. Yes, you can add a field to the program, but you have to do it at least twice - in the database and on-screen - and in any reports if you wish to see it. This program's functionality suits a busy salesperson whose day is filled with appointments, pursuing leads, writing proposals, closing sales and so on.

• **Accounting Program** : The main purpose of a customer database is to improve service and relationships with your customers. The main purpose of accounting software is to balance your books. Customer database deals with the client side of your business and does not go beyond order fulfillment. Accounting software deals equally with the sale and supply sides. You should track prospects on your customer database, but a prospect is of no interest to accounting. Customer database software includes information specific to your business; accounting software incorporates national tax laws. Even though some accounting programs include CRM modules, they lack the flexibility to record the business-specific information. In my view, customer database and accounting are different areas and don't mix well in one package.

• **Employing a Software Developer** : Use a software developer if your needs are different from other companies. Developers can build a system highly tailored to your business but you need to

know very well what you want to accomplish and relate this to a developer in a clear and concise brief.

Very often business people describe what they need as a "simple program". But as the project unfolds, it turns out the software should do more or handle special cases that were not initially planned. This causes disputes, cost increases and frustration on both sides.

When you are just starting and don't have the full knowledge of what you need, a better way is to experiment and fine-tune the database over time. Starting with a simple, easily customizable package, such as Simply Contacts Database, where you can add extra information time to time as per requirement.

- **Simply Contacts Database :** Then there are programs like Simply Contacts Database. Out of the box, it includes basic contact information, customer history, notes and can attach external files, such as text documents, spreadsheets or pictures to the customer records or history. It can print mailing labels and do mail merge and e-mail merge.

But the best thing about this software is its flexibility and expandability. There is a simple function to add extra or remove unwanted fields that automatically adjusts all standard screens and reports. On top of this, users can define their own screens and reports. For example, if you want to track both customers and suppliers on your database you can create "customer view" and "supplier view" with different fields to view the respective records, yet display full information in the "contact view".

With a program like Simply Contacts Database, you can start with the data that you already have and easily add more fields as the need arises, perfecting the understanding of the business requirements for your customer database. Once you develop the basic system, you can upgrade using the extensive modules library offered by the vendor, or go for an industry-specific or a custom system.

7.7.4 How Will it Work with Other Software We Use?

Most modern software packages can exchange data in standard formats, so there is no need to re-enter the data if you already have it in an accounting or a point-of-sale system. There are two main ways to keep the systems synchronized:

- **Export + Import**: Periodically export the data from one system and import it into another.
- **Interface Module**: a special program or a module that transfers the information automatically.
- **Open Database Connectivity**: programmatic access by one program into the database of another.

- **Export + Import :** is the most universal and popular method of copying the data, but may require some effort to set up properly. There are two types of problems you may experience:
  - Fields in one system may not correspond to the other one.

    For example : address in the accounting program may have separate fields for line 1 and line 2, while the customer database may have one long field instead. The easiest method to get around it is to have two address fields on the customer database as well.
  - Duplication of records: In order to be able to change data in one system and automatically propagate these changes to the other, you need to export the entire customer database, not just the new records. When you load the data into your customer database programs, this may create duplicates.

- Maintaining link between customers and sales records: To link a customer to multiple purchases, most systems extract customers and sales information in two different files. When the data is imported into the customer database system, this link breaks down. Some customer databases can import both files while maintaining the link between them. For example, in Simply Contacts Database the user can nominate a group of fields as "unique identifier" of a customer record. This allows the program to automatically find the appropriate customer record when loading sales data and correctly link sales to customers.
- **Interface Module** between the system is easier to set up but is only available between the limited number of programs. It already knows about the database structures of the two systems and ensures correct data transfer. Most mainstream contact managers such as ACT or Goldmine offer interface modules to Outlook and popular accounting programs like Quick books or MYOB. Simply Contacts Database includes interface module for Outlook.
- **Open Database Connectivity** (ODBC) is a technical standard that allows one system programmatically access and/or modify the database of another one.

  Accounting software Quicken and MYOB make their databases accessible via ODBC. Microsoft Access and systems based on it can both make their database available via ODBC and import data from other ODBC-compliant systems. Operation of ODBC-based connections is fairly easy as they eliminate extra steps required to export and then import a file.

  The downside is that setting up an ODBC-based link between two systems typically requires programmer's expertise. Thus Open Database Connectivity is often used in the pre-programmed interface modules.

  The following is the procedure in which we can access any database via ODBC.

  Step 1: In this step we open ODBC by selecting Start à Control Panel à Administrative Tool à Data Source (ODBC) then the following screen will appear.

  We select MS Access Database and then click on Add command button. The next screen will display as in Step 2

  Step 2 : We select one of the driver option available in Create New Data Source Screen. For example we select Driver do Microsoft Access (*.mdb) then click on Finish Command Button. The following screen will appear as shown in Step 3.

  Step 3: In this step we click on Select Command Button the following screen appear.

  Step 4: Here we select the database Drive and the Directory or Folder where the database reside and then click on OK command button.

  Step 5: Here we can see that whatever database file we select, will display on the screen and then Click OK command button. The selected database will connect.

7.7.5 How Much Will it Cost?

Most custom-built database programs for small businesses cost between 5,000 and 15,000. Apart from functionality, the factors that affect the cost include:

- Clarity and completeness of your requirements.
- Whether the system is web-based or desktop.
- Whether it is a multi-user or a single-user system.

- the number of records it must manage, i.e. hundreds versus hundreds of thousands.
- If you want to build a customer database program yourself in Microsoft Access, you would either need to have a retail copy of Access (around $200) or Office Professional on each computer or purchase Microsoft Visual Studio Tools for Office (around $800) for your development machine. Your time costs will be probably much more than the software.

The cost of industry-specific software including customer databases very dramatically from industry to industry. Sometimes these packages are cheaper, and sometimes they are more expensive than a custom-built program.

7.8 Advance Features of Web Enabled Accounting Information System

Web Enabled: This will help the user in reducing his paper work further. Now, report in Tally can be e-mailed directly from Tally. It is not just reports, but even invoices and purchase orders can also be e-mailed directly from Tally. For example Tally ees 6.3 is web enabled.

Procedure: Select any report (e.g. Balance sheet) à select Alt+M (E-mail) à specify all details as required by Tally.

Ability to publish reports and documents on the Internet: Now Tally allows users to upload reports on the web site directly from Tally. So companies that would want to publish reports on the web site can do so directly from Tally. Many companies would also like to publish their price list on their websites along with the product they deal with.

Procedure: Select any report (Profit and Loss A/C) à select Upload (Alt+O) à specify all details as required by Tally.

Direct Internet Access: Tally now offers direct Internet access. A Tally user while working on Tally can directly log on to tally website get details of all the facilities offered by Tally. The user can also download the latest releases of Tally 6.3 as and when available. Tally website also offers a facility of Tally Chat. Any user can now chat with a Tally representative and get any information regarding Tally.

Procedure: Start Tally à now, from any screen select Web Browser (Alt+W). Tally now takes you to the Tally Web site.

Print Preview: Any user would ideally like to view format of reports / Invoices / Vouchers before printing the same. Tally now offers a facility of print preview. Now any report can be viewed before printing or before it is mailed. Once Tally shows the preview the user can either opt to print or mail the same.

Protocol Support: Protocol Support for HTTP, HTTPS, FTP, SMTP, ODBC and RAW sockets with data interchange formats like XML HTMNL, HTML with XML Islands, SOAP, SDF and related formats.

Formats:

XML: Extensible Markup Language

HTML: Hyper Text Markup Language

SOAP: Simple Object Access Protocol

SDF: Standard Data Format

Formats, here means the standard for information to be generated from Tally or from other applications that can exchange data with Tally.

Protocol (Transport)

HTTP: Hyper Text Transfer Protocol

HTTPS: Hyper Text Transfer Protocol (Secure)

FTP: File Transfer Protocol

SMTP: Simple Mail Transfer Protocol

ODBC: Open Data Base Connectivity

Raw Sockets

Transport here refers to a mechanism by which information (data) can be pushed into Tally or from Tally.

Backup / Restore: Tally has an in built user friendly Backup and Restore option. The user can take a backup in the local hard disk or in any external media. Tally provides the user with capability to take backups of one or more companies or all companies in a single directory.

Procedure to take a backup in Tally: In Company Information screen à select Backup à select Source directory and path à select Destination (specify path) à select the companies for which the back up has to be taken. And save screen.

Procedure to restore data: In company information screen à select Restore à specify destination (specify path) à select source (specify path) à select the companies for which have to be restored and save screen.

Import / Export of Data: Tally allows users to import data from other software's as well as Export data from Tally to other software's. Tally allows users to import and export in ASCII, SDF and XML formats. XML is now the most widely used format of exporting data in the world. Any transactions can be exported from Tally and imported in other software after suitably altering the current structures to accept Tally data structure. The reverse is also possible by writing a small TDL program to accept the data from other software's. The data that is to be imported into Tally can be in either XML or DBF format.

7.9 Summary

The following are some question which helps a customer to decide whether he should go for software which are available in the market or should build a software in in-house or should go for outsourcing for maintaining Account Information System.

- **What should a customer decide? :** A customer should decide by preparing a cost benefit analysis, that should he purchase a software from the market or should design his own software by developer by fulfilling all his needs or he should go for outsourcing for Account Information System.
- **What did he think about prototyping (model)? :** In this phase of working the customer decides that if he go for designing of his own software by developer than it would work properly well or not in future.
- **What did he think about reengineering?:** When a customer goes for generalized software which are available in the market then he should decide that whether the system need not

reengineering. If the reengineering is not required then he will easily opt this option otherwise he will exercise that whether his extra requirement will be fulfilled or not. If not then he will never go for this option.

7.10 Unit end Questions

1. What do you understand by Accounting Information System? Explain it.
2. What are the major components of the Accounting Information System Technology?
3. Define the different applications of MIS in briefly.
4. How many phases involved in any system development? Explain each of them?
5. Define the different kind of Accounting Systems.
6. What is the function of database in any accounting software?
7. What do you mean of From Design? How many section a form includes? Define each of them.
8. What is a Report Object? Define all section which includes in Report Design.
9. What is the role of ODBC? Explain briefly.
10. What is a Query object? Explain its role in a database.

Unit - 8

System Development - Life Cycle Technologies and Practices Systems Planning Fesibility

Outline of the Unit:

8.0 Objectives

8.1 Introduction

8.2 System Concepts

- 8.2.1 Characteristics of a System
- 8.2.2 Important Terms Related to Systems
- 8.2.3 Business System Concepts

8.3 Planning the System / Project

- 8.3.1 Stages of a Project
- 8.3.2 Project Scheduling
- 8.3.3 Problem of Capacity
- 8.3.4 Problem of Throughput
- 8.3.5 Scheduling Techniques

8.4 Various Approaches for System development

- 8.4.1 Structured Analysis and Design Approach
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- 8.4.4 Participatory Design

8.5 System Development Life Cycle

- 8.5.1 Phases of SDLC
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- 8.5.3 System Development Life Cycle Models
- 8.5.4 Developing a Successful System

8.6 Feasibility Study

- 8.6.1 Objective of Feasibility Study
- 8.6.2 Types of Feasibility
- 8.6.3 Steps in Feasibility Analysis

8.7 Summary

8.8 Keywords

8.9 Abbreviations

8.10 Hint / Key to Activity / Self Assessment Questions

8.11 Questions for Practice

8.12 References

8.0 Objectives

After reading this unit you will –

- Acquaint with system and its various planning and development approaches
- Able to do feasibility analysis of any system
- Understand various phases of SDLC

8.1 Introduction

System is an organized relationship of components. It is a grouping of interdependent components linked together to achieve a specific goal. Each component has to do its own part of work in the system. In our day to day life we come in contact with various systems such as communication system, railway system, telephone system, production system, economic system, accounting system etc. Similarly, business systems are the means by which business organisations achieve their pre-determined goals. A business system combines politics, personnel, equipment and computer facilities to co-ordinate the activities of a business organisation.

8.2 System Concepts

In this section we will learn various systems related concepts to grasp the in-depth knowledge of system, system characteristics, and system type's and tries to understand the Business as a system.

8.2.1 Characteristics of a System:

There are various characteristics shown by systems:

i. Organisation: Organisation is the arrangement of components that helps to achieve objectives.
ii. Interaction: Interaction is the procedure using which various components of the system work together within the system.
iii. Interdependence: All components of the system work with one another and depend on each other for some input or result.
iv. Integration: All components of a system are attached together to achieve a single main objective.
v. Central Objective: It is the main goal of that system, for which the system is developed.

8.2.2 Important Terms Related to Systems:

i. A System's **purpose** is the reason for its existence.
ii. A System's **boundary** defines what is inside and what is outside that system.
iii. A System **Environment** is everything that is outside of its boundaries.
iv. A System's **Inputs** is the values it takes from its environment.
v. A System's **Outputs** are the values that go out from the system into the environment.
vi. A **Subsystem** is a component of a System, which is also a system in itself.

8.2.3 Business system Concepts:

A business can be defined in system terms. Business systems are the means by which business organizations achieve their predetermined goals. The various business system elements are:-

i. physical (buildings, raw materials, finished products)

ii. procedural (order processing routines, credit checking procedures)

iii. conceptual (statement of policy, market for products)

iv. social (workers, departments)

In general, a System is based on Input-Process-Output (IPO model). For taking the advantages of computer's seed and accuracy manual systems can be automated. Before the development of any computerized system, developers must understand all basic concepts of system. Various approaches are available for development of computerized system, but proper development approach must be adopted to get a foolproof system.

Self Assessment Question 8.1

Q Which of the following is not a component of an information system?

(A) Equipment (B) End-user (C) Organisational goals (D) Procedures

8.3 Planning the SYSTEM / project

"...careful planning at the beginning of the project is perhaps the single most important factor that distinguishes success from failure." Project Planning is the process of controlling and scheduling all the activities in advance and the process of controlling the development process of the developing project is known as Project Management. Project Planning and Management are always conducted within a defined set of constraints.

A plan is a map of a place to which one wishes to arrive and the path to obtain that goal. There are several groups of stakeholders - depending on the size of a project. At a minimum the stakeholders include (a) the customer, both the software users and the managers of those employees, (b) the managers of the project, such as the project executive, the project manager, and the team-lead, and (c) the team of developers for the project. Each of these groups has a stake in the success or failure of the project. Each group has its own goals and objectives. With such diversity among the various groups there must be a plan - and the plan must be developed with the input from all of the stakeholders in the process.

8.3.1 Stages of a Project:

Each project stage is characterised by a distinct set of activities that take the project from its first idea to its conclusion. Each stage is of equal importance and contributes to the overall success of the project. Projects are divided into six stages:

1. Definition
2. Initiation
3. Planning
4. Execution
5. Monitoring & Control
6. Closure

1. **Definition:-** Before a project starts the project manager must make sure the project goals, objectives, scope, risks, issues, budget, timescale and approach have been defined. This must be communicated to all the stakeholders to get their agreement. Any differences of opinion need to be resolved before work starts. There must be a clear boundary around the project so

that all personnel involved will know what is in the project and what is not.

2. **Initiation:-** This is perhaps the most important stage of any project as it sets the terms of reference within which the project will run. If this is not done well, the project will have a high likelihood of failure. The initiation stage is where the business case is declared, scope of the project decided and stakeholder expectations set. Time spent on planning, refining the business case and communicating the expected benefits will help increase the likelihood of success.
3. **Planning:-** The key to a successful project is the planning. Creating a project plan is the first task you should do when undertaking any project. Often project planning is ignored in favour of getting on with the work. However, many people fail to realise the value of a project plan in saving time, money and many other problems. Planning is the process of constructing a "road-map" from the current state to the goal state. The plan refines the scope and helps determine what is important and what is not. Uncertainty will occur and the environment will change during the course of the project. The project plan helps the project participants to focus on the goal.
4. **Execution:-** Doing the work to deliver the product, service or wanted outcome. This step assigns tasks, determines how they will be done, and the timeframe in which they must be completed.
5. **Monitoring & Control:-** Once the project is running it is important the project manager keeps control. This is achieved by regular reporting of issues, risks, progress and the constant checking of the business case to ensure that expected benefits will be delivered and are still valid. Controlling or monitoring the project to maintain the schedule. There will always be interruptions or delays. The project manager uses the plan to determine the best course of action to keep or return the project to an acceptable schedule.
6. **Closure:-** Often neglected, it is important to ensure that a project is closed properly. Many projects never end because there is no formal sign-off. It is important to get the customers agreement that a project has ended and that no more work will be carried out. Once closed, the project manager should review the project and record the good and bad points so successes can be repeated and failures avoided. A project that is not closed will continue to consume resources, albeit slowly.

In conclusion, the system project planning process is an important tool for the success of a development project. Creating such a plan is of vitally importance because of the nature of system development. Unfortunately, one person's interpretations are not the same as another's even when both are involved in the same project. These differences in opinion are cause of errors. Therefore, a specific, detailed project plan must be developed. It provides the following benefits:

i. It translates the high-level business objectives into a detailed 'road-map' of concrete deliverables.
ii. It provides a detailed list of resource requirements.
iii. It provides a realistic assessment of project timescales.
iv. It allows estimated project costs to be further validated.
v. It allows for issues to be identified early on, for example tasks taking longer than expected, slippage in target dates, team members not being productive.

8.3.2 Project Scheduling:

Projects are organised into modules, or segments, of related tasks. Modular planning has following advantages: it facilitates assigning responsibility and measuring processes, and it further allows systems analysts to work in concentrated areas of projects so they can master every aspect of that portion of the system. A schedule must be flexible because unexpected events may occur that may affect the schedule of development of the system. The charting techniques are the scheduling tools of the project planner. Even the simplest project should be charted so that progress can be measured. The Gantt chart is effective in simple projects, especially when the interrelationships among events are not too complex. Complicated scheduling usually requires a PERT chart.

A schedule has two primary functions; it is both a plan and a device for measuring progress. The key steps in a schedule are called milestones, or checkpoints. As the project progresses, the date on which each milestone is completed is compared with the date for which it was projected. If, in the original planning stage, the important milestones were anticipated correctly, reporting them as completed, late, ahead of schedule, or on time has significance to the status of the project. The status of fringe events is relatively insignificant. Here, the value of the PERT network as a tool for determining the relative importance of milestones is apparent. The status of projects is often reported in terms of percentage of completion. As a simplified reporting device, this is effective and allows easy communication with top management. The problem with reporting of percentage of completion is that events on the critical path are not emphasised. A project may have 90 percent of its events complete, but if one of the incomplete events is on the critical path and is two years late, then the project may be in serious trouble.

Accurate scheduling requires extensive experience. The novice scheduler almost always does not allow enough time for activities. When a project is behind schedule, corrective steps must be taken. Establishing milestones is meaningless unless the project manager can enforce adherence to schedule. Enforcement is a normal managerial duty. If a project leader cannot enforce a schedule, someone else should be leading the project. If one area is consistently behind schedule, or over budget, the project leader must discuss the problem with the individuals responsible and take corrective action. The project leader must determine the real cause of unsatisfactory progress. Perhaps, it is a budgetary or personnel problem.

Too often, a major cause of apparently unsatisfactory performance is that the original schedule estimates were wrong, and that progress is as good as can be expected under the circumstances. Projects have many target dates, but few deadlines. The project leader must distinguish one from the other. When target dates are missed, there may be some grumbling, but missed deadlines result in financial loss to the organisation. The project leader must remember that this is not the only project under way and delays will occur routinely simply because another, more important project may have to be handled first. Schedules are highly dependent upon priorities and should be planned accordingly.

8.3.3 The Problem of Capacity:

The problem of capacity occurs when a system component is not large enough. Capacity problems are specially common in organisations that experience peak periods of business. During peak periods, inadequate processing capacity, transmission capacity, storage capacity, staff capacity, and the like may all exist. Capacity problems are also evident in rapidly growing organisations. With growth, smaller-capacity equipment soon becomes too small; smaller staff groups soon become overworked. In either case, some expansion is needed to handle the increasing volume of business.

Many system problems are directed at solving capacity problems. Since it is often difficult to justify the purchase of new equipment or the hiring of new staff, people tend to put off such decisions until the very last moment. Consequently, when the systems group is contacted, the problem of capacity is easy to spot. For example, an analyst might be forced to suggest a short-term solution to the problem. This is done to gain time towards the formulation of a longer-term solution. When a short-term approach fails, the analyst may be tempted to implement a quick-fix computer-based solution. Unfortunately, this solution carries with it, the associated danger of creating an even more severe system problem in the near future.

8.3.4 The Problem of Throughput:

The problem of Throughput may be viewed as the reverse of the problem of capacity. Throughput deals with the efficiency of a system. If system capacity is high and production is low, a problem of throughput occurs.

Another limitation is the coverage given to tools that the analyst can use to identify and evaluate system problems. These tools are needed when the problems are not self-evident. Organisations face various types of problems during their course of operations and come across opportunities or situations, which could be converted into profitable solutions. Whenever there is an opportunity and /or problem in the existing system of operations or when a system is being developed for the first time, the organisation considers designing a new system for information processing.

8.3.5 Scheduling Techniques:

The following are various types of scheduling techniques in software engineering:

(1) **Work Breakdown Structure:** The work breakdown structure shows the overall breakup flow of the project and does not indicate any parallel flow. The project is scheduled in various phases following a bottom-up or top-down approach. A tree-like structure is followed without any loops. At each phase or step, milestone and deliverables are mentioned with respect to requirements. *Figure* depicts an example of a work breakdown structure.

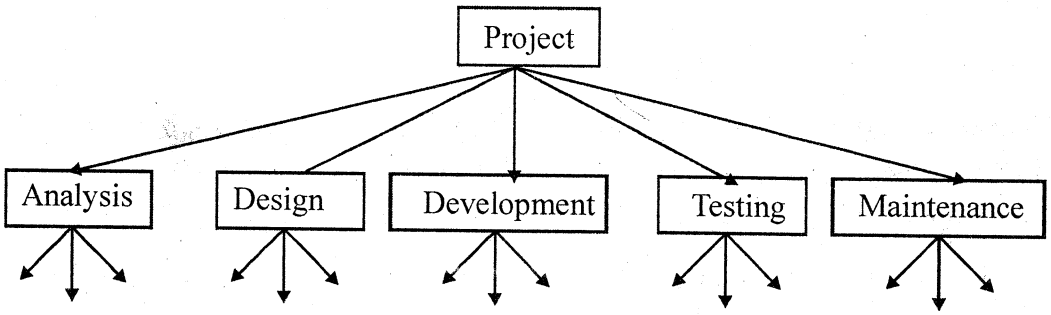


Diagram 8.1

Work Breakdown Structure

(2) **Flow Graph :** Various modules are represented as nodes with edges connecting nodes. Dependency between nodes is shown by flow of data between nodes. Nodes indicate milestones and deliverables with the corresponding module implemented. The arrows indicate the flow of information between modules. Cycles are not allowed in the graph. Start and end nodes indicate the source and terminating nodes of the flow. *Figure below* depicts a flow graph.

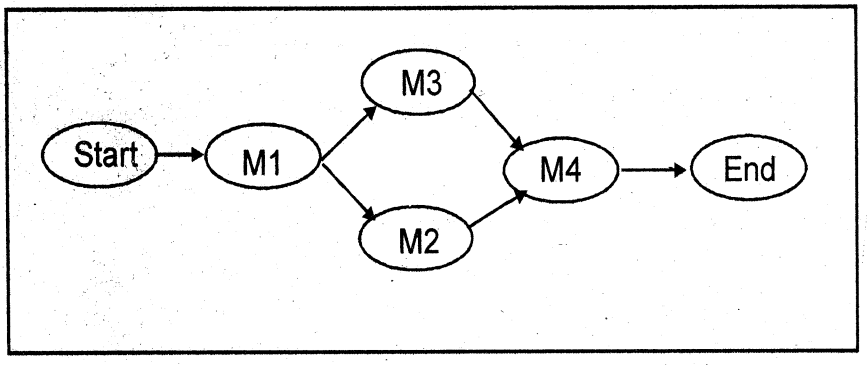


Diagram 8.2 Flow Graph

(3) Gantt Chart or Time Line Charts: A Gantt chart can be developed for entire project or a separate chart can be developed for each function. A tabular form is maintained where rows indicate the tasks with milestones and columns indicate duration (weeks/months). The horizontal bars that spans across columns indicate duration of the task. *Figure below* depicts a Gantt Chart. The circles indicate the milestones.

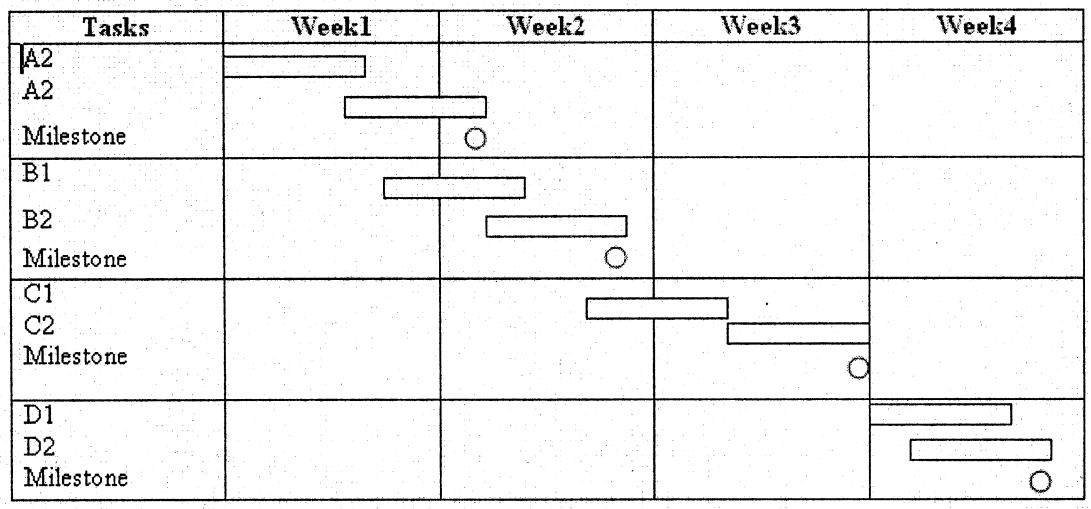


Diagram 8.3 Gantt Chart

(4) Program Evaluation Review Technique (PERT): Mainly used for high-risk projects with various estimation parameters. For each module in a project, duration is estimated as follows:

1. Time taken to complete a project or module under normal conditions, *tnormal.*
2. Time taken to complete a project or module with minimum time (all resources available), *tmin*
3. Time taken to complete a project or module with maximum time (resource constraints), *tmax.*
4. Time taken to complete a project from previous related history, *thistory.* An average of tnormal, tmin, tmax and thistory is taken depending upon the project.

Sometimes, various weights are added as 4*tnormal, 5*tmin, 0.9*tmax and 2*thistory to estimate the time for a project or module. Parameter fixing is done by the project manager.

Self Assessment Question 8.2

1. If Project A has twice as many resources as Project B, will Project A be twice as complex as Project B? Why or why not?

8.4 Various Approaches For Development of Information Systems

In the continuing effort to improve the systems analysis and design process, several approaches have been developed. Attempts to make system development less of an art and more of a science usually referred to as engineering techniques, are applied to system development. They are:

8.4.1 Structured Analysis and Design Approach:

It emphasizes the drawing of pictorial system models to document and validate both existing and/or proposed systems. Ultimately, the system model becomes the blueprint for designing and constructing an improved system. It is also known as model driven approach. The goal of structured system analysis and design is to reduce maintenance time and effort. Modeling is the act of drawing one or more graphical representations of a System.

Structured Analysis is a development method for the analysis of existing manual systems or automated systems, leading to development of specifications (expected functionality or behavior) for proposed system. The objective of structured analysis approach is to organize the tasks associated with requirement determination to provide an accurate and complete understanding of a current situation. The major tasks of structured system analysis approach are:

i. Preliminary Investigation
ii. Problem Analysis
iii. Requirement Analysis
iv. Decision Analysis

Structured analysis introduced a process-modeling tool called the *Data flow diagram*, used to illustrate business process requirements. With the help of DFD, the systems analyst can show the system overview. Data modeling tools such as *Entity relationship diagrams* are used to illustrate business data requirements. With the help of ERD, the analyst can show database overview.

Structured Design utilizes graphic description (Output of system analysis) and focuses on development of software specifications. The goal of structured design is to lead to development of programs consisting of functionally independent modules that perform relatively independently of one another. Structured Design introduced a modeling tool called Structure Charts. They are used to illustrate software (program) structure to fulfill business requirements. Structure charts describe the interaction between independent module and the data passing between the modules. These module specifications can be passed to programmers prior to the writing of program code.

8.4.2 Prototypes:

A prototyping approach emphasizes the construction of model of a system. Designing and building a scaled-down but functional version of the desired system is known as Prototyping. A prototype is a working system that is developed to test ideas and assumptions about the new system. It consists of working software that accepts input, perform calculations, produces printed or display information or perform other meaningful activities. It is also known as accelerated approach.

It is the first version or iteration of an information system i.e. an original model. Customer evaluates this model. Changes are expected as the system is used. This approach is useful when the requirements are not well defined. It may begin with only few functions and be expanded to include others that are identified later. The steps of Prototyping process are:

i. Identify the user's known information requirements and features needed in the system.

ii. Develop a working prototype.

iii. Revise the prototype based on feedback received from customer

iv. Repeat these steps as needed to achieve a satisfactory system.

Actual development of a working prototype is the responsibility of a systems analyst. The difference between a prototype model and an actual information system is that, a prototype will not include the error checking, input data validation, security and processing completeness of a finished application. It will not offer user help as in the final system.

Two key advantages of the prototyping technique are the large extent to which prototyping involves the user in analysis and design and its ability to capture requirements in concrete rather than verbal or abstract form. In addition to being used stand-alone, prototyping can also be used to augment the SDLC. Prototyping is a form of rapid application development or RAD. Based on the user feedback, the analyst improves the prototype and makes a new version of the prototype. This process continues till the client is satisfied and fulfils his/her needs. In some cases, prototypes are further scaled upwards to become full fledged software to be delivered to the customer.

8.4.3 Joint Application Development:

In the late 1970s, systems development personnel at IBM developed a new process for collecting information system requirements and reviewing systems designs. The process is called Joint Application Design (JAD). The basic idea behind JAD is to bring structure to the requirements determination phase of analysis and to the reviews that occur as part of design. Users, managers, and system developers are brought together for a series of intensive structured meetings run by a JAD session leader who maintains the structure and sticks to the agenda. By gathering the people directly affected by an Information System in one room at the same time to work together to agree on system requirements and design details, time and organizational resources are better put to use. An added advantage is that, group members are more likely to develop a shared understanding of what the information system is supposed to do. In this approach, requirements are identified and design details are finalized. It is defined as a structured approach in which users, managers, and analysts work together for several days in a series of intensive meetings to specify or review system requirements. The typical participants in a JAD are listed below:

i. **JAD session leader:** The JAD leader organizes and runs the JAD. This person is trained in group management and facilitation as well as system analysis. The JAD leader sets the agenda and sees that it is met.

ii. **Users:** The key users of the system under consideration are vital participants in a JAD. They are the only ones who have a clear understanding of what it means to use the system on a daily basis.

iii. **Managers:** The role of managers during JAD is to approve project objectives, establish project priorities, approve schedules and costs and approve identified training needs and implementation plans.

iv. **Sponsors:** A JAD must be sponsored by someone at a relatively high level in the company i.e. the person from top management.

v. **Systems Analysts:** Members of the systems analysis team attend the JAD session although

their actual participation may be limited.

vi. **Scribe:** The scribe takes down the notes during the JAD sessions. This is usually done on a personal computer or a laptop. Notes may be taken using a word processor.

vii. **IS staff** like systems analysts, other IS staff such as programmers, database analysts, IS planners and data centre personnel may attend to learn from the discussions and possibly to contribute their ideas on the technical feasibility of proposed ideas or on technical limitations of current systems.

The following are the various benefits of Joint Application Development:

i. actively involves users and management in project development,

ii. reduces the amount of time required to develop a system, and

iii. Incorporates prototyping as a means for confirming requirements and obtaining design approvals.

8.4.4 Participatory Design (PD):

Participatory Design (PD) represents a useful alternative approach to the SDLC. PD emphasizes the role of the user much more than other techniques do. In some cases, PD may involve the entire user community in the development process. Each user has an equal share in determining system requirements and in approving system design. In other cases, an elected group of users control the process. These users represent the larger community. Under PD, systems analysts work for the users. The organization's management and outside consultants provide advice rather than control. PD is partly a result of the role of labour and management in the workplace where labour is more organized and is more intimately involved with technological changes.

8.5 System Development Life Cycle

System development life cycle (SDLC) is a standard methodology for the development of Information System. It mainly consists of four phases: System Analysis, System Design, System Construction & Implementation and System Support. Every phase consist of inputs, tasks and outputs. Traditional SDLC was strictly sequential. The developers first complete the previous phase then start the next phase. But now concept of Repository (Store/Memory) is introduced in SDLC and it is known as FAST methodology where work is done across shared repository. It means that all the inputs and outputs of phases must be stored in the repository. At any time developers can backtrack to previous phase and they can also work on two phases simultaneously.

8.5.1 Phases of SDLC:

SDLC (System Development Life Cycle) consists of six steps (Project Initiation and planning, Project identification and selection, Analysis, Design, Implementation and Maintenance), but can be expanded to include other steps to incorporate software needs to make overall 12 steps of SDLC (Software Development Life Cycle) out of which 10 main steps are discussed below:

1. Recognition of Need
2. Project Identification and Selection
3. Project Initiation and Planning
4. Analysis
5. Design

6. Testing
7. Implementation
8. Evaluation
9. Maintenance
10. Project Termination

(1) Recognition of Need

One must know, what the problem is before it can be solved. The basis for a candidate system is recognition of a need for improving an information system or a procedure. This leads to a preliminary system survey or initial investigation to determine, whether an alternative system can solve the problem. It entails working into the duplication of efforts, bottlenecks, existing procedures, or whether parts of the existing system would be candidate for computerisation. If the problem is serious enough, management may want to have an analyst look at it. Such an assignment implies a commitment, especially, if an analyst is hired from outside. In larger organizations, where formal procedures are the norms, the analyst's first task is to prepare a statement specifying the scope and objective of the problem. He/She then reviews it with the user for accuracy. At this stage, only a rough "ball park" estimate of the development cost of the project may be reached.

(2) Project Identification and Selection

The next phase in the SDLC is called project identification and selection. In this phase, the user identifies the need for a new or improved system. Information requirements of the organization as a whole are examined, and projects to meet these requirements are proactively identified. The organization's information system requirements may result from requests to deal with problem in current system's procedures, from the desire to perform additional tasks, or from the realization that information technology could be used to capitalize on an existing opportunity. These needs can then be prioritised and translated into a plan for the Information System department including a schedule for developing new major systems. In smaller organizations, determination of which systems to develop may be affected by user request submitted as the need for new or enhanced systems arises as well as from a formal information planning process.

Project Selection -Systems analysts do not start working on any project they desire. They receive a lot of requests from the department managers, senior executives, operational level users, outside groups and system analysts for starting different types of projects. When projects are formally requested, the system analysts, under management direction, conduct a preliminary investigation. Some projects are feasible, while others may not for various reasons. In either case, during project identification and selection, an organization determines whether or not resources should be devoted to the development or enhancement of each information system under consideration. The outcome of the project identification and selection process is a determination of which systems development projects should be undertaken by the organization at least in terms of an initial study. On the basis of various problems faced in the existing system as requested by the systems members and their request in the form of new projects, the system analyst take decision, which projects to be selected and feasibility analysis be made of them as discussed in the next phase.

(3) Project Initiation and Planning

The third phase is project initiation and planning. A critical step at this point is determining the scope of the proposed system. The project leader and initial team of system analysts also produce

a specific plan for the proposed project, which the team will follow using the remaining SDLC steps. Now, this baseline project plan customizes the standardized SDLC and specifies the time and resources needed for its execution. The formal definition of a project is based on the likelihood that the organization's information system department is able to develop a system that will solve the problem or use the opportunity and determine whether the costs of developing the system outweigh the benefits it could provide. The final presentation with the subsequent project phases is usually made by the project leader and other team members to someone in management or to a special management committee with the job of deciding which projects the organization will undertake.

(4) Analysis

Analysis is a detailed study of the various operations performed by a system and their relationships within and outside the system. A key question is: What must be done to solve the problem? One aspect of analysis is defining the boundaries of the system and determining whether or not a candidate system should consider other related systems. During analysis, data are collected on the available files, decision points and transactions handled by the present system. Tools are used and logical models of the system developed. This phase has several sub-phases. In first sub-phase the requirements are studied and structured in accordance with their inter-relationships and eliminate any redundancies. Third, alternative initial design is generated to match the requirements. Then, these alternatives are compared to determine which alternative best meets the requirement in terms of cost and labour to commit to development process. In this phase, feasibility study of the proposed system is also performed.

Depending on the results of the initial investigation, the survey is expanded to a more detailed feasibility study. A feasibility study is a test of system proposal according to its workability, impact on the organization, ability to meet user's needs and effective use of resources. It focuses on three major questions:

i. What are the user's demonstrated needs and how does a candidate system meet them?
ii. What resources are available for a given candidate system? Is the problem worth solving?
iii. What are the likely impacts of the candidate system on the organization? How well does it fit within the organization's MIS plan?

The objective of the feasibility study is not to solve the problem but to acquire a range of its scope. Consequently, costs and benefits are estimated with greater accuracy at this stage. The result of the feasibility study is a formal proposal. This is simply a report – a formal document detailing the nature and scope of the proposed solution. After the proposal is reviewed by the management, it becomes a formal agreement that paves the way for actual design and implementation. If the proposed system is not feasible to develop, it is rejected at this very step.

The output of the analysis phase is a description of (not detailed design) the alternative solution recommended by the analysis team. Once, the recommendation is accepted by those with funding authority, you can begin to make plans to acquire any hardware and system software necessary to build or operate the system proposed. Once analysis is completed, the analyst has a firm understanding of what has to be done. The next step is to decide, how the problem might be solved. Thus, in system design, we move from logical to the physical aspect of the life cycle.

(5) Design

After analysis phase is complete, design of the system begins. The most creative and challenging phase of the system life cycle is system design. The term design, describes a final system

and process by which it is developed. During design, analysts convert the description of the recommended alternative solution into logical and then physical system specifications. You must design all aspects of the system from input and output screens to reports, databases, and computer processes. The key question here is: How should the problem be solved?

The first step is to determine, how the output is to be produced and in which format. Sample of output (and input) are also presented. Second, input data and master files (data base) have to be designed to meet the requirements of the proposed output. The operational (processing) phases are handled through program construction and testing, including a list of programs needed to meet the system's objectives and complete documentation. Finally, details related to justification of the system and an estimate of the impact of the system on the user and the organization are documented and evaluated by the management as a step towards implementation. The final reports prior to the implementation phase include procedural flow charts, record layout, report layout and workable plan for implementing the candidate system. Information on personnel, money, hardware, facilities and their estimated cost must also be available. At this point, projected cost must be close to actual cost of implementation. Design occurs in two phases, viz., logical design and physical design.

Logical Design - Logical design is not tied to any specific hardware and systems software platform. Theoretically, the system could be implemented on any hardware and systems software. The idea is to make sure that the system functions as intended. Logical design concentrates on the business aspects of the system.

Physical Design - In physical design, the logical design is turned into physical or technical specifications. You design various parts of the system to perform the physical operations necessary to facilitate data capture, processing, and information output. During the physical design, the analyst team decides the programming language in which the computer instructions will be written in, which database system and file structure will be used for the data, the platform that will be used and the network environment under which the system will be run. These decisions finalize the hardware and software plans initiated at the end of the analysis phase. Now, proceedings can be made with respect to acquisition of any new technology not already present in the organization.

The final product of the design phase is the physical system specification in a form ready to be turned over to programmers and other system builders for construction. The physical system specifications are turned over to programmers as the first part of the implementation phase. Architecture, including hardware and software, communication, software design (UML is produced here) are all part of the deliverables of a design phase.

(6) Testing

No system design is ever perfect. Communication problems, programmer's negligence or time constraints create errors that must be eliminated before the system is ready for user acceptance testing. A system is tested for online response, volume of transactions, stress, recovery form failure and usability then comes system testing, which verifies that the whole set of programs hang together, following system testing is acceptance testing or running the system with live data by the actual use. System testing requires a test plan that consists of several key activities and steps for programs, string, system and user acceptance testing.

(7) Implementation

During implementation, you turn system specification into working system that is tested and put into use. Implementation includes **coding, testing and installation**. During coding, programmers

write programs that make up the system. During testing, programmers and analysts test the individual programs and the entire system in order to find and correct errors. During installation, the new system becomes a part of the daily activities of the organization. Application is installed or loaded, on existing or new hardware and users are introduced to new system and trained. Installation of the system can be done in the following three ways:

i. **Direct conversion:** In this type of conversion, the software is directly installed at user's site.
ii. **Parallel conversion:** In this type of conversion, both the old and new systems are run in parallel for some time.
iii. **Phased conversion:** In this type of conversion, the system is installed module by module.

Implementation activities also include initial user support such as the finalization of *documentation, training programs, and ongoing user assistance*. Documentation is produced throughout the lifecycle. Implementation can continue for as long as the system exists since ongoing user support is also part of implementation. The implementation phase is less creative than system design. It is primarily concerned with user training, site preparation and file conversion. When the candidate system is linked to terminal or remote sites, the telecommunication network and tests of network along with the system are also included under implementation. Depending on the nature of the system, extensive user training may be required. Conversion usually takes place at about the same time, when the user is being trained or later. Once the programs become available, test data are read into computer and processed against the files provided for testing. If successful, the program is then run with live data. Otherwise, a diagnostic procedure is used to locate and correct errors in the program.

(8) Evaluation

Evaluation of the system is performed to identify its strengths and weaknesses. The actual evaluation can occur along any of the following dimensions:

i. **Operational Evaluation:** Assessment of the manner in which the system functions.
ii. **Organizational Impact:** Identification and measurement of benefits to the organization in such areas as financial concerns, operational efficiency and competitive impact.
iii. **User Manager Assessment:** Evaluation of the attitudes of senior manager and user within the organization, as well as end-users.
iv. **Development Performance:** Evaluation of the development process in accordance with such yardsticks as overall development time and effort, conformance to budgets and standards and other project management criteria.

(9) Maintenance

The final phase is maintenance. When a system is operating in an organization, users sometimes find problems with how it works and often think of better ways to perform its functions. Also, the organization's requirements with respect to the system change with time. During maintenance, programmers make the changes that users ask for and modify the system to reflect and support changing business conditions. These changes are necessary to keep the system running and useful. Maintenance is necessary to eliminate errors in the working system during its working life and to tune the system to any variations in its working environment. Maintenance is of three types:

i. **Corrective maintenance**: In this type, the errors that creep into the system are removed. Hence the name *corrective maintenance*.

ii. **Adaptive maintenance**: It is done to adapt with the changing external factors. For example, if the government rules change regarding the Dearness Allowance from 52% to 58%, then the changes have to be made in the Information System to adapt with the changing scenario.

iii. **Perfective maintenance**: This is done to satisfy the users' requirements to make the system more and more perfect.

(10) Project Termination

A system project may be dropped at any time prior to implementation, although, it becomes more difficult (and costly) when it goes past the design phase. Generally, projects are dropped if, after review of the project, it is termed that the existing design does not achieve changing objectives or requirements of clients. It may also be dropped, if benefits realized from candidate system do not justify commitment to implementation or if the cost and time exceeds beyond what was planned.

8.5.2 Products of SDLC Phases:

i. **Project Identification and Selection:** Priorities for systems and project, architecture for data, networks, hardware and Information System Management are the result of the associated system.

ii. **Project Initiation and Planning:** Detailed work plan for project, specification of system scope and high level system requirements, assignment of team members and other resources.

iii. **Analysis:** Description of current system, need to enhance or replace current system, explanation of alternative systems and justification of alternatives.

iv. **Logical Design:** Functional and detailed specification of all system elements (data, process, input and output).

v. **Physical design:** Technical, detailed specifications of all system elements, i.e., programs, files, network, system software, etc. and acquisition plan for new technology.

vi. **Implementation:** Code, documentation, training programs and support capabilities.

vii. **Maintenance:** New version of software with associated updates of documents, training and support.

8.5.3 System Development Life Cycle Models:

The General Model: - System life cycle models describe phases of the system cycle and the order in which those phases are executed. There are tons of models, and many companies adopt their own, but all have very similar patterns. Each phase produces deliverables required by the next phase in the life cycle. Requirements are translated into design. Code is produced during implementation that is driven by the design. Testing verifies the deliverable of the implementation phase against requirements. The general, basic model is shown below:

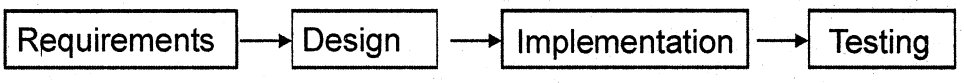


Diagram 8.4

Steps of SDLC

(1) Waterfall Model for System Development

This is often known as the "classical life cycle" or "linear sequential model". This model is derived from conventional engineering cycle. It encompasses all the activities discussed above. It is so called, because of it's diagrammatic representation. It is very simple to understand and use.

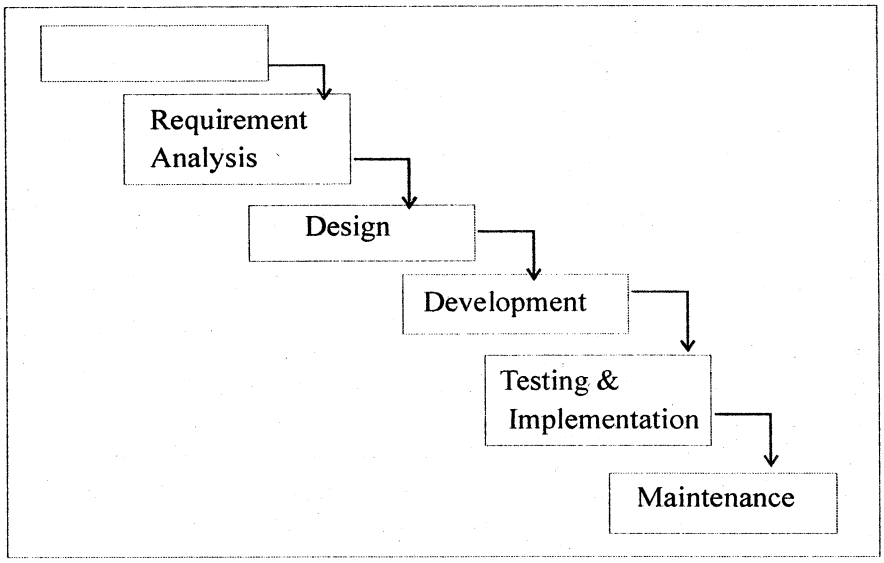


Diagram 8.5

Waterfall Model

All the steps are followed by each other. An activity starts only when the previous activity has been completed. In a waterfall model, each phase must be completed in its entirety before the next phase can begin. For example, as per the waterfall model, maintenance phase is started only when the implementation phase has been completed. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. Unlike general model, phases do not overlap in a waterfall model.

Advantages

i. Simple and easy to use.
ii. Easy to manage due to the rigidity of the model – each phase has specific deliverables and a review process.
iii. Phases are processed and completed one at a time.
iv. Works well for smaller projects where requirements are very well understood.
v. Easy to understand even by non-technical persons i.e., customers.
vi. Each phase has well defined inputs and outputs e.g., input to system design stage is Requirement Specification Document (RSD) and output is the design document.
vii. Easy to use as software development proceeds.
viii. Each stage has well defined deliverables or milestones.
ix. Helps the project manager in proper planning of the project.

Disadvantages

i. Adjusting scope during the life cycle can kill a project
ii. No working software is produced until late during the life cycle.
iii. High amounts of risk and uncertainty.
iv. Poor model for complex and object-oriented projects.
v. Poor model for long and ongoing projects.
vi. Poor model where requirements are at a moderate to high risk of changing.

vii. The biggest drawback of Waterfall model is that it does not support iteration.

viii. Software development on the other hand is iterative i.e., while designing activities are being carried out, new requirements can come up. Similarly while product is being coded, new design and requirement problems can come up.

ix. Another disadvantage of Waterfall model is that it is sequential in nature. One cannot start with a stage till preceding stage is completed e.g., one cannot start with the system design till all the requirements are understood and represented.

x. Users have little interaction with the project team. Their feedback is not taken during development.

xi. Customer gets opportunity to review the product very late in life cycle because the working version of product is available very late in software development life cycle.

xii. Model is very rigid because output of each phase is prerequisite for successive stage.

xiii. The Waterfall model also has difficulty in accommodating changes in the product after the development process starts.

xiv. Amount of documentation produced is very high.

xv. The model in no way supports delivery of system in pieces.

xvi. The model is not suitable for new projects because of uncertainty in the specifications.

(2) V-Shaped Model

Just like the waterfall model, the V-Shaped life cycle is a sequential path of execution of processes. Each phase must be completed before the next phase begins. Testing is emphasized in this model more so than the waterfall model though. The testing procedures are developed early in the life cycle before any coding is done, during each of the phases preceding implementation. Requirements begin the life cycle model just like the waterfall model. Before development is started, a system test plan is created. The test plan focuses on meeting the functionality specified in the requirements gathering.

The high-level design phase focuses on system architecture and design. An integration test plan is created in this phase as well in order to test the pieces of the systems ability to work together. The low-level design phase is where the actual software components are designed, and unit tests are created in this phase as well. The implementation phase is, again, where all coding takes place. Once coding is complete, the path of execution continues up the right side of the V where the test plans developed earlier are now put to use.

Advantages

i. Simple and easy to use.

ii. Each phase has specific deliverables.

iii. Higher chance of success over the waterfall model due to the development of test plans early on during the life cycle. The V model focuses on testing of all intermediate products, not only the final software.

iv. Works well for small projects where requirements are easily understood.

v. The model plans for verification and validation activities early in the life cycle thereby enhancing the probability of building an error free and good quality product.

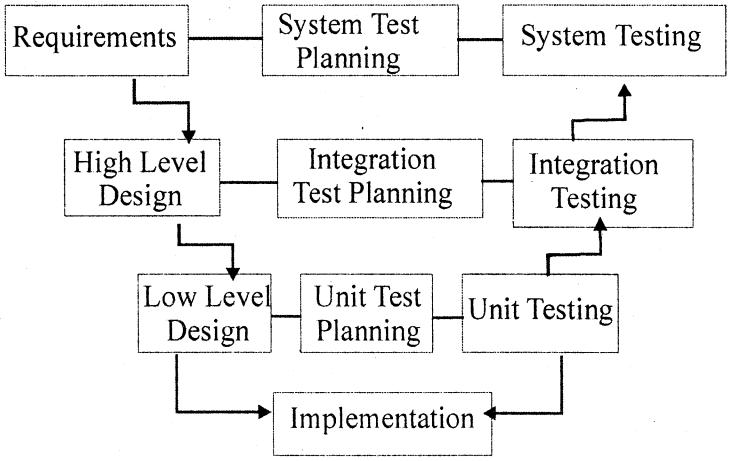


Diagram 8.6 V-Shape Model

Disadvantages

i. Very rigid, like the waterfall model.

ii. Little flexibility and adjusting scope is difficult and expensive.

iii. Software is developed during the implementation phase, so no early prototypes of the software are produced.

iv. Model doesn't provide a clear path for problems found during testing phases.

v. The model does not support iteration of phases and change in requirements throughout the life cycle.

vi. It does not take into account risk analysis.

(3) Prototyping

The conventional model of the waterfall or linear sequence has few problems. Theoretically, it is the best model for development but it has some practical problems. Often, a customer defines a set of objectives for the system but does not identify detailed input, processing, or output requirements. In other cases, the developer may be unsure of the efficiency of a procedure, the form that the human-machine interaction should take. In these situations, where the requirements of user are not clear, prototyping model may offer the best approach.

The prototyping paradigm begins with requirement gathering. Developer meets customer and define the overall objectives for the software, identifies whatever requirements are known and outlines areas where further definition is necessary. A design then occurs. In such a situation, if we use the SDLC waterfall approach, design would not commence early because analysis has not been completed. In prototyping, a prototype or model based on the gathered requirements is prepared. It is then evaluated by the user and is used to define requirements for the software to be developed. Iterations occur, as the prototype is tuned to satisfy the needs of the customer, at the same time enabling the developer to better understand what needs to be done. Another advantage of prototyping over waterfall lies in the fact that in the current situation, organizations and environment are changing fast. This may lead to a change in need of information. SDLC is a long process – often running into months. If information requirements of the organization, as identified during analysis phase, change by the time the system is implemented, the system does not prove to be useful any longer. If prototyping is used, the changed requirements are known by the developers at each iteration. Since information

collection is done at each iteration, new or changed requirements are updated every time. When the final prototype is ready, what do we do with it? We can do two things:

i. The prototype can be used as it is, since, it is actually a fully working model.

ii. The prototype can be partially or fully reconstructed. This is done to suit the needs of implementing on a specific platform, environment etc.

Advantages

i. Customers can see steady progress.

ii. This is useful when requirements are changing rapidly, when the customer is reluctant to commit to a set of requirements, or when no one fully understands the application area.

iii. A partial product is built in the initial stages. Therefore customers get a chance to see the product early in the life cycle and thus give necessary feedback.

iv. New requirements can be easily accommodated, as there is scope for refinement.

v. Requirements become clearer resulting into an accurate product.

vi. As user is involved from the starting of the project, he tends to be more secure, comfortable and satisfied.

vii. Flexibility in design and development is also supported by the model.

Disadvantages

i. It is impossible to know at the outset of the project how long it will take.

ii. There is no way to know the number of iterations that will be required.

iii. Insufficient analysis: The focus on a limited prototype can distract developers from properly analyzing the complete project.

iv. Excessive development time of the prototype

v. Expense of implementing prototyping: the start up costs for building a development team focused on prototyping may be high.

vi. User confusion of prototype and finished system: Users can begin to think that a prototype, intended to be thrown away, is actually a final system that merely needs to be finished or polished.

(4) Incremental Model

The incremental model is an intuitive approach to the waterfall model. Multiple development cycles take place here, making the life cycle a "multi-waterfall" cycle. Cycles are divided up into smaller, more easily managed iterations. Each iteration passes through the requirements, design, implementation and testing phases. A working version of software is produced during the first iteration, so you have working software early on during the software life cycle. Subsequent iterations build on the initial software produced during the first iteration.

Advantages

i. Generates working software quickly and early during the software life cycle.

ii. More flexible – less costly to change scope and requirements.

iii. Easier to test and debug during a smaller iteration.

iv. Easier to manage risk because risky pieces are identified and handled during its iteration.

v. Each iteration is an easily managed milestone.

vi. As product is to be delivered in parts, total cost of project is distributed.

vii. Limited number of persons can be put on project because work is to be delivered in parts.

viii. As development activities for next release and use of early version of product is done simultaneously, if found errors can be corrected.

ix. Customers or end users get the chance to see the useful functionality early in the software development life cycle.

x. As a result of end user's feedback requirements for successive releases become more clear.

xi. As functionality is incremented in steps, testing also becomes easy.

xii. Risk of failure of a product is decreased as users start using the product early.

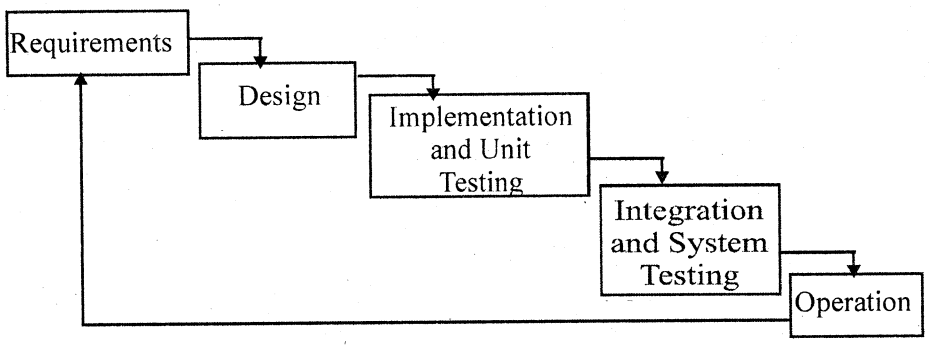


Diagram 8.7 Incremental Model

Disadvantages

i. Each phase of an iteration is rigid and do not overlap each other.

ii. Problems may arise pertaining to system architecture because not all requirements are gathered up front for the entire software life cycle.

iii. As product is delivered in parts, total development cost is higher.

iv. Well defined interfaces are required to connect modules developed with each phase.

v. The model requires well defined project planning schedule to distribute the work properly.

vi. Testing of modules also results into overhead and increased cost.

(5) The Spiral Model

The spiral model is one that couples the iterative nature of prototyping with controlled and systematic aspect of the linear sequential or waterfall model. It provides the potential for rapid development of incremental versions of the system. In a spiral model, a system is developed in a series of incremental releases. During each iteration, the incremental release might be a model or prototype. During later iterations, increasingly more complete versions of the engineered system are produced. The spiral model is similar to the incremental model, with more emphases placed on risk analysis. The spiral model has four phases: Planning, Risk Analysis, Engineering and Evaluation. A software project repeatedly passes through these phases in iterations (called Spirals in this model). The baseline spiral, starting in the planning phase, requirements are gathered and risk is assessed. Each subsequent spirals builds on the baseline spiral.

Requirements are gathered during the planning phase. In the risk analysis phase, a process is undertaken to identify risk and alternate solutions. A prototype is produced at the end of the risk analysis phase. System is produced in the engineering phase, along with testing at the end of the phase. The evaluation phase allows the customer to evaluate the output of the project before the project continues to the next spiral. In the spiral model, the angular component represents progress, and the radius of the spiral represents cost. The spiral model is divided into a number of framework activities, also called task regions. Typically, there are six task regions:

i. **Customer/user communication:** Establish effective communication between developer and user.

ii. **Planning:** Define resources, timeliness and other project related information.

iii. **Risk analysis:** Uses both technical and management risk.

iv. **Engineering:** Build one or more representations of application.

v. **Construction and release:** Construct, test, install and provide user support.

vi. **Customer evaluation:** User provides feedback based on evaluation of software.

Three to six of these task regions may be involved in each iteration. A number of iterations lead to a system fully acceptable by the users.

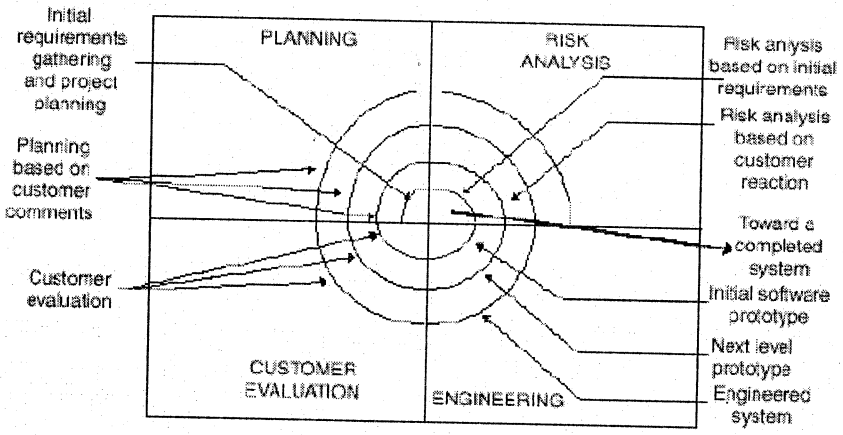


Diagram 8.8 Spiral Model

Advantages

i. High amount of risk analysis

ii. Good for large and mission-critical projects.

iii. Software is produced early in the software life cycle.

iv. The model tries to resolve all possible risks involved in the project starting with the highest risk.

v. End users get a chance to see the product early in life cycle.

vi. With each phase as product is refined after customer feedback, the model ensures a good quality product.

Disadvantages

i. Can be a costly model to use.

ii. Risk analysis requires highly specific expertise. The model requires expertise in risk management and excellent management skills.

iii. Project's success is highly dependent on the risk analysis phase.

iv. Doesn't work well for smaller projects. The model is not suitable for small projects as cost of risk analysis may exceed the actual cost of the project.

v. Different persons involved in the project may find it complex to use.

8.5.4 Development of a Successful System:

The success of any system depends on the approach of building it. If the development approach is right, the system will work successfully. For making a successful system, the following principles should be followed:

i. Both customers and developers should be involved for accuracy of the information.

ii. A problem solving approach should be adopted. The classic problem solving approach is as follows:

   (a) Study and understand the problem and its context

   (b) Define the requirements of a solution

   (c) Identify candidate solutions and select the best solution

   (d) Design and implement the solution

   (e) Observe and evaluate the solution's impact and refine the solution accordingly.

iii. Phases and activities should be established.

iv. For consistent development of a system, some standards should be established. These standards are:

   (a) Documentation standards: It should be an ongoing activity during the system development life cycle.

   (b) Quality Standards: Checks should be established at every phase for ensuring that the output of every phase meets the business and technology expectations.

   (c) Automated Tool standards: Hardware and software platforms should be finalized for the development of Information system. Automated tool standards prescribe technology that will be used to develop and maintain information systems and to ensure consistency, completeness, and quality.

v. Development of information system should be considered as capital investment: The developer of an information system should think about several solutions of a particular problem and every solution should be evaluated for cost-effectiveness and risk management. *Cost-effectiveness* is defined as the result obtained by striking a balance between the cost of developing and operating an information system and the benefits derived from that system. Risk management is defined as the process of identifying, evaluating and controlling what might go wrong in a project before it becomes a threat to the successful completion of the project or implementation of the information system. Multiple feasibility checkpoints should be built into system development methodology. At each feasibility checkpoint, all costs are considered sunk (i.e. not recoverable). Thus, the project should be re- evaluated at each checkpoint to determine if it remains feasible to continue investing time, effort, and resources.

At each checkpoint, the developers should consider the following options:

(a) Cancel the project if it is no longer feasible.

(b) Re-evaluates and adjusts the cost and schedule if project scope is to be increased.

(c) Reduce the scope if the project budget and schedule are frozen and not sufficient to cover all the project objectives.

vi. *Divide and Conquer* approach is the way of making a complex problem easier. In this approach, the larger problem (System) is divided into smaller problems (Subsystem).

Self Assessment Question 8.3

Q _____ spend most of their time in the beginning stages of the SDLC, talking with end-

users, gathering information, documenting systems, and proposing solutions.

A. Systems analysts B. Project managers

C. Network engineers D. Database administrators

8.6 Feasibility

The process followed in the determination of, whether or not a project is worth doing is called a feasibility study. This type of study determines if a project can and should be taken or not. The contents and recommendations of such a study will be used as a sound basis for deciding whether to proceed, postpone or cancel the project. Thus, keeping in view its sensitive nature, it becomes necessary that it should be conducted competently. This study should be done throughout the life cycle. In a project, at one point of time, it may seem that the project is feasible. But, after proceeding one or two phases, it may become infeasible. So, it is necessary to evaluate the feasibility of a project at the earliest possible time. Months or years of efforts, huge finances could be saved if an infeasible system is recognized at earlier stage.

8.6.1 Objective of the Feasibility Study:

The feasibility study is one of the major steps in the system development life cycle. The major objective of the feasibility study phase, are to find out the answers to these three key questions -

i. Is there a new and better way to do the job that will benefit the user?

ii. What are the costs and savings of the alternatives?

iii. What is recommended?

Providing answers to these questions means, presentation of alternative systems, evaluation of the costs and savings of each alternative, comparison of the various alternatives and recommendation of the most suitable alternative. That means, the major objective of the whole process of feasibility study is to find out, what the most optimal solution to the problem will be, given the objectives of the problems and constraints identified for solving the problem.

8.6.2 Types of Feasibility:

During feasibility analysis, the analyst considers eight distinct types of feasibility, all of which are interrelated.

i. Technical feasibility
ii. Operational feasibility
iii. Economic feasibility
iv. Legal Feasibility
v. Behavioral Feasibility
vi. Social Feasibility
vii. Management feasibility
viii. Time feasibility

(1) Technical Feasibility

Technical feasibility is concerned with the availability of hardware and software required for the development of the system, to see compatibility and maturity of the technology proposed to be used and to see the availability of the required technical manpower to develop the system. These three issues are addressed during this study.

Is the proposed technology proven and practical? At this stage, the analyst has to see or identify the proposed technology, its maturity, its ability or scope of solving the problem. If the technology is mature, if it has large customer base, it will be preferable to use as large customer base already exists and problems that stem from its usage may be less when compared to other technologies which don't have a significant customer base. Some companies want to use the state of art new technology irrespective of the size of customer base.

The next question is: does the firm possess the necessary technology it needs. Here, we have to ensure that the required technology is practical, and available. Now, does it have the required hardware, and software? For example, we need ERP software, and hardware which can support ERP. Now, if our answer is no for either of the questions, then the possibility of acquiring the technology should be explored.

The last issue related to technical feasibility is the availability of technical expertise. In this case, Software and Hardware are available. But, it may be difficult to find skilled manpower. The company might be equipped with ERP software, but the existing manpower might not have the expertise in it. So, the manpower should be trained in the ERP software. This may lead to slippage in the delivery schedules.

During technical feasibility study, financial resources and budget is also considered. The main objective of technical feasibility is to determine, whether the project is technically feasible, provided it is economically feasible.

(2) Operational Feasibility

During operational feasibility study, it is determined, whether the system will operate in the way that the user wants. Operational feasibility depends upon human resources for the development and implementation of the system. It is considered, whether the qualified and experienced manpower is available for development and implementation of the system. User involvement is more required in determining the operational feasibility. Operational feasibility is all about problems that may arise during operations. There are two aspects related with this issue:

i. What is the probability that the solution developed may not be put to use or may not work?

ii. What is the inclination of the management and end users towards the solution? Though, there is very least possibility of management being averse to the solution, there is a significant probability that the end users may not be interested in using the solution due to lack of training, insight, etc.

Also, there are other issues related with operational feasibility.

i. **Information** - The system needs to provide adequate, timely, accurate and useful information. It should be able to supply all the useful and required information to all levels and categories of users.

ii. **Response time** - It needs to study the response time of the system in term of throughput. It should be fast enough to give the required output to the users.

iii. **Accuracy** - A software system must operate accurately. It means that it should provide value to its users. Accuracy is the degree to which the software performs its required functions and gives desired output correctly.

iv. **Security** - There should be adequate security to information and data. It should be able to protect itself from fraud.

v. **Services** - The system needs to be able to provide desirable and reliable services to its users.

vi. **Efficiency** - The system needs to be able to use maximum of the available resources in an efficient manner so that there are no delays in execution of jobs.

(3) Economic Feasibility

Economic feasibility is the most important study that determines the cost and benefits of the proposed system and compares with the budget. The cost of the project should not outweigh the budget. The cost of the project includes the cost of hardware, software, development and implementation. Cost/benefit analysis is the common method to determine the benefits that are expected from the proposed system and compare them with the costs expected to spend on development of the system. If benefits are found to be more than costs, then the analyst decides to continue the development of the proposed system, otherwise considers it economically not feasible. This feasibility study presents both tangible (e.g., increased productivity, low operating cost, etc.) and intangible benefits (e.g., improved organizational planning, improved asset utilization, etc.) in a formal way.

In economic feasibility, cost benefit analysis will be done. There are two types of costs associated with a project: The costs involved with development of the system and costs associated with operation and maintenance of the system. At the same time, these estimations are bound to change as the requirements change during the development process. After the implementation, these costs may increase or decrease depending on the nature of updations done to the system. System development cost is one time cost, but maintenance and operating costs are recurring costs. Different costs are:

i. **Cost of human resources** It includes the salaries of system analysts, software engineers, programmers, data entry operators, operational, and clerical staff.

ii. **Cost of infrastructure** The cost of infrastructure including those of computers, cables, software, etc., comes under this head.

iii. **Cost of training** Both the developing staff and operating staff need to be trained for new

technologies and new system. So, the training cost has to be considered for calculating the cost of the system.

(4) Legal Feasibility

Legal feasibility is a determination of, whether a proposed project infringes on known acts, statutes, as well as any pending legislation. Although, in some instances the project might appear sound, on closer investigation it may be found to infringe on several legal areas. Legal feasibility studies issues arising out of the need to the development of the system. The possible consideration might include copyright law, labour law, antitrust legislation, foreign trade, regulation, etc. Contractual obligation may include the number of users who will be able to use the software. There may be multiple user's licenses, single user licenses, etc.

(5) Behavioral Feasibility

People are inherently resistant to change and computers have been known to facilitate change. An estimate should be made of how strong a reaction the user staff is likely to have towards the development of a computerized system. It is common knowledge that computer installation has something to do with turnover, transfer, retraining, and changes in employee job status.

(6) Social Feasibility

Social feasibility is a determination of, whether a proposed project will be acceptable to the people or not. This determination, typically examines the probability of the project being accepted by the group directly affected by the proposed system change.

(7) Management feasibility

It is a determination of, whether a proposed project will be acceptable to management. If management does not accept a project or gives a negligible support to it, the analyst will tend to view the project as a non-feasible one.

(8) Time feasibility

Time feasibility is a determination of, whether a proposed project can be implemented fully within a stipulated time frame. If a project takes too much time it is likely to be rejected.

After this study, a document is prepared, which is known as 'Feasibility Study Report'. Besides this report, the analyst also gives the oral presentation of feasibility study to the management.

8.6.3 Steps in Feasibility Analysis:

Feasibility analysis is carried out in the following steps:

i. **Form a Project Team and Appoint a Project Leader:** First of all, project management group of the organization, forms separate teams for independent projects. Each project team comprises of one or more system analysts and programmers with a project leader. The project leader is responsible for planning and managing the development activities of the system.

ii. **Start Preliminary Investigation:** The system analyst of each project team starts preliminary investigations through different fact finding techniques.

iii. **Prepare the Current Systems Flow Chart:** After preliminary investigations, the analysts prepare the systems flow chart of the current system. These charts describe the general working of the system in a graphical way.

iv. **Describe the Deficiencies in the Current System:** On studying the systems flow chart, the analysts identify and describe the deficiencies in the current system.

v. **Determine Objectives of the Proposed System:** The major objectives of the proposed systems are listed by each analyst and are discussed with the project leader.

vi. **Prepare the Proposed Systems Flow Chart:** After determining the major objectives of the proposed system, the analysts prepare their systems flow chart. Systems flow chart of the proposed system is compared with those of current system in order to ensure that they meet the objectives.

vii. **Determine the Technical Feasibility:** The existing computer systems (hardware and software) of the concerned department are identified and their technical specifications are noted down. The analysts decide, whether the existing systems are sufficient for the technical requirements of the proposed system or not.

viii. **Determine the Economic Feasibility:** The analysts determine the costs and benefits of the proposed system in order to ensure that the project is economically feasible.

ix. **Determine the Operational Feasibility:** After determining the economic feasibility, the analysts identify the responsible users of the system and hence, determine the operational feasibility of the project.

x. **Presentation of Feasibility Analysis:** During the feasibility study, the analysts also keep on preparing the feasibility study report. At the end of feasibility analysis, the feasibility analysis report is given to the management along with the oral presentation.

Self Assessment Question 8 .4

what is the difference between system development life cycle & software development life cycle (SDLC) what is system development life cycle?

8.7 Summary

To help understand and implement the SDLC phases (Project Initiation, Design Analysis, System Design Specification, Programming and Testing, Installation and Maintenance, and Destruction), various SDLC models have been created by software development experts, universities, and standards organizations. There are various software development approaches defined and designed which are used/employed during development process of software, these approaches are also referred as "Software Development Process Models". Each process model follows a particular life cycle in order to ensure success in process of software development. SDLC models are tools that allow the development team to correctly follow the SDLC steps to create software that meets a business need. The SDLC models have evolved as new technology and new research have addressed weaknesses of older models. Ideas have been borrowed and adapted between the various models.

Project lifecycle models are not interchangeable. To deliver a quality system, it's critical to know the risks facing your project and to use a model that reduces those risks. Software life cycle models describe phases of the software cycle and the order in which those phases are executed. There are tons of models, and many companies adopt their own, but all have very similar patterns. Main phases of software development life cycle are—requirements analysis, system design, coding, testing, delivery and maintenance. Popular process models are waterfall model, V model, incremental model, Spiral model, Prototyping model etc.

8.8 Keywords / Definitions

Abstract System – A System hidden by its environment.

Analysis- It is the process of complete understanding of the system.

Business System- The activities and entities related to business environment which includes production, marketing, transactions etc.

Feasibility – It is the possibility of completion of a task in various senses such as financially, technically, timely, legally etc.

Flow Graph – A diagram showing the flow of the activities of business.

Gantt chart – A chart showing duration of sub-tasks of a big task/ project in graphical manner.

Incremental Development Model – Development of any project with continuous enhancement.

PERT – It is a technique of measuring schedule of any complex project.

Plan – It is a document which shows the activities of any project in advance with time and sequence of activities.

Prototype – It is a small working model of original system.

Schedule – It is the timed distribution of jobs.

Subsystem – A part of the system, which is a system itself.

System – A process which takes input from its environment, process on these inputs and generates outputs according to the type and provides this output to its environment.

System Models – A process of system development.

Work Breakdown – Classification of tasks into subtasks and subtasks into its subtasks.

8.9 Abbreviations

3 GL	–	Third Generation Languages
4 GL's	–	Fourth Generation Languages
ATM	-	Automated Teller Machine
CASE	–	Computer Aided Software Engineering
CPM	-	Critical Path Method
DFD	–	Data Flow Diagram
ERD	–	Entity Relationship Diagram
ERP	-	Enterprise Resource Planning
IBM	–	International Business Machines
IS	–	Information System
I/O	–	Input / Output
JAD	–	Joint Application Development
MIS	–	Management Information System
PD	–	Participatory Design
PERT	-	Programme Evaluation Review Technique
RAD	–	Rapid Application Development

RSD	–	Requirement Specification Document
SDLC	–	Software Development Life Cycle
UML	–	Unified Modeling Language

8.10 Hint / Key To Activity / Self Assessment Questions

ACTIVITY 8.1 (C)

ACTIVITY 8.2

Project A might actually require considerably more than twice as many resources as Project B. As team sizes increase the number of interactions also increases and thus as many relationships can mean more delay, misunderstandings, and difficulty in coordinating tasks. Also the scope of the project could vary greatly between the projects. If one project has more deliverables regardless of the team size the complexity is affected.

ACTIVITY 8.3 (A)

ACTIVITY 8.4

In SDLC we have six phases initial phase, analysis phase, design phase, coding phase, testing phase, delivery and maintenance phase this is done in programming part while developing a code these rules are followed. In software testing life cycle(STLC) after developing the program this cycle is performed which consists of again 6 phases test planning, test design, test execution, result analysis, bug tracking, reporting.

8.11 Questions For Practice

1. Explain Software Development Life Cycle Model?
2. What are the Different Software Development Models?
3. Identify the components of a computer-based information system.
4. Identify two advantages of prototyping.
5. Identify and briefly discuss the four project management phases.
6. Define work breakdown structure.
7. What are the characteristics of a task?
8. What is a Gantt chart? What is a PERT chart? Which would most likely be used for information systems development?
9. Briefly list the six feasibility categories.

8.12 References

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Unit - 9

Analysis, Step of System Analysis, Fact Gathering and Organising Technologies of System Design

Outline of the Unit:

9.0 Objectives

9.1 Introduction

9.2 Steps of System Analysis

- 9.2.1 Requirement Analysis
- 9.2.2 Feasibility Report
- 9.2.3 Hardware / Software Study
- 9.2.4 System Implementation
- 9.2.6 Evaluation and Acceptance
- 9.2.7 System Maintenance

9.3 Tools of Structured Analysis

- 9.3.1 DFD
- 9.3.2 Decision Tree
- 9.3.3 Structured English
- 9.3.4 Decision Table
- 9.3.5 Data Dictionary

9.4 Fact Gathering and Organising

- 9.4.1 System Requirement Specifications
- 9.4.2 Fact Finding
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- 9.4.4 Fact Finding Techniques

9.5 Technologies of System Design

- 9.5.1 Design Objectives
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- 9.5.4 Processing Techniques
- 9.5.5 Process of Design
- 9.5.6 Design Principles
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- 9.5.8 Physical Design
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9.5.11 Types of Information
9.6 Summary
9.7 Keywords / Definitions
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9.10 Questions for Practice
9.11 References

9.0 Objectives

After reading this unit you will –

- Able to analyze any system in real world
- Acquaint with tools and techniques used in system analysis and design
- Get in touch various fact finding techniques

9.1 Introduction

Building computer based information system needs a careful analysis and design before implementation. Detailed study to understand the information requirement forms the major component of the analysis. Providing a system that would meet the information requirement in an efficient manner is the subjects of information system design. With the increased availability of new products and services ever-improving price performance ratio, such analysis and design become far more challenging. The newer products and services provides new ways of daring business as well, While the conventional analysis of information system requirement may indicate some possible alternatives, an alert analyst who is abreast of current and emerging developments in information technology, may propose entirely new systems. Such exercises known as business "re-engineering" are the by products of good systems analysis and design, It should be clearly understood that good systems analysis is not merely an efficient way of getting computers to do what has been done manually for years. Such type of mechanization fall short of the real objectives of good systems design, particularly these days when Information Technology is moving leaps and bounds.

While these techniques are definitely important it must be clearly borne in mind that systems analysis is fundamentally different from programming. As an analogy, systems analysis can be viewed as the job of an architect, while the job of programming of comparable to that of construction. Yet another way of distinguishing between these two different, yet related disciplines is that programming is skill oriented but systems analysis is more knowledge oriented. Systems analysis calling for very generous skills in limited to a handful of successful individuals; while programming skills being specific is easily acquired by fairly intelligence people. Naturally mass producing programmers is fairly easy compared to training a large number of analysts. In summary systems analysis is holistic in nature while programming is individualistic in nature.

9.2 Steps of System Analysis

The design of an information system produces the details that clearly describe how a system will meet the requirements identified during systems analysis. Systems specialists often refer to this stage as logical design, in contrast to the process of developing program software, which is referred

to as physical design. The steps in system analysis include the following eight steps generally known as systems life cycle:

i. Requirement Analysis
i. Determination
ii. Specification
ii. Feasibility Analysis
iii. Hardware/Software Study
iv. System Design
v. System Implementation
vi. Evaluation and Acceptance
vii. System Maintenance

9.2.1 Requirement Analysis:

Requirement Determination is generally done though extensive study of the system including the understanding of the goals, processes and constraints of the system for which information systems are designed, several forms are also designed and illustrated in the texts of system analysis. Such techniques must be left to the ingenuity of the analyst: there is no straight forward algorithm to elicit the requirement from the user. It is an iterative process which the analysts use while interviewing several user/users groups. It will continue to remain an art rather than science, for Requirement Specification both at the preliminary as well as the detailed stage, several diagramming techniques have evolved. We will detail below some of the diagramming techniques.

- **Data Flow Diagram (DFD)**

Data Flow Diagram (DFD) is a powerful diagram that can be used to document the information flow. It also presents itself to be broken down in top-down fashion. At the top level, data flows are represented at very abstract aggregate level. Each component of the data flow is further broken down to different levels, so that at each level we have just a few entities to concentrate on. DFD have developed a representation scheme to represent data store, processes and entities and the actual information flows. Breaking down the DFDs into different levels is generally known as Leveling and the DFDs are correspondingly termed Top level DFD and Leveled DFD. A diagram similar to DFD is the context diagram that is generally a summary diagram that fully depicts the information flows and the entities involved. It is more useful to the end user than the analyst. The detailed DFDs carry enough details that the analyst can hand them over to the programmer for detailed coding.

- **Data Dictionary**

Another powerful tool that is extensively used is system analysis is the data dictionary. DDs as they are called provide a detailed reference to every data item - the different names by which the item is represented, in different program modules, different data structures used to represent the item in different modules, the modules where the data item is generated, where it is stored and destroyed. In essence it provides a quick snapshot of every data item used by the information system. Needless to say it is extremely detailed and very useful for consistency checks, system modification and completeness checking.

9.2.2 Feasibility Report:

Feasibility Report is a preamble that sets the stage for the project, followed by goal statement

that quantifies precisely the goals of the proposed information system. This must be understandable to any intelligent person not necessary a computer professional or even a computer literate. Being *a* feasibility study the alternatives are unlikely to be detailed to the full extent, Until the full system is developed in its entirety, the full details are unlikely to be known, Yet we cannot go ahead with the final system without doing a feasibly analysis. In a sense the details of the system to be built will unfold gradually from feasibility study stage to system specification stage to final implementation stage. These steps must be clearly understood by the user as well as the analyst.

9.2.3 Hardware/Software Study:

- **Hardware Selection**

The decision to acquire computer hardware or software must be handled in the same way as any other business decision. The variety of sizes and types of computing resources available puts a burden on the analyst who must select suitable hardware, software or services and advise the top management accordingly. Today, selecting a system is a serious and time-consuming business.

The selection process should be viewed as a project and a project team should be formed with the help of management. The selection process consists of several steps which are discussed below:

i. Requirements analysis: The first step in selection is understanding the user's requirements within the framework of the organisation's objectives and the environment in which the system is being installed.

ii. System specifications: These specifications must reflect the actual applications to be handled by the system it include system objectives, flowcharts, input-output requirements, file structure and cost.

iii. Request for proposal: After the requirement analysis and system specifications have been defined, a request for proposal is prepared and sent lo selected vendors for bidding.

iv. Valuation and validation: It looks into items such as price, availability and technical support.

v. Vendor selection: This step determines the vendor with the best combination of reputation, reliability, service record, training, delivery time, lease / finance terms.

- **Software Selection**

Software selection is a critical aspect of system development. There are two ways of acquiring software: custom- made or "off-the-shelf' package. Today, there is great demand for these packages because they are quite cheap. There are other benefits also.

i. A good package can get the system running quickly.
ii. MIS personnel are released for other projects.
iii. 'Home-grown' software can take more time and its cost cannot be predicted.
iv. Package can be tested before purchasing it.

Some drawbacks of software packages are:

i. These packages may not meet user requirements in all respect.
ii. Extensive modifications of a package usually results in loss of the vendor's support.

It can be observed that price alone cannot determine the quality of software. A systematic review is crucial for selecting the desired software. Prior to selecting the software, the project team must set up criteria for selection. The criteria for software selection are:

i. Reliability: gives consistent results without any failure for a specified time period.
ii. Functionality: functions to standards.
iii. Capacity: satisfies volume requirements of the user.
iv. Flexibility: adapts to the changing needs
v. Usability: is user-friendly.
vi. Security: maintains integrity and prevents unauthorised user.
vii. Performance: delivers the results as expected.
viii. Serviceability: has good documentation and vendor support.
ix. Ownership: has right to modify and share use of package.
x. Minimal costs: is justified and affordable for intended application.

- **Costing Factor**

Cost consideration is quite important factor in computer acquisitions. Costs are of two types:

i. One-time costs such as cost of site preparation (space, false ceilings, special floorings, electrical fittings, air- conditioning etc.)
ii. Continued running and maintenance costs of the entire installations.

- **Hardware Factors**

i. Hardware performance and its reliability: Maintenance should be low, high speed and error free items.
ii. Facilities for modularity
iii. Provision for backup facilities
iv. Firmness of delivery date: The order should be completed in due time by the vendor.
v. Compatibility with existing systems
vi. Expandability: It requires regular up gradation of the system, so the provision should be there.

- **Software Factors**

i. Performance of software and its price
ii. Efficiency and reliability of available software
iii. Programming languages available
iv. Availability of well documented package programs
v. Firmness of delivery date for a promised software
vi. Ease of use and modification as per user requirements
vii. Portability and its capacity to interface with the environment

9.2.4 System Design:

Thoroughly the detailed specifications are worked out followed by hardware / software plan. This constitutes a system design which once again needs to be whetted by the user. Once this is done detailed system design starts. Effectively one can say that the analysis phase ends here and the design phase begins. Being a detailed design it may involve substantial effort on the part of technical system analysts, hardware, software, communication specialists etc. A major component of detailed system design is the database design covered in the next section. Actual coding is undertaken after the database design is complete.

- **Database Design**

While DBMS permit efficient storage and manipulation of data files they do not cater to the structuring of the database themselves. One of the basic observations made by the early analysts was the possible "loss of information" by careless update operations on databases. This led to the concepts of normalisation pioneered by Codd. Intuitively normalisation leads to the decomposition in such a way that no information is lost due to processing of data. Normalization ensures no loss of information and avoids insertion update and other anomalies. Physical design of database includes the storage devices and their management. This calls for detailed knowledge of the specific hardware and software on which the Information System is likely to be implemented.

9.2.5 System Implementation:

System implementation includes the detailed design of the process, their validation and thorough checking. While the formal methods of proving program correctness are evolving, they are still not useful to test out large commercial software to help information system planning. Many of the analysts use experimental version using what is known as "parallel runs". Here both the current system and proposed new system are run in parallel for a specified time period and the current system is used to validate the purposed system.

9.2.6 Evaluation and Acceptance:

The process of evaluating software to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase is known as Software Verification. For example, the correctness or the performance of a software system is properties we would be interested in verifying. Verification can be performed either by formal analysis methods or through testing. A common technique for doing verifiability is the use of "software monitors". Modular design disciplined coding practices, and use of an appropriate programming language contributes to verifiability. Verifiability is usually an internal quality. "Testing is an activity in which a system or component is executed under specified conditions; the results are observed and recorded and an evaluation is made of some aspect of the system or component."

9.2.7 System Maintenance:

All of the programs and entire source statements had to be corrected when faults were detected, modified as user requirements changed, or adapted to new hardware that was purchased. These activities were collectively called software maintenance. Effort spent on software maintenance began to absorb resources at an alarming rate. There is evidence that maintenance costs exceed 60% of the total costs of software. To analyze the factors that affect such costs, it is customary to divide software maintenance into three categories: corrective, adaptive and perfective maintenance. Maintenance performed to correct faults in hardware or software is known as Corrective Maintenance. Corrective maintenance accounts for about 20 percent of maintenance cost. Software maintenance performed to make a computer program usable in a changed environment is known as Adaptive maintenance. Adaptive maintenance accounts for nearly another 20 percent of maintenance costs while over 50 percent is absorbed by perfective maintenance. Software maintenance performed to improve the performance, maintainability, or other attributes of a computer program is known as Perfective maintenance. Here, changes may be due to the need to modify the functions offered by the application, add new functions, improve the performance of the application, make it easier to use, etc.

Self Assessment Question 9.1

1. It is necessary to consult the following while drawing up requirement specification

   A. only top managers

   B. only top and middle management

   C. only top, middle and operational managers

   D. top, middle and operational managers and also all who will use the system

9.3 Tools of Structured Analysis

9.3.1 DFD (Data Flow Diagram):

Graphical description of a system's data and how the processes transform the data is known as Data Flow Diagram (DFD). Unlike detail flow charts, DFDs do not supply detailed descriptions of modules but geographically, describe a system's data and how the data interact with the system. DFD describes data flow rather than how they are processed, so it does not depend on hardware, software, data structure or file organization. A DFD, also known as a "bubble chart", serves the purpose of clarifying system requirements and identifying major transformations that will become programs in system design. A DFD consists of a series of bubbles joined by lines. The bubbles represent data transformations and lines represent data flows in the system. There is no limit on the number of levels of Data Flow Diagrams that can be drawn. It depends on the project at hand. A DFD can be categorized in the following forms:

Context diagram: An overview of an organizational system that shows the system boundaries, external entities that interact with the system and the major information flows between the entities and the system. In this diagram, a single process represents the whole system.

First level DFD: A data flow diagram that represents a system's major processes, data flows, and data stores at a high level of detail.

Functional decomposition diagram: Functional decomposition is an iterative process of breaking the description of a system down into finer and finer detail which creates a set of charts in which one process on a given chart is explained in greater detail on another chart. In this diagram, sub-processes of first level DFD are explained in detail.

The following are various components of a Data Flow Diagram:

1. **Process** - A circle or a bubble (some people use an oval bubble) represents process that transforms incoming data flow(s) into outgoing data flow(s). During a process, the input data is acted upon by various instructions whose result is transformed data. The transformed data may be stored or distributed. When modeling the data processing of a system, it doesn't matter whether the process is performed manually or by a computer. People, procedures or devices can be used as processes that use or produce (transform) data. The notation (given by Yourdon) for process is



2. **Data Flow** - An arrow identifies data flow – data in motion. It is a pipeline through which information flows. Data moves in a specific direction from a point of origin to point of

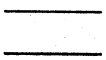
destination. The data flow is a "packet" of data. The notation (given by Yourdon) for data flow is



3. **Source or sink of data** - A square defines a source or a destination of system data (External entity). The origin and /or destination of data some times referred to as external entities. These external entities may be people, programs, organization or other entities that interact with the system but are outside its boundaries. The term source and sink are interchangeable with origin and destination. The notation (given by Yourdon) for source or sink is



4. **Data store** - An open rectangle is a data store – data at rest – or a temporary repository of data. A data store is data at rest. They are referenced by a process in the system. Notation for data store is



- **Development Process**

System analysts must first study the current system, that is, the actual activities and processes that occur. The physical system is translated into logical descriptions that focus on data and processes. It is advantageous to emphasize data and processes in order to focus on actual activities that occur and the resources needed to perform them.

- **Context Diagram**

The context diagram is the top level DFD. It represents a system as a single process with only major inputs and outputs to the system represented as data flows. The source and destination of the data as external entities are also represented. Figure 11.1 represents a context diagram. This is a level O DFD for an accounts payable system. Note that, only a single process is shown. The vendor is both the source and the destination of data.

- **Level 1 and Higher Level DFD**

When we explode the context diagram and break the single process into a number of detailed processes, then level 1 DFD is created. Further breaking of each process leads to further levels of DFDs. The numbering convention in the DFD is as follows:

i. In the Context diagram, no number is given to processes as only one process exists.

ii. In the level 1 DFD, the processes are numbered as 1, 2, 3.

iii. In the next level, the processes are numbered depending on which process has been broken. For example, if process 2 of level 1 DFD is broken, the processes are numbered as 2.1, 2.2 and so on.

iv. The processes are numbered as 3.2.1, 2.3.2.1 and so on as further levels of DFD are created.

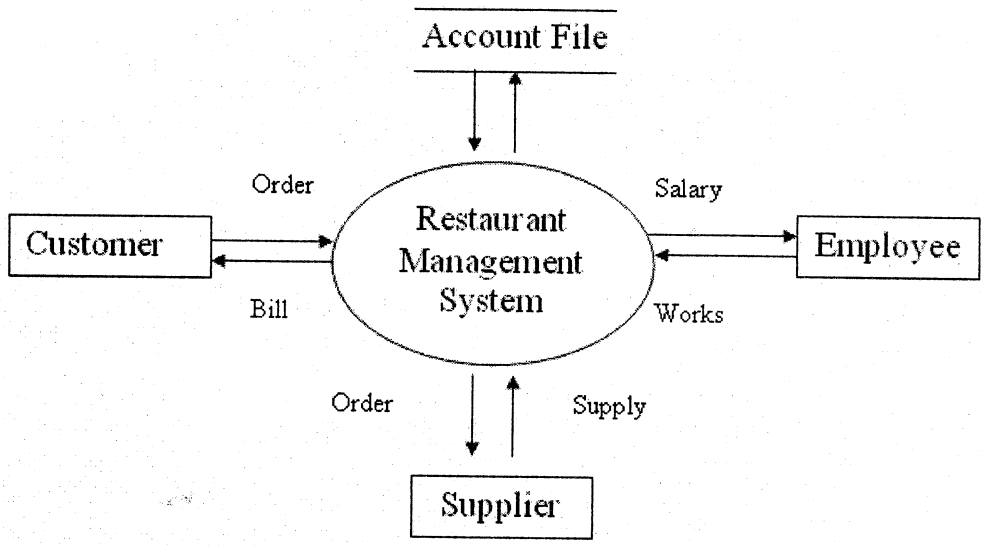


Diagram 9.1

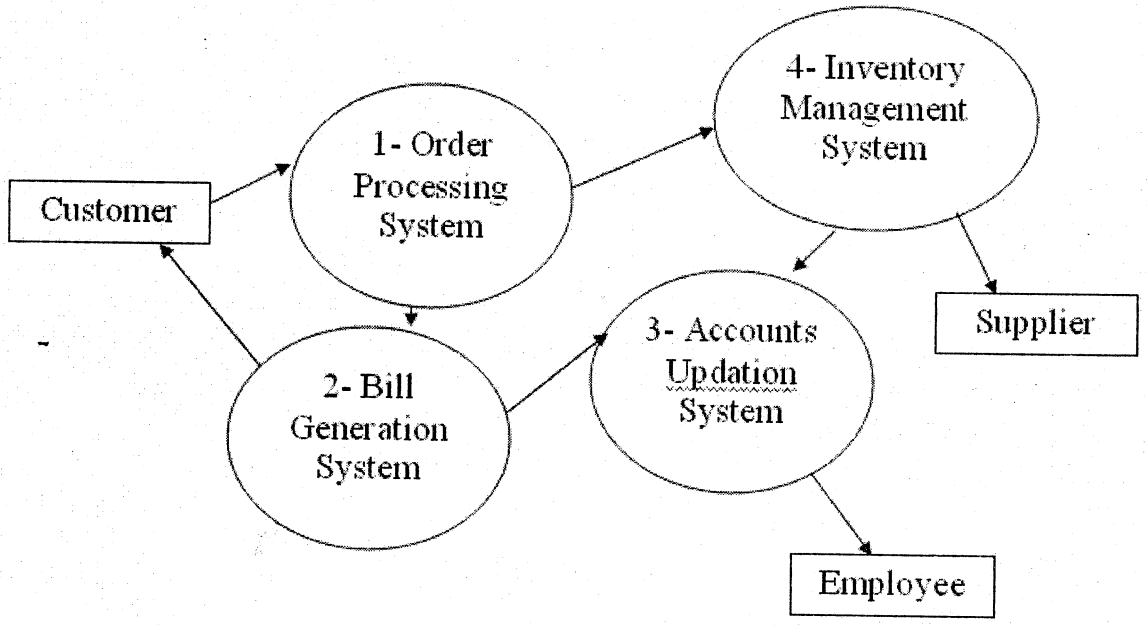


Diagram 9.2

Top Level DFD

9.3.2 Decision Tree:

Decision tree is a tool for documenting procedures where actions need to be taken depending on a number of conditions. If the group of conditions has a specific value, a certain action is taken. The action taken differs with the value of group of conditions. In such cases, decision trees are used. It is a diagram that presents conditions and actions sequentially and thus shows which conditions are considered first, which second and so on. It is also a method of showing the relationship of each

condition and its permissible actions. The diagram resembles branches on a tree and hence, the name.

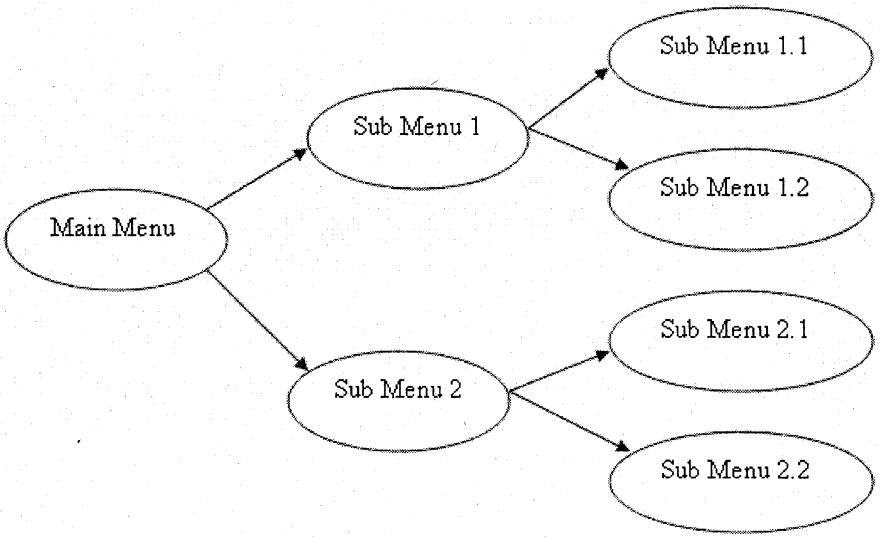


Diagram 9.3 Decision Tree

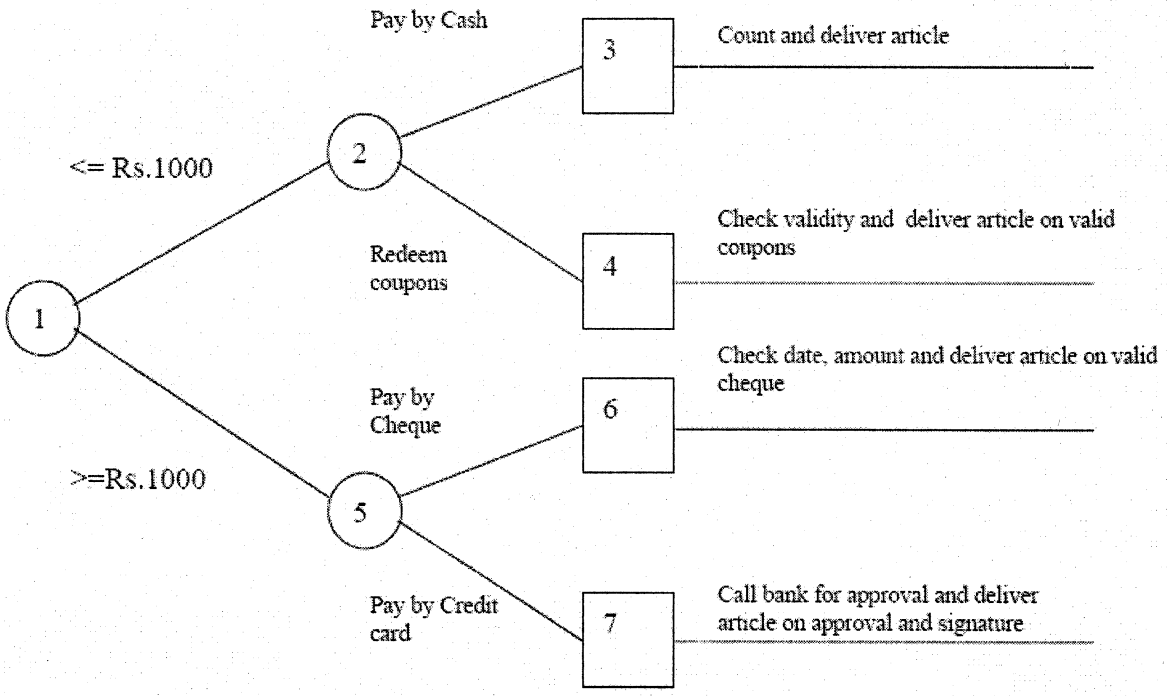


Diagram 9.4 Decision Tree

The root of the tree, on the left of the diagram is the starting point of the decision sequence. The particular branch to be followed depends on the conditions that exist and the decision to be made. Progression from left to right along a particular branch is the result of making a series of decisions. The nodes of the tree, thus, represent conditions and indicate that a determination must be made about which condition exists before the next path can be chosen. The right side of the tree lists the actions to be taken, depending on the sequence of conditions that is followed.

Developing a decision tree is beneficial to an analyst in two ways. First of all, the need to describe conditions and actions forces the analyst to formally identify the actual decisions that must be made. Decision tree also forces analysts to consider the sequence of decisions. Decision trees may not always be the best tool for decision analysis. A decision tree for a complex system with many sequences of steps and combinations of conditions may be unwieldy. A large number of branches, with many paths through them, will cloud rather than aid analysis. The analyst may not be able to determine, which business policies or practices guide the formulation of specific decisions. Where these problems arise, decision tables should be considered.

9.3.3 Structured English:

Structured English notation is based on the principles of structured programming. Process specification logic consists of a combination of sequences of one or more imperative sentences with decision and repetition constructs. It is a tool for describing process. There are three valid constructs in this notation. They are:

i. A sequence of single declarative statements.

ii. The selection of one or more declarative statements based on a decision, e.g., if-then-else, switch, case.

iii. The repetition of one or more declarative statements, e.g., looping constructs such as do-while, for-do

- **Rules for Structured English**

i. An imperative sentence usually consists of an imperative verb followed by the contents of one or more data stores on which the verb operates. For example, add persons-salary to total salary

ii. In imperative sentences, verbs such as "process", "handle" or "operate" should not be used. Verbs should define precise activities such as "add" or compute average etc.

iii. Adjectives that have no precise meaning such as "some" or "few" should also not be used in imperative sentences, because they cannot be used later to develop programs.

iv. Boolean and arithmetic operations can be used in imperative statements.

v. Structured English logic: Structured English uses certain keywords to group imperative sentences and define decision branches and iterations. These keywords are: (Begin, end), (repeat, until), (if, then, else), (do, while), for, case, etc.

vi. Grouping imperative sentences:

(a) Sequence Construct A sequence of imperative statements can be grouped by enclosing them with BEGIN and END keywords

(b) Decision (Selection)

- A structure, which allows a choice between two groups of imperative sentences. The key words IF, THEN and ELSE are used in this structure. If a condition is 'true', then group 1 sentences are executed. If it is false, then group 2 sentences are executed.
- A structure which allows a choice between numbers of groups of imperative sentences. The keywords CASE and OF are used in this structure. The value of a variable is first computed. The group of sentences that are selected for execution depends on that value.

(c) **Repetition** This structure shows two ways of specifying iterations in structured English.

- One way is to use the WHILE...DO structure. Here, the condition is tested before a set of sentences is processed. Alternative to WHILE...DO is FOR structure.
- REPEAT...UNTIL structure. Here, a group of sentences is executed first then the condition is tested. So, in this structure, the groups of sentences are executed at least once.

9.3.4 Decision Tables:

A decision table is a matrix of rows and columns. Decision rules, included in a decision table, state what procedures to follow when certain conditions exist. This method can be used in analysis of business functions. Decision Table is very useful for specifying complex policies and decision-making rules. Decision tables use a standard format and handle combinations of conditions in a very concise manner. Decision table provides technique for identifying policy incompleteness and contradictions. The following are various components of a Decision table:

i. **Condition stubs**: This portion of table describes the conditions or factors that will affect the decision or policy making of the organisation.

ii. **Action stubs**: This portion describes the possible policy actions or decisions in the form of statements.

iii. **Rule**: Rules describe which actions are to be taken under a specific combination of conditions.

Process Name		Rules 1	2	3	4	5	6	7	8
Conditions	———	X	—	.	.	.	.	.	.
	———								
	———								
Actions	———	—	X	?	.	.	.	.	.
	———								
	———								

X— Action (condition is true)
__ — Condition is irrelevant for this rule
? — Unknown rule

Diagram 9.5

Decision Table

- **Building Decision Tables**

To develop decision tables, analysts should use the following steps:

i. Determine the most relevant factors to be considered in making a decision. This identifies the conditions in the decision. Each condition selected should have the potential to either occur or not occur, partial occurrence is not possible.

ii. Determine the most feasible steps or activities under varying conditions. This identifies the actions.

iii. Study the combinations of conditions that are possible. For every number N of conditions, there are 2^n combinations to be considered. For example, for three conditions, there are eight possible combinations; $2^3 = 8$. For four, $2^4 = 16$ combinations are possible and can be included in the table.

iv. Fill in the table with decision rules. There are two ways to fill in the table. The first and longer method is to fill in condition rows with a yes or no value for each possible combination. That is, fill the first half of rows with Y and other half with N. Then follow with 25%Y, 25%N, 25%Y, 25%N, then fill the next row with 12.5% of Y and N alternatively and so on. The other method deals with one condition at a time and does not add duplicate combinations of conditions and actions, as discussed below.

1. State the first condition and permissible actions.
2. Add the second condition by duplicating the first half of the matrix and filling in different Y and N values from the new condition in both halves of the expanded matrix.
3. Repeat previous step for each additional condition.
4. Mark action entries with X to signal action(s) to be taken; leave cells blank or mark with a dash to show that no action applies to that row.

v. Examine the table for redundant rules or for contradictions within rules.

TITLE : Author : Comments :	Date : System :
Condition Stub	Condition Entry
Action Stub	Action Entry

Diagram 9.6

Decision Table Entry

9.3.5 Data Dictionary:

A data dictionary is a catalog – a repository – of the elements of the system. These elements center on data and the way they are structured to meet the user requirements and organization needs. A Data Dictionary consists of data about data. The major elements of data dictionary are data flows, data stores and processes. The data dictionary stores details and descriptions of these elements. It does not consist of actual data in the database.

- **Why Data Dictionary?**

A data dictionary defines each term (called a data element) encountered during the analysis and design of a new system. For example, suppose you want to print the vendor's name and address at the bottom of a cheque, the data dictionary might define vendor's name and address as follows:

Vendor name and address = Vendor name +
Street +
City+

State +

Pin +

Phone +

Fax +

email

Data dictionaries allow analysts to define precisely what they mean by a particular file, data flow, or process. Some commercial software packages, usually called Data Dictionary Systems (or DDS), help analysts maintain their dictionaries with the help of the computer. Analysts use data dictionaries for the following reasons:

i. To manage the detail in large systems.

ii. To communicate a common meaning for all system elements.

iii. To document the features of the system.

iv. To facilitate analysis of the details in order to evaluate characteristics and determine changes that should be made to the system.

v. To locate errors and omissions in the system.

vi. It is a valuable reference for designing the system. It is used to build the database and write programs during design phase.

vii. It assists in communicating meanings of different elements, terms and procedures.

- **Major Symbols**

A data dictionary uses the following major symbols:

i. = Equivalent to

ii. + . And

iii. [ ] Either / or

iv. ( ) Optional entry

- **Components of a Data Dictionary**

The dictionary contains two types of descriptions for the data flowing through the system: Data elements and Data structures.

(1) **Data elements:** Data elements are grouped together to make up a data structure. Data elements are recorded in data dictionary at the fundamental data level. Each item is identified by a data name, description, alias and length and has specific values that are permissible for it in the system. The most fundamental data level is the data element. No smaller unit than this has meaning to the system analyst or the user. For example, invoice number, invoice date, etc. Data elements are building blocks for other data in a system. The data element entry consists of the following items:

i. Data Name

ii. Data Description: Brief description of what the data element represents

iii. Aliases or additional names for the data element

iv. Length or size of the element

v. Data Values: It is the list of possible values for the data element

Example

Data Name	:	Part_Color
Data Description	:	This is the color of the part of the machinery and is ordered time to time from local vendor
Aliases	:	P_Colour, Color
Length	:	Text of Length 15
Data Values	:	May take one of the following values. Red, Orange, Yellow, Blue, Purple, Pink

(2) Data Structure: A data structure is a set of data items that are related to one another and that collectively describe a component in a system. Both data flows and data stores are data structures. Data structures are built on four relationships of components which may be data elements, or other data structures.

i. Sequence Relationship: Defines the components that are always included in a particular data structure; a concatenation of two or more data items.

ii. Selection (Either/Or) Relationship: Defines alternative data items included in a data structure.

iii. Iterational (Repetitive) Relationship: Defines the repetition of a component, zero or more times.

iv. Optional Relationship: A special case of iteration; data elements may or may not be treated zero or one time.

If analysts want to know, how many characters are in a data item, and by what other names it is referenced in the system, they should be able to find the answers in a properly developed data dictionary. Data dictionary is developed during data flow analysis and assists the analysts involved in determining system requirements.

Self Assessment Question 9.2

A data dictionary is useful as

(i) it is a documentation aid
(ii) it assists in designing input forms
(iii) it contains al data in an application including temporary data used in processes
(iv) it is a good idea in system design

A. (i) and (ii) B. (i) and (iv) C. (i),(ii) and (iii) D. (i) and (iv)

9.4 Fact Gathering And Organizing

The very first step in a system, for the purpose of selection is the understanding of requirements within the framework of the organization's objectives and the environment in which that system is being installed.

9.4.1 System Requirement Specifications:

It is a document that describes the functions of a system and the constraints that will govern

its development. The system specification also describes the information that is to input and to output from the system. The specifications should delineate the user's requirements. They must reflect the actual applications to be handled by the system and include system objectives, flow charts, input-output requirements, file structure and cost. The specifications must also describe each aspect of the system clearly, consistently and completely.

9.4.2 Fact-Finding:

Fact-finding means learning as much as possible about the present system. Fact-finding is the formal process of using research, interviews, questionnaires, sampling and other techniques to collect information about systems, requirements and preferences. It is also called information gathering or data collections. Tools, such as data and process models, document facts, and conclusions are drawn from facts. If you can't collect the facts, you can't use the tools. Fact-finding skills must be learned and practiced. There are many occasions for fact– finding during the system development life cycle. However, fact finding is most crucial to the system planning and system analysis phases. It is during these phases that the analyst learns about the vocabulary, problems, opportunities constraints, requirements, and priorities of a business and a system.

9.4.3 How to do Fact-Finding?:

For fact-finding, the system analyst does the following:

i. Sampling of written (existing) documents
ii. On-site observations
iii. Interview
iv. Questionnaires
v. Research and site visits.
vi. Observes the current system
vii. Gather forms and documents currently in use
viii. Determines the flow of data through the system, and
ix. Clearly defines the system requirements.

9.4.4 Fact Finding Techniques:

No two projects are ever the same. This means that, the analyst must decide on the information gathering tool and how it must be used. Although, there are no standard rules for specifying their use, an important rule is that information must be acquired accurately, methodically, under the right conditions and with minimum interruption to user personnel. Each tool has a special function, depending on the information needs.

(1) Reviews of Literature, Procedures and Forms

Very few system problems are unique. The increasing number of software packages suggests that, problem solutions are becoming standardized. Therefore, as a first step, a search of the literature through professional reference and procedures manuals, textbooks, company studies, government publications, or consultant studies may prove invaluable. The primary drawback of the search is time. Often it is difficult to get certain reports, publications may be expensive and the information might be outdated due to a time lag in publication. Procedure manuals and forms describe the format and functions of the present system. Up-to-date manuals save hours of information gathering time.

Unfortunately, manuals are usually outdated or do not exist

(2) Onsite Observation

Another information gathering tool used in system studies is on-site observation. It is the process of recognizing and noting people, objects and occurrences to obtain information. The major objective of any onsite observation is to get as close as possible to the real system being studied. The following questions can serve as a guide for onsite observations:

i. What kind of system is it? What does it do?

ii. Who runs the system? Who are the important people in it?

iii. What is the history of the system? How did it get to its present stage of development?

iv. Apart from its formal function, what kind of system is it in comparison with other systems in the organization? Is it a primary or a secondary contributor to the organization? Is it fast paced or is it a leisurely system that responds slowly to external crisis?

When human observers are used, four alternative observation methods are considered:

i. Natural or Contrived: A natural observation occurs in a setting, such as the employees, place of work; a contrived observation is set up by the observer in a place like a laboratory.

ii. Obtrusive or Unobtrusive: An obtrusive observation takes place, when the respondent knows he/she is being observed; an unobtrusive observation takes place in a contrived way, such as behind a one-way mirror.

iii. Direct or Indirect: A direct observation takes place, when the analyst actually observes the subject or the system at work. In an indirect observation, the analyst uses mechanical devices such as cameras and videotapes to capture information.

iv. Structured or Unstructured: In a structured observation, the observer looks for and records a specific action. Unstructured methods place the observer in a situation to observe whatever might be pertinent at that time.

Any of these methods may be used in information gathering. Electronic observation and monitoring methods are becoming widely used information gathering tools because of their speed, efficiency and low cost. Onsite observations are not without problems, some of these are:

i. Intruding into user's area often results in adverse reactions by the staff therefore, adequate preparation and training are important.

ii. Attitudes and motivations of subjects cannot be readily observed – only the actions that result from them.

iii. Observations are subject to error due to the observer's misinterpretation and subjective selection of what to observe, as well as the subjects' altered work pattern during observation.

iv. Unproductive long hours are often spent in an attempt to observe specific one-time activities or events.

v. Onsite observation to be done properly in a complex situation can be very time consuming. Proper sampling procedures must be used to ascertain the stability. Inference drawn from small samples of behavior can be inaccurate. Observing a system requires caution. When people know they are being observed: They usually behave differently, working more efficiently and at higher speeds to impress the analyst.

- **Advantages**

i. The process of recording facts site visits is highly reliable.

ii. Sometimes, site visits take place to clear doubts and check the validity of the data.

iii. Site visit is inexpensive when compared to other fact finding techniques.

iv. In this technique, systems analyst will be able to see the processes in the organization at first hand.

v. The systems analyst can easily understand the complex processes in the organization.

- **Disadvantages**

i. People usually feel uncomfortable when being watched; they may unwillingly perform their work differently when being observed.

ii. Due to interruptions in the task being observed, the information that is collected may be inaccurate.

iii. Site visits are done during a specific period and during that period, complexities existing in the system may not be experienced.

iv. There may be scheduling problems for the systems analysts when the activities take place during odd hours.

v. Sometimes, people may be more careful to adopt the exact procedure which they do not typically follow.

(3) Interviews

The interview is a face-to-face, interpersonal role situation in which a person called the interviewer asks a person being interviewed, questions designed to get information about a problem area. The interview is the oldest and most often used device for gathering information in systems work. It has qualities that behavioral and onsite observations do not possess. It can be used for two main purposes:

i. as an exploratory device to identify relations or verify information, and

ii. to capture information as it exists.

- **Guides to a Successful Interview**

Interview should be approached as logically as programming. In an interview, the following steps should be taken:

i. **Stage Setting:** This is an "ice-breaking", relaxed, informal phase, where the analyst opens the interview by focusing on the purpose of the interview, why the subject was selected and the confidential nature of the interview.

ii. **Establishing Rapport:** In one respect, data collection is an imposition on user staff time and intrusion into their privacy. Even though, the procedure is authorized by the management in advance, many staff members are reluctant to participate. So, one must take care of the following:

(a) Avoid misleading the user staff about purpose of study.

(b) Assure confidentiality of interview.

(c) Avoid personal involvement in affairs of user's department/work.

(d) Avoid sharing information received from other sources.

(e) Avoid acting like an expert or consultant.

(f) Respect time schedules. Do not extend preoccupied time.

(g) Do not make false promises.

(h) Dress and behave properly.

(i) Do not interrupt the talking.

iii. **Asking the Questions:** Except in unstructured interviews, it is important that each question be asked exactly as it is worked. Ask questions in a predefined sequence.

iv. **Record the Response:** Obtain the response in detail and note it down correctly.

v. **Data Recording and Notebook:** Care must be taken to record the data, their source, and time of collection.

Like an investigative reporter trying to discover who, what, when, why and how of a story, the analyst should conduct the interview in such a way that people provide honest descriptions of their jobs. Interviews help gather vital facts about existing problems, such as lack of quality control sufficient security, but they also allow the analyst to involve people in change, easing them into it. After all, it is the users' system, not the analyst's.

- **Advantages**

i. Interviews permit the systems analyst to get individual's views and get the specific problem work wise and operation wise.

ii. Interviews allow the systems analyst to obtain a better clarity of the problem due to feedback from the interviewees.

iii. In the process of interviews, the interviewer has time and scope to motivate the interviewee to respond freely and openly.

iv. Interviews allow the systems analyst to understand the user requirements and to know the problems faced by the user with the current system.

v. It is an effective technique to gather information about complex existing systems.

- **Disadvantages**

i. Interviews are very time consuming.

ii. Success of interviews, in most of the cases, depends on the systems analyst's interpersonal relationship skills.

iii. Some times, interviews may be impractical due to the location of interviewees.

(4) Questionnaires

In contrast to the interview is the questionnaire, which is a term, used for almost any tool that has questions to which individuals respond. It is usually associated with self-administered tools with items of the closed or fixed alternative type.

- **Closed Questions**

Closed questions are those in which the responses are presented as a set of alternatives. There are five major varieties of closed questions.

i. Fill in the blank questions request specific information. These responses then can be statistically analyzed. Example

i. What is the name of MIS directory in your firm?

ii. What is the average number of calls you receive from clients?

iii. _____

ii. Dichotomous (Yes/No) type questions that offer two answers have advantages similar to those of the multiple choice type. The problem is making certain that, a reliable response can be answered by yes or no; otherwise, an additional choice (e.g., yes, no, don't know) should be included. The question sequence and content is also important. Example

i. Are you personally using a microcomputer in your business? Yes / No

ii. If not, do you plan to be using one in the next 12 months? Yes / No

iii. In the performance of your work, are you personally involved in the computer hardware/ software purchase decisions? (Please circle one) Yes / No

iii. Ranking scale questions ask the respondents to rank a list of items in order of importance or performance. In the following example, the first question asks the respondent to rank five statements on the basis of, how they describe his/her present job. Example

i. Please rank the five statements in each group on the basis of, how well they describe the job mentioned on the front page. Write "1" for the statement that best describes the job, write "2" for the next best and so on to "5" for the least well that describes the job. Workers on this job

i. _____ are busy all the time.

ii. _____ have work where they do things for other people.

iii. _____ try out their own ideas.

iv. _____ are paid well in comparison with other workers.

v. _____ have opportunities for advancement.

iv. Multiple choice questions offer respondents specific answer choices. This offers the advantage of faster tabulation and less analyst bias due to the order in which the answers are given. Respondents have a forward bias towards the first alternative item. Alternating the order in which answer choices are listed may reduce bias but at the expense of additional time to respond to the questionnaire. In any case, it is important to be aware of these types of biases when constructing multiple choice questions. Example

i. What is the average salary of an entry level analyst? (Tick one)

i. _____ under Rs 15, 000

ii. _____ Rs 15, 000 - Rs 19, 999

iii. _____ Rs 20, 000 - Rs 24, 999

v. Rating scale questions are an extension of the multiple choice design. The respondent is offered a range of responses along a single dimension. For example, the respondent is asked to rate various aspects of his/her job on a scale of 1-5.

- **Procedure for Questionnaire Construction**

The procedure for questionnaire construction consists of six steps.

i. Decide what data should be collected; define the problem to be investigated.

ii. Decide on the type of questionnaire and then write the questions.

iii. Outline the topics for questionnaire and then write the questions.

iv. Edit the questionnaire for technical defects or biases that reflect personal values.

v. Pretest (try out) questionnaire to see how well it works.

vi. Do a final editing to ensure that the questionnaire is ready for administration. This includes a close look at the content. Form a sequence of questions as well as the appearance and clarity of the procedure for using the questionnaire.

Questionnaires economically gather data from both large and small groups of people. Properly constructed, they do not take long to complete and statistical results can be quickly tabulated. Development of a questionnaire requires in depth planning, and usually more than one draft is necessary. Questionnaire design is critical. Questions should be short, easy to understand, unbiased, non-threatening, and specific. To make sure questions will stimulate needed information, the analyst can test them with one or two outsiders before widespread distribution. Prepaid return envelopes accompanying questionnaires sent to outside help assure prompt response. When all the questionnaires are returned, the data can be tabulated.

- **Advantages**

i. It is an inexpensive means of collecting the data from a large group of individuals.

ii. It requires less skill and experience to administer questionnaires.

iii. Proper formulation and interaction with respondents leads to unbiased response from the customers.

iv. Customers can complete it at their convenience.

v. Responses can be tabulated and analyzed quickly.

- **Disadvantages**

i. Sometimes, the number of respondents is low.

ii. There is no guarantee that the respondents will answer all the questions.

iii. Sometimes, the individual may misunderstand the question. In that situation, the analyst may not get correct answer.

(5) Site visit

Site visits are to be conducted where the work load is normal. After studying the work and normal work load, systems analyst can observe the work at peak hours to see the effect caused by increased volumes. The systems analyst should collect the input /output form, documents at the time of his/her visit. The following guidelines need to be followed at the time of observation and site visit:

i. Keep a low profile at the time of site visit.

ii. Take necessary permissions from appropriate officials to conduct site visit.

iii. Inform the individuals who will be observed at the time of site visit.

iv. Take notes of the study of site visit immediately.

v. Do not make any assumptions.

(6) Gather forms and documents currently in use

The analyst turns his attention to the details of operations by making data flow of the system. While determining the flow of data, the analyst collects samples of all relevant documents, such as sample forms, invoices, packing slips, and other relevant forms. This creates a record of all type of from and documents. The assembled documents help an analyst understand what data the new system must collect and process. In addition to these documents, it is useful to have copies of reports prepared by various departments of the organisation.

(7) Determines the flow of data through the system

i. Look at the system from the inside to the outside
ii. Identify the activities
iii. Locate the data flows
iv. Show the relationships between activities
v. Find the internal inputs or outputs that exist within the system
vi. Level complex processes in the DFD into simpler ones
vii. Look for duplication of data flows or data stores (files)

When all necessary facts, figures, documents, data-flow diagrams, questionnaires and observations are complete, the analyst can write the final report. The format of the final report, called the feasibility study, parallels that of the preliminary report.

Self Assessment Question 9.3

Information requirements of an organization can be determined by

A. interviewing managers and users and arriving at the requirements based on consensus

B. finding out what similar organizations do

C. telling organization what they need based on your experience

D. sending a questionnaire to all employees of the organization

9.5 Technologies of System design

System Design is the specification or construction of a technical, computer based solution for the business requirements identified in system analysis phase. The system design process is not a step by step adherence of the procedures and guidelines, Though, certain clear procedures and guidelines have emerge in recent days, but still much of design work depends on knowledge and experience of the designer. When designer starts working on system design, he will face different type of problems. Merely of these will be due to constraints imposed by the user or limitations of the hardware and software available in the market. Sometimes, it is difficult to enumerate the complexity of the problems and solutions thereof since the variety of likely problems is so great and no solutions are exactly similar. However, following considerations should be kept in mind during the system designing phase:

9.5.1 Design Objectives:

The primary objective of the design; of course, is to deliver the requirements as specified in the feasibility report. In general, the following design objectives should be kept in mind:

i. **Practicality:** The system must be stable and can be operated by people with average intelligence.

ii. **Efficiency:** This involves accuracy, timeliness and comprehensiveness of the system output.

iii. **Cost:** It is desirable to aim for a system with a minimum cost subject to the condition that it must satisfy dl the requirements.

iv. **Flexibility:** The system should be modifiable depending on the changing needs of the user. It should also be portable to different computer systems.

v. **Easy to use:** The system must be stable and can be operated by people with average intelligence. Many technical features of system reliability, accuracy and processing speed are secondary to the human aspects of a system design. Therefore, every analyst strives to design the system to be engineered for people and to include economic features.

vi. **Ensure that system features meet user requirements:** User requirements are translated into system characteristics during design. System must performs the right procedures properly, presents information and instructions in an acceptable and effective fashion, produces accurate results and provides an acceptable interface and method of interaction.

vii. **Security:** This is very important aspect of the design and should cover areas of hardware reliability, fall back procedures, physical security of data and provision for detection of fraud and abuse.

9.5.2 Design Constraints:

The designer normally works under following constraints:

i. **Hardware:** The existing Hardware will obviously affect the system design.

ii. **Software:** The available software (operating system, utilities, language etc.) in the market will constrain the design.

iii. **Budget:** The budget allocated for the project will affect the scope and depth of design.

iv. **Timescale:** The new system may be required by a particular time (e.g. the start of a financial year). This may put a constraint on the designer to find the best design.

v. **Interface:** The new system may require some data from another computerised system with other or may provide data to another system in which case the files must be compatible in format and the system must operate with a certain processing cycle.

9.5.3 Properties of the Design:

Design bridges the gap between specifications and coding. Some of the properties of design are:

i. **Verifiability:** It is concerned with how easily the correctness of design can be argued.

ii. **Traceability:** It requires that all design must be traceable to the requirements. It helps in design verification.

iii. **Completeness:** The software must be complete in all respects.

iv. **Consistency:** It requires that there are no inherent inconsistencies within the system.

v. **Efficiency:** It is concerned with proper usage of resources by the system.

vi. **Simplicity:** It is related to simple design so that user can easily understand and use it. Simple designs are easy to maintain in the long run or through the lifecycle of a software system.

9.5.4 Processing Techniques:

The processing options available to the designers are:

i. Batch processing 1

ii. Real-time processing

iii. On-line processing

iv. A combination of all the above

It is quite interesting to note, however, that a combination of these is often found to be ideal in additional data processing applications. This increases through-put of the system and also brings down the response time of on-line activities.

9.5.5 The Process of Design:

The computer system design process is an exercise of specifying "how" the system will work. Mainly, following five parts have been included in the system design process:

i. **Output design:** The starting point of the design process is the proper knowledge of system requirements which will normally be converted in terms of output.

ii. **Input design:** The next step is to find out what data need to be made available to the system to produce the desired outputs. The basic documents, in which these data are available, need to be identified.

iii. **File design:** Once the input data is captured in the system, these data will generally be stored in files in a logical manner. The designer will have to devise the techniques of storing and retrieving data from these files.

iv. **Procedure design:** This step involves specifications of how processing will be performed. In this, there are two aspects:

(a) Computer procedure - The computer procedure will specify what functions will be carried out on computer. What will be different programs and in what sequence the programs will be run?

(b) Non-computer procedure - The non- computer procedure will specify the manual procedures for feeding input data, receiving outputs etc.

v. **Control design:** The control design indicates necessary procedures which will ensure correctness of processing, accuracy of data, timely output etc. This will ensure that the system is functioning as per requirement.

Generally, these steps are inter-dependent and some of them may have to be used together and traversed many times until a satisfactory design is prepared. It is just like the situation of "Two-step forward - one step backward" kind. The Figure presents an ideal situation about the progress of a project. But this situation occurs rarely in day-today life. Most of the time progress of a project takes different ripple shape. The system design process is, therefore, an iterative process where decisions made or changed at one step will have a "ripple effect" on other steps. For example, if an output report is modified, it may necessitate changes in input design, file design and control design.

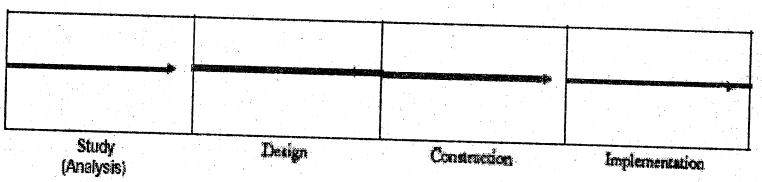


Diagram 9.7
IDEAL Project Design

9.5.6 Design Principles:

There are certain principles that can be used for the development of the system. These principles are meant to effectively handle the complexity of process of design. These principles are:

i. **Problem Partitioning:** It is concerned with partitioning the large problems. *Divide and Conquer* is the policy adopted here. The system is divided into modules that are self dependent. It improves the efficiency of the system. It is necessary that all modules have interaction between them.

ii. **Abstraction:** It is an indispensable part of design process and is essential for problem partitioning. Abstraction is a tool that permits the designer to consider a component at an abstract level (outer view) without worrying about details of implementation of the component. Abstraction is necessary when the problem is divided into smaller parts so that one can proceed with one design process effectively and efficiently. Abstraction can be functional or data abstraction. In functional abstraction, we specify the module by the function it performs. In data abstraction, data is hidden behind functions/ operations. Data abstraction forms the basis for object-oriented design.

iii. **Coupling:** Coupling is a measure of interconnection among modules in a program structure. Coupling depends on interface complexity between modules, the point at which entry or reference is made to a module and what data passes across the interface. In systems design, we strive for lowest possible coupling. Simple connectivity among modules results in software that is easier to understand and less prone to "ripple effect" caused when error occurs at one location and prorogates through a system. Relatively high levels of coupling occur when modules are tied to an environment external to software. For example, I/O couples a module to specific devices, formats and communication protocols.

iv. **Cohesion:** Cohesion is the degree to which a module performs a single task. A cohesive module performs a single task within a software procedure, requiring little interaction with procedures being performed in other parts of a program. Stated simply, a cohesive module should (ideally) do just one thing. We always strive for high cohesion. In practice, a designer need not be concerned with categorizing cohesion in a specific module. Rather, the overall concept should be understood and low level of cohesion should be avoided when modules are designed. Combining the function in single module can only serve the likelihood of error propogation when a modification is made to any one of the tasks. High cohesion is characterized by a module that performs one distinct procedural task. It is unnecessary to determine the precise level of cohesion. Rather, it is important to strive for high cohesion and recognize low cohesion so that software design can be modified to achieve greater functional independence.

v. **Span of Control:** Span of control refers to the number of subordinate modules controlled by a calling module. In general, we should seek to have no more than five to seven subordinate modules. On the one hand, excessive span of control, meaning a high number of subordinate modules, create considerable overhead in determining which module to invoke under certain conditions and in establishing calling sequences to pass data and results.

vi. **Module Size:** How large should a module be? While it is impossible to fix a specific number of instructions, there are useful guidelines to manage module size. A common one is that no module should contain more than 50 instructions. Another is that, the listing of source code

for a module should fit into a single printed page. In some situations, these rules are appropriate but in others they result in arbitrary decisions that miss the point of managing module size. In general, we should seek designs in which the modules focus on a single purpose, are highly cohesive and are loosely coupled. The size of a module also depends on the language. Lesser instructions are used in a 4GL, while in any 3GL, the number of instructions may be higher for the same task.

vii. **Shared Modules:** We want to design the system so that a certain calculation (such as determination of sales tax) is performed once. Then the module can be shared throughout the system by invoking it from various calling modules. Why share modules? There are several reasons:

(a) Sharing modules minimizes the amount of software that must be written.

(b) It minimizes the number of changes that must be made during system maintenance.

(c) Having a single shared module reduces the risk of error.

Many systems establish library modules – predefined procedures – that are included in the system's program library. The routine is quickly invoked by a single command or call. Shared library modules are a means by which good designers follow the principles of system design.

viii. **Modular Specifications:** Modular specifications are entered in a document, that is, the complete details of the modular design process of the system have been included into it. Modular specifications identify inputs becomes the outputs and describe the functional aspects of the system. The specifications then are used as a basis for the graphic representation of the modular system. So we can say that, it serves as a blue print and helps in developing and implementing the new modular system. The result of the system design process is a document known as "system specifications". The complete details of design about the proposed system have been included in it. It serves as a blue print and helps in developing and implementing the new system. This also forms the primary documentation on which the system maintaining persons will fall back upon after the system is in use. Later on, this document is normally divided into different parts for easy reference. Thus we get system manual, user manual, and operational manual.

ix. **Top-Down Design:** This approach starts by identifying major components of the system decomposing them into their own subordinate level components and interacting until the desired level of detail is achieved. Top down design methods often result in some form of stepwise refinement, starting from an abstract design, in each step, the design is refined to a more concrete level until we reach a level where no more refinement is required and the design can be implemented directly. This iterative process can go on till we reach to a complete software system. Top down design strategies work very well for system that is made from the scratch. For example Top-Down Approach of "Library Information System" can be represented as given in figure below.

x. **Bottom Up Design:** In bottom up strategy, we start from the bottom and move upwards towards the top of the software. This approach leads to a style of design where we decide the process of combining modules to provide larger ones, to combine these to provide even larger ones and so on till we arrive at one big module. That is, the whole of the desired program. This method has one weakness. We need to use a lot of intuition to decide the functionality that is to be provided by the module. If a system is to be built from existing

system, this approach is more suitable as it starts from some existing modules.

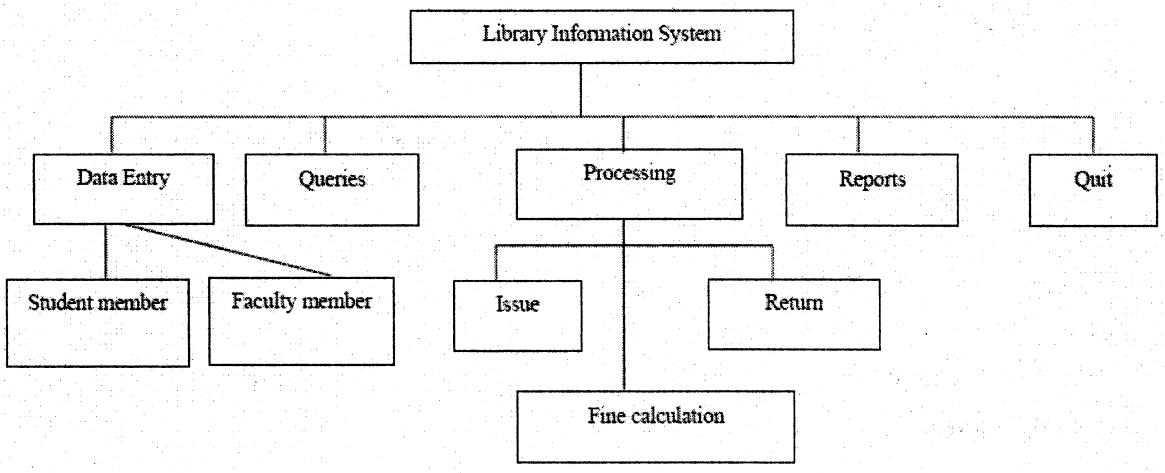


Diagram 9.8

Top Down Approach

9.5.7 Logical Design:

System design goes through two phases of development: logical and physical design. Logical Design is the phase of system development life cycle in which system analyst and user develops concrete understanding of the operation of the system. It includes the following steps:

i. designing forms (hard copy and computer displays) and reports, which describe how data will appear to users in system inputs and outputs;

ii. designing interfaces and dialogues, which describe the pattern of interaction between users and software; and

iii. designing logical databases, which describe a standard structure for the database of a system that is easy to implement in a variety of database technologies.

In logical design, all f· nctional features of the system chosen for development in analysis are described independently of any computer platform. The three sub phases mentioned in the figure are not necessarily sequential. The complete logical design must ensure that each logical design element is consistent with others and satisfactory to the end user. When analysts prepare the logical system design, they specify the user needs at a level of detail that virtually determines the information flow into and out of the system and the required data resources.

(1) Form Design

System inputs are designed through forms. The general principles for input design are:

i. Capture only variable data.

ii. Do not capture data that can be calculated or stored in computer programs.

iii. Use codes for appropriate attributes.

iv. Include instructions for completing the form.

v. Data to enter should be sequenced.

(2) Reports Design

System outputs are designed through Reports.

- **Types of outputs**

i. **Internal outputs**: Internal outputs are intended for the owners of the system and users within the organization. There are three sub-classes of internal outputs:

i. Detailed reports—Present information with little or no filtering or restrictions;

ii. Summary reports—Categorize information for managers who do not want to go through details; and

iii. Exception reports—Filter data before it is presented to the manager as information.

ii. **External outputs**: These are intended for customers, suppliers, partners and regulatory agencies. They usually conclude or report on business transactions. Examples of external outputs are invoices, account statements, paycheques, course schedules, telephone bills, etc.

- **Implementation methods for outputs**

The following are commonly used output formats.

i. **Tabular output**: It presents information as rows and columns of text and numbers.

ii. **Zoned output**: It places text and numbers into designated areas or boxes of a form or screen.

iii. **Screen output**: It is the online display of information on a visual display device, such as CRT terminal or PC monitor.

iv. **Graphic output**: It is the use of a picture to convey information in ways that demonstrate trends and relationships not easily seen in tabular output.

The following are various guidelines for output design:

i. Computer outputs should be simple to read and interpret.

ii. The timing of computer outputs is important.

iii. The distribution of (or access to) computer outputs must be sufficient to assist all relevant system users.

iv. The computer outputs must be acceptable to the system users who will receive them.

(3) User interface design

User interface design is concerned with the dialogue between a user and the computer. The overall flow of screens and messages is called a dialogue. The following are various guidelines for user interface design:

i. The system user should always be aware of what to do next.

ii. The screen should be formatted so that various types of information, instructions and messages always appear in the same general display area.

iii. Messages, instructions or information should be displayed long enough to allow the system user to read them.

iv. Use display attributes sparingly.

v. Default values for fields and answers to be entered by the user should be specified.

vi. A user should not be allowed to proceed without correcting an error.

vii. The system user should never get an operating system message or fatal error.

viii. If the user does something that could be catastrophic, the keyboard should be locked to

prevent any further input, and an instruction to call the analyst or technical support should be displayed.

9.5.8 Physical Design:

In physical design, the logical design is turned into physical or technical specifications. During the physical design, the analyst team decides the programming language in which the computer instructions will be written in, which database system and file structure will be used for the data, the platform that will be used and the network environment under which the system will be run. These decisions finalize the hardware and software plans initiated at the end of the analysis phase. Now, proceedings can be made with respect to acquisition of any new technology not already present in the organization. The final product of the design phase is the physical system specification in a form ready to be turned over to programmers and other system builders for construction. The steps to be followed during physical design are given below:

i. **Designing physical files and databases** — describes how data will be stored and accessed in secondary computer memory and how the quality of data will be ensured.

ii. **Designing system and program structure** — describes the various programs and program modules that correspond to data flow diagrams and other documentation developed in earlier phases of lifecycle.

iii. **Designing distributed processing strategies** — describes how your system will make data and processing available to users on computer networks within the capabilities of existing computer networks.

This produces the working system by defining the design specifications that tell programmers exactly what the candidate system must do. In turn, programmers write the necessary programs or modifies the software package that accepts input from the user, preforms the necessary calculations through the existing file /database, produce the report on a hard copy or displays it on a screen and maintains an updated database of all times. Specifically, a physical system design consists of the following steps:

i. Design the physical system

i. Specify input/output media.

ii. Design the database and specify backup procedures.

iii. Design physical information flow through the system and a physical design walkthrough.

ii. Plan system implementation

i. Prepare a conversion schedule and a target date.

ii. Determine training procedure, courses and time table.

iii. Devise a test and implementation plan and specify any new hardware/software.

iv. Update benefits, costs, conversion date and system constraints (legal, financial, hardware, etc.)

9.5.9 Design Methodologies:

The scope of the systems design is guided by the framework for the new system developed during analysis. More clearly defined logical method for developing system that meets user requirements has led to new techniques and methodologies that fundamentally attempt to do the following:

i. improve productivity of analysts and programmers

ii. improve documentation and subsequent maintenance and enhancements.

iii. cut down drastically on cost overcomes and delays

iv. improve communication among the user, analyst, designer, and programmer.

v. standardize the approach to analysis and design

vi. simplify design by segmentation.

(1) Structured Design

Structured design is a data-flow based methodology.

i. The approach begins with a system specification that identifies inputs and outputs and describes the functional aspects of the system.

ii. The specifications, then, are used as a basis for the graphic representation.

iii. The next step is the definition of the modules and their relationships to one another in a form called a structure chart, using a data dictionary and other structured tools.

Logical design proceeds from the top-down. General features, such as, reports and inputs are identified first. Then each is studied individually and in more detail. Hence, the structured design partitions a program into small, independent modules. Thus, structured design is an attempt to minimize the complexity and make a problem manageable by subdividing it into smaller segments, which is called modularization or decomposition. In this way, structuring minimizes intuitive reasoning and promotes maintainable provable systems.

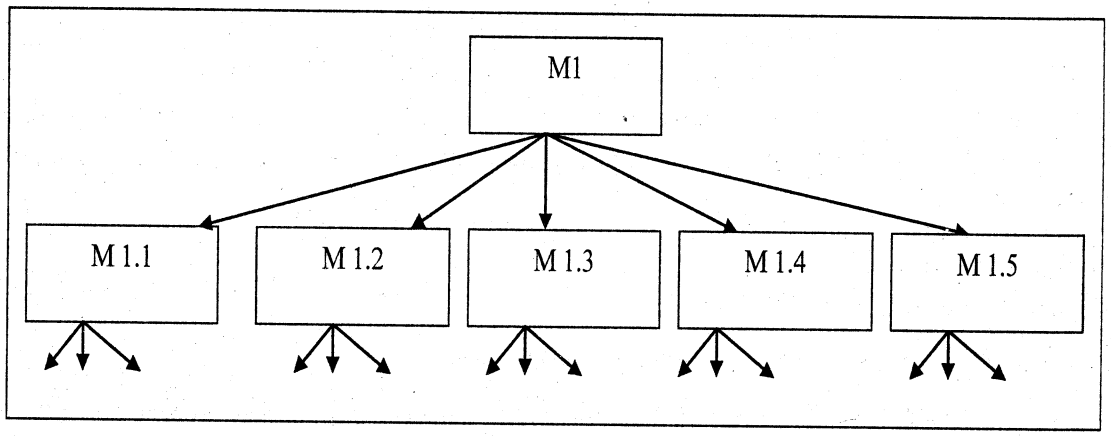


Diagram 9.9 Modular Design

In modular design technique, the software is divided into separately named and addressable components, called modules that are integrated to satisfy problem requirements. Modularization is based on a "divide and conquer" policy – it's easier to solve a complex problem when we break it into manageable pieces, the effort (cost) to develop an individual software module does decreases, as the total number of modules increases, given the same set of requirements – more modules means smaller individual size. However, as modules grow, the effort (cost) associated with integrating the modules also grow. We should modularize but care should be taken, under-modularity or over-modularity must be avoided.

- **Structure Charts**

Each system should consist of a hierarchy of modules. Lower level modules are generally smaller in scope and size compared to higher level modules and serve to partition processes into

separate functions. Higher modules must "call" lower level modules. For this, some data must be passed on to lower level modules, after performing its functions. This relationship is represented by a structure chart. A structure chart depicts the modular organization of a system. The organization is hierarchical. A structure chart graphically shows the way the components of a program or a system are related. The relationships are shown in terms of parameter passing mechanisms applied and the basic structured programming operations namely sequence, selection and repetition. Figure below depicts a structure chart. *System* is the top module. It's subordinate modules are *Get X* and *Make Y*. The subordinate modules of *Get X* are *Get W* and *Make X*. There are no subordinate modules for *Make Y*.

A structure chart depicts the internal structure of a system. It always has one coordinating module at the top. The modules at the next level are called by the subordinate module. If a menu based system is concerned, the main menu may be considered as the coordinating module and the options in it may be considered as subordinate modules. The calling mechanism is hierarchical. The coordinating module at the top calls the modules at the next level and the modules at this level call the modules at the next level to them. A module calls a subordinate module whenever there is a need for the operation to be performed by the subordinate module.

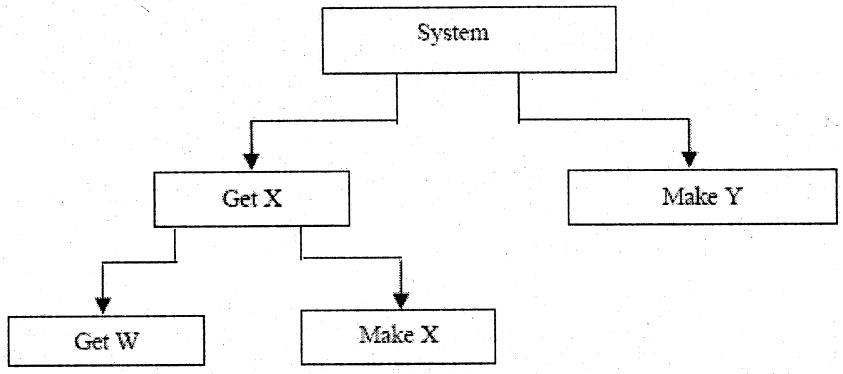


Diagram 9.10 Structure Chart

(2) Form-Driven Design

Prototype is a working system that is developed to test ideas and assumptions about the new system. The prototype is actually a pilot or test model. It is designed to be easily changed. Information gained through its use is applied to a modified design that may again be used as a prototype to reveal still better design information. The process is repeated as many times as necessary to reveal essential design requirements. Prototype / form driven design is considered to be most useful under the following conditions:

i. No system with the characteristics of the one proposed has yet been constructed by the developers.

ii. The essential features of the system are only partially known; others are not identifiable even through careful analysis of requirements.

iii. Experience in using the system will significantly add *to* the list of requirements the, system should meet.

iv. Alternate versions of the system, additional development and refinement of features are required.

v. Where system users participation in the development process is required.

Systems prototyping is an interactive process. It may begin with only a few functions and be expanded to include others that are identified later. Typically, these are the steps in the prototyping process:

i. Identify the user's known requirements and features needed in the system.

ii. Develop a working prototype.

iii. Use the prototype, noting needed enhancements and changes. These expand the list of known system requirements.

iv. Revise the prototype based on new information and requirements.

v. Repeat these steps as needed to achieve a satisfactory system.

Two key advantages of the prototyping technique are the large extent to which prototyping involves the user in analysis and design and its ability to capture requirements in concrete rather than verbal or abstract form.

(3) IPO Charts

IPO is an acronym for Input, Processing and Output. Each letter represents a column in this three column form. First column lists the variables for the Inputs, the second column shows any processing items (variables created within the code) as well as the pseudo code or flowchart used to solve the problem. The third column lists the variables that are to be output. IPO chart identifies a program's inputs, its outputs, and the processing steps required to transform the inputs into the outputs. The components of the IPO model are defined as:

i. I: Input - The information, ideas, and resources used

ii. P: Processing - Actions taken upon / using input or stored material

iii. O: Output - Results of the processing

iv. S: Storage - Location(s) where material inside the system is/are placed for possible use at a later time.

IPO charts are graphical representation of the modules (user-defined, not built-ins) to be implemented in a program, demonstrating in what order they will be called and which functions call which other functions. It is a tabular representation of the modules to explain the data communication between modules as well as the function of the module itself.

Date: ..... Author: .....

Description: Restaurant Bill Preparation

INPUT	PROCESS	OUTPUT
1. Order Given 2. Quantity Consumed	1. Read orders from Table No. 2. Total Consumed Qty 3. Rate * Consumed Quantity 4. Calculate Total Amt 5. Reduce Discount, if any 6. Calculate Net Amount	1. Print Bill

Diagram 9.11 IPO Chart

9.5.10 Design Specifications:

Design specifications which are major deliverables while designing forms and reports have the following three sections:

i. **Narrative Overview:** This contains the general overview of the characteristics of actual users of the form or report, task, the system that will be used and the environment factors in

which the form or report will be used. The main purpose of Narrative overview is to provide information in detail to the people who will develop the final form or report, regarding the main aim of the form, who the actual users of the form will be, and how it will be used, so that they can make appropriate implementation decisions.

ii. **Sample Design:** The sample design of the form may be hand-drawn using a coding sheet or it may be developed using CASE or standard development tools. If the sample design is done using actual development tools, then the form can be thoroughly tested and assessed.

iii. **Testing and Usability Assessment:** This section provides information required for testing and usability assessment. While testing, it is important to use realistic or reasonable data and demonstrate all controls.

9.5.11 Types of Information:

Information can be classified according to their distribution inside or outside the organization and the people who read and use them as follows:

(1) **Internal Information:** Internal information is the information that is collected, generated or consumed within an organization. That is, this information is intended only for the internal system owners and system users within an organization. Internal information can also consists of simple informational reports summarizing daily activities within the organization. The following are three sub classes of internal information:

i. **Detailed reports:** These reports present information with little or no filtering or restrictions. Ex.: Detailed listing of all customer accounts, orders or products in inventory.

ii. **Summary reports:** These reports categorize information for managers who do not want to wade through details. The data in summary reports are categorized and summarized to indicate only trends and potential problems. We can also include charts and graphs in the summary report so that it clearly summarizes trends at a glance. Ex.: Report that summarizes the months and years total sales by product types and category.

iii. **Exception reports:** These reports filter data before they are presented to the manager as information, i.e., these reports include exceptions to some conditions or standards. Ex.: A report that identifies items, which are low in stock.

(2) **External Information:** External information refers to the information collected from or created for customers, suppliers, competitors, regulatory agencies, etc. outside the organization. Examples of external information are: Invoices, account statements, Product documentation, Purchase orders, Mailing labels, etc.

(3) **Turnaround Documents:** There will be several instances where the information output is again used as input to obtain new information. The document that consists of such information is a turnaround document. These begin as external information delivered to an external customer as an output, but ultimately return (in part or in whole) as internal information to provide new information as an input to an information system. For example, warranty card or acknowledge slip. This form has pre-printed system generated information that a customer must verify and return to the organization. The customer also adds new information (Ex.: Name, Address, etc.), which serves as input to the customer tracking system.

Self Assessment Question 11.4

Q Good system design prevents data entry errors by

(i) Designing good forms with plenty of space to write in block capitals

(ii)By giving clear instructions to a user on how to fill a form

(iii)Reducing keystrokes of an operator

(iv)Designing good keyboard

A. i, ii, iii B. i, ii, iv C. i, ii D. iii and iv

9.6 Summary

System analysis is the process of investigating a system, identifying problems, and using the information to recommend improvements to the system. The typical use of systems analysis is to guide decisions on issues such as national or corporate plans and programs, resource use and protection policies, research and development in technology, regional and urban development, educational systems, health and other social services. Systems flowcharts are graphic illustrations of the physical flow of information through the entire accounting system. A systems flowchart is commonly used in analysis and design. Accountants use system flowcharts to describe the computerized processes, manual operations, and inputs and outputs of an application system. Auditors use system flowcharts to identify key control points in an accounting system's internal control structure. Data flow diagrams present the logical flow of information through a system in graphical or pictorial form. Data flow diagrams (DFDs) show the data used and provided by processes within a system. Systems analysis and design of business application systems, including accounting systems, once used methodologies that were primarily based on pencils and templates. Recently developed methodologies, such as CASE, are employing design automation techniques linked to code generators as well as computer-aided planning and analysis.

Structured English is a form of pseudo code that is confined to the three basic control structures of sequence, selection, and repetition. Structured English states each operation or task in an English-like, syntax-free phrase. We confine the objects to data elements that are in the data elements that are in the dictionary. Verbs are confined to operations that are generic to most languages. The goal is to lay out the logic of a program module in an algorithmic manner while staying away from language specificity. Programmers can take a structured English module and write code in any programming language. Decision tables help a person understand a system process by separating a complex problem into its underlying conditions and actions. The benefit provided by the decision table is that all possible conditions and their actions can be considered. Fact gathering is a very volatile activity. However the skills and the integrity of the professional can go a long way towards reducing anxieties and gaining cooperation. Skills enable the professional to collect critical, relevant data easily and assure that once collected it will not be lost. But, integrity is more important. Make sure that you always gather data from the top authority in the organization, the person doing the work, and treat that person with the respect due a top authority.

9.7 Keywords / Definitions

Cohesion – It is the measurement of bond between internal units of a system.

Coupling – It is the amount interconnection between different components of a system.

Context Diagram – It is the diagram showing the problem statement of the system.

Data Dictionary – It is the dictionary of terms related to a system.

Decision Table – It is a table showing variety of decisions in a system and actions taken accordingly.

Decision Tree – It is the diagrammatic representation of the actions taken upon series of decisions.

Documentation – The written file about the system, its components and working.

Fact Finding – It is the process of finding the hidden or confusing details about the system.

IPO Chart – A chart showing Inputs, Processing and Output statements related to a problem.

Module - A part of the problem connecting with other parts with predefined interfaces.

Structure Chart – It is a chart showing the structure of the problem in hierarchical manner.

9.8 Abbreviations

DB	-	Database
DBMS	-	Database Management System
DD	-	Data Dictionary
DDS	-	Data Dictionary System
DFD	-	Data Flow Diagram
GUI	-	Graphical User Interface
IPO	-	Input Processing Output
JCL	-	Job Control Language

9.9 Hint / Key To Activity / Self Assessment Questions

Activity 9.1 (D)

Activity 9.2 (C)

Activity 9.3 (A)

Activity 9.4 (A)

9.10 Questions For Practice

1. What are the primary deliverables for requirements determination?
2. What are the guidelines for effective interviewing? What is involved?
3. List the four methods for selecting questionnaire respondents.
4. Compare the usefulness of interviews and questionnaires.
5. Identify eight things document analysis can tell you about new system requirements.
7. When is prototyping most useful for requirements determination?
8. What is a source/sink? Provide three examples of a source/sink. What should you not consider about a source/sink?
9. What is a context diagram? What is a primitive data flow diagram?

9.11 References

1 Gary B. Shelly and Harry J. Rosenblatt; "Rethinking the Role of Business Analysts" Systems Analysis and Design (Ahelly Cashman Series)

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3 Dixit J B , Raj Kumar; Structured *System Analysis* and Design

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Unit - 10

Financial Control Over Information Systems

Outline of the Unit

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10.6 Summary

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10.0 Objectives

After reading this unit you will –

- Able to identify various controls incurred on a system.
- Acquaint with financial control techniques.
- Get in touch types of control techniques for internal and external control of any system.

10.1 Introduction

The word 'control' in an organizational context has traditionally been used interchangeably with 'financial control'. It is very closely associated with terms such as 'budgets', 'variances', and 'audits' etc.

Control is one of the managerial functions like planning, organizing, staffing and directing. It is an important function because it helps to check the errors and to take the corrective action so that deviation from standards are minimized and stated goals of the organization are achieved in desired manner. According to modern concepts, control is a foreseeing action whereas earlier concept of control was used only when errors were detected. Control in management means setting standards, measuring actual performance and taking corrective action. Thus, control comprises these three main activities.

To establish financial control in terms of effective action control and/or results control, an important prerequisite is a control environment that provides minimal opportunities for misrepresenting facts and/or committing fraud. Financial control pertains to processes within the finance department as well as to processes in the entire organization. The important components of financial control are - financial policies and procedures, segregation of duties, book-keeping, financial control tools for reviewing and analyzing financial performance, controlling assets employed in the business, and financial information systems.

A financial policy is a directive on the financial aspects of the organization and comprises guidelines that need to be followed for activities which have a financial implication. It ensures transparency and accountability within the organization. An Information system is an arrangement of people, data, processes, information presentation and information technology that interacts to support and improve day-to-day operations in a business as well as support the problem solving and decision making needs of management and users.

10.2 Control

10.2.1 Definitions:

According to Henri Fayol,

"Control of an undertaking consists of seeing that everything is being carried out in accordance

with the plan which has been adopted, the orders which have been given, and the principles which have been laid down. Its object is to point out mistakes in order that they may be rectified and prevented from recurring."

According to EFL Breach,

"Control is checking current performance against pre-determined standards contained in the plans, with a view to ensure adequate progress and satisfactory performance."

According to Harold Koontz,

"Controlling is the measurement and correction of performance in order to make sure that enterprise objectives and the plans devised to attain them are accomplished."

In 1916, Henri Fayol formulated one of the first definitions of control as it pertains to management:

"Control consists of verifying whether everything occurs in conformity with the plan adopted, the instructions issued, and principles established. It ['s] object [is] to point out weaknesses and errors in order to rectify [them] and prevent recurrence."

Robert J. Mockler presented a more comprehensive definition of managerial control:

"Management control can be defined as a systematic effort by business management to compare performance to predetermined standards, plans, or objectives in order to determine whether performance is in line with these standards and presumably in order to take any remedial action required to see that human and other corporate resources are being used in the most effective and efficient way possible in achieving corporate objectives."

10.2.2 Characteristics of Control:

i. Control is a continuous process
ii. Control is a management process
iii. Control is embedded in each level of organizational hierarchy
iv. Control is forward looking
v. Control is closely linked with planning
vi. Control is a tool for achieving organizational activities

10.2.3 Elements of Control:

The four basic elements in a control system are -

i. the characteristic or condition to be controlled,
ii. the sensor,
iii. the comparator , and
iv. the activator

The first element is the characteristic or condition of the working system which is to be measured. The second element of control, the sensor, is a means for measuring the characteristic or condition. The third element of control, the comparator, determines the need for correction by comparing what is occurring with what has been planned. The fourth element of control, the activator, is the corrective action taken to return the system to expected output.

10.2.4 Relationships between the Elements of Control and Information:

- **Controlled Characteristic or Condition**

The primary requirement of a control system is that it maintains the level and kind of output necessary to achieve the system's objectives. It is usually impractical to control every feature and condition associated with the system's output. Therefore, the choice of the controlled item is extremely important. There should be a direct correlation between the controlled item and the system's operation. In other words, control of the selected characteristic should have a direct relationship to the goal or objective of the system.

- **Sensor**

After the characteristic is sensed, or measured, information pertinent to control is fed back. Exactly what information needs to be transmitted and also the language that will best facilitate the communication process and reduce the possibility of distortion in transmission must be carefully considered. Information that is to be compared with the standard, or plan, should be expressed in the same terms or language as in the original plan to facilitate decision making.

- **Comparison with Standard**

In a social system, the norms of acceptable behavior become the standard against which so-called deviant behavior may be judged. Regulations and laws provide a more formal collection of information for society. Social norms change, but very slowly. In contrast, the standards outlined by a formal law can be changed from one day to the next through revision, discontinuation, or replacement by another. If there is a significant and uncorrectable difference between output and plan, the system is "out of control." This means that the objectives of the system are not feasible in relation to the capabilities of the present design. Either the objectives must be reevaluated or the system redesigned to add new capacity or capability.

- **Implimentor**

The activator unit responds to the information received from the comparator and initiates corrective action. If the system is a machine-to-machine system, the corrective inputs (decision rules) are designed into the network. When the control relates to a man-to-machine or man-to-man system, however, the individual(s) in charge must evaluate (1) the accuracy of the feedback information, (2) the significance of the variation, and (3) what corrective inputs will restore the system to a reasonable degree of stability.

10.2.5 Process of Controlling:

Now, we can summerise the process of control in following steps-

i. Setting performance standards.
ii. Measurement of actual performance.
iii. Comparing actual performance with standards.
iv. Analysing deviations.
v. Correcting deviations.

10.2.6 Kinds of control:

Control may be grouped according to three general classifications:

i. Open/Cosed-loop control - based on the nature of the information flow designed into the system

ii. Man/Machine control systems – based on the kind of components included in the design

iii. Organizational/Operational control - the relationship of control to the decision process

- **Open- and Closed-Loop Control**

A street-lighting system controlled by a timing device is an example of an open-loop system. At a certain time each evening, a mechanical device closes the circuit and energy flows through the electric lines to light the lamps. Note, however, that the timing mechanism is an independent unit and is not measuring the objective function of the lighting system. If the lights should be needed on a dark, stormy day the timing device would not recognize this need.

If control is exercised as a result of the operation rather than because of outside or predetermined arrangements, it is a closed-loop system. The home thermostat is the classic example of a control device in a closed-loop system. When the room temperature drops below the desired point, the control mechanism closes the circuit to start the furnace and the temperature rises. The furnace-activating circuit is turned off as the temperature reaches the preselected level. The significant difference between this type of system and an open-loop system is that the control device is an element of the system it serves and measures the performance of the system.

An essential part of a closed-loop system is feedback; that is, the output of the system is measured continually through the item controlled, and the input is modified to reduce any difference or error toward zero. Many of the patterns of information flow in organizations are found to have the nature of closed loops, which use feedback. In general, every goal-seeking system employs feedback.

- **Man and Machine Control**

The performance of any system is according to the standard or not can be measured as well as corrected using manual or automated control. Manual control takes time to detect, manipulate and correct errors or deviations from standards. Automated systems are fast and more accurate in controlling predefined tasks.The elements of control are easy to identify in machine systems.

- **Organizational and Operational Control**

The direction for organizational control comes from the goals and strategic plans of the organization. General plans are translated into specific performance measures such as share of the market, earnings, return on investment, and budgets. The process of organizational control is to review and evaluate the performance of the system against these established norms.

In contrast to organizational control, operational control serves to regulate the day-to-day output relative to schedules, specifications, and costs. In both instances, the elements of feedback are present, but organizational control tends to review and evaluate the nature and arrangement of components in the system, whereas operational control tends to adjust the daily inputs.

10.2.7 Problems of control:

The objective of the system is to perform some specified functions. When we try to control any problematic situtation some problems always occur. Some of these problems are as follows-

- **Measurement of Output**

Subjective inputs may be transferred into numerical data, but there is always the danger of an incorrect appraisal and transfer, and the danger that the analyst may assume undue confidence in such data after they have been quantified. External factors over which neither executive had any control may have influenced the difference in "effectiveness". The behavior of individuals working on the system or operating the system ultimately dictates the success or failure of every system.

- **Information Flow**

A system generating feedback inconsistent with current need will tend to fluctuate and will not adjust in the desired manner. One solution to this problem involves measuring not only the change but also the rate of change. The correction is outlined as a factor of the type and rate of the error. The difficulty also might be overcome by reducing the time lag between the measurement of the output and the adjustment to input. It is usually more effective for an organization to maintain continuous measurement of its performance and to make small adjustments in operations constantly. Information feedback, consequently, should be timely and correct to be effective. That is, the information should provide an accurate indication of the status of the system.

- **Setting Standards**

Setting the proper standards or control limits is a problem in many systems. Business managers face the problem establishing standards that will be acceptable to employees. Standards should be as precise as possible and communicated to all persons concerned. Moreover, communication alone is not sufficient; understanding is necessary. Leadership and positive motivation then become vital ingredients in achieving the proper response to input requirements. Most control problems relate to design; thus the solution to these problems must start at that point. Automatic control systems, provided that human intervention is possible to handle exceptions. There is a danger, however, that we may measure characteristics that do not represent effective performance or that improper information may be communicated.

10.2.8 Design Organization Structure and Control Systems:

Organization structure refers to the role-responsibility relationships of different employees in an organization along with their pre-defined interaction patterns. It facilitates the flow of information both vertically and horizontally in an organization. An organization should be structured in such a way as to go beyond maximizing performance levels and effectiveness of operations. It should encourage participation and innovation throughout the organization. In an organizational setting, it is necessary that the performance measurement systems are designed to be fair.

The controllability principle says that each manager should be assessed and rewarded only for those factors that are under his/her control. The controllability of a subsidiary's results goes from high to low as we move from the multi-domestic strategy to international strategy to global strategy to transnational strategy, as the interdependencies and the costs of control go from low to high. For multi-domestic strategy and international strategy, results controls are therefore more appropriate. For global strategy and transnational strategy, it is more appropriate to use action controls and personnel/cultural controls.

Self Assessment Question 10.1

Q. What is software change control, and what are the four steps typically involved?

10.3 Internal Control

In accounting and auditing, internal control is defined as a process effected by an organization's structure, work and authority flows, people and management information systems, designed to help the organization accomplish specific goals or objectives. It is a means by which an organization's resources are directed, monitored, and measured. It plays an important role in preventing and detecting

fraud and protecting the organization's resources, both physical (e.g., machinery and property) and intangible (e.g., reputation or intellectual property such as trademarks).

At the organizational level, internal control objectives relate to the reliability of financial reporting, timely feedback on the achievement of operational or strategic goals, and compliance with laws and regulations. At the specific transaction level, internal control refers to the actions taken to achieve a specific objective (e.g., how to ensure the organization's payments to third parties are for valid services rendered). Internal controls within business entities are also referred to as operational controls. There are many definitions of internal control, as it affects the various constituencies (stakeholders) of an organization in various ways and at different levels of aggregation. Internal control is broadly defined as a process, affected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives in the following categories:

i. Effectiveness and efficiency of operations;
ii. Reliability of financial reporting; and
iii. Compliance with laws and regulations.

Five main components associated with internal control, these are:

i. **Control Environment**- It is the entire organization which will be affected by control or need to control.
ii. **Risk Assessment**- It is the identification of risk which is associated with the control measures.
iii. **Information and Communication**- It is the process by which each individual is associated in the process of controlling.
iv. **Control Activities**- These are the policies and procedures that help ensure management directives are carried out.
v. **Monitoring**- It is the processes used to assess the quality of internal control performance over time.

10.3.1 Roles and responsibilities in internal control:

Everyone in an organization has responsibility for internal control to some extent. Virtually all employees produce information used in the internal control system or take other actions needed to effect control. Each major entity in corporate governance has a particular role to play:

i. **Management:** The Chief Executive Officer (the top manager) of the organization has overall responsibility for designing and implementing effective internal control. More than any other individual, the chief executive sets the "tone at the top" that affects integrity and ethics and other factors of a positive control environment. In a large company, the chief executive fulfills this duty by providing leadership and direction to senior managers and reviewing the way they're controlling the business. Senior managers, in turn, assign responsibility for establishment of more specific internal control policies and procedures to personnel responsible for the unit's functions.
ii. **Board of Directors:** Management may be in a position to override controls and ignore or stifle communications from subordinates, enabling a dishonest management which intentionally misrepresents results to cover its tracks. A strong, active board, particularly when coupled with effective upward communications channels and capable financial, legal

and internal audit functions, is often best able to identify and correct such a problem.

iii. **Auditors:** The internal auditors and external auditors of the organization also measure the effectiveness of internal control through their efforts. They assess whether the controls are properly designed, implemented and working effectively, and make recommendations on how to improve internal control. There are laws and regulations on internal control related to financial reporting in a number of jurisdictions. To provide reasonable assurance that internal controls involved in the financial reporting process are effective, they are tested by the external auditor (the organization's public accountants), who are required to opine on the internal controls of the company and the reliability of its financial reporting.

10.3.2 Limitations:

Internal control can provide reasonable, not absolute, assurance that the objectives of an organization will be met. The concept of reasonable assurance implies a high degree of assurance, constrained by the costs and benefits of establishing incremental control procedures.

Effective internal control implies the organization generates reliable financial reporting and substantially complies with the laws and regulations that apply to it. However, whether an organization achieves operational and strategic objectives may depend on factors outside the enterprise, such as competition or technological innovation. These factors are outside the scope of internal control; therefore, effective internal control provides only timely information or feedback on progress towards the achievement of operational and strategic objectives, but cannot guarantee their achievement.

10.3.3 Describing Internal Controls:

Internal controls may be described in terms of:

(a) The objective they pertain to; and

(b) The nature of the control activity itself.

- **Objective categorization**

Internal control activities are designed to provide reasonable assurance that particular objectives are achieved, or related progress understood. Control objectives fall under several detailed categories; in financial auditing, they relate to particular financial statement assertions, but broader frameworks are helpful to also capture operational and compliance aspects such as:

i. **Existence (Validity):** Only valid or authorized transactions are processed.

ii. **Occurrence (Cutoff):** Transactions processed timely.

iii. **Completeness:** All transactions are processed.

iv. **Valuation:** Transactions are calculated using an appropriate methodology.

v. **Rights & Obligations:** Assets represent the rights of the company, and liabilities its obligations.

vi. **Presentation & Disclosure (Classification):** Components of financial statements are properly classified and described.

vii. **Reasonableness:** transactions or results appear reasonable relative to other data or trends.

Management is responsible for implementing appropriate controls that apply to transactions in their areas of responsibility. Internal auditors perform their audits to evaluate whether the controls are designed and implemented effectively to address the relevant objectives.

- **Activity categorization**

Control activities may also be explained by the type or nature of activity. These include:

i. **Segregation of duties** - separating authorization, custody, and record keeping roles to limit risk of fraud or error by one person.

ii. **Authorization of transactions** - review of particular transactions by an appropriate person.

iii. **Retention of records** - maintaining documentation to substantiate transactions.

iv. **Supervision or monitoring of operations** - observation or review of ongoing operational activity.

v. **Physical safeguards** - usage of cameras, locks, physical barriers, etc. to protect property, such as merchandise inventory.

vi. **Top-level reviews**- analysis of actual results versus organizational goals or plans, periodic and regular operational reviews, metrics, and other key performance indicators (KPIs).

vii. **IT Security** - usage of passwords, access logs, etc. to ensure access restricted to authorized personnel.

viii. **Top level reviews**- Management review of reports comparing actual performance versus plans, goals, and established objectives.

ix. **Controls over information processing**- A variety of control activities are used in information processing. Examples include edit checks of data entered, accounting for transactions in numerical sequences, comparing file totals with control accounts, and controlling access to data, files and programs.

10.3.4 Control precision:

Control precision describes the alignment or correlation between a particular control procedure and a given control objective or risk. A control with direct impact on the achievement of an objective (or mitigation of a risk) is said to be more precise than one with indirect impact on the objective or risk. After identifying specific financial reporting material misstatement risks, management and the external auditors are required to identify and test controls that mitigate the risks.

10.3.5 Fraud and internal control:

Internal control plays an important role in the prevention and detection of fraud. Companies are required to perform a fraud risk assessment and assess related controls. This typically involves identifying scenarios in which theft or loss could occur and determining if existing control procedures effectively manage the risk to an acceptable level.

10.3.6 Internal Controls and Improvement:

If the internal control system is implemented only to prevent fraud and comply with laws and regulations, then an important opportunity is missed. The same internal controls can also be used to systematically improve businesses, particularly in regard to effectiveness and efficiency.

10.3.7 Continuous Controls Monitoring:

Advances in technology and data analysis have led to the development of numerous tools which can automatically evaluate the effectiveness of internal controls. Used in conjunction with continuous auditing, continuous controls monitoring provides assurance on financial information flowing through the business processes.

10.3.8 Various Administrative Controls:

Various administrative control tools used by an organisation are:

i. **Delegation** - Delegation is an approach to get things done, in conjunction with other employees. Delegation generally includes assigning responsibility to an employee to complete a task, granting the employee sufficient authority to gain the resources to do the task and letting the employee decide how that task will be carried out.

ii. **Evaluations** - Evaluation is carefully collecting and analyzing information in order to make decisions. There are many types of evaluations in organizations, for example, evaluation of marketing efforts, evaluation of employee performance, program evaluations, etc. Evaluations can focus on many aspects of an organization and its processes, for example, its goals, processes, outcomes, etc.

iii. **Financial Statements (particularly budget management)**- Review of financial statements is one of the more common methods to monitor the progress of programs and plans. The most common financial statements include the balance sheet, income statement and cash flow statement. Financial audits are regularly conducted to ensure that financial management practices follow generally accepted standards, as well.

iv. **Organizational Control Techniques** - Control techniques provide managers with the type and amount of information they need to measure and monitor performance. The information from various controls must be tailored to a specific management level, department, unit, or operation. To ensure complete and consistent information, organizations often use standardized documents such as financial, status, and project reports.

v. **Financial controls** - After the organization has strategies in place to reach its goals, funds are set aside for the necessary resources and labor. As money is spent, statements are updated to reflect how much was spent, how it was spent, and what it obtained. Managers use these financial statements, such as an income statement or balance sheet, to monitor the progress of programs and plans.

vi. **Financial statements** provide management with information to monitor financial resources and activities. The **income statement** shows the results of the organization's operations over a period of time, such as revenues, expenses, and profit or loss. The *balance sheet* shows what the organization is worth (assets) at a single point in time, and the extent to which those assets were financed through debt (liabilities) or owner's investment (equity).

vii. **Financial audits**, or formal investigations, are regularly conducted to ensure that financial management practices follow generally accepted procedures, policies, laws, and ethical guidelines. Audits may be conducted internally or externally. **Financial ratio analysis** examines the relationship between specific figures on the financial statements and helps explain the significance of those figures:

   (a) **Liquidity ratios** measure an organization's ability to generate cash.

   (b) **Profitability ratios** measure an organization's ability to generate profits.

   (c) **Debt ratios** measure an organization's ability to pay its debts.

   (d) **Activity ratios** measure an organization's efficiency in operations and use of assets.

viii. **Human resource controls** - Human resource controls help managers regulate the quality of

newly hired personnel, as well as monitor current employees' developments and daily performances. Common control types include performance appraisals, disciplinary programs, observations, and training and development assessments. Because the quality of a firm's personnel, to a large degree, determines the firm's overall effectiveness, controlling this area is very crucial.

ix. **Computers and information controls** - Many organizations privately monitor each employee's computer usage to measure employee performance, among other things. Managers must carefully weigh the benefits against the costs—both human and financial—before investing in and implementing computerized control techniques. Although computers and information systems provide enormous benefits, such as improved productivity and information management, organizations should remember the following limitations of the use of information technology:

(a) **Performance limitations.** Computerized information systems are expensive and difficult to develop. After the system has been purchased, coordinating it—possibly with existing equipment—may be more difficult than expected.

(b) **Behavioral limitations.** Information technology allows managers to access more information than ever before. But too much information can overwhelm employees, cause stress, and even slow decision making.

(c) **Health risks.** Potentially serious health-related issues associated with the use of computers and other information technologies have been raised in recent years.

Self Assessment Question 10.2

1. An internal audit is carried out by:

(A) Qualified accountants who have a specialist knowledge of the internal systems of the organisation.

(B) Employees of the organisation.

(C) External auditors when focusing on internal controls of the organisation.

(D) Any of the above answers.

10.4 Financial Control

Financial control focuses on monetary values rather than physical units. Financial control is an instrument for protecting the interests of the organisations. Financial control is divided into preliminary and subsequent control on the basis of the duration of the control and the character of the tasks performed. Preliminary control is control over the compilation, examination, and approval of, for example, estimates, financial plans, and budgets. Subsequent control is exercised after the expenditure of resources and the receipt of income. On the basis of records and accounts, this type of control provides information on the amount of revenue received and the timeliness of the receipts, on the condition of material assets and the availability of monetary resources, and on breaches of financial discipline.

10.4.1 Financial Control Factors:

The financial control factors fall into the categories of:

i. Significant investment – It is the inmvestment done in buildings, tools and macines used in the business.

ii. Unreimbursed expenses – These are the expenses done in terms of stationary or power cunsumed in the business.

iii. Opportunity for profit or loss – These are the day to day transactions and financial statements.

iv. Services available to the market – The work performed or the area of the business.

v. Method of payment – It is either through cash, cheque or net banking.

10.4.2 Financial Control of the Enterprise:

Financial Control should be fair, comply with legal requirements, comprehensively address real-life business situations, and be implementable at a reasonable cost. Procedures specified ensure standardization of work practices in keeping with financial policies.

There are four categories of duties in financial control. Authorization refers to the process of reviewing and approving transactions. Custody refers to the control over or access to any physical asset. Record-keeping entails creating and maintaining records of transactions. Reconciliation refers to verifying the processing or recording of transactions to ensure validity, authorization, and regularity.

Book-keeping is the function of storing financial data by maintaining and updating various books of accounts like journal and ledgers. Its focus is on monitoring the organization's financial activities and maintaining documentary evidence of the inflows and outflows. It is required to ensure transparency and enforcing financial accountability. A good book-keeping system enables provision of regular reports to interested parties.

Financial statements and financial ratios are extensively used as tools of financial control. The three financial statements used extensively are: the Balance Sheet, Profit and Loss Account, and Cash Flow Statement.

i. The balance sheet reflects and facilitates control over the wealth and liquidity position of the organization, and the proportion of self-owned financial resources to borrowed funds used by a company.

ii. The profit and loss account facilitates analysis of the expenses in relation to the income being generated and the trends in income and expenses over time.

iii. The cash flow statement depicts the cash flows from operating activities, investing activities, and financing activities.

Financial ratios are required to reflect the effectiveness of an organization's financial performance and to provide an analytical view of the financial data from multiple perspectives. Broadly, financial ratios are of five types – liquidity ratios, leverage ratios, turnover ratios, profitability ratios, and valuation ratios.

i. Liquidity ratios reflect the organization's capacity to pay off its short-term obligations and can be classified into three types - current ratio, acid-test ratio, and cash ratio.

ii. Leverage ratios assess the capital structure of an organization and the risk arising from the use of debt as a source of funds. They can be classified into structural ratios (financial leverage ratio, debt-equity ratio, and debt-assets ratio) and coverage ratios (interest coverage ratio, fixed charges coverage ratio, and debt service coverage ratio.

iii. Turnover ratios (also known as efficiency ratios or asset management ratios) measure how efficiently a company utilizes its assets. Important turnover ratios are the inventory turnover ratio, the debtors' turnover ratio, the average collection period, the fixed assets turnover ratio, and the total assets turnover ratio.

iv. Profitability ratios measure the outcomes of business operations. Gross profit margin, net profit margin, return on assets, earning power, return on capital employed, and return on equity are some of the profitability ratios.

v. Valuation ratios indicate how the stock of the company is valued in the capital market. Some valuation ratios are the price earning ratio, yield, and the market value to book value ratio.

Computerized financial information systems enable better control over the organization's operations by making available financial data from various perspectives at the click of a button. In keeping with the various activities in an organization (sales, purchase, inventory, production, logistics, etc.), financial information systems comprise financial accounting systems, sales accounting systems, purchase accounting systems, and inventory accounting systems.

Financial accounting systems facilitate generation of variance reports which compare the actual expenses and incomes with the budgeted figures, trend analysis, and support ratio analysis on a real-time basis.

Sales accounting systems aim at fulfilling the financial control goals of monitoring sales revenues, timely collection of amounts receivable, and evaluating the performance of various products, customer categories, and distribution channels.

Purchase accounting systems aim at fulfilling the financial goals of ensuring that purchases are made at an optimal cost, keeping a close watch over timeliness and value of cash and bank outflows to vendors, analyzing input costs, and lowering associated costs of purchasing.

Inventory accounting systems focus on financial control goals of monitoring inventory movements and ensuring timely replenishment, optimizing inventory holding costs, and assessing inventory-related losses. Various reports are generated by the financial information system to achieve its goals.

There are various roles (personnel of the finance and accounts function, auditors, management, Board of Directors, etc.) in an organization that can and should exercise control over its financial aspects. Personnel of the finance and accounts function are responsible for different aspects of day-to-day financial control in an organization.

The responsibilities of the management include - maintaining an environment that is conducive to financial control; formulating and adhering to financial policies and procedures; authorizing transactions, analyzing business performance; ensuring financial growth, profitability, and sustainability of the organization; and conducting periodic reviews of financial controls to ensure their adequacy.

The responsibilities of the Board of Directors include - approving policies, budgets, and capital expenditure decisions; reviewing utilization of resources; reviewing audited financial statements; appointing external auditors and members for top management positions and deciding on their compensation; and guiding the management on strategic decisions that have a long-term financial impact.

Other employees and external entities such as regulators, customers, suppliers, and financial analysts may also contribute to financial control.

Tools of Financial Control

i. Financial Statements
ii. Financial Ratios
iii. Economic Value Added (EVA)
iv. Market Value Added (MVA)
v. Cash Flow Return on Investment (CFROI)
vi. Strategic Profit Model (SPM)
vii. Segment Margin Report

The principal financial control techniques are audits, checks of balance sheets and other financial reports, analyses of economic activity, cross-checks, and inventories.

10.4.3 Techniques of Financial Control:

By analyzing our business's financial reports, we are able to determine how well our business is doing and what we need to do to improve its financial viability. There are three basic financial reports that all business owners need to understand and interpret in order to manage their businesses successfully—the balance sheet, the income/profit and loss (P&L) and the cash flow statement. These are often referred to as the financials. Financial controls provide the basis for sound management and allow us to establish guidelines and policies that enable the business to succeed and grow.

- **Proactive vs. reactive financial management**

The proactive financial manager uses pro forma or projections to plan ahead for the problems the business is likely to encounter and the opportunities that may arise. To be proactive we must read and analyze financial statements on regular basis. Monthly financial analysis is preferred, quarterly is more common, yearly is not often enough. The proactive manager has financial data available based on actual results and compares them to the budget. This process points out weaknesses in the business before they reach crisis proportion and allows the manager to make the necessary changes and adjustments before major problems develop.

A reactive manager waits to react to problems, and then solves them by crisis management. This type manager goes from crisis to crisis with little time in between to notice opportunities that may become available. The reactive manager's business is seldom prepared to take advantage of new opportunities quickly. Businesses that are managed proactively are more likely to be successful.

- **Assistance in developing financial controls**

We may need an accountant or business consultant to assist in setting up chart of accounts. Accountants use a standard numbering system for the business accounts in the chart, but each business may have a different chart of accounts depending on the operational plan. The accountant or business consultant also will assist you in setting up the financial reports you need to manage the operation of your business. Many business owners purchase computer software programs to do recordkeeping and develop financials. These programs provide a chart of accounts that can be individualized to your business and the templates for each account ledger, the general ledgers, etc. and the financial reports.

An organization will have certain objectives to achieve. A finance manager has to plan the things according to the organizational objectives. Further, these controlling techniques help in

appraising the performance of various departmental heads. The techniques of financial control, besides budgeting are,

i. **Divisional Performance Control-** Every organization will have divisions which carry out the specific work. The division performance control gives the measure of the divisional performance which helps in assessing the proportionate profit of the division in the profit of the organization.

ii. **Parta System -** In Parta system a unit-in-charge is responsible to the chairman of the company or group. In this system the performance of the unit-in-charge is monitored by the group chairman. Based on important variables like daily quantity of production, value of production, sales, material consumed, cost of material consumed, fixed costs, profit etc.

iii. **Flexible Budgeting -** A flexible budget is a budget that is prepared for a range, i.e. for more than one level of activity. A flexible budget is defined as a budget which, by recognizing the difference between fixed and variable costs, is designed to change in relation to the level of activity attained. The flexible budget is also known as variable budget, dynamic budget, sliding scale budget.

iv. **Statutory Audits -** Auditing is generally done by persons called auditors. Auditors will examine and evaluate the financial statements and records of the firm and will give his opinion in the form of report. Audits are classified into two types:

(A) External or Statutory Audit

(B) Internal Audit

- **Control Systems**

Financial Control encompasses a number of things. Some examples of financial control measures include:

i. A good computerised bookkeeping system, always up to date
ii. Clear and secure procedures for the spending of money
iii. Budgets which are regularly reviewed
iv. Regular financial reports which include comparisons to budget
v. Regular examination of KPIs, and a bias for action
vi. Regular reconciliation of bank accounts
vii. Tight accounts receivable policies, with regular reviews
viii. Clear accounts payable standards with regular reviews
ix. Regular cash forecasting, and sound cash management
x. Regular reviews of inventory and work-in-progress
xi. Regular insurance reviews
xii. Clear and documented operational policies, for delegation and training
xiii. Logical separation of responsibilities to minimise fraud risk.

- **Marketing controls**

Marketing controls help monitor progress toward goals for customer satisfaction with products and services, prices, and delivery. The following are examples of controls used to evaluate an

organization's marketing functions:

i. **Market research** gathers data to assess customer needs—information critical to an organization's success. It also helps identify competitors.

ii. **Test marketing** is small-scale product marketing to assess customer acceptance. Using surveys and focus groups, test marketing goes beyond identifying general requirements and looks at what (or who) actually influences buying decisions.

iii. **Marketing statistics** measure performance by compiling data and analyzing results. Managers look at *marketing ratios,* which measure profitability, activity, and market shares, as well as *sales quotas,* which measure progress toward sales goals and assist with inventory controls.

10.4.4 Budget as an Instrument of Control:

Budgets can be defined as a quantitative statement, for a defined period of time, which may include planned revenues, expenses, assets, liabilities, and cash flows. Budgeting refers to the process of designing, implementing, and operating budgets. Budgeting, as a control tool, provides an action plan to ensure that the organization's actual activities are least deviated from the planned activities. Budgets are used to give an overview of the organization and its operations. They are useful in resource allocation where resources are allocated in such a way that the processes which are expected to give the highest returns are given priority.

- **Defining the Budget**

A few basic rules will help ensure that an accurate and realistic budget is produced:

i. Assume that resources will only be productive for 80 percent of their time.

ii. Resources working on multiple projects take longer to complete tasks because of time lost switching between them.

iii. People are generally optimistic and often underestimate how long tasks will take.

iv. Make use of other people's experiences and your own.

v. Obtain an expert view.

vi. Include management time in any estimate.

vii. Always build in contingency for problem solving, meetings and other unexpected events.

viii. Cost each task in the Work Breakdown Structure to arrive at a total, rather than trying to cost the project as a whole.

ix. Agree a tolerance with your customer for additional work that is not yet defined.

x. Communicate any assumptions, exclusions or constraints you have to your customer.

xi. Provide regular budget statements to your customer, copying your team, so that they are always aware of the current position.

Budgets influence employee behavior. For example, the attainability of budget goals has a significant impact on the behavior of the employees who are required to achieve these goals. Easily attainable budget goals will not trigger enough effort from the employees and managers toward performance. On the other hand, if the budget goals are too demanding, there are chances that the employees and managers may resort to unscrupulous means to achieve these goals. Budgets should therefore be challenging but attainable. Budgetary slack refers to the amount that is budgeted in excess of the actual requirement. Slack is sometimes beneficial as it may help improve creativity,

help solve goal conflicts, and also help the management in retaining people. On the other hand, it also has negative effects as it represents managerial inefficiency and self-interest.

- **Budget controls**

A budget depicts how much an organization expects to spend (expenses) and earn (revenues) over a time period. Amounts are categorized according to the type of business activity or account, such as telephone costs or sales of catalogs.

Budgets not only help managers plan their finances, but also help them keep track of their overall spending. A budget, in reality, is both a planning tool and a control mechanism. Budget development processes vary among organizations according to who does the budgeting and how the financial resources are allocated. Some budget development methods are as follows:

i. **Top-down budgeting.** Managers prepare the budget and send it to subordinates.

ii. **Bottom-up budgeting.** Figures come from the lower levels and are adjusted and coordinated as they move up the hierarchy.

iii. **Zero-based budgeting.** Managers develop each new budget by justifying the projected allocation against its contribution to departmental or organizational goals.

iv. **Flexible budgeting.** Any budget exercise can incorporate flexible budgets, which set "meet or beat" standards that can be compared to expenditures.

10.4.5 Financial — definitions and classifications:

The balance sheet

The balance sheet is a snapshot of the business's financial position at a certain point in time. This can be any day of the year, but balance sheets are usually done at the end of each month. This financial statement is a listing of total assets (what the business owns- items of value) and total liabilities (what the business owes). The total assets are broken down into subcategories of current assets, fixed assets and other assets. The total liabilities are broken down into subcategories of current liabilities, long-term liabilities/debt and owner's equity.

The balance sheet shows the financial position of a business at a specific point in time, for example, the last day of the month or the year. This financial statement shows total assets (what the business owns — items of value) and total liabilities (what the business owes). The total assets are broken down into subcategories of current assets, fixed assets and other assets. The total liabilities are broken down into subcategories of current liabilities, long-term liabilities/debt and owner's equity. The total assets must equal the total liabilities plus owner's equity. The accounting equation, assets = liabilities + owner's equity, is a simple formula to describe the balance sheet.

- **Assets**

i. **Current assets** - Current assets are those assets that are cash or can be readily converted to cash in the short term, such as accounts receivable or inventory. In the balance sheet shown for Star Retail, the current assets are cash, petty cash, accounts receivable and inventory. Some business people define current assets as those the business expects to use or consume within the coming fiscal year.

ii. **Fixed assets** - Fixed assets are those assets that are not easily converted to cash in the short term; i.e., they are assets that only change over the long term. Land, buildings, equipment, vehicles, furniture and fixtures are some examples of fixed assets. In the balance sheet for

Star Retail (below), the fixed assets shown are furniture and fixtures and equipment.

iii. **Intangible assets (net)** - Intangible assets also may be shown on a balance sheet. These may be goodwill, trademarks, patents, licenses, copyrights, formulas, franchises, etc. In this instance, net means the value of intangible assets minus amortization.

- **Liabilities**

i. **Current liabilities** - Current liabilities are those coming due in the short term, usually the coming year. These are accounts payable; employment, income and sales taxes; salaries payable; central and state unemployment insurance and the current year's portion of multi-year debt. (See the sample balance sheet below.)

ii. **Long-term debt** - Long-term debt/liabilities may be bank notes or loans made to purchase your business's fixed asset structure. Long-term debt/liabilities come due in a time period of more than one year. The portion of a bank note that is not payable in the coming year is long-term debt/liability.

For example, a business owner may take out a bank note to buy land and a building. If the land is valued at Rs.50,000 and the building is valued at Rs.50,000, the business's total fixed assets are Rs.100,000. If Rs.20,000 is made as a down payment and Rs.80,000 is financed with a bank note for 15 years, the Rs.80,000 is the long-term debt.

iii. **Owner's equity** - Owner's equity refers to the amount of money the owner has invested in the firm. This amount is determined by subtracting current liabilities and long-term debt from total assets.

Table - 10.1

Star Retail - Projected Balance Sheet Year Ended, 1997			
Assets			
Current Assets			
Cash	Rs.11,250		
Account Recievable	6,500		
Inventory	30,000		
Deposits			
Utilities	75		
Telephone	100		
Sales Tax Bond	960		
Rent Deposit	2,000		
Total Current Assets		Rs.50,885	
Fixed Assets			
Equipment	Rs.25,000		
(Less Accum Depr)	(5,000)		
Furniture & Fixtures	12,500		
(Less Accum Depr)	(4,500)		
Total Fixed Assets		Rs.28,000	
Total Assets			Rs.78,885

Liabilities			
Current Liabilities			
Accounts Payable	Rs.5,080		
Current Portion Ltd	10,100		
Total Current Liabilities		Rs.15,180	
Long-Term Liabilities			
Note Payable	Rs.36,400		
Total Long-Term Liabilities		Rs.36,400	
Total Liabilities		Rs.51,580	
Owner's Equity	Rs.27,305		
Total Owner's Equity		Rs.27,305	
Total Liabilities & Owner's Equity			**Rs.78,885**

- **The income profit and loss statement (P&L)**

The income/profit and loss statement (P&L) represents the relation of income and expenses for a specific time interval. This financial statement is cumulative for a twelve-month fiscal period, at which time it is closed out. The income/profit and loss (P&L) statement shows revenues, minus the cost of goods sold, minus operating expenses, plus other revenues and expenses and the net income/loss before taxes. The profit and loss statement is divided into five major categories.

i. **Sales or revenue** - The sales or revenue portion of the income statement is where the retail price of the product is expressed in terms of Ruppes times the number of units sold. This can be product units or service units.

ii. **Cost of goods sold/cost of sales** - The cost of goods sold/sales portion of the income statement is where we show the cost of products purchased for resale, or show the direct labor cost (service person wages) for service businesses. Cost of goods sold/sales also may include additional categories, such as freight charges cost or sub-contract labor costs.

iii. **Gross profit** - The gross profit portion of the income/P&L statement tells us the difference between what we sold the product or service for and what the product or service cost us.

iv. **Operating expenses** - The operating expense section of the income/P&L statement is a measurement of all the operating expenses of the business. There are two types of expenses, fixed and variable. Fixed expenses are those expenses that do not vary with the level of sales, thus, you will have to cover these expenses even if your sales are less than the expenses. Variable expenses are those expenses that vary with the level of sales. Expense control is an area where the entrepreneur can maximize net income by holding expenses to a minimum.

v. **Net income** - The net income portion of the income/P&L statement is the bottom line. This is the measure of a firm's ability to operate at a profit. Many factors affect the outcome of the bottom line. Level of sales, pricing strategy, inventory control, accounts receivable control, ordering procedures, marketing of the business and product, expense control, customer service and productivity of employees are just a few of these factors.

Star Retail - Income Statement Year ending 2011		
	2011	% Sales
SALES		
Revenues	Rs.305,000	100.00%
(less) returns & allowances	5,000	
TOTAL SALES	300,000	100.00%
COST OF GOODS SOLD		
Beginning Inventory	5,760	1.92%
+ Purchased	101,760	33.92%
- Ending Inventory	(11,520)	-3.84%
= Cost of Goods Sold	96,000	32.00%
GROSS PROFIT	204,000	68.00%
EXPENSES		
Gross Wages	48,000	16.00%
Payroll Expenses	5,280	1.76%
Supplies	6,000	2.00%
Maintenance	6,000	2.00%
Advertising	2,400	.80%
Accounting and Legal	2,400	.80%
Rent	48,000	16.00%
Telephone	3,600	1.30%
Utilities	7,200	2.40%
Insurance	6,400	2.13%
Interest	21,492	7.16%
Bank Charges	480	0.16%
Depreciation	20,000	6.67%
Miscellaneous Expenses	1,296	0.43%
TOTAL EXPENSES	Rs.178,548	59.52%
NET PROFIT	**Rs.25,452**	**8.48%**

- **The cash flow statement**

The most important tool for planning and control is the budgeted cash flow for a business. The cash flow statement is the detail of cash received and cash expended for each month of the year. A projected cash flow statement helps you determine if the company has positive cash flow. If your company's projections show a negative cash flow, you must revisit your business plan and solve this problem. The cash flow statement is the most important financial tool you have. The cash flow statement is the detail of cash received and cash expended for each month of the year. By closely monitoring the cash flow, the entrepreneur can manage the business's most important asset effectively.

In the long run profitability and cash flow have a direct relationship, but profit and cash flow do not mean the same thing in the short run. A business can be operating at a loss and have a strong cash flow position. Conversely, a business can be showing an excellent profit but not have enough cash flow to sustain its sales growth. The cash flow statement is composed of:

i. **Cash on hand** - Cash on hand is the starting cash position of the business on the first day of the month. It usually represents the business's checkbook balance.

ii. **Cash receipts** - Cash receipts is the total of cash inflows — cash sales, collections from accounts receivable, monies received from loans, etc. The cash flow statement considers only cash. It does not take into account any uncollected portion of a credit sale.

iii. **Cash expense** - Cash expense represents the total cash paid out of the business account. Purchases, wages, taxes, expenses, capital equipment purchases, loan repayments and owner's withdrawals represent most cash expenses. The cash flow statement measures and takes into account all of these cash expenditures as they are paid.

iv. **Ending cash position** - Total cash available minus total cash paid out equals the end of month cash position. The ending cash position should equal the balance of the checkbook account at the end of the month of business activity.

Monthly Cash Flow Projection Worksheet — Star Retail				
Item	Pre-Startup	Month 1	Month 2	Month 3
1. Cash on Hand	20,000	24,280	17.733	12,896
2. Cash Receipts				
a. Cash Sales		10,520	15,200	20,000
b. Collections				
c. Loans	50,000			
3. TOTAL RECEIPTS	50,000	10,520	15,200	20,000
4. CASH AVAILABLE	70,000	34,800	32,933	32,896
5. CASH PAID OUT				
a. Purchases	20,000	6,150	9.120	12,000
b. Gross Wages		4,000	4,000	4,000
c. Payroll Expenses		512	512	512
d. Services		100	100	100
e. Supplies	2,800	200	200	200
f. Maintenance		200	200	200
g. Advertising	1,200	150	150	150
h. Car and Travel	200	80	80	80
i. Accounting and Legal	500	120	120	120
j. Rent	1,200	4,000	4,000	4,000
k. Telephone	320	80	80	80
l. Utilities	1,000	600	600	600
m. Insurance	2,500			
n. Taxes				
o. Interest		375	375	375
p. Other Expenses	1,000			
1. PROFIT SHARE				
2. LICENSE				
3.				
q. Miscellaneous				
r. Subtotal	30,720	16,567	19.537	22,417
s. Loan Payment		500	500	500
t. Capital Purchase	15,000			
u. Initial Expense				
v. Owner's Fee				
6. TOTAL PAID	45,720	17,067	20,037	22,917
7. CASH POSITION	Rs.24,280	Rs.17,733	Rs.12,896	Rs.9,979

SELF ASSESSMENT QUESTION 12.3

Q1.Adopting a 'Financial Control' approach from the corporate centre involves:

(A) Complete devolution of strategic issues but retention of major financial controls

(B) Providing financial devolution but retaining strategic planning principles

(C) Retaining financial control and strategic planning principles

(D) Complete devolution of both financial and strategic issues

10.5 Financial Audit

A financial audit, or more accurately, an audit of financial statements, is the review of the financial statements of a company or any other legal entity (including governments), resulting in the publication of an independent opinion on whether or not those financial statements are relevant, accurate, complete, and fairly presented. Financial audits are typically performed by firms of practicing accountants due to the specialist financial reporting knowledge they require.

The financial audit is one of many assurance or attestation functions provided by accounting and auditing firms, whereby the firm provides an independent opinion on published information. Many organisations separately employ or hire internal auditors, who do not attest to financial reports but focus mainly on the internal controls of the organization. External auditors may choose to place limited reliance on the work of internal auditors.

10.5.1 Purpose of Audit:

The following are the objectives of Audit:

i. To improve the quality of information systems, prevent failure and minimize the effects of failure, and speed up the process of recovery in the event of a failure. This will help Information System to be more reliable.

ii. To make an information system more secure from natural as well as manmade disasters, unauthorized access, and other destructive actions.

iii. To improve the cost performance of an information system by optimum utilization of its resources, this leads to increase in efficiency.

To achieve the above objective, the following documents should be made available to the auditors

i. A diagram of the Information System (Application)

ii. Network diagram

iii. A hierarchical diagram of the project team

10.5.2 Stages of Audit:

A financial audit is performed before the release of the financial statements (typically on an annual basis). The following are the stages of a typical audit:

- **Planning and risk assessment**

Timing: before year-end

Purpose:

i. To understand the business of the company and the environment in which it operates.

ii. What should auditors understand?

iii. The relevant industry, regulatory, and other external factors including the applicable financial reporting framework

iv. The nature of the entity

v. The entity's selection and application of accounting policies

vi. The entity's objectives and strategies, and the related business risks that may result in material misstatement of the financial statements

vii. The measurement and review of the entity's financial performance

viii. Internal control relevant to the audit

- **Internal controls testing**

Timing: before and/or after year-end

Purpose:

To assess the operating effectiveness of internal controls including IT General Controls.

- **Substantive procedures**

Timing: after year-end

Purpose:

To collect audit evidence that the management assertions made in the Financial Statements are reliable and in accordance with required standards and legislation.

- **Finalization**

Timing: at the end of the audit

Purpose:

i. To compile a report to management regarding any important matters that came to the auditor's attention during performance of the audit,

ii. To evaluate and review the audit evidence obtained, ensuring sufficient appropriate evidence was obtained for every material assertion and to consider the type of audit opinion that should be reported based on the audit evidence obtained.

10.5.3 Commercial Relationships v/s Objectivity:

One of the major issues faced by private auditing firms is the need to provide independent auditing services while maintaining a business relationship with the audited company. The auditing firm's need to maintain a viable business through auditing revenue may be weighed against its duty to examine and verify the accuracy, relevancy, and completeness of the company's financial statements.

10.5.4 Audit of Transactions on Computer:

Audit through computer is important to find out the accuracy and integrity of information system output. These types of audit are done by information system expert and use test data to check the adequacy and accuracy of control mechanism built-in to the system.

Benefits of Audit Information system audit is increasingly becoming the focal point of the independent audit, compliance audit, and operational audits. An information system audit can help the organizations in many ways:

i. Improve system and process controls.
ii. Prevent and detect errors as well as fraud.
iii. Reduce risk and enhance system security.
iv. Plan for contingencies and disaster recovery.
v. Manage information & developing systems.
vi. Prepare for the independent audit.
vii. Evaluating the effectiveness and efficiency related to the use of resources.
viii. Standardization.
ix. Improve business efficiency.
x. Cost control.
xi. Competitive advantage.

- **Computer Assisted Audit Techniques**

The auditors use various types of automated audit software to carryout IS audit. The use of Computer Assisted Audit Tools (CAATs) should be controlled by the IS Auditor to provide reasonable assurance that the audit objectives and the detailed specifications of the CAATs have been met. There are two major types of CAATs namely *audit software* and *test data.*

Audit Software This is a computer program used to process data of significance for audit from entity's accounting system. The auditor should substantiate their validity for audit purposes before making use of these tools. Various commercial audit software are available to carry out System Audit. Some of them are:

i. Visual Audit Pro
ii. IDEA
iii. E-Z Audit

- **Audit Trail**

Audit trail is a log of changes made in the data, settings and related changes. Log provides information for the system auditor to be able to determine who initiated the transaction, the time of the day, date of entry, the type of entry, fields of information that were affected and the terminal used. System log should be analyzed to provide detailed information on all normal and abnormal transactions during each processing period. System access and attempted access violations can be automatically logged by the computer and can be reported for check & review.

Audit trail is the path which a transaction traces through a data processing system from source documents to summary reports. In other words, it refers to the facilities or procedures which allow a transaction to be traced through all stages of data processing beginning with its appearance on a source document and ending with its transformation into information on a final output document. The auditors use these tools which management has found necessary for internal purposes.

Self Assessment Question 10.4

Q. Which of the following procedures would an auditor most likely include in the planning phase of a financial statement audit?

(A) Obtain an understanding of the entity's risk assessment process

(B) Identify specific internal control activities designed to prevent fraud

(C) Evaluate the reasonableness of the entity's accounting estimates

(D) Perform cutoff tests of the entity's sales and purchases.

10.6 Summary

Managers use a series of control methods and systems to deal with the various problems of their organizations. The major control systems that assist a manager in exercising control are financial control, budgetary control, quality control, inventory control, operations management and computer-based information systems. Control systems are classified into feed forward, concurrent and feedback control systems based on the management level at which they are used, as well as on the nature of their timing. Financial control systems are feedback control systems. Under financial control, we discussed financial statements and ratio analysis.

Financial statements include balance sheets, income statements and cash flow statements, which contain information that helps maintain financial control in organizations. Ratio analysis is the study of the ratios of various items in a financial statement. Various ratios such as liquidity, asset management, debt management, and profitability ratios help managers compare the current performance of an organization with its past performance or with the performance of its competitors, and enable them to take appropriate measures in case of any large deviations. While financial controls are a major tool of top management, budgetary controls are used by middle managers. Budgets are a widely used means for planning and control at every level of the organization. Budgeting is the formulation and quantification of future plans for the organization.

Financial controls are important tools. The three most important financial controls are: (1) the balance sheet, (2) the profit and loss (P&L)/ income statement and (3) the cash flow statement. Each gives the entrepreneur a different perspective on and insight into how well the business is operating toward its goals. The business plan requires a projection of these statements to obtain financing. Analyzing monthly financial statements is a must if we want to successfully manage our new business. Accurate and timely financial reports show the progress and current condition of the business. We can compare performance during one period of time (month, quarter or year) with another period, calculate trends and plan for the business's future.

10.7 Keywords / Definitions

- **Audit Trail** - It is a log of changes made in the data, settings and related changes.
- **Balance Sheet** - It is a snapshot of the business's financial position at a certain point in time.
- **Budget** – It shows how much an organization expects to spend (expenses) and earn (revenues) over a time period.

- **Cash Flow Statement** - It is the detail of cash received and cash expended for each month of the year.
- **Financial Audits** – It is the review of the financial statements of a company or any other legal entity (including governments), resulting in the publication of an independent opinion on whether or not those financial statements are relevant, accurate, complete, and fairly presented. **Financial Control** – It is the effective action control and/or results control that provide minimal opportunities for misrepresenting facts and/or committing fraud.
- **Internal Audit** – It is the arrangement in large firms where their own staffs ensure that the accounting data and the records are maintained according to the principles of accounting and to see whether the management is complying with the laid policies and procedures.
  Internal Control - It is a means by which an organization's resources are directed, monitored, and measured.
- **P & L Statement** - It represents the relation of income and expenses for a specific time interval.

10.8 Abbreviations

CAAT	-	Computer Assisted Audit Tools
CF	-	Cash Flow
EDP	-	Electronic Data Processing
EVA	-	Economic Value Added
GAAP	-	Generally Accepted Accounting Principles
IS	-	Information System
IT	-	Information Technology
KPI	-	Key Performance Indicator
P&L	-	Profit and Loss
ROI	-	Return on Investment
RONW	-	Return on Net Worth
SPM	-	Strategic Profit Model
ZBB	-	Zero Based Budgeting

10.9 Hint / Key To Self Assessment Questions

Activity 10.1

Software change control is the process of managing and controlling changes requested after the system requirements document has been submitted and accepted. A procedure for processing requests for changes to an information system's requirements consists of four steps:

a. Complete a change request form by the person requesting the change.

b. Take initial action on the request form. Coordinator enters a sequential control number and the date on the change request form, reviews the specific change, and then determines if the

change should be deferred or rejected. A copy of the form is sent back to the requestor.

c. Analyze the impact of the requested change. PM or a systems analyst must review the request and determine the impact of incorporating the change into the requirements.

d. Determine the disposition of the requested change. Based on the prior three conditions the change might be accepted, deferred, or rejected. In each of the cases, the project coordinator informs the requestor of the action taken.

Activity 10.2

(D)

Activity 10.3

(C)

Activity 10.4

(A)

10.10 Questions For Practice

1. Which of the following is not a factor included in the control environment?

   (A) Integrity and ethical values. (B) Risk assessment.

   (C) Commitment to competence. (D) Organizational structure.

2. Which statement is correct concerning the relevance of various types of controls to a financial audit?

   (A) An auditor may ordinarily ignore a consideration of controls when a substantive audit approach is taken.

   (B) Controls over the reliability of financial reporting are ordinarily most directly relevant to an audit but other controls may also be relevant.

   (C) Controls over safeguarding of assets and liabilities are of primary importance, while controls over the reliability of financial reporting may also be relevant.

   (D) All controls are ordinarily relevant to an audit.

3. What is the ultimate goal of the audit?

4. If we are not able to execute our audit as planned this potentially may result in what type of reporting condition?

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Unit -11

Computer And Information System Security

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11.0 Objectives

At the end of this chapter, you will learn about

- Various stages of computer security and basic components of security
- Need and importance of security
- Various types of attacks and forms of crimes
- Various security measures to be undertaken
- Physical and software security that can be provided to your computer and their need.

11.1 Introduction

Computer security is a branch of computer technology known as information security as applied to computers and networks. The objective of computer security includes protection of information and property from theft, corruption, or natural disaster, while allowing the information and property to remain accessible and productive to its users.

Computer hardware, software and data are the valuable assets of the organization .They are required to be protected against unauthorized access, fraud, fires and natural disasters. Without providing proper safeguards to computer based resources, an organization can not survive. Security of PCs (Personal Computer) and information systems is necessary for every organization. In this unit , we will discuss the basic concepts of computer, information system and data security.

11.2 What Is Security

Security is measures adopted to prevent the unauthorised use, misuse, modification of facts, data or information. For example whenever you go out, you lock your home to provide it security, so that nobody can enter without your permission.

11.3 Basic Components Of Security

Computer security rests on confidentiality, integrity, and availability. These are the basic components of security.

- **Confidentiality:**

Confidentiality is the secrecy of information or resources. The need for keeping information secret arises from the use of computers in sensitive fields such as government and industry. For example, military and civilian institutions in the government often restrict access to information to those who need that information. Access control mechanisms support confidentiality. One access control mechanism for preserving confidentiality is cryptography

- **Integrity:**

Integrity refers to the trustworthiness of data or resources, preventing improper or unauthorized change. Integrity includes data integrity and origin integrity (called *authentication*).

- **Availability :**

Availability refers to the ability to use the information or resource desired. Availability is an important aspect of reliability as well as of system design because an unavailable system affects the name of organization. Resources may get fail so the availability of secondary sources is beneficial.

11.4 Types Of Security

Computer security includes protection of information means the information must not get leaked. To prevent the data various security systems are developed. There are three types of computer security which are discussed below:

11.4.1 Computer System Security:

The term computer system security means the processes and mechanisms by which valuable information are protected from illegal activities

The security of computer hardware and its components is also necessary for the overall protection of data. Even if the computer is not plugged into a network, a person can open its cabinet and gain access to the hard disk..

11.4.2 Computer Network Security:

Computer networks are an integral part of any organization these days, as they facilitate the free flow of data and services to the authorized users. Thus making network security necessary.

Security is critical for maintaining the integrity of data stored on the network servers. For protecting network from virus:

You should apply following procedures to protect your network from attack of viruses:

- You can make the directories in the hard disk of server computers as read only..
- You can make programs execute only.
- You can make individual files read only using DOS attribute, and the make the users not to modify in that directory.

11.4.3 Computer Information and Data Security :

It is important to avoid data and information loss in case of hard disk crashes. The only solution is to regularly keep backups of all the data on other media such as magnetic tapes, CD-ROM, etc. People usually backup database files, spreadsheet files and large documents. It is better to take regular backups, in order to avoid any loss.

11.5 Need Of System And Data Security

The protection of computer –based resources which include hardware, software, data , procedures and people against unauthorized use or natural disaster is known as *security or system security.* Contrary to system security, which concerns with the whole system, data security refers to the protection of data from modifications, deletions, destruction or disclosure by unauthorized persons. Security is needed mainly due to following reasons :

i. Privacy : Privacy defines the rights of the individual users to keep their personal data and information secret. Most people feel that their personal information should not be monitored by the others without their consent. Without security, the important confidential data of organizations is often sold or sent to the other companies and is misused .Therefore all users need security for keeping privacy of their confidential data and software.

ii. Accuracy : Most of the damages to data and systems of an organization is caused by errors and omissions made by people. An organization always need accurate data for transaction processing, providing better service to their customers and making effective decisions.

iii Threats by dishonest employees : A dishonest employee is a major threat to an organization. A dishonest programmer can easily access any software or data, if proper control measures are not provided to the system. So security is necessary to disable the dishonest employees for stealing official data from computers.

iv. Threats of fire and natural disasters : Fire and natural disasters like floods , storms, lightning etc. are likely to cause damage to the PCs ,software and data. There should be adequate measures to protect computer –based resources against such disasters.

v. Computer Crimes : computer resources can be misused for unauthorized or illegal functions , which are called as computer crimes. Computer crimes includes embezzelling money by bank employees , unauthorized copying of costly soft wares , unauthorized modifications of data to falsify important records , malfunctioning of computers and performing other illegal functions for causing harm to computers. Personal computers are vulnerable to most form of computer crimes due to the following reasons :

11.6 Forms Of Crimes

There are several forms of computer crimes such as Data Diddling, Trapdoor Programs, Superzap Programs, Logic Bombs and Viruses, Hacking, Leakage, Eavesdropping and Wiretapping, Downloading, Software Piracy. Let us discuss these.

(i) Data Diddling

(ii) Trapdoor Programs

(iii) Superzap Programs

(iv) Logic Bombs and Viruses

(v) Hacking

(vi) Leakage

(vii) Eavesdropping and Wiretapping

(viii) Downloading

(ix) Software Piracy

(i) Data Diddling:

Data diddling refers to the unauthorized modification of data by dishonest employees of the organization. It is mostly done by the staff. For example, an accountant may change the amount figures of the debtors , which could cause excessive loss to the organization.

(ii) Trapdoor Programs:

It refers to the special routines of a program, which allows the programmers to monitor storage area of memory or other technical details of system in order to check whether the program is performing correctly or not. These routines allow users to illegally access passwords and other information.

(iii) Superzap Programs:

It refer to the another special routines of the softwares, which do not have regular control mechanisms and passwords. These are used only when the normal functioning of the software is disturbed or stopped. Although only authorized persons can use Superzap programs, here is possibility that unauthorized persons use them. In those circumstances, Superzap programs may lead to computer crimes.

(iv) Logic Bombs and Viruses:

These are the most dangerous computer crimes. Logic bombs refer to the special routines that cause excessive damage to the data or vital programs and thus either disturb or completely stop the working of the system. For example, a logic bomb may be a program-

- To format the hard disk
- To erase system files
- To delete important files
- To change important data

Viruses are the most common form of logic bombs. Viruses refers to the programs that invades and disrupts the normal working of PCs by spreading from one PCs to other.

(v) Hacking:

Hacking refer to get into someone else's computer system without permission in order to find out information or do something illegal. Hacking has become very widespread over the last decade. A person who gain access to a computer system or network without authorization is called as *Hacker.*

(vi) Leakage:

It refer to unauthorized copying of confidential data from hard disk to floppy disks. Leakage results when an employee leaves the office by carrying sensitive data on small floppies.

(vii) Eavesdropping and Wiretapping:

Eavesdropping refers to monitoring of data transmissions which are meant for other persons. Wiretapping is one of the methods of eavesdropping. It refer to setting up a special transmission path for diverting the flow of data. Wiretappers attach a cable on the local area network for diverting the flow of transmission of data.

(viii) Downloading:

It refers to receiving of data and software, which are transmitted from other computers. Downloading is a common method of copying files via internet. So internet provides a convenient way for making computer crimes.

(x) Software Piracy:

It refers to illegal copying for the purpose of distribution or sale. It is the most common form

of computer crime. Because users prefer to use pirated copies rather than spending money on buying softwares.

11.7 Types of Attacks

Attacks are types of programs by which the programs running on computer get affected. Attacks can be made through different networks across the world. The several types of attacks that are discussed below:

11.7.1 Viruses :

A virus is a program that can copy itself and infect various parts of your computer, such as documents, programs, and parts of your operating system. Most viruses attach themselves to a file or part of your hard disk and then copy themselves to other places within the operating system. Some viruses contain code that inflicts extra damage by deleting files or lowering your security settings, inviting further attacks.

11.7.2 Worms :

A worm is a program that makes copies of itself and can spread outside your operating system; it can copy itself from one computer to another by using e-mail or another transport mechanism. Worms can damage computer data and security in much the same ways as viruses, but are different from viruses in that they copy themselves from system to system.

11.7.3 Trojan horse :

A Trojan horse is a harmless-looking program designed to trick you into thinking it is something you want, but which performs harmful acts when it runs. It is typically received through downloads from the Internet. Trojan horses do not spread by themselves like viruses and worms. Most virus protection programs only detect a limited number of Trojan horses. A good way to help protect your computer from Trojan horses is to visit only Web sites you trust, and avoid downloading things unless you trust the source as well.

11.7.4 Root Kit :

A root kit is a piece of software that once installed on a victim's machine opens up a port to allow a hacker to communicate with it and take full control of the system. Root kits are also known as back doors. Some root kits give a hacker even more control of a machine than a victim may have themselves.

The SubSeven root kit allows an attacker to turn off a victim's monitor, move the mouse and even turn on an installed web cam and watch the victim without their knowledge.

11.7.5 Hybrids :

Often malware is a dangerous hybrid that can combine the features of the different classifications described above. The SubSeven root kit is delivered and classified as a trojan.

11.7.6 Scanners :

Scanners are tools designed to interrogate machines on the Internet to elicit information about the types and versions of the services that they are running. There are a variety of scanners, some just ping for the presence of a machine, others look for open ports, while others are more specialized in looking for vulnerabilities of a particular type of service, or the presence of a root kit.

Scanners are a favorite tool of a hacker, but are just as useful to security professionals trying to

detect and close down system vulnerabilities. KFSensor detects scanners and is effective at misleading them.

> Self Assessment Question 11.1
>
> What is the difference between virus and worm?

11.8 Attack Prevention

We have discussed the various types of attacks. Now the question arises how to prevent attacks from invading your computer systems. Various measures of attack prevention are:

(i) Legislation

(ii) Awareness of Users

(iii) Use of Anti-virus Software

(iv) Use of Virtual Device Drivers

(v) Use of Scanners

(vi) Check summers

(i) Legislation :

You should use only legal software to prevent your system from viruses. The government must punish people who write virus programs. It slow down creation of new viruses.

(ii) Awareness of users :

Users do not regard computer problems as their own. They regard them as the domain of the MIS department. Users can be given precise procedures to follow, to check all incoming softwares and about how to acquire them.

A good set of rules are as follows :

- Any incoming floppy disks must be virus-checked.
- If your anti-virus software finds a virus then destroy it first.
- If the rules are broken, user can be punished.

(iii) Use of anti-virus software :

Anti-virus software is the solution to many problems created by viruses. There are many types of anti-virus software. You must tell the computer to virus check everything each time when it is loaded.

(iv) Use of virtual device drivers :

On a windows 3.x or 95 this device can be install. A VxD is a32-bit device driver, which checks everything that arrives on the computer, whether it is a floppy disk, running program or the accesses file. It will check incoming files no matter where they come from.

(v) Use of scanners :

A scanner is a program that knows how to find a particular repertoire of viruses. Scanners are updated periodically.

(vi) Check summer :

A check summer is a change detector. Executable files should not change, except for a good reason like updating of the software. A check summer aims to detect changes. The advantage of this is that they do not detect a repertoire of viruses, so do not need updating. The downside of this is that they are more of a hassle than scanners because files change on your computer more often than you might have thought .

11.9 Security Process

Now we will discuss the various process of security that can be provided to your compter. These security processes are available in market. They need to be install on your computer and get updated after fixed duration. These are as follows:

11.9.1 Antivirus Software :

How do antivirus programs help to protect computer?

Antivirus programs scan e-mail and other files on your computer for viruses, worms, and Trojan horses. If a virus, worm, or Trojan horse is found, the antivirus program either quarantines it or deletes it entirely before it damages your computer and files.

Some companies that make antivirus programs provide regular updates for viruses. Many antivirus programs have an automatic update capability. When your antivirus software is updated, new viruses are added to a list of viruses to check for, protecting your computer from new attacks. If your antivirus updates are not automatic, we recommend that you check for updates on a frequent basis because new viruses are identified every day. If the antivirus program you are using requires a subscription, we strongly recommended that you keep the subscription current to receive regular updates. If your list of viruses is out of date, your computer is vulnerable to new threats.

- **Using antivirus software**

Viruses are destructive or deceptive programs that spread from computer to computer over the Internet or a network. Viruses can be attached to other files or disguised as files that look ordinary. You can help protect your computer from viruses and other security threats by:

- Installing and using up-to-date antivirus software.
- Setting up your e-mail and Internet software so that it is more difficult for files containing viruses to make their way onto your computer at all.

In addition to using up-to-date antivirus software, you should also make sure that it has a "real-time scanning" feature (depending on the brand of software, this feature might have another name). Real-time scanning checks files before they are opened or used.

- **Using Automatic Updates to help protect your computer**

For enhanced security, and to ensure that your computer always receives the latest updates in a timely manner, you should set up Automatic Updates so that it automatically downloads and installs critical updates as soon as they are released.

With Automatic Updates, Windows can routinely check for the latest important updates for your computer and install them automatically. These updates, which include critical updates and security updates, should be installed on your computer as soon as they are released, so that they can help protect your computer against viruses and other security threats.

11.9.2 Firewalls :

What is Windows Firewall?

A firewall helps to keep your computer more secure. It restricts information that comes to your computer from other computers, giving you more control over the data on your computer and providing a line of defense against people or programs (including viruses and worms) that try to connect to your computer without invitation.

You can think of a firewall as a barrier that checks information (often called *traffic*) coming from the Internet or a network and then either turns it away or allows it to pass through to your computer, depending on your firewall settings. See the following illustration.

In Microsoft Windows XP Service Pack 2 (SP2), Windows Firewall is turned on by default. (However, some computer manufacturers and network administrators might turn it off.) You do not have to use Windows Firewall—you can install and run any firewall that you choose. Evaluate the features of other firewalls and then decide which firewall best meets your needs. If you choose to install and run another firewall, turn off Windows Firewall.

- **How does it work?**

When someone on the Internet or a network tries to connect to your computer, we call that attempt an "unsolicited request." When your computer gets an unsolicited request, Windows Firewall blocks the connection. If you run a program such as an instant messaging program or a multiplayer network game that needs to receive information from the Internet or a network, the firewall asks if you want to block or unblock (allow) the connection. If you choose to unblock the connection, Windows Firewall creates an *exception* so that the firewall won't bother you when that program needs to receive information in the future.

For example, if you are exchanging instant messages with someone who wants to send you a file (a photo, for example), Windows Firewall will ask you if you want to unblock the connection and allow the photo to reach your computer. Or, if you want to play a multiplayer network game with friends over the Internet, you can add the game as an exception so that the firewall will allow the game information to reach your computer.

Although you can turn off Windows Firewall for specific Internet and network connections, doing this increases the risk that the security of your computer might be compromised.

- **What Windows Firewall does and does not do**

Do's	Don't Do
1. **Help block computer viruses and worms** from reaching your computer.	**Detect or disable computer viruses and worms** if they are already on your computer. For that reason, you should also install antivirus software and keep it updated to help prevent viruses, worms, and other security threats from damaging your computer or using your computer to spread viruses to others.

2. **Ask for your permission** to block or unblock certain connection requests.	**Stop you from opening e-mail with dangerous attachments**. Don't open e-mail attachments from senders that you don't know. Even if you know and trust the source of the e-mail you should still be cautious. If someone you know sends you an e-mail attachment, look at the subject line carefully before opening it. If the subject line is gibberish or does not make any sense to you, check with the sender before opening it.
3. **Create a record (a security log)**, if you want one, that records successful and unsuccessful attempts to connect to your computer. This can be useful as a troubleshooting tool..	**Block spam or unsolicited e-mail** from appearing in your inbox. However, some e-mail programs can help you do this. Check the documentation for your e-mail program to learn more.

11.9.3 Smart Cards :

Authenticating an individual can be accomplished by using any combination of something you know, something you have, or something you are. Passwords have been used to prove the identify of an individual to a computer system. Over time, organizations have found out that relying on something you know is not the best way to authenticate an individual. Passwords can be guessed or the person may write it down and the passwords becomes known to others. To alleviate this problem, security has moved to the other authentication methods .

Smart cards can be used for authentication and thus can reduce the risk of someone guessing a password. If a smartcard is stolen and if it is the sole form of authentication, the thief could masquerade as a legitimate user of the network or computer system . an attack against a vulnerable system will not be prevented with smart cards, as a smart card system relies on the user actually using the correct entry path into the system.

11.9.4 Intrusion detection :

Intrusion detection systems were once touted as the solution to the entire security problem. No longer we would need to protect our files and systems, we could just identify where someone was doing something wrong and stop them. In fact, some of the intrusion detection systems were marketed with the ability to stop attacks before they were successful. We are even seeing new systems marketed as intrusion prevention systems. They will also not detect legitimate users who may have inappropriate access to information.

Intrusion detection systems that support automatic protection features may be also used to generate additional security problems. Imagine a situation where the system is configured to block access from an attacking address. Then you find that a customer is generating traffic that is falsely identified as an attack. All of a sudden, the customer cannot do business with you.

11.9.5 Policy Management :

Policy and procedures are important components of a good security program, and the management of policies across computer systems is equally important. With a policy management system, an organization can be made aware of any system that does not conform to policy. However,

policy management may not take into account vulnerabilities in systems or misconfigurations in application software. Either of these may lead to a successful penetration.

Policy management on computer systems also does guarantee that users will not write down their passwords or give their passwords to unauthorized individuals

11.9.6 Encryption :

Encryption is an effective and practical method to secure data. Encryption refers to encode data by converting the standard data code into proprietary code. Just opposite to encryption Decryption is the process to convert encrypted data into original form. Encryption and decryption techniques are commonly used during transmission of data from one computer to another. The basic concept of encryption / decryption explained below:

(1) The plain text message , which has to be transmitted is encrypted to produce ciphertext.

(2) The ciphertext is transmitted to other terminals over communication lines.

(3) The ciphertext is received at authorized receiver and encrypted back into plaintext.

The general techniques of encryption/ decryption is based on algorithms given by National Bureau Standards. This technique is known as Data Encryption Standards(DES). DES uses a binary number as the key for encryption.

Encryption is the primary mechanism for communications security. It will certainly protect information in transit. Encryption might even protect information that is in storage by encrypting files. However , legitimate and illegitimate users if both present the same keys to the encryption algorithm. Therefore, encryption by itself will not provide security. There must also be controls on the encryption keys and the systems as a whole.

11.9.7 Biometrics:

Biometrics systems are yet another authentication mechanism and they too can reduce the risk of someone guessing a password. There are many types of biometric scanners for verifications of any of the following :

- Fingerprints
- Retina/iris
- Palm prints
- Hand geometry
- Facial geometry
- Voice

Each method usually requires some type of device to identify the human characteristics. In many cases, these devices have to be fairly sophisticated to detect spoofing attempts. For example, fingerprint readers much check for warmth and a pulse when a finger is presented .

11.9.8 Access Controls:

Each and every computer system within an organization should have the capability to restrict access to files based on the ID of the user attempting the access. If systems are properly configured and the file permissions set appropriately, file access can restrict legitimate users from accessing files they should not have access to. File access controls will not prevent someone from using a system vulnerability to gain access to the system as an administrator and thus see files on the system.

Even access control systems that allow the configurations of access controls on systems across the organization cannot do this. To the access control system, such an attack will look like a legitimate administrator attempting to access files to which the account is allowed access.

Self Assessment Question 11.2

1. Which program scan e-mail and other files on your computer for attacks.

(a) firewalls (b) encryption

(c) smart cards (d) Antivirus software

11.10 Security Measures

The measures for data protection taken by an organization reflect its awareness and attitude towards information and Information Technology. If top management treats computers as a de-humanized, intangible, but necessary, evil, the measures taken to protect data, individual privacy and data integrity would, at best, be lackadaisical. On the other hand, if the management considers information as an important resource and computers as an aid in decision making one would find a positive approach and involvement by the management towards security of information. This attitude naturally percolates down to the lower levels and the workers consider the computer correspondingly as an enemy.

One of the best and first steps in ensuring data security is to create awareness and develop a culture within the organization towards the ways in which information can be lost / altered and what would be the consequences, of such an occurrence, to the organization and individuals. All other steps that can be taken are:

- IT Planning : The organization must decide on a policy for introduction of IT. This must be done at the highest level and should address issues such as level of protection for various aspects of information relating to the organization.
- Selection of technology, keeping in mind obsolesces due to new innovations and necessity for keeping in step.
- Identification of points of exposure of weak links to device means to plug them.
- Physical protection of machine and media.

Control and Monitoring the access to data, its usage, by persons and its integrity must be clearly defined and responsibility for ensuring these must test on persons designated for these tasks. An audit procedure would go a long way in ensuring adherence to laid down guidelines. While the above are relevant for any computer based MIS implementation, in case of PCs, the rules for acquisition and use must be unambiguously stated. Additional points to be looked into are:

- Information classification;
- Responsibilities for Security;
- User training to increase security awareness and propagation of "do's and don'ts"
- Guidelines for creation and changes to passwords etc.

There are four principles for ensuring security and recovery in case of breaches of security:

- **Prevent :** The best method is of course stopping all breaches of security before they occur. 'Need-to know policy is an off-shoot of the principle of prevention.
- **Detect :** However one may try to ensure it, total security is almost impossible. The next principle, therefore, is that you must be able to detect breaches to security, whenever they occur, within the shortest possible time. This helps in damage assessment and, also, in devising further preventive measures.
- **Minimize Damage :** The aim here is to contain the damage, when losses occur, to reduce the adverse effects of such damage.
- **Recovery :** There must be enough resilience in the system to recoup the losses/damage and become functional, by reinstating the status, at the earliest.

We would now look at the various measures available to the PC user, to ensure security of machine and data, relating to the principles enumerated above.

11.10.1 Physical Security :

These measures are for PCs being used in offices. The PC may be in use by an individual or being shared between two or more users. The measures available are :

- Physically bolt down the PC to a table so that it cannot be casually lifted and taken away.
- Locate the PC in such a way that it is conveniently accessible to the user, but hidden from casual passers-by.
- Have likeable cupboards for floppies and keep them locked at all times, except when used.
- Keyboard and PC locking devices can be fitted so that the PC cannot be operated unless these locks are opened.
- Keep a record of all floppies in use. do not permit unknown floppies into the organization.
- Use lockable rooms for PCs, specially those handling sensitive data. Make it a practice to lock the room when leaving it for even a short time.
- The above apply to server, gateways and the like.
- **Environmental Conditions :**

The PCs are fairly rugged and can tolerate wide ranges of temperatures, humidity and voltages. However, to ensure trouble free and prolonged life, consider the following measures :

- Have temperature and humidity gauge placed in the close proximity of PC and keep a casual watch to ensure that conditions are within limits. Switch off if the limits are exceeded.
- If your normal electrical supply is subject to large variations of voltage and frequency or spikes, it is prudent to have voltage and frequency stabilizers for the PC.
- Ensure that excessive dust or paper scrap does not accumulate near the PC.
- The plug sockets should fit snugly and cables leading to terminals and printers should be secured properly and not left hanging.
- You may consider putting a thin transparent plastic cover on the key board if it does not hamper your handling the keyboard.
- The most important is the use of a vacuum cleaner at regular intervals.

11.10.2 Software Security :

There are some measures you can take to ensure that data is not corrupted or modified by unauthorized users and to reinitiate the database to its known status these are :

- Use original software for Operating System, compilers or software packages. You may have to pay for it, but you can then be sure that it would be bug-free, known also as "licensed" software.
- Use correct procedures for shutting down the PC so that all files etc. would be properly closed.
- If you develop your own applications introduce passwords to access your application; these passwords should not be visible on the screen when keyed-in.
- Keep back-ups of all your files.

11.10.3 Network Security :

The protection required for networked systems is much more extensive as physical security measures are totally inadequate. It is also extremely difficult to know who, when and how someone is accessing your data. in LANs, generally there would be one server which holds the shareable data on network and services the requests of various nodes. The normal method used is password identity for permitting access. The measures that can be adopted for additional security are :

- Keep the servers away and limit physical access to them.
- Run servers in the background mode. thus the server can be booked on, for use in the network, but, for direct use of the server, a separate password would be necessary.
- Some networks provide auditing facilities, which can be used to advantage.
- Be aware that the network cables can be tapped, so try and shield or conceal them to prevent easy access. if possible use optical fibre.
- Use codes and ciphers in data communication. remember, however, that this would impose considerable overheads on your resources.
- Use fibre-optic cables for highly sensitive networks as they are difficult to tap. however, here too it may be possible to steal data through sensing the perturbations of the fibre itself.
- Prohibit the use of passwords embedded in communication access scripts. if this is unavoidable, use encryption for passwords.
- Consider the use of see-through devices for any system accessed through networks or through dial up.
- **Protection against virus :**

A number of measures are available for reducing the risk of being attacked by computer virus:

- Build employee awareness of the risk.
- Do not allow the use of outside programs for company PCs or networks.
- Do not interface company networks to outside "Bulletin Boards".
- Make system/server files "Read only".
- Try and obtain source code for important software in use and compile it in-house.

- If source code is difficult to follow, it should ring a warning bell in your head.
- Check executable code, using "debug" or separate utilities to study code structure and check spaces for viruses.

11.10.4 Password Security :

In most organizations or computer systems, the only authorization for data access is giving the correct password; rightly speaking, this is only the first step. The whole process would be:

- **Identification:** The Password only indicates an object with a unique identity assigned to it. Thus it should not become authorization to access data without further checks, if some measure of security is desired.
- **Authentication:** This process verifies that a person or object is who he, she or it claims to be. This could be achieved by asking some standard questions (from a large selection) and getting answers to them. If the answers match with those held on the systems, the person or object is authenticated.
- **Authorization:** This is the last step in the process. Through this, you can ensure that only a given user, terminal or other resource, can access data to which permission has been granted to read, write or alter. Thus a matrix can be created to indicate which users have access to which file, records or fields. If the user request passes the matrix he is allowed access, otherwise he is denied access to some parts of the database.
- **Other Aspects:** We would now take a quick look at the protection, detection and recovery mechanisms available on large systems. This is in order to give you pointers for discerning when to go in for a larger system rather than a PC LAN and what facilities to look for.
- **Database Access:** Larger systems provide various mechanisms to prevent access to data. User classes can be defined automatically prohibiting access to data by user class. User can be given only "query view" of the data so that he can have only "read" access to a limited amount of data. In some systems, certain terminal numbers can display or access only some parts of database, thus, even a user with higher access permissions cannot access some data on those terminals.
- **Access to Operating Systems:** In some systems the operating system is written in a lower level language and users are not given the use of that language. Thus, the user cannot alter any part of the operating system. Some operating system follows the concept of access control levels. In this any program which has equal or higher access control level cannot access any routines which are below that level. The operating system routines are placed at much lower level and paths are predefined for access to these, which incidentally, are via other system routines placed at a high level. From this point of view 'UNIX' is not a secure Operating System as, 'C', which is the language in which 'UNIX' is written, is also available to the user as a programming language, however, it have many good security features.

Activity 11.3

Protect your computer and data it contains by providing password security to it.

11.11 Disaster Recovery

In spite of all security measures, organizations are always vulnerable to disaster. Disaster recovery refers to the contingency measures that an organization must take to recover data in case it is damaged or lost due to security breaches. Backup is the most efficient method of disaster recovery.

- **Backup :**

Backup, with reference to software and data, refers to create duplicate copies of important data and software on various storage devices, such as magnetic tapes and floppies in order to restore data in case of failure of hardware and software. Back is the extremely important disaster recovery procedure.

11.12 Summary

Security of computer and information system is mandatory for every organization. Security is needed mainly for privacy, accuracy, threats by dishonest employees, threats by fires and natural disaster and computer crimes. Computer security depends on many aspects of a computer system.. Given enough resources, an attacker can often evade the security procedures and mechanisms that are in place. Such a desire is tempered by the cost of the attack, which in some cases can be very expensive. If it is less expensive to regenerate the data than to launch the attack, most attackers will simply regenerate the data.

Various forms of computer crimes are Data Diddling, Trapdoor Programs, Superzap Programs, Logic Bombs and Viruses, Hacking, Leakage, Eavesdropping and Wiretapping , Downloading and Software Piracy. The various preventive measures are available for keeping computer free from attacks. Security is of three types physical, network, software and password security. In case of loss of data due to any reason it is good to have backup for disaster recovery.

11.13 Keywords

- Security :- Security is measures adopted to prevent the unauthorised use, misuse, modification of facts, data or information.
- Computer security :- It is a branch of computer technology known as information security as applied to computers and networks.
- Data Diddling :- Data diddling refers to the unauthorized modification of data by dishonest employees of the organization.
- Trapdoor Programs :- It allows the programmer to monitor technical details of system.
- Viruses :-They disrupt the normal functions of PCs.
- Hacker :- He gain access to a computer system or network without authorization.
- Worms:- It is a program that makes copies of itself and can spread outside your operating system.
- Firewall :- A method of keeping a network secure.
- Anti-virus software :- An application program that detects and removes the viruses.
- Encryption :-The process of encoding data to prevent unauthorized access during access
- Decryption :- The process to convert encrypted data into original form

- Backup :- Create duplicate copies of important data and software on various storage devices

11.14 Abbreviations

CD	-	Compact Disk
DES	-	Data Encryption Standard
IT	-	Information Technology
LAN	-	Local Area Network
MIS	-	Managing Information System
PC	-	Personal Computer
ROM	-	Read Only Memory
SAQ	-	Self Assessment Question
SP2	-	Service Pack 2

11.15 Hint Or Key To Activities/SAQ

Activity 11.1

The objective of computer security includes protection of information and property from theft, corruption, or natural disaster.

Activity 11.2

Worms are different from viruses in that they copy themselves from system to system.

Activity 11.3 (d)

Activity 11.4

Go to control panel and then click on user accounts to create password

11.16 Questions For Practice

1. Define security with reference to information system.
2. What is the main objective behind providing security.
3. Why does an organization needs security? Discuss in brief.
4. Discuss different types of security in brief.
5. Discuss the concept of encryption and decryption.
6. Explain the following terms.
   (i) Data Diddling
   (ii) Trapdoor Program
   (iii) Superzap program
   (iv) Hacking
7. What is software piracy?
8. What is computer crime? What are its forms? Explain with suitable examples.
9. How can a virus be detected and removed?

10. How can the system be protected from virus?
11. What is an attack ? Explain various types of attacks.
12. What is ciphertext? Explain.
13. Explain the functions of following:
    (i) Antivirus software
    (ii) Firewalls
    (iii) Smart cards
    (iv) Cryptography
    (v) Access control
11. What is backup? Why it is needed?

11.17 Reference/Suggested Books

1 Arora,Ashok "Foundation of computer science" , Firewall Media, New Delhi

2 Maiwald, Eric "Network Security –Â beginners guide", Tata McGraw hill, New Delhi

3 Leon, Alexis and Leon, Mathews " Computers for everyone" ,Leon press and Vikas publishing house pvt. Ltd., New Delhi

4 *Ritchey, W. Steen "Internet Security Professional Reference" ,New Riders*

5 *Kahatl "Cryptography and Network security",* Tata McGraw Hills, New Delhi

6 Wesley ,Aelison "Introduction to Computer Security", Addison Wesley Professional

7 Bishop, Matt " Copmuter Security –Art and Science", Addison Wesley Professional

8 Stallings,Willams "Cryptography and Network Security ", Tata Mcgraw Hill Publications, New Delhi

9 Lehtinen ,Rick and Russel Deborah and Gangeni, G.T. "Computer Security Basics,Second Edition", O'Reilly Media publication

Unit - 12

Electronic Spread Sheets And Databases

Outline of the Unit :

12.0 Objective

12.1 Introduction

12.2 What is Electronic Spreadsheet

12.3 Advantages of Electronic Spreadsheet

12.4 Types of Spreadsheets

12.5 Database

12.6 Purpose of database system

12.7 Database management system

12.8 Database Concepts

12.9 Types of Database

12.10 Use of database in Excel

12.11 Summary

12.12 Keywords

12.13 Abbreviations

12.14 Hint or key to Activities/SAQ

12.15 Questions for practice

12.16 Reference/Suggested Books

12.0 Objective

At the end of this chapter, student will learn about

- Overview of spreadsheet and types of spreadsheets
- Advantages of spreadsheet
- Overview of database and types of databases.
- Use of database in accounting using Excel
- Purpose of database
- Use of spreadsheet in accounting

12.1 Introduction

A **spreadsheet** is a computer application that simulates a paper, accounting spreadsheet. It displays multiple cells that together make up a grid consisting of rows and columns, each cell containing alphanumeric text, numeric values or formulas. A formula defines how the content of that cell is to be calculated from the contents of any other cell (or combination of cells) each time any cell is updated. Spreadsheets are frequently used for financial information because of their ability to re-calculate the entire sheet automatically after a change to a single cell is made.

Visicalc is usually considered the first electronic spreadsheet (although this has been challenged), and it helped turn the Apple II computer into a success and greatly assisted in their widespread application. Lotus 1-2-3 was the leading spreadsheet when DOS(Disk Operating System) was the dominant operating system. Excel now has the largest market share on the Windows and Macintosh platforms.

A database consists of an organized collection of data for one or more multiple uses. People use several databases in their day to day life.

12.2 What is Electronic Spreadsheet ?

An electronic spreadsheet or spread sheet program is used to perform calculations, store information in the memory of a computer and display the information or the results in the required format on your computer screen. In such a spreadsheet , information is entered through the keyboard and displayed on the computer screen. The information already entered can be changed very easily. If information is changed then spreadsheet program automatically recalculates results on the basis of new information. For example you can use spreadsheet program to calculate the total sales by multiplying the quantity sold with the unit price. Latter if you make changes in the unit price, the spreadsheet program will automatically will recalculates and display new total sales value. The spreadsheet program can also display the results in the form of graphs.

You can store all kind of information in the spreadsheet. Some common areas where spreadsheet programs are used are:

- Budgets
- Annual reports of business forms
- Income statements
- Income tax calculations
- Payrolls
- Billing
- Accounts table
- Production and marketing analysis
- Investment and loan analysis
- Banking and other financial services
- Inventory control
- Tender revaluation
- Scientific calculation
- Cost effective analysis

Self Assessment Question 12:A

1. How Electronic Spreadsheet is better to use in accounting than paper pencil work ?

12.3 Advantages of Electronic Spreadsheet

The electronic spreadsheet offers several advantages.

- The results are accurate.

- The spreadsheet can be quite big in size and any part can be viewed and edited.
- Data entered in the spreadsheet can be formatted in several ways to give it a professional workbook.
- Several mathematical, financial, logical and statistical functions are built in.
- Data can be analyzed in form of graphs (charts). These graphs can be of various types.
- The spreadsheet is saved in an electronic file. This file can be viewed later when required and can be modified later if required.
- An existing spreadsheet or any part of it can be merged with existing or new spreadsheet.
- The information entered in an spreadsheet can be sorted in a desired format.
- With the electronic spreadsheet , you can easily and quickly produce reports
- The information stored in a spreadsheet can be transferred to other software programs, such as Word, FoxPro, dBase etc. Similarly, information stored in other software programs can also be transferred to the spreadsheet.

Consider the Profit and loss Statement of a business firm as shown in Table 12.1

Table 12.1 : Profit and Loss Account of XYZ Pvt. Ltd: 2009-2010

Profit and Loss Account of XYZ Pvt. Ltd. 2009-2010				
	January	February	March	April
Costs	60000	80000	90000	70000
Overheads	10000	15000	20000	20000
Sales	80000	100000	120000	95000
Profit	10000	5000	10000	5000
Total Sales	395000			
Total Profit	30000			

This statement includes figures for the cost , overheads and sales. The profit figures are calculated by subtracting 'cost + overheads' from 'Sales' for each month.

Similarly, the total sales is calculated by adding up sales for all the months. The total profit is calculated by adding up profit for all the months. The manual addition of figures and then writing results is very difficult when many figures are involved.

Suppose after you have calculated all the results and typed the statement, the marketing manager informs you that the sales figure for the month of April is 1,05,000 not 95,000. it was very easy for marketing manager to inform you. Now its your responsibility to change the figure and recalculate the total profit and total sales and retype the statement.

But in real case, the Profit and Loss statement of a company is not so easy to calculate again because it involves hundreds of figures, several of them are interrelated from one page to another. If one figure is changes, you may have to spend hours to recalculate the final figure and retype the statement. On the other hand, if you are using an electronic spreadsheet and when you change the figure, the spreadsheet program automatically recalculates all the figures immediately when data is updated.

12.4 Types Of Spreadsheets

- Paper spreadsheet
- Autoplan/ Paper spreadsheets
- Batch spreadsheet report generators
- LANPAR Autotab spreadsheet
- APLDOT modeling language
- VisiCalc
- Lotus 1-2-3 and other MS-DOS spreadsheets
- Microsoft Excel
- Web based spreadsheets
- **Paper spreadsheets :** The paper spreadsheet is like a sheet of paper made of rows and columns. The word "spread-sheet" means the format which is used to present book-keeping ledgers—with columns for categories of expenditures across the top, invoices listed down the left margin, and the amount of each payment in the cell (where its row and column intersect)
- **Batch spreadsheet :** It was developed in1961 for computerized accounting and budgeting. These batch Spreadsheets basically deal with the addition or subtraction of entire columns or rows rather than individual cells.
- **LANPAR spreadsheet compiler :** The software LANPAR stands for Language for Programming Arrays at Random. This was developed in 1969. LANPAR was used for budgeting operations.. Its uniqueness was the incorporation of natural order recalculation.
- **Autoplan / Autotab spreadsheet :**In 1968, Leroy Ellison, Harry N. Cantrell, and Russell E. Edwards developed this spreadsheet software. Autoplan/AutoTab was not a WYSIWYG (What You See Is What You Get) spreadsheet program, it was a simple scripting language for spreadsheets. The user only defines the names and labels for the rows and columns, then the formulas that defined each row or column.
- **APLDOT modeling language :** APLDOT was developed in 1976 .The application was used successfully for developing financial and costing models.
- **VisiCalc :** This spreadsheet concept became known in early 1980s. Dan Bricklin and Bob Frankston's invented VisiCalc. VisiCalc was the first spreadsheet that combined all essential features of modern spreadsheet applications, such as WYSIWYG , automatic recalculation, status and formula lines, range copying with relative and absolute references, formula building by selecting referenced cells.
- **Lotus 1-2-3 and other MS-DOS spreadsheets :** Lotus 1-2-3 was developed in November 1982. Lotus 1-2-3 was released in the market on January 26, 1983. It was the mostly used spreadsheet before the invention of MS Excel.
- **Microsoft Excel :** Microsoft has developed this spreadsheet program. After the invention of Excel, Lotus was out of market, Microsoft had started compiling their office suite. It was developed in mid of 1990s, Microsoft Excel is the most popular in commercial electronic spreadsheet market.

- **Web based spreadsheets :** With the advent of advanced web technologies, a new generation of online spreadsheets has emerged. The web based online spreadsheets have many special features such as multi-user collaboration. Some of web based spreadsheet offer real time updates from remote sources such as stock prices and currency exchange rates.

12.5 Data Base

Database is also referred to as a **list** or a **table**. It is an organized collection of related information. The organized collection of information or database server a base from which specific information can be retrieved and decisions made by further reorganizing the data. People use several databases in their day to day life. The dictionary is the most common example of database where words are arranged in arranged in alphabetical order.

Each row of the list is called as a **record**, and each column is called as a **field**. The column heading is called **fieldname** and the row containing fieldnames is called **header row**. An office may have a database of employees containing names, address, date of birth, salaries, deductions etc.

Let us take an example of the employee details as shown below in Table 12.2 :

Table 12.2
Database of Employee

EMPCODE	NAME	AGE	DEPARTMENT	SALARY
E001	Rishi	27	Marketing	4500
E002	Sandeep	35	Marketing	6000
E003	Vinita	24	Accounts	7000
E004	Prakash	23	Inventory	8200
E005	Arun	34	Marketing	8700

In this example, EMPCODE, NAME, AGE, DEPARTMENT and SALARY are the field names. Each row with the data for one employee is the record of that employee. The first row containing fieldnames EMPCODE, NAME, AGE, DEPARTMENT and SALARY is the Header row. The second row contains record of EMPCODE E001 such as its name, age, department, and salary. This row is record of E001. Next row is record of E002 and so on .

The field names must be unique and there should not be any blank row between the field names and the records.

Applications of database

- Banking: all transactions
- Airlines: reservations, schedules
- Universities: registration, grades
- Sales: customers, products, purchases
- Manufacturing: production, inventory, orders, supply chain
- Human resources: employee records, salaries, tax deductions

Self Assessment Question 12.2

1. What is database? List the applications of database.

12.6 Purpose of Database System

- In the early days, database applications were built on top of file systems
- Drawbacks of using file systems to store data:
  - Data redundancy and inconsistency
    - Multiple file formats, duplication of information in different files
  - Difficulty in accessing data
    - Need to write a new program to carry out each new task
  - Data isolation — multiple files and formats
  - Integrity problems
    - Integrity constraints (e.g. account balance > 0) become part of program code
    - Hard to add new constraints or change existing ones
  - Atomicity of updates
    - Failures may leave database in an inconsistent state with partial updates carried out.
    - E.g. transfer of funds from one account to another should either complete or not happen at all.
  - Concurrent access by multiple users
    - Concurrent accessed needed for performance
    - Uncontrolled concurrent accesses can lead to inconsistencies
  - Security problems
- Database systems offer solutions to all the above problems

12.7 Database Management Systems

A database management system (DBMS) consists of software that organizes the storage of data. A DBMS controls the creation, maintenance, and use of the database storage structures of social organizations and of their users.

Database management systems(DBMS) are collections of tools used to manage databases. A DBMS is a major software component of database system. It consists of collection of interrelated data and programs to access that data. The primary goal of a DBMS is to provide an environment which is both convenient and efficient to use in retrieving information from and storing information into the database. Four basic functions performed by all DBMS are:

- Create, modify, and delete data structures, e.g. tables
- Add, modify, and delete data
- Retrieve data selectively
- Generate reports based on data

In another way we can say that Database Management System **(DBMS)** is a

- Collection of interrelated data

- Set of programs to access the data
- DBMS contains information about a particular enterprise
- DBMS provides an environment that is both *convenient* and *efficient* to use.

Database management systems are usually categorized according to the database model that they support, such as the network, relational or object model. The model tends to determine the query languages that are available to access the database. One commonly used query language for the relational database is SQL.

A short list of database applications would include:

• Inventory	• Payroll	• Membership
• Orders	• Shipping	• Reservation
• Invoicing	• Accounting	• Security
• Catalogues	• Mailing	• Medical records

12.8 Database Components

Looking from the top down, databases are composed of related tables, which in turn are composed of fields and records.

- **Field :** A field is an area (within a record) reserved for a specific piece of data. Examples: customer number, customer name, street address, city, state, phone, current balance.

Fields are defined by:

- Field name
- Data type
  - Character: text, including such things as telephone numbers and zip codes
  - Numeric: numbers which can be manipulated using math operators
  - Date: calendar dates which can be manipulated mathematically
  - Logical: True or False, Yes or No
- Field size
  - Amount of space reserved for storing data

- **Record :** A record is the collection of values for all the fields pertaining to one entity: i.e. a person, product, company, transaction, etc.
- **Table :** A table is a collection of related records. For example, employee table, product table, customer, and orders tables. In a table, records are represented by rows and fields are represented as columns.
- **Database :** A database is a collection of related tables. It can also include other objects, such as queries, forms, and reports. The structure of a database is the *relationships* between its tables.
- **Relationships :**There are three types of relationships which can exist between tables:
  - One-to-One
  - One-to-Many
  - Many-to-Many

An example of a One-to-Many relationship would be a Customer table and an Orders table each order has only one customer, but a customer can make many orders. One-to-Many relationships consist of two tables, the "one" table, and the "many" table.

An example of a Many-to-Many relationship would be an Orders table and a Products table. An order can contain many products, and a product can be on many orders. A Many-to-Many relationship consists of three tables: two "one" tables, both in a One-to-Many relationship with a third table. The third table is sometimes referred to as the *lien*.

- **Key Fields :** In order for two tables to be related, they must share a common field. The common field (key field) in the **"one" table** of a One-to- Many relationship needs to be a primary key. The same field in the **"many" table** of a One-to-Many relationship is called the foreign key.
- **Primary key :** A Primary key is a field or a combination of two or more fields. The value in the primary key field for each record uniquely identifies that record.

  In the above example(Table 14.1), EMPCODE is the Primary key for the Employee table. A EMPCODE identifies one and only one employee in the Employee table. The primary key for the Orders table would be a field for the order number.
- **Foreign key:** When a "one" table's primary key field is added to a related "many" table in order to create the common field which relates the two tables, it is called a foreign key in the "many" table.

  In the example above, the primary key (customer number) from the Customer table ("one" table) is a foreign key in the Orders table ("many" table).
- **Rationalization and Redundancy :** Grouping logically-related fields into distinct tables, determining key fields, and then relating distinct tables using common key fields is called rationalizing a database. There are two major reasons for designing a database this way:
  - * To avoid wasting storage space for redundant data
  - * To eliminate the complication of updating duplicate data copies

  For example, in the Customers/Orders database, we want to be able to identify the customer name, address, and phone number for each order, but we want to avoid repeating that information for each order. To do so would take up storage space needlessly and make the job of updating multiple customer addresses difficult and time-consuming.

To avoid redundancy:

1. Place all the fields related to customers (name, address, etc.) into a Customer table and create a Primary key field which uniquely identifies each customer: Customer ID.
2. Put all the fields related to orders (date, salesperson, total, etc.) into the Orders table.
3. Include the Primary key field (Customer ID) from the Customer table in the table for Orders.

The One-to-Many relationship between Customer and Orders is defined by the common field Customer ID. In the table for Customers (the "one" table) Customer ID is a primary key, while in the Orders table (the "many" table) it is a foreign key.

Self Assessment Question 12.4

1. Give examples of all three relationships: one to one, one to many and many to many.

12.9 Types of Database

There are mainly two types of databases :

Internal Database - Databases created in the worksheet are called Internal database. Like database created in MS Excel.

External Database - Database which is created through other DBMS or RDBMS packages like MS-ACCESS, FOXPRO, dBASE, SQL Server, ORACLE.

12.10 Use Of Database In Excel

At times, we need to keep track of information and a good place to this is in an Excel database file. Whether it is a list of phone numbers, a contact list for members of an organization or team, or a collection of books, an Excel database file makes it easy to enter, store, and find specific information. Excel has built it tools to help you keep track of data and to find specific information.

1. Entering the data - How data is stored
2. Entering Data Correctly - Avoid common errors
3. Rows are Records - Organizing your data
4. Columns are Fields- Organizing your data
5. Creating the Table - Create the database
6. Using the Database Tools - Sorting and filtering data
7. Expanding the Database - Adding new records
8. Formatting the Database - Adding color and alignment changes

- **Entering Data Correctly**

The first step in creating an Excel database is to enter the data. When doing so, it is important to ensure that it is entered correctly. If the data is entered correctly, the program gives you desired results.

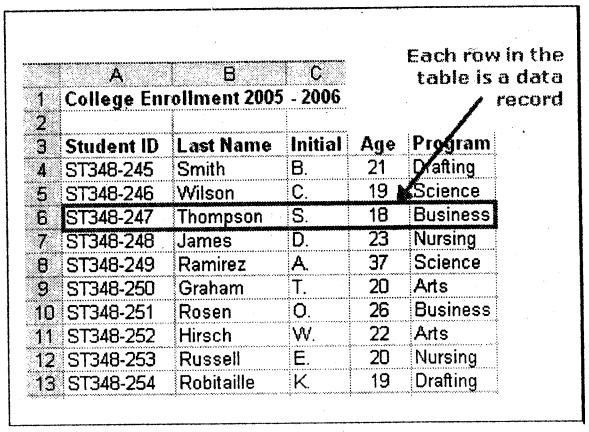
	A	B	C		
1	College Enrollment 2005 - 2006				
2					
3	Student ID	Last Name	Initial	Age	Program
4	ST348-245	Smith	B.	21	Drafting
5	ST348-246	Wilson	C.	19	Science
6	ST348-247	Thompson	S.	18	Business
7	ST348-248	James	D.	23	Nursing
8	ST348-249	Ramirez	A.	37	Science
9	ST348-250	Graham	T.	20	Arts
10	ST348-251	Rosen	O.	26	Business
11	ST348-252	Hirsch	W.	22	Arts
12	ST348-253	Russell	E.	20	Nursing
13	ST348-254	Robitaille	K.	19	Drafting

Leave no empty cells in the table when entering data

Figure 12.1

Source: complied from the website spreadsheets.about.com

- **Rows are Records**



	A	B	C	D	E
1	College Enrollment 2005 - 2006				
2					
3	Student ID	Last Name	Initial	Age	Program
4	ST348-245	Smith	B.	21	Drafting
5	ST348-246	Wilson	C.	19	Science
6	ST348-247	Thompson	S.	18	Business
7	ST348-248	James	D.	23	Nursing
8	ST348-249	Ramirez	A.	37	Science
9	ST348-250	Graham	T.	20	Arts
10	ST348-251	Rosen	O.	26	Business
11	ST348-252	Hirsch	W.	22	Arts
12	ST348-253	Russell	E.	20	Nursing
13	ST348-254	Robitaille	K.	19	Drafting

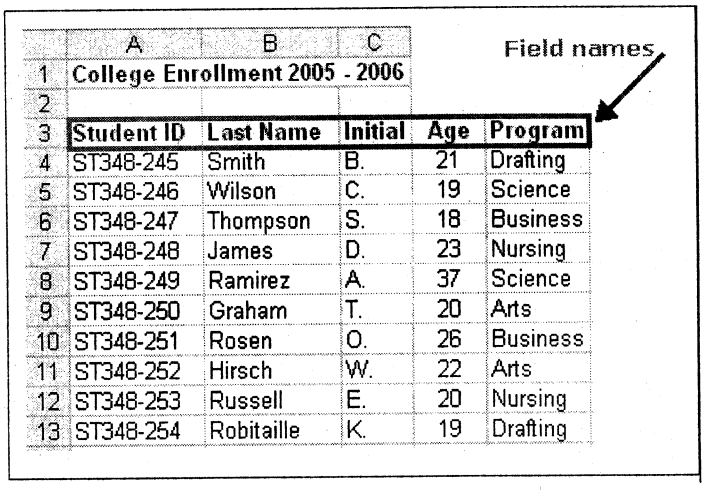
Figure 12.2

Source: complied from the website spreadsheets.about.com

As mentioned, rows of data, in a database are known as records. When entering records keep these guidelines in mind:

- Leave no blank rows in the table being created, not even between the headings and the first row of data.
- A record can contain data about only one specific item.
- A record must also contain ALL the data in the database about that item. There can't be information about an item in more than one row.

- **Columns are Fields**



	A	B	C	D	E
1	College Enrollment 2005 - 2006				
2					
3	Student ID	Last Name	Initial	Age	Program
4	ST348-245	Smith	B.	21	Drafting
5	ST348-246	Wilson	C.	19	Science
6	ST348-247	Thompson	S.	18	Business
7	ST348-248	James	D.	23	Nursing
8	ST348-249	Ramirez	A.	37	Science
9	ST348-250	Graham	T.	20	Arts
10	ST348-251	Rosen	O.	26	Business
11	ST348-252	Hirsch	W.	22	Arts
12	ST348-253	Russell	E.	20	Nursing
13	ST348-254	Robitaille	K.	19	Drafting

Figure 12.3

Source: complied from the website spreadsheets.about.com

While rows in an Excel database are referred to as records, the columns are known as **fields**. Each column needs a heading to identify the data it contains. These headings are called field names.

- Field names are used to ensure that the data for each record is entered in the same sequence.
- Make sure that all the data in a column is entered using the same format.
- Leave no blank columns in the table.

- **Creating tables and list**

(i) Creating tables The basic format for storing data in an Excel database is a table. In a table, data is entered in rows. Each row is known as a record.

Once a table has been created, Excel's data tools can be used to search, sort, and filter records in the database to find specific information. Although there are a number of ways you can use these data tools in Excel, the easiest way of doing so is to create what's known as a **list** from the data in a table. Refer to the figure 14.4 shown below.

	A	B	C	D	E
1	College Enrollment 2007 - 2008				
2					
3	Student ID	Last Name	Initial	Age	Program
4	ST348-245	Walton	L.	21	Drafting
5	ST348-246	Wilson	R.	19	Science
6	ST348-247	Thompson	G.	18	Business
7	ST348-248	James	L.	23	Nursing
8	ST348-249	Peterson	M.	37	Science
9	ST348-250	Graham	J.	20	Arts
10	ST348-251	Smith	F.	26	Business
11	ST348-252	Nash	S.	22	Arts
12	ST348-253	Russell	W.	20	Nursing
13	ST348-254	Robitaille	L.	19	Drafting

Figure 12.4

Source: complied from the website spreadsheets.about.com

1. Type the first two ID's - ST348-245 and ST348-246 into cells A5 and A6 respectively.
2. Drag select the two ID's to highlight them.
3. Click on the fill handle and drag it down to cell A13.
4. The rest of the Student ID's should be entered into cells A6 to A13 correctly.

(ii) Creating list

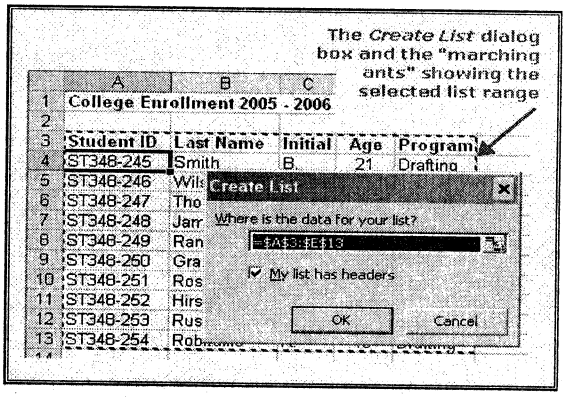


Figure 12.5

Source: complied from the website spreadsheets.about.com

Once the data has been entered into the table, it can be converted to a **list**. To do so:

1. Drag select cells A3 to E13 in the spreadsheet.
2. Click on **Data > List > Create List** from the menu to open the *Create List* dialog box.
3. While the dialog box is open, cells A3 to E13 on the worksheet should be surrounded by the marching ants.
4. If the marching ants surround the correct range of cells, click Ok in the *Create List* dialog box.
5. If the marching ants **do not** surround the correct range of cells, drag select the correct range in the spreadsheet and then click Ok in the *Create List* dialog box.

6. The table should be surrounded by a dark border and have drop down arrows added beside each field name.

- **Using the Database Tools**

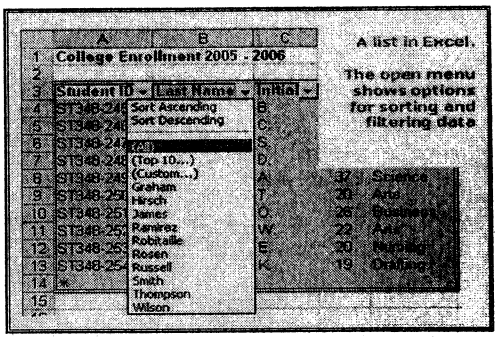


Figure 12.6

Source: complied from the website **spreadsheets.about.com**

Once you have created the database, you can use the tools located under the drop down arrows beside each field name to sort or filter your data.

- **Sorting Data** :

To arrange the records in either ascending or descending order of a field is called sorting. To sort a database, first create the database shown in figure 14:.

1. Click on the drop down arrow next to the *Last Name* field name.
2. Click on the *Sort Ascending* option to sort the database alphabetically from A to Z.
3. If you click on the *Sort Descending* option it will sort the database from to Z to A.
4. After Ascending sorting, *Graham J.* will be the first record and *Wilson.R* will be the last.

- **Filtering Data** :

Viewing records that meet certain criteria is called filtering the database. For example, in the database of employee, you have stored the data of all the employees of your organization. The Manager want to view the details of all those employees who have been working with the organization for more the 5 years. This would be your search criteria to find all those records which would meet this criteria.

In the figure 14: suppose you want to select those student who are enrolled in Business program then to do this follow these steps:

1. Click on the drop down arrow next to the *Program* field name.
2. Click on the *Business* option to filter out any students not in the business program.
3. Click OK.
4. Only two students - G. Thompson and F. Smith should be visible since they are the only two enrolled in the business program.
5. To show all records, click on the drop down arrow next to the *Program* field name.
6. Click on the *All* option.

- **Using Advanced Filters :**

These filters are used to filter the data on the basis of more than one field.

1. Enter the data
2. Choose **Data -> Filter -> Advanced Filter** command.

- **Expanding the database :**

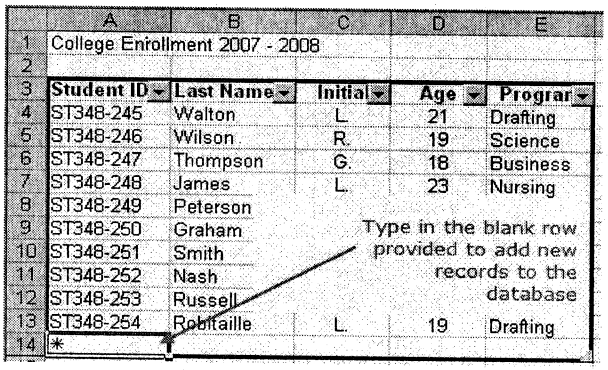


Figure 12.7

Source: complied from the website spreadsheets.about.com

To add additional records to your database:

- A blank row containing an asterisk (cells A14 to E14 in figure 14:14) is added to the bottom of the database when it is created.
- Additional data can be added to the database using this blank row.
- Add the following data:

Cell - Data

A14 - ST348-255

B14 - Christopher

C14 - A.

D14 - 22

E14 - Science

- **Formatting the database:**

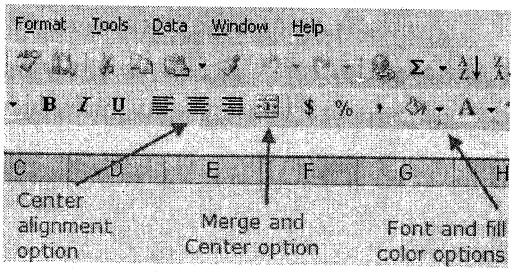


Figure 12.8

Source: complied from the website spreadsheets.about.com

This step involves using icons located on the **Formatting toolbar**, which is normally located at the top of the Excel screen.

Drag select cells in the spreadsheet.

(i) Click on the *Merge and Center* icon on the **Formatting** Toolbar to center the title.

(ii) With cells still selected, click on the *Fill Color* icon on the **Formatting** Toolbar (looks like a paint can) to open the background color drop down list.

(iii) Choose any color from the list to change the background color of selected cells

(iv) Click on the *Font Color* icon on the **Formatting** Toolbar to open the font color drop down list.

12.11 Summary

Before the computer, bookkeepers, record keepers, and accountants used the paper and pencil method along with a ledger or record book containing worksheets. Information and records were stored by hand and financial records were calculated manually and entered in to the worksheets. Ledgers used rows and columns that people learned could be used not only for financial records, but also for things like scheduling, inventory tracking, and employee information.

The dawn of the computer age brought applications that could store information, perform complex calculations, and provide a printed output. The first application with any real power was Visi-Calc, which later became Lotus 1-2-3. The advantages of using a spreadsheet application rather than paper and pencil were numerous - not the least of which was that when data was changed, totals and other formulas were automatically recalculated. Currently, Microsoft Excel, along with Lotus 1-2-3, are used in most of the market for spreadsheet applications.

A database organizes information on a particular subject for retrieval. Databases utilize one or more tables of information entered by the user to retrieve data for a variety of purposes. Data can be retrieved through methods such as asking questions of the data (querying), sorting or filtering, and pulling information into a formatted report, like an invoice, that can be printed.

Excel spreadsheets must be used to quickly calculate what changes in price and sales could do to their revenue by creating various scenarios. They could also use their sales information in Excel to analyze trends by generating charts and graphs. This gave them an easy way to analyze their data and trends in a tool with understandable and meaningful formats. Databases should be used for data storage and spreadsheets should be used to analyze data.

12.12 Keywords

- **Spreadsheet :-** It is a computer application that displays multiple cells that together make up a grid consisting of rows and columns.
- **Database:-** It is an organized collection of related information.
- **Record:-**Each row of the list is called as a record.
- **Field:- E**ach column is called as a field.
- **Fieldname:-**The column heading is called fieldname.
- **Header row :-**The row containing fieldnames is called header row.
- **Database management systems:-** DBMS are collections of tools used to manage databases. A DBMS is a major software component of database system.
- **Primary key :-** The value in the primary key field for each record uniquely identifies that record.
- **Filtering a Database :-**Viewing records that meet certain criteria is called filtering the database.
- **Advanced Filters :-** These filters are used to filter the data on the basis of more than one field.

12.13 Abbrevations

CPU	-	Central Processing Unit
DBMS	-	Data Base Management System
DOS	-	Disk Operating System
LANPAR	-	Language for Programming Arrays at Random
MS	-	Microsoft Excel
OLAP	-	On Line Analytical Processing
PC	-	Personal Computer
RDBMS	-	Relational Data Base Management System
SADP	-	Subject-Area Database Program
SAQ	-	Self Assessment Questions
WYSIWYG	-	What You See Is What You Get

12.14 Hint or Key To Activities/Saq

SAQ 12.1

If you make changes in any data, the spreadsheet program will automatically will recalculates and display new result. But in manual accounting it is time consuming

SAQ 12.2

Database is an organized collection of related information. Databases are used in Banking, Airlines, Universities, Sales, Manufacturing and Human resources etc.

SAQ 12.3

One to one- One department has only one Head.

One to many- In a class one teacher teaches many students.

Many to many- One customer can buy many different types of products and one type of product can be taken by many different customers.

12.15 Questions For Practice

1. What is an electronic Spreadsheet ?.
2. Explain various types of electronic Spreadsheet
3. What is an electronic Spreadsheet ?. What are its advantages.
4. What is database? What is the purpose of inventing Database.
5. Differentiate between Primary key and Foreign key.
6. What is database? Explain basic concepts of database.
7. Create a database of an Employee of an organization and sort the database of Employee in ascending order of Empcode
8. Create a database of an customer of a bank and filter the names of those customers whose loan amount is greater than Rs. 1,50,000

9. How database is created in an electronic worksheet. Explain it through any example.
10. Create a database of employee in excel and sort the data in alphabetical order
11. In the above question 12 Filter the names of employee those are working from last five years.
12. In the above question 12 expand the database of employee by adding record of new employee.

12.16 Reference/Suggested Books

1 **Beynon-Davies, P.** "Database Systems. 3rd Edition.", Houndmills, Basingstoke.

2 **Connolly, Thomas and Carolyn Begg,** "Database System", Harlow

3 **Date, C. J.** "An Introduction to Database Systems, Eighth Edition", Addison Wesley, 2003.

4 **Kroenke, David M. and David J.** "Database Concepts. 3rd edition.", Prentice, 2007.

5 **Walkenbach, John** "MicroSoft Excel 2010-Bible", Wiley Publishcations

6 **Carlber, Conard** " Business Analysis with Microsoft Excel", Que publishing

Unit - 13

Electronic Spreadsheets: Important Features of Ms-excel, Working with Excel , Formatting Functions

Outline Of Unit :

13.0 Objectives

13.1 Introduction

13.2 What Is Ms Excel

13.3 Features Of Ms Excel

13.4 Working With Excel

- 13.4.1 Components Of Excel Screen
- 13.4.2 Getting Started With Excel
- 13.4.3 Standard Toolbar
- 13.4.4 Formatting Toolbar
- 13.4.5 Using The Functions
- 13.4.6 Using Charts

13.5 Formatting Functions

- 13.5.1 Comma formatting
- 13.5.2 Date formatting
- 13.5.3 Currency formatting
- 13.5.4 Page Set Up
- 13.5.5 Fonts
- 13.5.6 Alignment
- 13.5.7 Background color
- 13.5.8 Merge and centre
- 13.5.9 AutoFormat
- 13.5.10Format Painter

13.6 Summary

13.7 Keywords

13.8 Abbreviations

13.9 Hint or key to Activities/SAQ

13.10 Questions for practice

13.11 Reference/Suggested Books

13.0 Objectives

After going through this chapter, student will learn about

- MS Excel and features of MS excel

- How to work with MS Excel
- Standard toolbar
- Various formatting functions
- Functions used in Excel and how to use them
- Creating graphs using given data

13.1 Introduction

MS Excel is an integrated electronic worksheet program developed by Microsoft Corporation USA. It includes three components – worksheet, graph and database management. It lets you create your worksheet and enter information. It performs all kinds of calculations and display results on the screen in the form of figures or graphs. You can perform various database functions on the data entered in the worksheet. Today manipulating numbers, analyzing results and viewing results in form of graphs are important requirements in offices, business, and commercial organizations. This can be easily done with MS Excel.

MS Excel is a Windows based application package that can be used to automate tasks such as calculation and analysis of data. It includes some of the following features:

Tip Wizard - Guides you to work more effectively while you work by displaying various helpful tips and techniques based on what you are doing.

Drag and Drop Feature - It help you to reposition the data and text by simply dragging the data with the help of mouse.

Autofill - It helps you to fill rows or columns with the series of data.

Autosum - You can add a large range of data by simply selecting a tool button.

Windows Interface - As Excel is Windows based package therefore the user interface is consistent.

Shortcut Menus - Commands appropriate to the task that you are doing appear by clicking the right mouse button.

Built-in Spell Check - You can maintain a dictionary of the words usually used in your work and spell-check your spreadsheet.

13.2 What is MS Excel

MS EXCEL is the spreadsheet part of the Microsoft Office Suite. This can be used for calculating, manipulating and analyzing numbers. It also has a powerful Graphical facility to present the information in the form of *Charts* and *Graphs* for simple understanding. In business and other organizations, it is used to prepare budgets, accounts, calculations and to perform various analysis. Even if the volume of data is very large then use of inbuilt functions like AutoSum, Max, Avg etc. makes things much easier.

Understanding worksheet and workbook

A Spreadsheet is also called a Worksheet in MS Excel and it consists of a grid of rows and columns. The intersection of these rows and columns is called a Cell. A cell is a rectangular area where you can enter the data. Excel Documents are called Workbooks, which in turn consists of a number of worksheets. A workbook is just like a notebook which consists of number of sheets, likewise a workbook consists of number of worksheets.

Self Assessment Questions 13.1
Differentiate between Worksheet and Workbook.

13.3 Features of MS Excel

Some of the important features of MS Excel are as follows:

1. Entering data series(AutoFill)
2. AutoSum function
3. Navigating in worksheet
4. Editing a workbook
5. Formatting worksheet
6. Saving and opening a book
7. Manipulating database in excel
8. Applying formula and function
9. Creating charts

13.3.1 Entering Data Series(AutoFill) :

In Excel, you can automatically fill a series of data, into a specified range of cells. For example, you might wish to prepare a column in which running Serial Numbers are filled up or with continuous dates like 1 Jan, 2 Jan, 3 Jan, or with a list of all Mondays in a year like 4 May, 11 May, 18 May, . . and so on

(1) Type 1 in the place of first Sl. No. Use the mouse and specify the whole range (including Sl. No. 1), which you wish to fill up with consecutive Numbers

(2) Choose Series from Fill command from Edit menu; (A screen like this one will appear.)

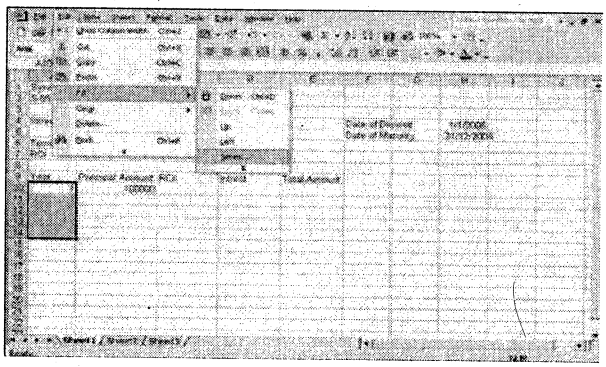


Figure 13.1: Auto Fill box
Source: compiled from website spreadsheet.about.com

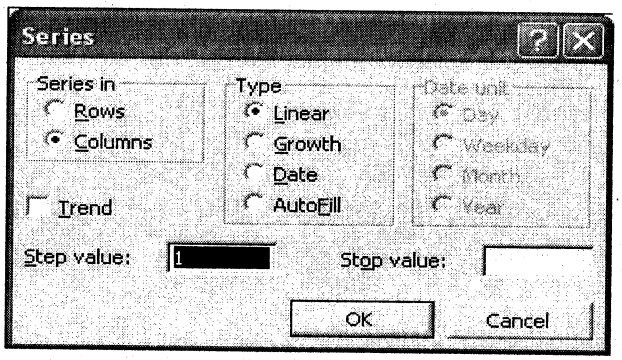


Figure 13.2 Source: compiled from website solutions.com

(3) Click on this radio button for filling up for Dates;

(4) Click on Ok.

OR

To fill a series of data, follow these steps.

- Select the range of cells that contain starting values (number, day, month etc.)
- Drag the fill' handle in the direction in which you want to fill the values. The values are automatically filled into cells.

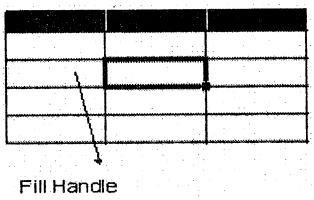


Figure 13.3

13.3.2 Autosum function:

It is the one of the most important feature of MS Excel. It finds the sum of numbers automatically. To do this:

(1) Click on empty cell after last entry of range of cells.

(2) Select the columns or rows you want to add

(3) Click on the Auto Sum button on the formatting toolbar.

(4) You will get the Sum of the desired columns or rows.

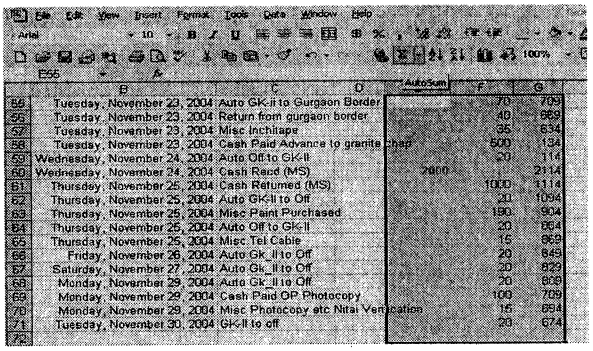


Figure 13.4

Source: compiled from website spreadsheet.about.com

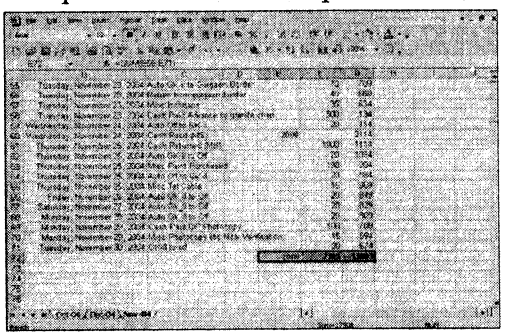


Figure 13.5

Source: compiled from website spreadsheet.about.com

13.3.3 Navigating in worksheet :

You can move in the worksheet for entering or editing or viewing data. For example, to enter

data into a specific cell of the, worksheet you have to move to that cell. You can move with mouse or keyboard keys You can also switch from one worksheet to another by simply clicking the tab of desired worksheet.

13.3.4 Editing a workbook :

The process of making changes in the workbook is called Editing. It is the most important feature of Microsoft Excel. Some features of editing are explained below.

(i) Copy / Move & Paste

In Excel, you can copy or move or paste data from one location of worksheet to another location or to another worksheet of different workbook or even to another application program.

The commands that are used for this purpose are:

Copy - This command is used to copy the selected data

Cut - It is used to move the selected data

Paste - It is used to paste (insert) the text

(ii) Deleting in Excel

You can delete the data of a cell or range of cells or the rows or columns or entire worksheet can be deleted from the workbook.

(iii) Inserting in Excel

You can insert new rows, columns, cells and worksheets in Excel.

(iv) Undoing & Redoing in Excel

Excel also provides the facilities of Undo command to cancel the actions of different operations and Redo command to cancel the action of Undo command.

(v) Finding & Replacing in Excel

You can also search data in worksheet as well as replace data with another one

(vi) Proofing the Excel Worksheet

You can also check the spelling of text entered into the worksheet cells and can correct the wrong spelling.

(vii) Hiding / Un-hiding Rows & Columns

You can hide the rows and columns of the worksheet. The hidden rows and columns are not printed on the printer.

13.3.5 Formatting worksheet:

In formatting a worksheet, you can change the appearance of data in cells as:

- by changing the font, font style and font size.
- by aligning data in cells.
- by setting numeric format..
- by setting border style and border color of cell.
- by setting column width and row height.

In Excel, you can use the formatting toolbar or Format menu for formatting the worksheet.

13.3.6 Saving and opening a workbook :

In Microsoft Excel, data can be stored permanently in a file on the disk for future use. When workbook is saved, Excel gives an extension XLS to the file name.

- **Protecting Workbook with Password**

In Microsoft Excel, you can protect your workbook by applying password so that unauthorized person cannot display as well as modify your workbook.

- **Opening an Existing Workbook**

The workbooks are stored on the disk for future use. You can open the existing workbook for further working on it.

13.3.7 Manipulating database in Excel :

A database is a collection of related records .A worksheet can be used as database, in which rows represent records and columns represent fields.

(i) Creating Database

In Excel, to create a database, follow these steps.

* Type the field names in the first row of worksheet.
* Type the data of records under the related fields. For example, type one record per row.

(ii) Sorting Database

The process to arrange data of database or data stored in worksheet in a specific order based on value in columns or fields is known as Sorting. In Excel, you can sort data alphabetically, numerically or by date.

13.3.8 Applying formula and function :

In Excel you can apply formula, and function to perform the arithmetic operations on the numeric data etc.

Functions are predefined formulae used to perform calculations. Excel contains a number of built-in functions used for special purpose. The function returns the calculated value. Each function is written according to its syntax.

13.3.9 Creating charts in Excel :

In Excel, you can also create charts for numerical data. The graphical representation of numerical data is known as chart or graph. It makes easy to compare and to understand the numerical data.

Self Assessment Question 13.2

1. Which command can automatically fill a series of data, into a specified range of cells
   (a) Auto sum (b) Auto fill
   (c) Auto do (d) Auto range

13.4 Working with Excel

MS Excel runs under MS windows and follows its standards. Let us see first how to load the

MS Excel in the memory of the computer.

Loading Excel

1. To do this, just click on the Start button.
2. Point to Programs.
3. Click on MS Excel.

   A blank document will open in front of you with the components as marked.

13.4.1 Components of MS Excel screen :

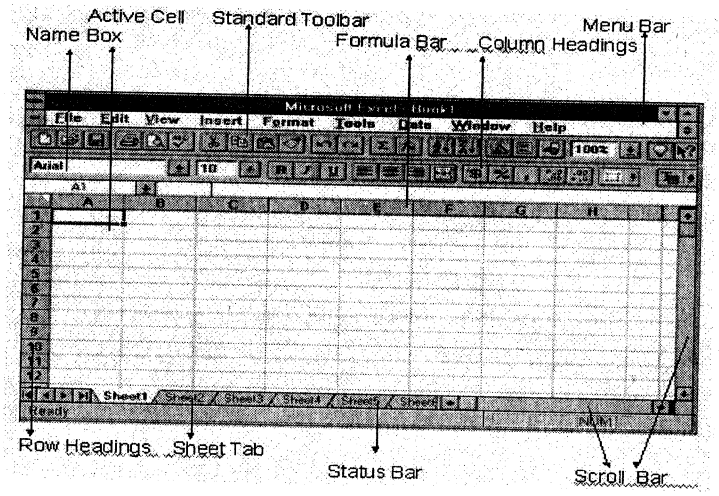


Figure 13.6 : Components of MS Excel Screen

Source: compiled from website www.r.office.microsoft.com

Menu Bar : Different options for selection

Title bar : It shows name of the current workbook in which you are working and three standard window buttons on its right side.

Standard toolbar : The most commonly used options like opening the new file, saving the file, printing a file, cut/copy/paste options etc. are present here in the form of small buttons.

Formatting toolbar : Formatting features like changing font type, size , style, alignment etc. are present here in the form of small buttons.

Cell pointer : A cell pointer is a rectangular pointer which when move to a cell, makes it an active cell so that operations can b done on it.

Name box : It shows name of the active cell.

Formula bar : When you click on a cell, you can see and edit its contents in the formula bar.

Worksheet tabs : These are used to move from one worksheet to another.

Scroll Bars : Used to move up or down in the worksheet using mouse.

Sheet Tab : Displays the name of the current worksheet that can be changed by double clicking on it and giving a new name in the dialogue box.

Status Bar: Left part displays the various messages like Ready mode (when Excel is ready to accept data into the spreadsheet) or Edit mode (while in the editing mode). The right part highlights the status of keys of the keyboard.

Row Headings: They are numbered as 1, 2, 3 .... 16384.

Column Headings: These are addressed as A, B, C,....IV.

Active Cell: Intersection of each row and column is called a cell. The first cell is named as A1 because it is an intersection of Coulmn A and Row1. Next cell is named as A2 so on.

13.4.2 Getting started with Excel

Firstly, open the workbook to start your work on a worksheet. At times, you might require to insert or delete a worksheet, and cells to be selected.

Create a Workbook

Select the New.. command from the File menu. The Workbook is opened by the default name of BOOK1.

Open a Workbook

To open an existing Workbook, select Open option from the File menu. Names of the recently used files are listed in the File menu and can be selected by merely clicking on the name of the file to be opened.

Find a Workbook

Choose File -> Open command. Select Find File.. option from the dialogue box that is opened. Consequently, another dialogue box is opened in which the details like file name, directory are to be given.

Insert a Worksheet

To insert a Worksheet between two worksheets choose Worksheet option from the Insert menu.

Delete a Worksheet

To remove a worksheet from the workbook, select Delete Sheet from the Edit menu. A dialogue box will appear to confirm this action.

Move the Worksheet

To move the worksheet in the same workbook, place the mouse pointer on the sheet tab, press the left mouse button and drag it to the desired position. Release the button.

Selecting Cells

You can select a single cell or a group of cells using mouse or keyboard.

13.4.3 Standard Toolbar

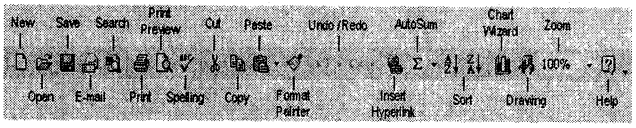


Figure 13.7

Source: compiled from website solutions.com

New - Creates a new empty workbook with a given number of worksheets. Alternatively **(File > New).** (Ctrl + N)

Open - Displays the **(File > Open)** dialog box to open existing workbooks. (Ctrl + O).

Save - Saves the active workbook. Displays the **(File > Save As)** dialog box the first time a workbook is saved. (Ctrl + S).

Permission - (Added in 2003). Used in conjunction with Windows Rights Management services.

E-mail - Emails the active workbook or active worksheet.

Search - (Removed in 2003). Finds files, Web pages, and Outlook items based on the search criteria you enter.

Print - Prints the active worksheet (**File > Print**). There is NO prompt. (Ctrl + P).

Print Preview - Displays the **(File > Print Preview)** dialog box.

Spelling - Displays the **(Tools > Spelling)** dialog box. (F7).

Research - (Added in 2003). Opens the Research task pane allowing you to access online information.

Cut - Cuts the current selection to the clipboard. (Ctrl + X).

Copy - Copies the current selection to the clipboard. (Ctrl + C).

Paste - Pastes the entry from the clipboard. (Ctrl + V). The **Paste Options** smart tag provides quick access to some of the Paste Special options.

Format Painter - Copies the format from a cell or range allowing it be pasted elsewhere.

Undo - Undoes the last 16 actions you performed. (Ctrl + Z).

Redo - Redoes the last 16 actions you performed.

Insert Hyperlink - Displays the **(Insert > Hyperlink)** dialog box. (Ctrl + K).

AutoSum - Inserts the SUM ( ) function.

Sort Ascending - Sorts data alphabetically from A to Z and numerically from the lowest number to the highest.

Sort Descending - Sorts the data alphabetically from Z to A and numerically from the highest number to the lowest.

Chart Wizard - Displays the **(Insert > Chart)** dialog box.

Drawing - Display the Drawing toolbar.

Zoom - Adjusts the size that the worksheet appears on the screen.

Microsoft Excel Help - Displays the **(Help > Microsoft Excel Help)** dialog box. (F1).

13.4.4 Format Toolbar :

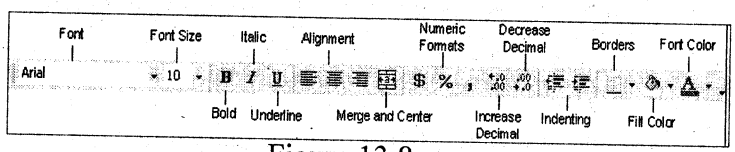


Figure 13.8

Source: compiled from website www.solutions.com

Font - Provides a list of all the available fonts.

Font Size - Lets you adjust the character size.

Bold - Toggles bold on the current selection.

Italic - Toggles italics on the current selection.

Underline - Toggles underline on the current selection.

Align Left - Aligns data to the left edge of the cell.

Centre - Aligns data in the middle of the cell.

Align Right - Aligns data to the right edge of the cell.

Merge and Centre - Combines 2 or more adjacent cells to create a single cell.

Currency Style - Applies the currency format "£#,##0.00".

Percent Style - Displays the number as a percentage by applying the format "0%".

Comma Style - Adds a comma and two decimal places to the number by applying the format "#,##0.00".

Increase Decimal - Adds one decimal place from the number.

Decrease Decimal - Removes one decimal place from the number.

Decrease Indent - Decreases the indent by 1 or removes the indent completely.

Increase Indent - Increases the indent by 1.

Borders - Applies a border to the current selection.

Fill Color - Applies a color to the background of the current selection. This is actually a tear off toolbar.

Font Color - Changes the color of the font of the current selection. This is actually a tear off toolbar.

13.4.5 Using The Functions

Functions are pre-written formulae that accepts the values as arguments and return the result in the cell where the formula has been typed. The structure of a function begins with an equal sign (=), followed by the function name, an opening parenthesis, the arguments for the function separated by commas, and a closing parenthesis.

General Syntax of Function:

= Function name(Arguments)

Arguments are two types:

(i) Constant: The value are given directly in the function

Example: =SUM(12,4,32)

(ii) Range: Range of cells is given as argument

Example: = SUM(A1:A5)

Excel functions are classified into following categories:

- Statistical Functions:
- Math Functions
- Text functions
- Date and time Function
- Logical Functions

- **Statistical Functions:**

MS Excel supports 70 statistical functions, few of them are as follows:

= AVERAGE(num1,num2,...) -Returns the average of given arguments.

Example : In the table 15:1 given below, type the formula in cell B6 as =AVERAGE(B2: B5) and press enter key. Then it will give answer 77.5 as shown Table 15.2

= MAX (num1,num2,...) - Returns the maximum value out of given arguments.

= MIN(num1,num2,...) - Returns the minimum value out of given arguments.

Table-13.1

	A	B
1	Subject	Marks
2	English	67
3	Hindi	76
4	Maths	78
5	Science	89

Table-13.2

Function	Result
= AVERAGE(B2:B5)	77.5
= MAX(B2:B5)	89
= MIN(B2:B5)	67

Math Functions

Math Functions perform the mathematical operations on numeric data entered in the worksheet. Some commonly use math functions are as follows:

= SUM(num1,num2,...) - Returns the summed value of given arguments.

Example: =SUM(B2:B5) will give 310

= PRODUCT(num1,num2,...) - Returns the multiplication value of given arguments.

Example: =PRODUCT(4,2,3) will give 24

= MOD(num1,num2) - Returns the remainder after dividing num1 by num2.

Example: = MOD(23,5) will give 3

= SQRT(num) - Returns the square root of given number

Example: =SQRT(9) will give 3

=ROUND(number, num_digits) - Rounds a number to a specified number of digits.

Where :

Number - is the number you want to round.

Num_digits - specifies the number of digits to which you want to round number.

Example : =ROUND(96.54,0) returns answer as 97

Text Functions :

These functions are used to manipulate textual data. Some of them are as follows:

=CONCATENATE (text1, text2, ...) - Joins several text items into one text item.

Example : =CONCATENATE("Soft", "ware") returns answer as Software

=LEN(text) - Returns the number of characters in a text string.

Example: =LEN("accountancy") returns answer as 11

=LOWER(text) - Converts all uppercase letters in a text string to lowercase.

Example: =LOWER("LiMit") returns answer as limit

=UPPER(text) - Converts text to uppercase.

Example : =UPPER("balance") returns answer as BALANCE

Date and Time Functions :

Excel stores Date and Time as serial numbers. The functions to manipulate date and time are:

=DATE(year, month, day) -Returns the serial number of a particular date.

Where :

Year - is a number from 1900 to 2078 in Microsoft Excel for Windows

Month - is a number representing the month of the year.

Day - is a number representing the day of the month.

Example: =DATE(97, 2, 12) returns 2/12/1997

=DAY(serial_number) -Returns the day of the month corresponding to serial_number.

Example : =DAY("16-JAN") returns answer as 16

=MONTH(serial_number) -Returns the month corresponding to serial_number. The month is given as an integer, ranging from 1 (January) to 12 (December).

Example : =MONTH("15-MAY") returns answer as 6

=YEAR(serial_number) - Returns the year corresponding to serial_number.

Example : =YEAR("7/5/96") returns answer as 96

Logical Functions :

These functions are used to test the conditions. They return the logical value as TRUE or FALSE.

=AND(logical 1, logical 2, ...) - Returns TRUE if all its arguments are TRUE; returns FALSE if one or more arguments are FALSE.

Example : =AND(14>12, 4=4) . It will return answer TRUE

=OR(logical 1, logical 2, ...) - Returns TRUE if any argument is TRUE; returns FALSE if all arguments are FALSE.

Logical1, logical2,... - are 1 to 30 conditions you want to test that can be either TRUE or FALSE.

=IF(logical_test, value_if_true, value_if_false) -Returns one value if logical_test evaluates to TRUE and another value if it evaluates to FALSE

Where :

Logical_test - is any value or expression that can be evaluated to TRUE or FALSE.

Value_if_true - is the value that is returned if logical_test is TRUE.

Value_if_false - is the value that is returned if logical_test is FALSE.

Example : (i) =IF(35>20, 35, 20) returns answer as 35

(ii) =IF(35<20, 35, 20) returns answer as 20

13.4.6 Using Charts

In excel you can analyse the data graphically by creating charts using Chart Wizard. The Chart Wizard is a series of dialog boxes that guides you through the steps required to create chart .

Following are the steps to create the chart through Chart Wizard :

1. To create a new chart, enter the data given below.

	A	B	C	D
1	REGION	QUARTER 1	QUARTER 2	QUARTER 3
2	NORTH	3,335	4,000	6,450
3	SOUTH	4,500	2,960	5,000
4	EAST	6,000	5,000	6,660
5	WEST	5,000	3,800	4,900

2. Click on Chart Wizard tool button from Standard Toolbar.
3. Select the type of chart . Click on Next.
4. Enter the range of data in the Chart Source Data Box and click on Next.
5. Enter values of X-axis ,Y label and Title in Chart option Box. Click on Next.
6. Select the location of chart. Click on **finish.**
7. Chart of the selected data will appear as shown in Figure 15:09

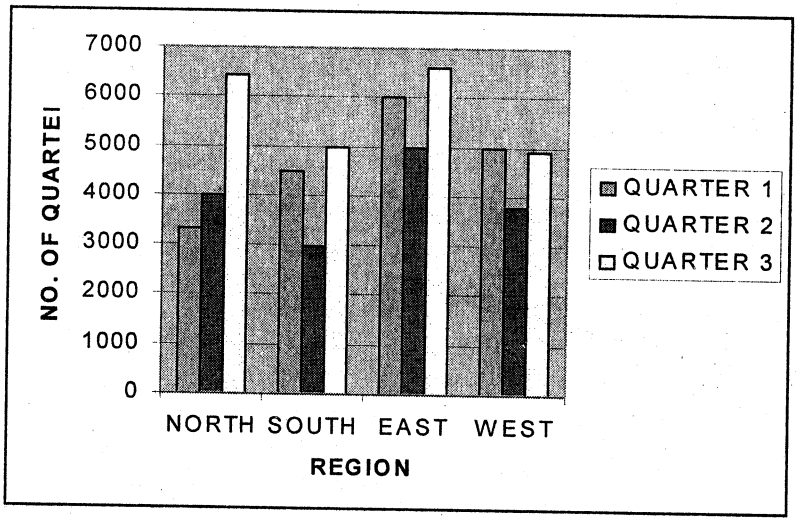


Figure 13.9

Self Assessment Question 13.3
Create a worksheet of marks obtained in X class .Enter the marks of your at least five friends in the cells then find the total marks of each friend using AutoSum function

13.5 Formatting Functions

13.5.1 Comma Formatting :

1. Select cells in the spreadsheet.
2. Click on **Format > Cells** from the menu to open the Format Cells dialog box.

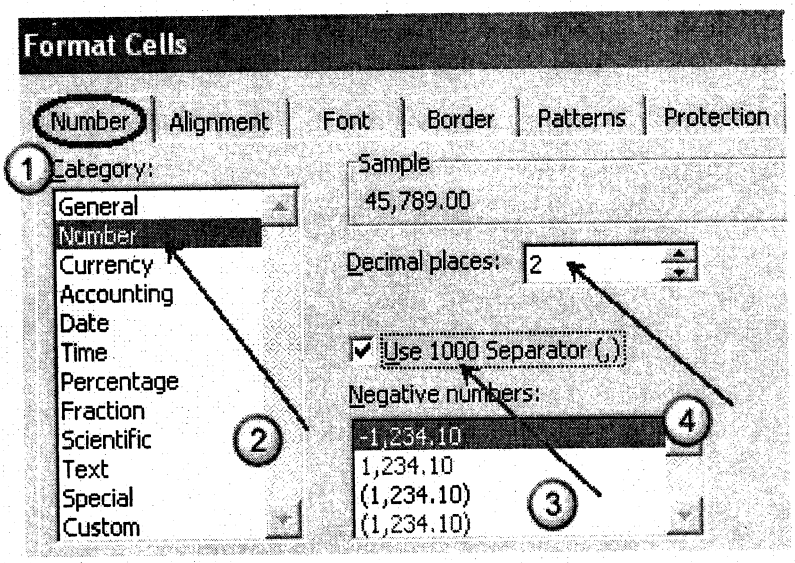


Figure 13.10 : Format cell dialog box

Source: complied from the website spreadsheets.about.com

1. Click on the Number Tab (circled in the figure 15.10)
2. Select Number in the Category Window.
3. Make sure that the Use 1000 Separator box is checked.
4. Change the number of decimal places to 2.

When finished, Click **OK** at the bottom of the Format Cells dialog box.

13.5.2 Date Formatting

1. Select cell.
2. Choose **Format > Cells** from the menu to open the Format Cells dialog box.

With the **Format Cells dialog box** open:

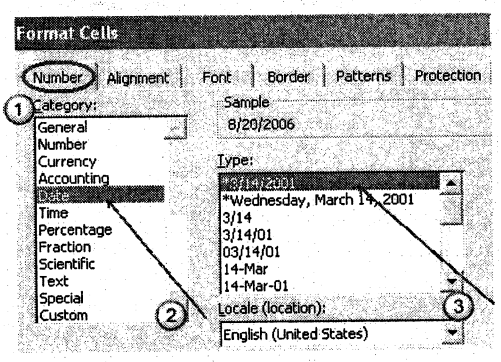


Figure 13.11 : Format cell dialog box

Source: complied from the website spreadsheets.about.com

1. Click on the **Number** Tab (circled in the figure 15:11).
2. Select **Date** in the Category Window.
3. Select the type of date format (for ex- *3/14/2001) in the Type Window.

When finished, Click **OK** at the bottom of the Format Cells dialog box.

13.5.3 Currency Formatting

1. Select cells.
2. Choose **Format > Cells** from the menu to open the Format Cells dialog box.

With the **Format Cells dialog box** open:

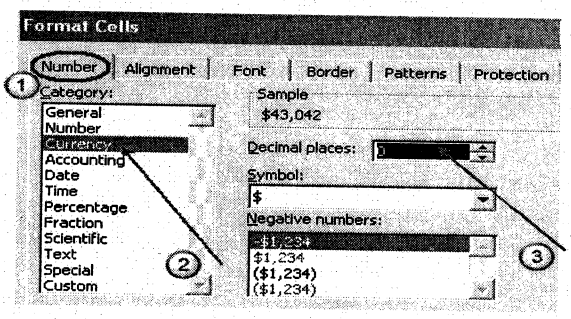


Figure 13.12 : Format cell dialog box

Source: complied from the website spreadsheets.about.com

Note: For help on these steps, refer to the figure 13.15 shown above.

1. Click on the **Number** Tab (circled in the figure 13:12).
2. Select **Currency** in the Category Window.
3. Change the number of decimal places to Zero (0).

When finished, Click **OK** at the bottom of the Format Cells dialog box.

13.5.4 Page Set-up

Excel also provides you with the feature of WYSIWYG (what you see is what you get). For this :

1. Cick on File Menu.
2. Click on the **Page Set-up**.

The following dialogue box is displayed.

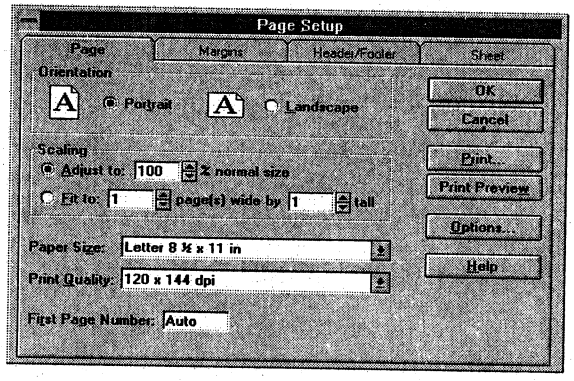


Figure 13.13

Source: complied from the website egyankosh.ac.in

From the **Page** option you can set the paper size, orientation of the data. Form the **Margin** option you can set the top, bottom, left and right margins of the page. The **Header/Footer** option gives you the option to set the header (displayed at the top of each page) and the footer (which will be displayed at the bottom of every page).

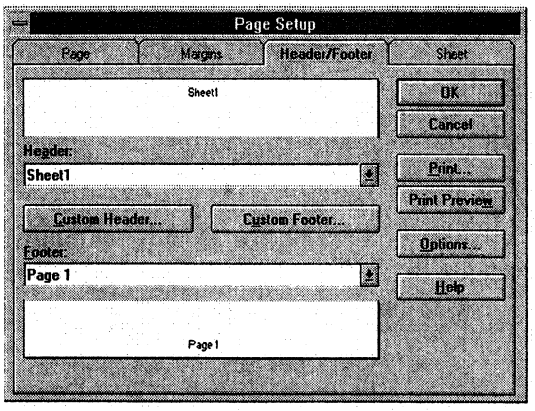


Figure 13.14

Source: complied from the website egyankosh.ac.in

The **Sheet tab** has the option to select the area to be printed (i.e. the range of cells), set the row or column titles (these will be printed on every page), or select the page order from the multiple worksheet etc.

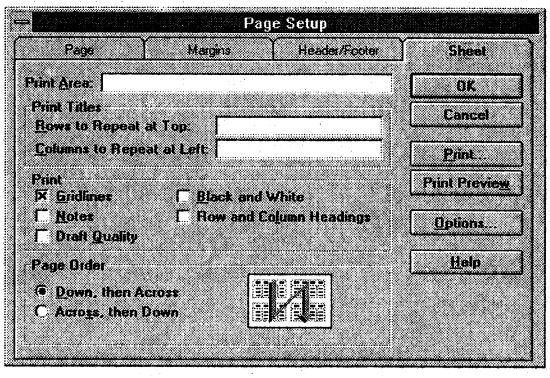


Figure 13.15

Source: complied from the website egyankosh.ac.in

Change Column Width and Row Height

The width of the column(s) and the height of the row(s) can be easily changed by different ways:

Using Menu Commands

To Set the Column Width

1. Select any cell(s) in the column(s) to change its width.
2. Click on **Format -> Column -> Width..** option
3. Then box will appear as shown in Figure 13.16
4. The default width is 8.43 .It can be changed by typing-in the new width.

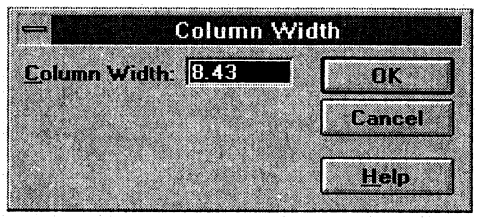


Figure 13.16

Source: complied from the website egyankosh.ac.in

The other option available for formatting columns are :

To Set the Row Height

1. Select the cell(s) of the row(s).
2. Choose **Format -> Row -> Height.**
3. Then box will appear as shown in Figure 13.17
4. The default height is 12.75. It can be changed by typing-in the new height. as per your requirement.

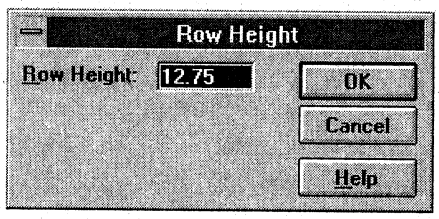


Figure 13.17

Source: complied from the website egyankosh.ac.in

13.5.5 Fonts

Fonts are the typefaces (e.g. TIMES NEW ROMAN, ARIAL etc.) which have Size (in points) colour special effects (like strike through, superscript, and subscript)

Fonts can be in bold, italics, or regular. They could also be underlined. Fonts can be changed either through Formatting Toolbar or through the menu command :

Through Formatting Toolbar:

1. Select the cells or characters to be formatted.
2. Click on the appropriate options on the Toolbar.

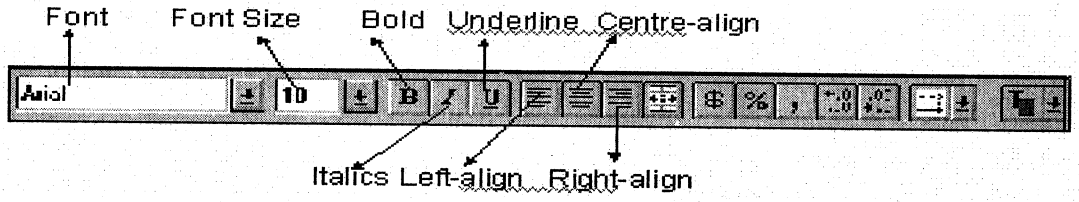


Figure 13.18

Through the menu command :

1. Select the cells or characters to be formatted.
2. Choose **Format -> Cells.**
3. Select the **Font** option.

Following dialogue box is displayed.

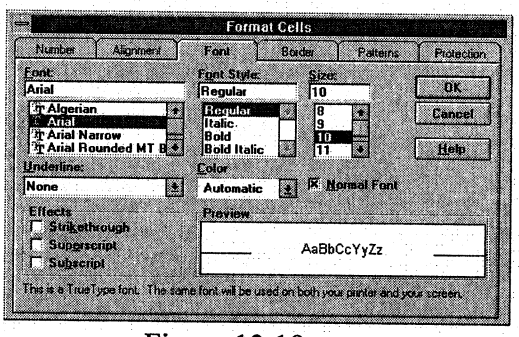


Figure 13.19

Source: complied from the website egyankosh.ac.in

4. Select the type of Font, Font style, Size. **Click on OK**
5. Selected range of cells will appear in the selected font style, type and size.

13.5.6 Alignment

Alignment is of four types:

Right alignment - aligns the contents to the right of the cell.

Left alignment - aligns the contents to the left of the cell.

Center alignment - aligns the contents to the center of the cell.

Justify - this option is selected with multiple lines of text as it wraps the contents from left to right.

Right Alignment of Text

1. Select cell in the spreadsheet.
2. Choose **Format > Cells** from the menu to open the Format Cells dialog box.

With the Format Cells dialog box open:

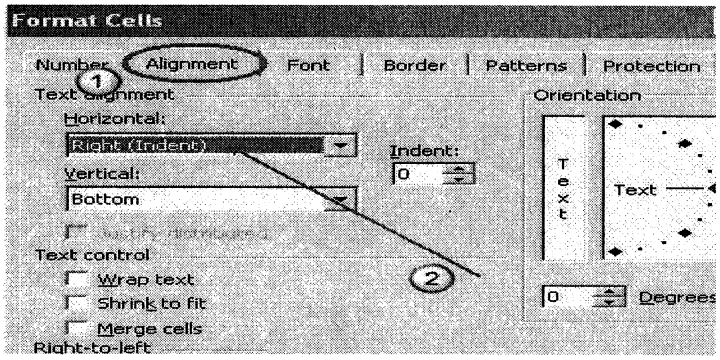


Figure 13.20

Source: complied from the website spreadsheets.about.com

1. Click on the Alignment Tab (circled in the figure 15:20)
2. Select Right (indent) from the horizontal text alignment drop down box.

When finished, Click **OK** at the bottom of the Format Cells dialog box.

Left Alignment of Text

Repeat the above steps except selecting Right(Indent) select Left(indent) from the horizontal text alignment drop down box.

Centre Alignment of Text

Repeat the above steps except selecting Right(Indent) select Centre (indent) from the horizontal text alignment drop down box.

Justify Alignment of Text

Repeat the above steps except selecting Right(Indent) select Justify (indent) from the horizontal text alignment drop down box.

13.5.7 Background Color Formatting

1. Select cells
2. Choose **Format > Cells** from the menu to open the Format Cells dialog box.

With the **Format Cells dialog box** open:

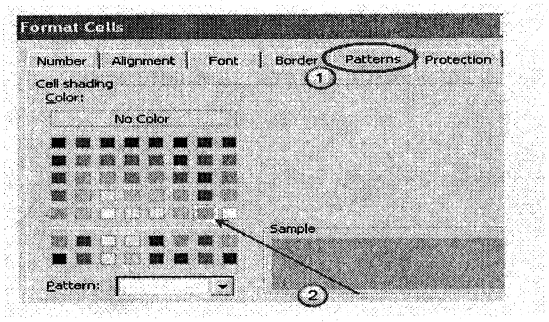


Figure 13.21

Source: complied from the website spreadsheets.about.com

1. Click on the Patterns Tab (circled in the figure 15:21).
2. Select the light purple color (or another that you prefer) from the color option.

When finished, Click OK at the bottom of the Format Cells dialog box.

13.5.8 Merge and Centre

This is the useful feature of MS Excel. This is done to merge the number of cells into one big cell and then enter the data in it. Data will be in centre. It can be done by applying following steps:

(i) Enter the data in the cell (like XYZ pvt. Ltd. in the cell A1) .

(ii) Select the range of cells.

(iii) Click on Merge and Centre button.

Then it will appear like shown in table 13.3

XYZ Pvt.Ltd.			
Employee record			
EMPCODE	Name	Dept.	Salary (Rs.)
1	Ashish	HR	20,000
2	Kirti	Production	10,000
3	Ram	Sales	8,000

Table13.3

Merge and Centre

13.5.9 AutoFormat

This feature includes the formatting of numbers, border alignment, font, color, row height and column width.

To apply Autoformat to a range of cells follow the given steps :

1. Select the range of cells.
2. Select Autoformat option from the Format menu.
3. Choose the appropriate format from the list of Table Format.
4. Click on OK.

13.5.10 Format Painter

This feature of Excel provides the facility to copy the format of cell(s) to the selected cells easily and quickly by clicking on the Format Painter tool button on the Standard Toolbar.

To apply Format Painter

1. Select the formatted cells whose format you want to copy.
2. Press the left mouse button on the Format Painter tool button.
3. Drag the mouse pointed through the cell(s) where you want to apply the formatting.

This formatting technique can be repeated without going through the steps given above. If you double-click the Format Painter tool button, the cursor remains active until you click on the button again.

Self Assessment Questions 13.4

What are Left, Right , Justify and centre alignment? What are there uses?

13.6 Summary

In this chapter, you have learned the features and formatting techniques of MS Excel. MS Excel is an integrated electronic worksheet program. In business and other organizations, it is used to prepare budgets, accounts, calculations and to perform various analysis. We have studied various features such as AutoSum which is used for calculating the sum of given range of data and AutoFill option which is used to fill the consecutive data.

The few formatting functions of MS Excel which are discussed in the chapter are that -

- The width of the columns and the height of the rows can be changed
- Fonts can be selected from the Formatting Toolbar as well as from the dialogue box.
- You can provide different type of alignment to the data
- You can choose the format of numbers to display
- Format Painter make to makes repetitive tasks easier.

13.7 Keywords

- **Ms Excel** :- It is the spreadsheet used for calculating, manipulating and analyzing numbers.
- **Cell** :- The intersection of the rows and columns
- **Workbooks** :- It consists of a number of worksheets.
- **Auto Fill** :- It automatically fill a series of data, into a specified range of cells.
- **Auto Sum** :- It automatically adds the selected data by selecting a tool button.
- **Functions** :- Functions are pre-written formulae that accepts the values as arguments and return the result
- **Standard toolbar**:- The options like opening the new file, saving the file, printing a file, cut/ copy/paste options etc. are present here in the form of small buttons on this toolbar.
- **Formatting toolbar**:- Formatting features like changing font type, size , style, alignment etc. are present here in the form of small buttons on this toolbar.
- **Header/Footer**:- It gives you the option to set the header and footer.
- **Fonts**:- Fonts are the typefaces which have Size, colour and special effects.
- **AutoFormat**:- It includes the formatting of numbers, border alignment, font, colour, row height and column width.

13.8 Abbreviations

MS - Microsoft Excel

SAQ - Self Assessment Question

WYSIWYG - What You See Is What You Get

13.9 Hint or Key to Activities/Saq

SAQ 15.1

A Worksheet is consists of a grid of rows and columns. Workbooks, which in turn consists of a number of worksheets.

SAQ 13.2 (b)

SAQ 13.3

Collect marks of your 5 friends. Enter the marks of each friend. Select the Cells and then click on AutoSum button on Standard toolbar to get the total marks of each friend.

SAQ 13.4

Left - aligns the contents to the left of the cell.

Center - aligns the contents to the center of the cell.

Right - aligns the contents to the right of the cell.

Justify - wraps the contents from left to right.

13.10 Questions For Practice

1. Explain briefly the features of MS Excel?
2. Draw the formatting toolbar .Explain the functions of formatting toolbar buttons.
3. How will you prepare chart for given data. Explain Step by Step procedure.
4. Explain the components of MS Excel screen
5. What are AutoSum and AutoFill Functions? What are their uses.
6. What are different categories of functions used in Excel? Explain logical functions with examples.
7. What do you understand by functions. Explain few mathematical functions.
8. Write short notes on formatting functions of Excel.
9. Create a Workbook of sales report with given values. Find the percentage of sales increase for each product in 1981

Product	1980	1981	Increased percentage
Books	1009	1789	
Pencils	2300	2567	
CDs	1590	3000	
Pens	4000	5050	
Total Sells			

10. In the above question find the total number of selling of all products in each year.
11. What is page set up? What is the use of Header and footer.
12. Explain the following terms :

(a) Autoformat

(b) Autofit

(c) Font

(d) WYSIWYG

(e) Page Setup

14. What is Alignment ? What are its different options that are available ?

15. Make entries of electronic items sales as shown in year 2000 and 2005

A	B	C	D
	2000(Rs.)	2005(Rs.)	Profit
TV	2,00,000	4,00,050	
DVD Player	50,500	1,90,000	
Music System	60,000	80,000	
Computers	5,00,000	18,00,000	
Camcorder	70,000	1,00,000	
Refrigerator	4,00,500	4,00,000	
Washing machine	4,00,390	4,00,600	
Microwave oven	1,50,000	2,50,000	
Max Profit			
Min Profit			

(a) Find the profit for each item in 5 years.

(b) Find the item whose sales was maximum to earn the highest profit.

(c) Find the item whose sales was minimum to earn the lowest profit.

13.11 Reference/Suggested Books

1 Lecorps, Rudy " Microsoft Excel Fundamentals- A practical workbook for beginners and advanced users", RGL learning Publications

2 Walkenbach, John "MicroSoft Excel 2010-Bible", Wiley Publishcations, New York

3 Taxali, RK "PC Software for Windows Made simple", Tata Mcgraw Hill, NewDelhi

4 Readiy,Elizabeth Eisner "Micrrosoft Office Excel 2007", Thomson Course Technology

5 Carlber, Conard " Business Analysis with Microsoft Excel", Que publishing

UNIT - 14

Graphics in Excel

Outline of The Unit:

14.0 Objectives

14.1 Introduction

14.2 Creating a Chart

14.3 Move and Resize a Chart

14.3.1 Column charts

14.3.2 Clustered Columns

14.3.4 Stacked Column

14.3.4 100% Stacked Column

14.3.5 3-D Clustered Column, Stacked Column in 3-D, and 100% Stacked Column in 3D

14.3.6 3-D Column

14.4 Embedded charts printing

14.5 Working with Pictures and Graphics

16.5.1 Snap Sub Menu

14.6 Text Box

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14.0 Objectives

After studying this unit, you will be able to:

- How to insert graphics into Ms-excel
- learn how Excel charts work and how you can transform ordinary tables of information into graphical representations, complete with columns, bars, lines, and even bubbles

Learn how to use Excel's graphics capabilities to display your data in a chart, charts techniques, charts styles and layouts, adding; selecting and formatting the charts elements and how to use Excel's other drawing tools to enhance a worksheets like Picture Handling, Clip Art, Shape Drawing (and fancy text) and Smart Art.

14.1 Introduction

Excel is great for displaying and calculating data, but all those numbers can get a little boring. If you're planning to share your work with someone, you might want to add some graphics to bring some life to your data. You can add clip art, pictures or any other graphic to Excel just as you put graphics into other Microsoft Office programs such as Word. Excel is the most commonly used software for creating charts. Charts depict data visually, so you can quickly spot overall trends. They're a fabulous way to help you find the meaning hidden in large amounts of data. You can create many different types of charts in Excel, including pie charts that present polling results, line charts that plot rising or declining assets over time, and three-dimensional area charts that show relationships between environmental conditions in a scientific experiment. Excel's charting tools are enormously flexible: You can generate a simple chart with standard options in a couple of mouse clicks, or you can customize every aspect of your chart's appearance (including colors, scale, titles, and even 3-D perspective). This tutorial takes the first approach and explains how to generate straightforward charts. You'll also learn which chart types are out there, and how to fine-tune your charts for maximum effect. You'll start by looking at how you can use basic formatting techniques to change the color and font of different chart components. Then you'll learn how to set a chart's scale, unleash 3-D views, and make your data stand out no matter what type of chart you use.

Instructions

Step 1: Decide where you want your graphic. Select the cell where you want the graphics upper left corner to be located. The graphic will cover up cells rather than be part of a cell, so choose a cell away from data.

Step 2: Choose "Picture" from the insert menu. You'll see a menu with the different types of graphics you may insert into Excel.

Step 3: Select "Clip Art" to bring up the Microsoft Office clip art wizard and search for a piece of clip art. Select "AutoShape" to insert a customizable shape. Double click the shape to edit the outline, fill color, size and other properties of the shape. Choose "WordArt" for a wizard that allows you to create decorative text.

Step 4: Click "Organization Chart" to open a wizard who guides you through creating a corporate organizational hierarchy.

Step 5: Insert graphics into Excel from a scanner or digital camera by choosing "From Scanner or Camera." Excel works with your scanner or camera to scan or acquire the image directly.

Step 6: Put a graphic from your hard drive into Excel by choosing "From File." Navigate to where the graphic is on your hard drive and click the "Insert" button.

Step 7: Resize the graphic by placing your mouse pointer over its corners. You can also move the graphic by clicking and dragging it.

14.2 Creating A Chart:

A chart is a visual representation of numeric values. Charts (also known as graphs) have been an integral part of spreadsheets since the early days of Lotus 1-2-3. Charts generated by early spreadsheet products were quite crude but have improved significantly over the years. Excel provides you with the tools to create a wide variety of highly customizable charts. Displaying data in a well-conceived chart can make your numbers more understandable. Because a chart presents a picture, charts are particularly useful for summarizing a series of numbers and their interrelationships. Making a chart can often help you spot trends and patterns that may otherwise go unnoticed. Excel provides a dizzying number of different chart types, but they all share a few things. In this section, you'll learn about basic Excel charting concepts that apply to almost all types of charts; you'll also create a few basic charts. To create a chart, Excel needs to translate your numbers into a graphical representation. The process of drawing numbers on a graph is called plotting. Before you plot your information on a chart, you should make sure your data's laid out properly. Here are some tips:

- Structure your data in a simple grid of rows and columns.
- Don't include blank cells between rows or columns.
- Include titles, if you'd like them to appear in your chart. You can use category titles for each column of data (placed in the first row, atop each column) and an overall chart title (placed just above the category-title row).If you follow these guidelines, you can expect to create the sort of chart shown in figure below

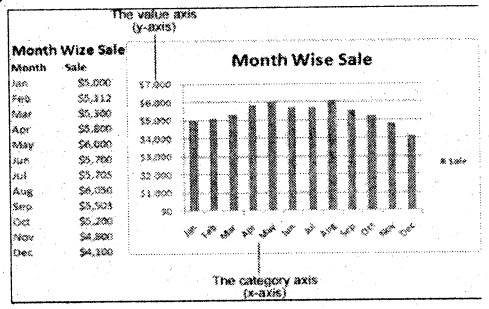


Figure 14.1 Source: Complied from the website BetterSolutions.com

This figure14.1 shows a table of data and a simple column chart based on Excel's standard chart settings. Nothing fancy, but it gets the job done.So how do you create a chart like the one shown in figure below? Easy all it takes is a couple of clicks in the ribbon. Here's how it works:

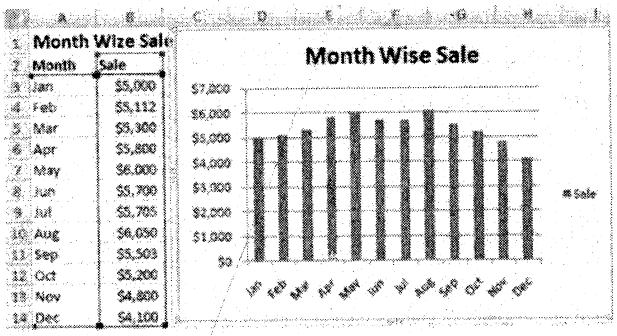


Figure 14.2 Source: Complied from the website Better Solutions.com

1. Select the range of cells that includes the data you want to chart, including the column and row headings and any chart title. If you were using the data shown in above figure, you'd select cells A1 to B14.

   For speedier chart building, just position your cursor somewhere inside the data you want to chart. Excel then automatically selects the range of cells that it thinks you want. Of course, it never hurts to remove the possibility for error by explicitly selecting what you want to use before you get started.

2. Head to the ribbon's Insert Charts section. You'll see a separate button for each type of chart (including column charts, line charts, pie charts, and so on). Click the type you want. When you choose a chart type, you get a drop-down list of subtypes (see figure below). The different chart types are explained in more detail later. For now, it's best to stick to some of the more easily understood choices, like Bar, Column, or Pie. Remember, the chart choices are just the starting point, as you'll still be able to configure a wide range of details that control things like the titles, colors, and overall organization of your chart.
3. Click the subtype you want. Excel inserts a new embedded chart alongside your data, using the standard options (which you can fine-tune later).

14.3 Move and Resize A Chart

If your chart is an embedded chart, you can freely move and resize it with you mouse. When you insert a chart into an existing worksheet, it becomes a floating object, hovering above your worksheet. Depending on where Excel puts it, it may temporarily obscure your data. The chart box doesn't damage your data in any way, but it can end up hiding your worksheet's numbers and text.You have to learn to grab hold of these floating boxes and place them where you really want them. The process is pretty straightforward:

1. Click once on the chart to select it. You'll notice that when you select a chart, Excel highlights the worksheet data the chart uses. At the same time, three new tabs appear in the ribbon, under the Chart Tools heading.
2. Hover over the chart border until the mouse pointer changes to a four-way arrow.
3. Click and drag with your mouse to move or resize the chart. Using the four-way arrow, you can drag the chart anywhere on your worksheet, releasing the mouse button when it's in the right spot.Using the two-way arrow, you can drag the border to make the chart larger or smaller. Once you make a chart box larger.
4. When you're finished, click a cell anywhere in the worksheet to go back to your data. At this point, life returns to normal, and the Chart Tools tabs disappear.

   You can resize a chart in another way. You can set the Height and Width boxes in the Chart Tools: Format > Size section of the ribbon. Although this isn't as quick as dragging the chart edge, it lets you set the size exactly, which is indispensable if you have several charts on the same worksheet and you need to make sure they're all the same size.

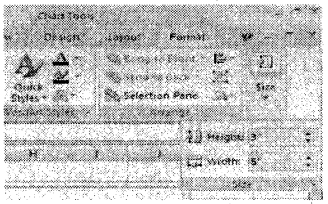


Figure 14.3 Source: Complied from the website BetterSolutions.com

You also can use standard cut and paste techniques to move an embedded chart. In fact, this is the only way move a chart from one worksheet to another. Select the chart and choose Home > Clipboard > Cut (or press Ctrl+X). Then activate a cell near the desired location and choose Home > Clipboard > Paste (or press Ctrl+V). The new location can be in a different worksheet or even in a different workbook. If you paste the chart to a different workbook, it will be linked to the data in the original workbook .You have two options for placing charts in a workbook. You can create an embedded chart, which appears in an existing worksheet (usually next to the appropriate data), or you can create a standalone chart, which appears in a new worksheet of its own.Ordinarily, when you pick a chart type from the ribbon, Excel creates an embedded chart. However, you can easily switch your chart over to a new worksheet if you're running out of room just follow these steps:

1. Right-click the chart, and then choose Move Chart (or, select the chart, and then choose Chart Tools : Design > Location > Move Chart). The Move Chart dialog box appears.
2. Choose "New sheet", and then enter the name for the new worksheet.
3. Click OK

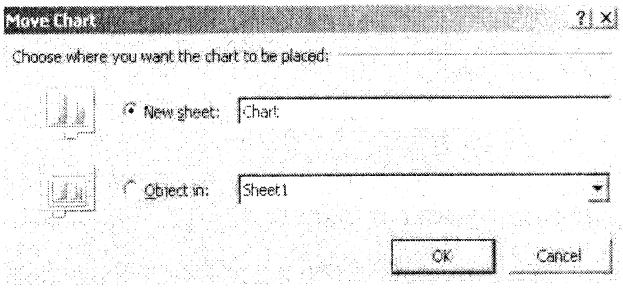


Figure 14.4 Source: Complied from the website BetterSolutions.com

Excel creates the new worksheet and places the chart on it. The new worksheet goes in front of the worksheet that contains the chart data. (You can always move the worksheet to a new position in your workbook by dragging the worksheet tab.) Tip: You can move or resize only embedded chartsthe ones that appear in floating boxes inside other worksheets. If you've created a standalone chart, you can't move or resize it. Instead, it automatically shrinks or enlarges itself to match the Excel window's display area.After you select the data to use in a chart, the next step is to select the type of chart. The commands in the Insert > Charts group are all drop-down controls. Click a control, and you see icons that represent the subtypes for the chart type. For example, a Line chart has seven subtypes.

14.3.1 Column charts

Probably the most common chart type is column charts. Column charts actually come in several different variations (technically known as subtypes). The main difference between the basic column chart and these subtypes is how they deal with data tables that have multiple series. A column chart displays each data point as a vertical column, the height of which corresponds to the value. The value scale is displayed on the vertical axis, which is usually on the left side of the chart. You can specify any number of data series, and the corresponding data points from each series can be stacked on top of each other. Typically, each data series is depicted in a different color or pattern. Column charts are often used to compare discrete items, and they can depict the differences between items in a series or items across multiple series. Excel offers seven column-chart subtypes. In order to learn about a chart subtype, you need to know its name. The name appears when you hover over the

subtype thumbnail, either in the Insert Charts list or the Insert Chart dialog box. Quick summary of column chart choices.

14.3.2 Clustered Column

In a clustered column, each value's shown in its own separate column. To form a cluster, the columns are grouped together according to category.

14.3.3 Stacked Column

In a stacked column, each category has only one column. To create this column, Excel adds together the values from every series for each category. However, the column is subdivided (and color-coded), so you can see the contribution each series makes.

14.3.4 100% Stacked Column

The 100% stacked column is like a stacked column in that it uses a single bar for each category, and subdivides that bar to show the proportion from each series. The difference is that a stacked column always stretches to fill the full height of the chart. That means stacked columns are designed to focus exclusively on the percentage distribution of results, not the total numbers.

14.3.5 3-D Clustered Column, Stacked Column in 3-D, and 100% Stacked Column in 3-D

Excel's got a 3-D version for each of the three basic types of column charts, including clustered, stacked, and 100 percent stacked. The only difference between the 3-D versions and the plain-vanilla column charts is that the 3-D charts are drawn with a three-dimensional special effect, that's either cool or distracting, depending on your perspective.

14.3.6 3-D Column

While all the other 3-D column charts simply use a 3-D effect for added pizzazz, this true 3-D column chart actually uses the third dimension by placing each new series behind the previous series. That means if you have three series, you end up with three layers in your chart. Assuming the chart is tilted just right, you can see all these layers at once, although it's possible that some bars may become obscured, particularly if you have several series.

Along with the familiar column and three-dimensional column charts, Excel also provides a few more exotic versions that use cylinders, cones, and pyramids instead of ordinary rectangles. Other than their different shapes, these chart types work just like regular column charts. As with column and bar charts, you can specify how cylinder, cone, and pyramid charts should deal with multiple series. Your options include clustering, stacking, 100% stacking, and layering (true3-D).

14.4 Embedded Charts Printing

You can print embedded charts in two ways. The first approach is to print your worksheet exactly as it appears on the screen, with a mix of data and floating charts. In this case, you'll need to take special care to make sure your charts aren't positioned over any data you need to read in the printout. To double-check, use Page Layout view (choose View > Workbook Views > Page Layout View).You could also print out the embedded chart on a separate page, which is surprisingly easy. Just click the chart to select it, and then choose Office Button > Print (or Office Button > Print > Print Preview to see what it'll look like). When you do so, Excel's standard choice is to print your chart using landscape orientation, so that the long edge of the page is along the bottom, and the chart's wider than it is tall. Landscape is usually the best way to align a chart, especially if it holds a large amount of data, so Excel automatically uses landscape orientation no matter what page orientation

you've configured for your worksheet. If you want to change the chart orientation, select the chart, then choose Page Layout > Page Setup > Orientation > Portrait. Now your chart uses upright alignment, just as you may see in a portrait-style painting.If you select an orientation from the Page Layout > Page Setup > Orientation list while your chart is selected, you don't end up configuring the orientation for the worksheet itself. Instead you configure the embedded chart's orientation when you print it out on a separate page. If you want to configure the orientation for the whole worksheet, make sure nothing else is selected when you choose an orientation.

Excel also includes some page setup options that are specific to charts. To see these options, head to the Page Layout > Page Setup section, click the dialog launcher in the bottom-right corner to show the Page Setup dialog box, and then choose the Chart tab (which appears only when you've got a chart currently selected). You'll see an option to print a chart using lower print quality ("Draft quality"), and in black and white instead of color ("Print in black and white").Its easy to chart a list that contains two columns you want to graph one with text labels and one with numeric data. But, in real life, you'll probably need to deal with many different types of data that occupy many different configurations on your works

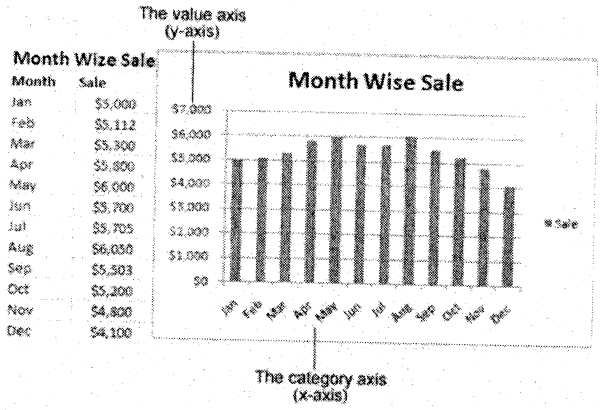


Figure 14.5 Source: Complied from the website BetterSolutions.com

Consider all the possible variations on the simple sales chart shown in above figure. You may need to compare the sales figures but, rather than showing region-to-region comparisons, you want to show how well (or poorly) each of your firm's products sold. Or perhaps you want to chart the quarterly performance of different stores over a five-year period, or determine the relationship between sales and profitability. All these charts require a slightly different arrangement of data.In this section, you'll get a quick introduction to all these possibilities, using just the simple column chart and line chart.You'll learn how to customize your charts to the maximum so that they look exactly as you want. You also pick up some slick charting tricks that will make your charts even more impressive.

14.5 Working with Pictures and Graphics

- Every worksheet has an invisible draw layer, which lets you insert graphic objects.
- To paste a picture of a cell, chart or graphic object, select the object and then hold down Shift while selecting (Edit > Copy Picture)
- SS - Toggles the display of the Drawing toolbar (Standard toolbar)
- The term graphics refers to a whole range of objects including: clipart, word art, photos, pictures, organization charts

Adding graphics to your workbook will increase visual impact and emphasis The Drawing

toolbar offers a huge range of drawing tools for modifying existing shapes as well as creating more. This toolbar also comes in handy for annotating your charts. After you insert a graphic, small white squares called "selection handles" will surround the object's border These selection handles indicate which object is currently selected. To select an object just click anywhere on it.

- When selection handles appear, you can the use these handles to move and resize the object.
- You can use the worksheet gridlines as a guide.
- If you want to draw a perfect square or circle then hold down the Shift key as you drag the handle.
- If you change an object and it is not as you expected you can use (Edit > Undo) to
- To add an Auto shape to your worksheet click the Auto shapes button on the Drawing toolbar and choose an Auto shape from the menu.
- Then click the shape you want to add.
- The "Change Auto shape" command is a special command for converting one shape into another (Draw > Change AutoShape).
- If you have a list of countries with values assigned to each one, then (Insert > Map) will automatically construct a map to visually display the values.

14.5.1 Snap Sub Menu

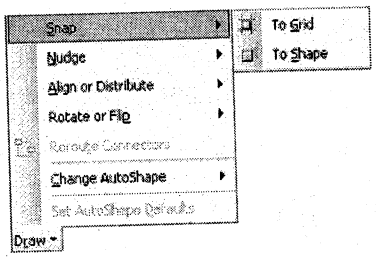


Figure 14.6 Source: Complied from the website BetterSolutions.com

To move an AutoShape select once and drag. To resize select once and drag one of the eight sizing handles in the appropriate direction. You can also flip, rotate, free rotate etc. More complex AutoShapes have additional sizing handles, these are in yellow and diamond shaped.You can insert AutoShapes from the drawing toolbar. In addition you can apply drop shadows, text or 3D effects to the shapes.For precise movements you can use the nudge operation. Draw > Nudge. Nudge operations will not move the object beyond the current window so you will have to manually scroll the display.To add text to an AutoShape just right click the shape and select "Add Text". Once you have added your text just press Escape. You can format the text by right clicking the border and choosing "Format AutoShape"AutoShapes are just pre-defined drawing objects such as circles and arrows that you can add to a worksheet to improve its appearance. Most AutoShapes allow you to add text.To link an AutoShape to a cell, select the AutoShape and in the formula bar enter a formula that links to a worksheet cell(Insert > Picture > From File)If you have got Microsoft Clip Gallery installed then you can also insert sounds and films as well as images.One of the easiest ways to add some text into a graphic logo is to use the WordArt feature.There is even a dedicated WordArt oolbar that allows you to curve the text in various directions and to modify the spacing between letters.You can hide and show a toolbar at any time by clicking with the right mouse button on any toolbar to display a list of all toolbars.

14.6 Text Box

Excel does not offer full word processing capabilities however blocks of text can be added to a worksheet by using a text box. You can insert a text box onto a worksheet using the Text Box button from the Drawing toolbar. Text Box - Inserts a textbox anywhere on your worksheet.Using a text box provide a way of displaying text that is independent of the row and column boundaries

16.6.1 Resizing the text box

Drag to draw a textbox to the correct size. The text is left aligned by default.

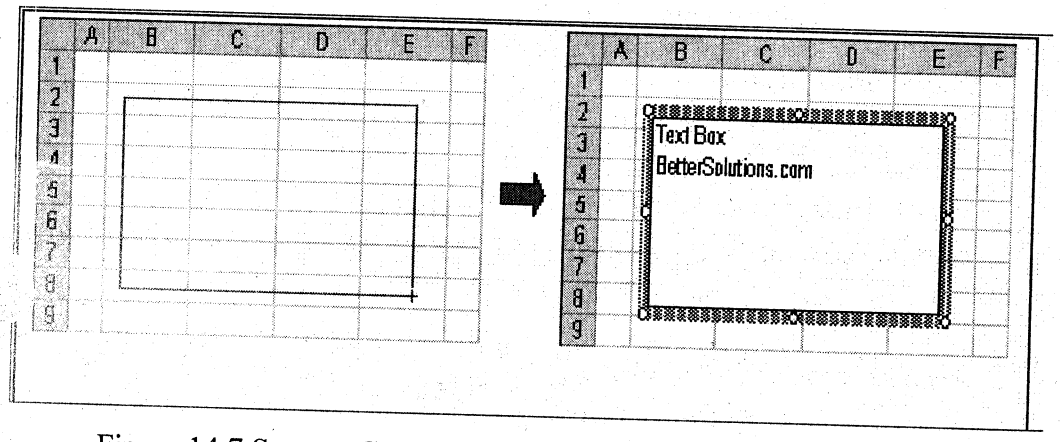


Figure 14.7 Source: Complied from the website BetterSolutions.com

When the text box is selected the border is displayed as dotted lines. A text box can be easily resized at any time by dragging one of the white selection handles.

14.6.2 Highlighting Text

Once the text box is selected you can highlight all or some of the text inside the text box by using the mouse. You can also double click a text box to be taken directly into the text edit mode.

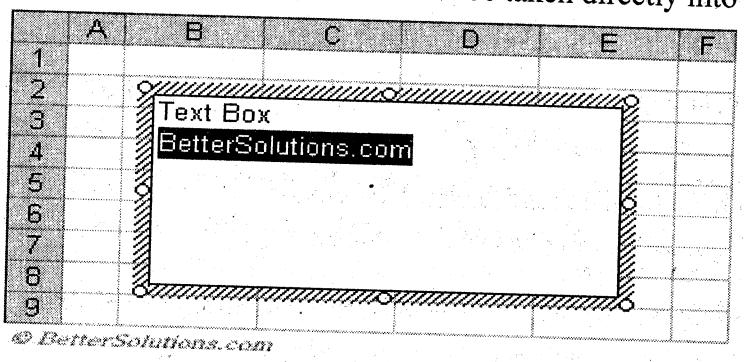


Figure 14.8

Source: Complied from the website BetterSolutions.com

When text inside the text box is selected the border is displayed as a hatched-line.

14.6.3 Formatting Text

The text inside a text box can be formatted in the usual way. You can quickly display the Font formatting options by using the shortcut menu and selecting Format Text Box. Alternativley you can also use the Formatting toolbar directly or select (Format > Text Box) from the menu bar.

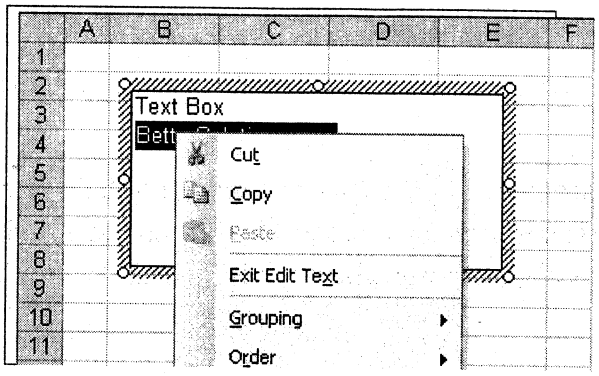


Figure 14.9 Source: Complied from the website BetterSolutions.com

The only tab that is displayed is the Font tab.

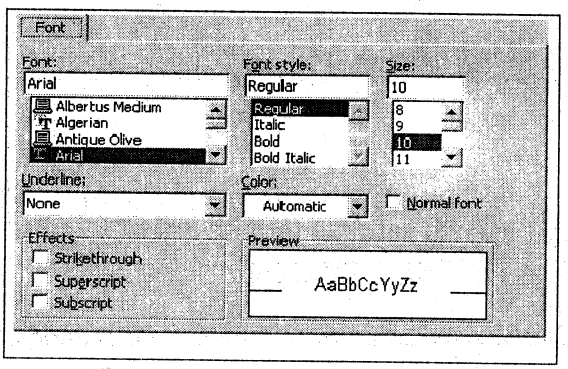


Figure 14.10 Source: Complied from the website BetterSolutions.com

A text box can be easily deleted by selecting the border and pressing Delete.

14.6.4 Displaying a Value from a cell

Instead of typing your text directly into an Autoshape it is possible to refer to the contents of a cell. Select the AutoShape you want to add the text to and use the formula bar to insert the corresponding formula.

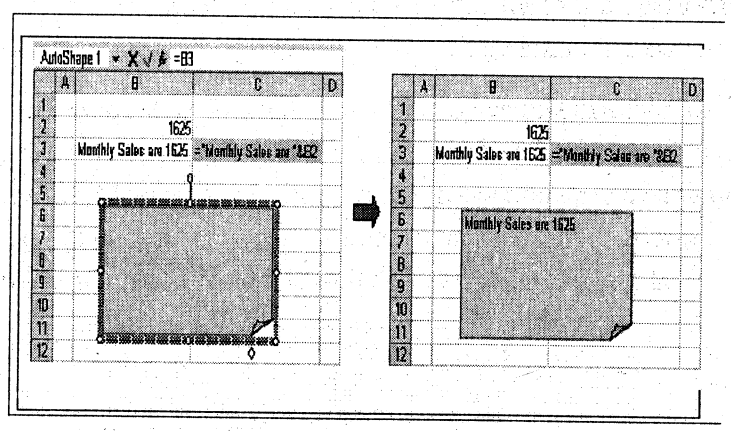


Figure 14.11 Source: Complied from the website BetterSolutions.com

Self Assesment 14.1

What are the important components of Chart?

Define Auto Shape?

Define the important components of DBMS?

14.7 Formatting Your Autoshapes

AutoShapes basically include everything that can be inserted from the Drawing toolbar except pictures and clipart.

14.7.1 Format AutoShape Dialog Box

Depending on the type of auto shape that is selected will depend on the specific formatting options available. You can display the Format AutoShape dialog box by selecting any auto shape object by using the shortcut menu. Screen shots of all the possible tabs that can be displayed are shown below:

Properties Tab

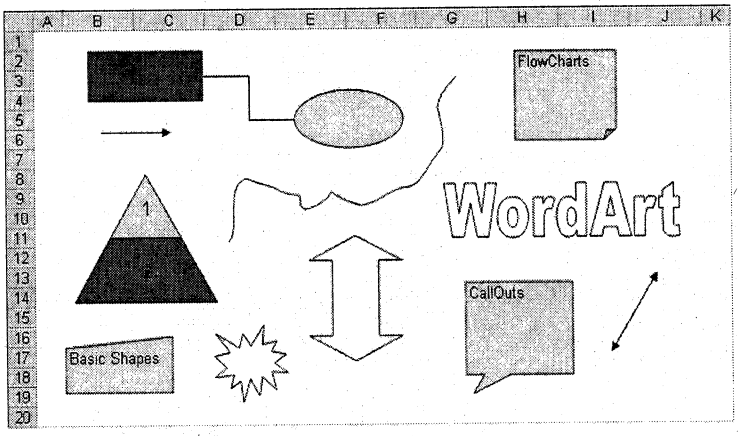


Figure 14.12 Source: Complied from the website BetterSolutions.com

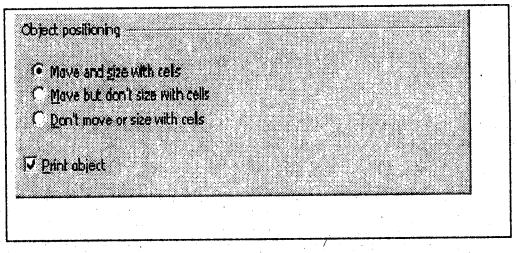


Figure 14.13 Source: Complied from the website BetterSolutions.com

This applies to any cells that have a border between the upper left and lower right corners of the autoshape. For example all the shaded cells will be affected with the following two autoshapes

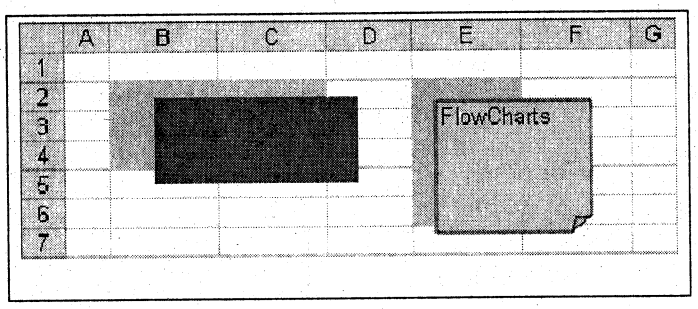


Figure 14.14

Source: Complied from the website BetterSolutions.com

Move and size with cells: Changing the size of the cells underneath the auto shape will change the size of the auto shape.

Move but don't size with cells: Changing the size of cells (or inserting/deleting rows and columns) will move the auto shape without resizing it.

Don't move or size with cells: Changing the size of cells (or inserting/deleting rows and columns) will not affect the auto shape

14.8 Diagrams of Color and Lines Tab

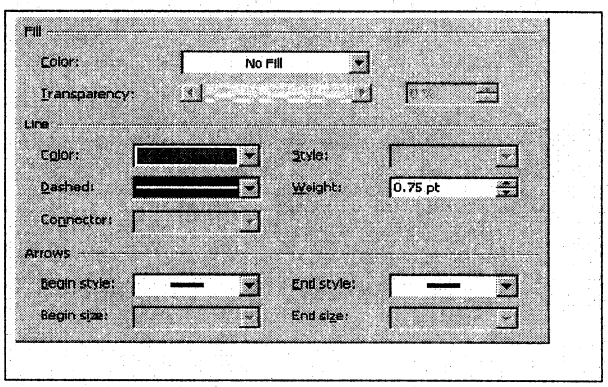


Figure 14.15 Source: Complied from the website BetterSolutions.com

14.9 Diagram of Alignment

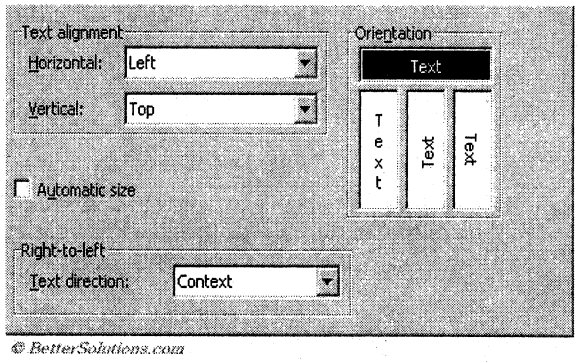


Figure 14.16 Source: Complied from the website BetterSolutions.com

14.10 Diagram of Font Tab

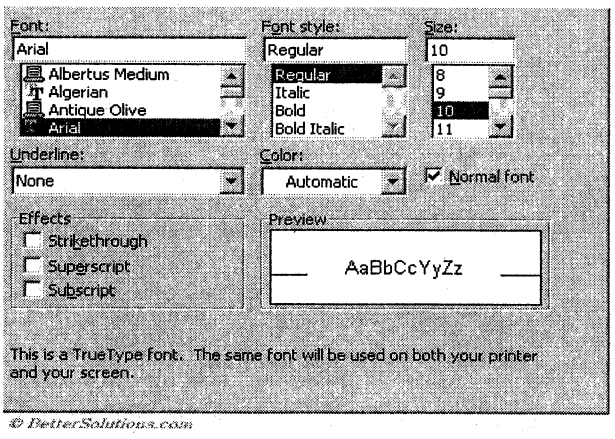


Figure 14.17 Source: Complied from the website BetterSolutions.com

14.11 Diagram of Margins Tab

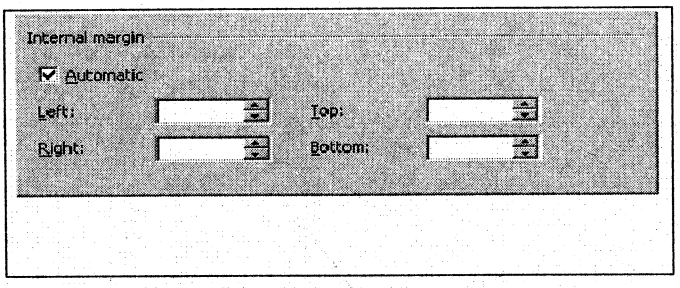


Figure 14.18 Source: Complied from the website BetterSolutions.com

14.12 Diagram of Size Tab

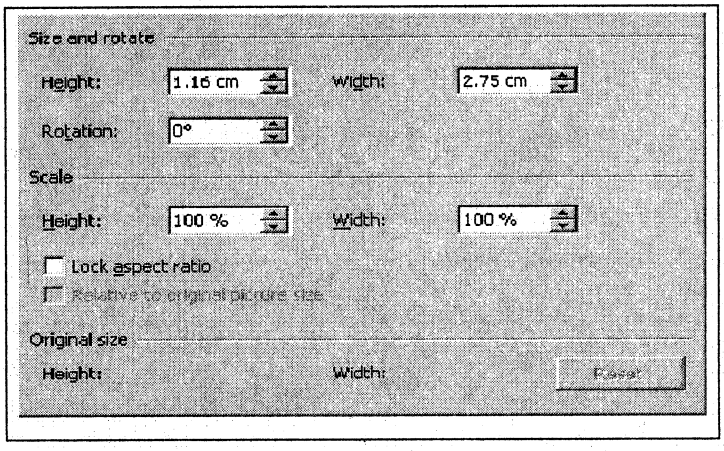


Figure 14.19 Source: Complied from the website BetterSolutions.com

14.13 Diagram of Protection Tab

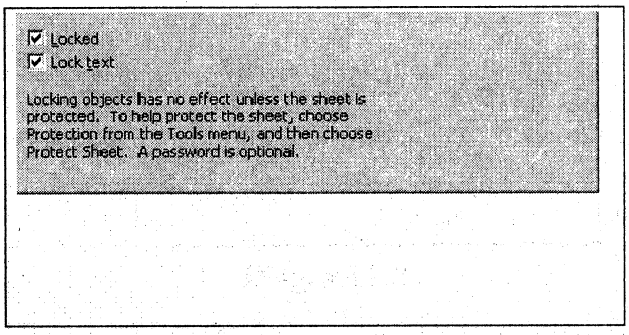


Figure 14.20 Source: Complied from the website BetterSolutions.com

14.14 Diagram of Web Tab

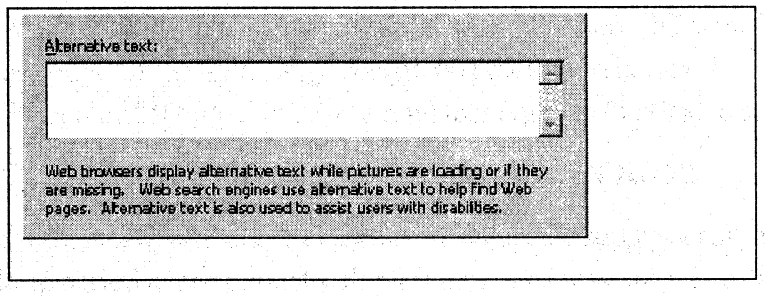


Figure 14.21 Source: Complied from the website BetterSolutions.com

Self Assesment 14.2

What are the size and font tab?

Define Color and Line tab?

14.15 Summary

The menus related to graphs and graph formatting have been changed completely in Excel 2007. Some common activities in using graphs are rather less transparent than previously. For example, to add a curve to a graph, one can right click on the graph and choose "select data" from the drop-down menu, or use the "chart tools/design" tab. However, when there are other drop-down menus open, this drop-down menu just doesn't show up and the "select data" option is grayed out (unavailable) from the tool bar. That fact of the menu system must be "discovered" by the user. These quirks and other nontransparent features contribute to a long learning curve, and to annoyance if one returns to Excel after an absence long enough to forget these little "tricks" of the menu system

14.16 Key Words

Stacked	:	A large, usually conical pile of straw or fodder arranged for outdoor storage.
		An orderly pile, especially one arranged in layers.
Clustered	:	A number of things of the same kind growing together; a bunch.
Embedded Chart	:	**Embedded chart** exists as an object on the same worksheet with the plotted data.
Margin Tab	:	Space on paper in left,right.top and bottom with different sides.
Bubbles	:	Round shape as same as circle.
Techniques	:	A technique is a procedure used to accomplish a specific activity or task
Depicted	:	Represented graphically by sketch or design or lines.
Polling	:	The process of drawing numbers on a graph is called Polling.

14.17 Abbreviations

Ctrl+V : Home>Clipboard>Past

Ctrl+X : Home >Clipboard> Cut

Ctrl+Z : Undo

3-D : 3 dimensional

16.18 Hint/Key of SAQs

Self Assessment 14.1

1. The "Change Autoshape"command is a special command for converting one shape into another
2. A chart is a visual representation of numeric values. Charts (also known as graphs) have been an integral part of spreadsheets..and Read 14.4 topic.

Self Assessment 14.2

1. For changing color .lines, width and styles (begin-end).
2. for changing font,font style,size and effects..

14.19 Practical Question

1. How can you put the finishing touch on the already created chart?
2. List all the chart tools?
3. Explain the different chart types?
4. Define how can we insert multiple chats on a single chart sheet?

14.20 Reference/Suggested Books

1 **Craig Stinson, Mark Dodge** – " Microsoft® Office Excel® 2003", Amazon.com.

2 **Curtis D. Frye** - " Microsoft Office Excel 2007", Microsoft Press

3 **Nancy Muir** ," Teach Yourself VISUALLY Excel 2007", Paperback: 304 pages Publisher: Visual; 1 edition (December 6, 2006)

4 **John Walkenbach** ,"Excel 2007 Formulas", Paperback: 840 pages Publisher: Wiley (February 12, 2007)

5 **Faithe Wempen,** "Microsoft Office 2007 For Seniors For Dummies" , Paperback: 360 pages Publisher: For Dummies (July 27, 2009) **ss**

6 **Curtis Frye,"** Microsoft® Office Excel® 2007 Step by Step", Paperback: 432 pages Publisher: Microsoft Press (January 31, 2007)

7 **Mark Dodge, -"**Microsoft® Office Excel® 2007 Inside out", Paperback: 1088 pages Publisher: Microsoft Press (February 14, 2007)

8 **Nancy Conner, Matthew MacDonald**, "Office 2010: The Missing Manual", Paperback: 800 pages Publisher: Pogue Press; 1 edition (July 15, 2010)

Unit - 15

Working with MS-Access Create Databas its Manipulation in Account

Outline of the Unit:

15.0 Objectives

15.1 Introduction

15.2 Concepts of The Navigation Pane

15.3 How to start Access

15.4 How to create a new Database

15.4.1 Review of Starting Microsoft Access

15.4.2 Creating and Viewing Tables

15.5 Creating a Table Using the Design View

15.6 Example of Creating Table

15.6.1 Viewing and Adding Data to a Table

15.6.2 Adding Data to a Table

15.7 Creating Relationships Between Tables

15.8 Review of Creating and Viewing Tables

15.9 Application Development with Microsoft Access

15.10 Technical Requirements design

15.11 Commercial Requirements design

15.12 Summary

15.13 Abbreviations used

15.14 Keywords

15.15 Hint/Key of SAQs

15.16 Question for Practice

15.17 Reference/suggested Books

15.0 Objectives

After studying this unit, you will be able to:

- Explain what is Database table and how can create the database table.
- Will be able to work on Ms-Access.
- Understand the concept of Navigation Pane.
- Can develop different applicationwith Access .

15.1 Introduction

We begin this unit by explaining the database table in MS Access. A database can best be

described as a way of storing large amounts of information. The data can be retrieved and we can even ask questions of the data and get answers. For example I may want to know how many customers sold widgets in the city of London for the month of July. Access is a PC desktop database and it is possible to create some powerful systems. This will take you into design view of the table.Access uses what are known as tables to store the data. No, this has nothing to do with a dining table – a table in Access is a container with columns such as name, address etc. Tables are the most important object in MS Access and are a useful starting point for any new database. Access will ask you to save the table and to enter a name for it. Enter a name and click the ok button.

Now you are in table design view. The two columns to be concerned with are 'Field Name' and also 'Data Type'. Access has already created a column called 'ID'. This is fine and should be left here.

Click on the second line and enter a column name. I will be entering 'FirstName'. You can add a space between the words, but there are good reasons not to. Tab along to the 'Data Type' column and click the down arrow. You will then see a list of possible data types to use for the 'FirstName' column. Can you guess which one to use? Well, I am not entering a price so I don't want to use a numeric or number data type. In this case for a 'FirstName' the most suitable data type would be 'Text'.

- At the bottom of the screen you can set how many characters should be entered for this 'FirstName' column. I set it to 20.
- Enter some more columns and choose the appropriate data type and column size.
- When you are done click the save button.
- Right click the table tab and select the 'Close' option.

15.2 Concepts of the Navigation Pane

The navigation pane replaces the database window used in previous versions of MS Access. It holds all objects in the database such as tables, forms, queries, reports, macros and program code modules.The navigation pane is tucked away at the left hand side. Click the double arrow, known as the 'Shutter bar open/close button' to expand or collapse the pane. The table I just created is held there.

- Click the small down arrow to select the object you wish to view. Right click the table and select the 'Open' option.
- Click in the 'FirstName' column and enter some data.
- Tab along to each field and enter more information.
- Click on a new line to enter a new record

Note: When you enter data into a table or even a form, MS Access saves it automatically.

- Now close the table.
- Right click the table tab and select the close option.

In any database application, each of the tables requires a means to get data into them and retrieve the data at a later time. The primary way to get data into tables is to use data entry forms. The primary ways to get data back out of tables or to display data in tables are to use queries or reports. For this , we will create a data entry form for each table, a query for each table and a report for each table.

15.3 How to start Access:

Starting Microsoft Access As with most Windows programs, Access can be executed by navigating the Start menu in the lower left-hand corner of the Windows Desktop. To start Access, click on the Start button, then the Programs menu, then move to the MS Office menu and finally click on the Microsoft Access menu item. The MS Office Professional menu is shown below.

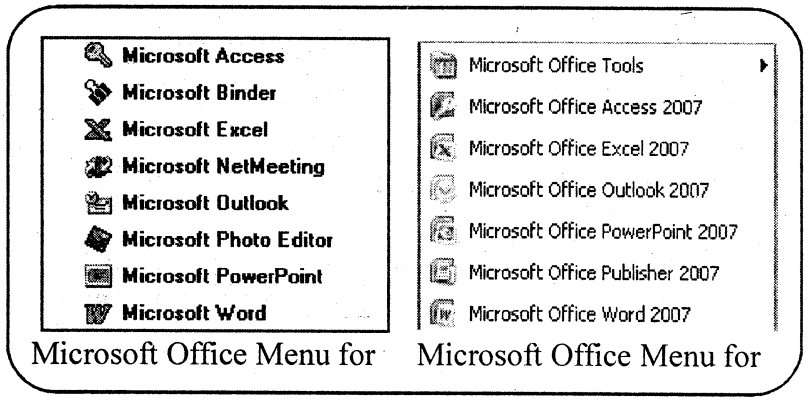


Figure 15.1 - Source: www.access-databases.com

15.3.1 Middle Ages Accounting:

During the thirteenth to the fifteenth centuries, trade flourished places such as Florence, Venice and Genoa, thus, there was advancement in account keeping methods, thanks to the merchants and the bankers of such time. During the 1211 A.D., one of the systems in accounting was kept by a Florentine banker. However, the system was primitive as the concept of equality for entries was absent. Double entry records first came out during 1340 A.D. in Genoa. In 1494, the first systematic record keeping was formulated by Fra Luca Pacioli, a Franciscan monk and one of the most celebrated mathematicians to this day. Pacioli is considered as the father of accounting.

15.3.2 Accounting during Industrial Revolution:

Note that this arrangement of menus may vary depending on how MS Office was installed on the PC you are using. After click the Microsoft Office Access, The Microsoft Office Access window is show.

15.4 How to Create a new Database

Once Access is running, an initial screen will be displayed:

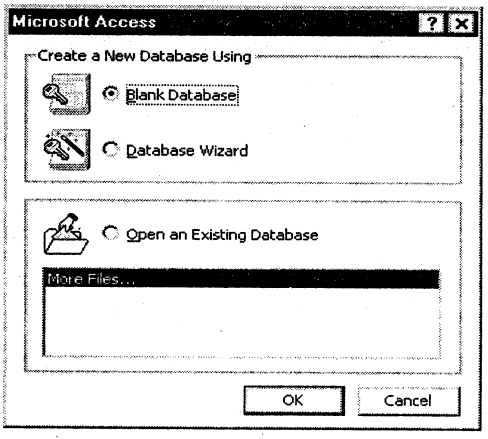


Figure 15.2 - Source: www.access-databases.com

From this initial screen, the user can create a new database (either blank or with some tables created with the database wizard), or open up an existing database. In general, the first time one begins a project, a new, blank database should be created. After that point, use the *Open existing database* option to re-open the database created previously.

Note- If you have previously created a database, and then create it again using the same name, you will overwrite any work you have done. For the purposes of this tutorial, if you are going through these steps for the first time, choose the option to create a new, blank database as shown in the above figure.

For Access '97 and 2000 versions selecting Blank Database and clicking on the OK button, will cause the screen below to appear in order to give the new database a file name. Fill in *File Name* as bankdb.mdb and click on the Create button to create the database as in the figure below.

For Access 2007, click on the round Office button in the upper left corner and choose New from the drop down menu. Fill in *File Name* as bankdb.accdb and click on the Create button to create the database as in the figure below.

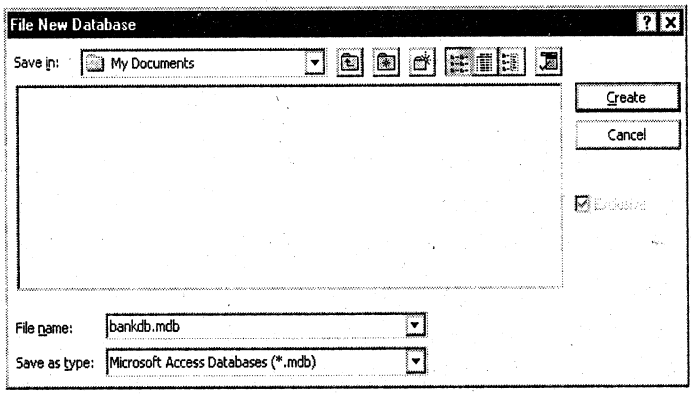


Figure 15.3 - Source: www.access-databases.com

New database screen for Access '97 and 2000.In the above file name, bankdb is the name chosen for this particular database and .mdb is the three letter extension given for *Microsoft DataBase* files.It is advisable to keep the name of the database (bankdb in the above example) relatively short and do not use spaces or other punctuation in the name of the database. Also, the name of the database should reflect the database's contents. Once the new database is created, the following main Access screen will appear:

MS Access '97

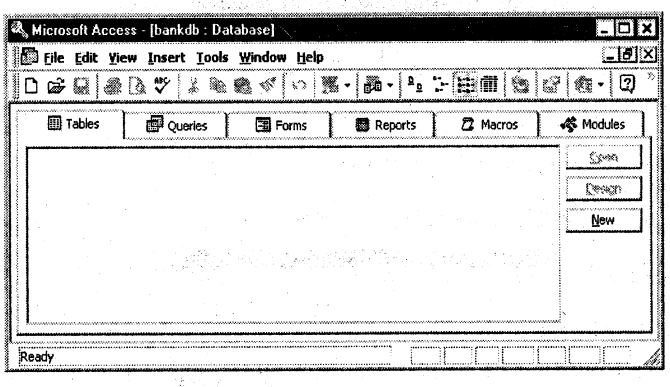


Figure 15.4 Source: www.lisisoft.com

MS Access 2000

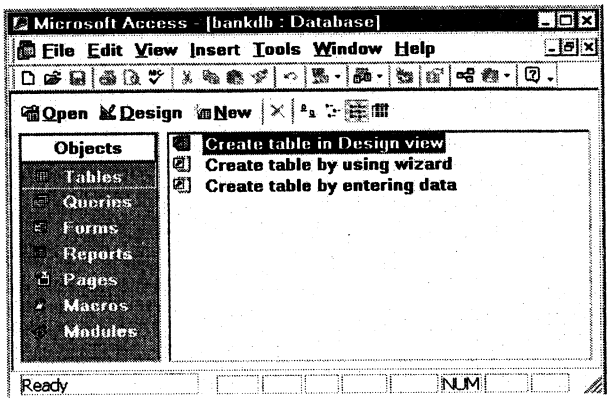


Figure 15.5 Source: www.lisisoft.com

In Access '97 and Access 2000, The two main features of this main screen are the menu bar that runs along the top of the window and the series of *tabs* in the main window. The menu bar is similar to other Microsoft Office products such as Excel. The menus include:

- File - Menu items to Open, Close, Create new, Save and Print databases and their contents. This menu also has the Exit item to exit Access.
- Edit - Cut, Copy, Paste, Delete
- View - View different database objects (tables, queries, forms, reports)
- Insert - Insert a new Table, Query, Form, Report, etc.
- Tools - A variety of tools to check spelling, create relationships between tables, perform analysis and reports on the contents of the database.
- Window - Switch between different open databases.
- Help - Get help on Access.

The tabs in the main window for the database include:

- Tables - Displays any tables in the database.
- Queries - Displays any queries saved in the database.
- Forms - Displays any forms saved in the database.
- Reports - Displays any reports saved in the database.
- Macros - Displays any macros (short programs) stored in the database.
- Modules - Displays any modules(Visual Basic for Applications procedures)stored in the database.

In MS Access 2000, these tabs appear along the left hand side of the window by default. MS Access 2000 also adds some selections such as Web Pages and Favorites

15.4.1 Review of Starting Microsoft Access

To start Microsoft Access:

1. Use the Start button on the task bar to open: Programs -> MS Office -> Microsoft Access
2. To create a new database, choose **Blank Database** and specify a new file name for the database. Be sure to use a descriptive name for the new database. Click on the OK button to create the new database.

3. To open an existing database, choose **Open an Existing Database**, highlight *More Files...* and click on the OK button. Then navigate to the drive, highlight the existing database file on the floppy disk and click the OK button again to open the database.

To exit Access, pull down the File menu (or Office menu) and select the Exit menu item.

15.4.2 Creating and Viewing Tables:

Tables are the main units of data storage in Access. Recall that a table is made up of one or more *columns* (or *fields*) and that a given column may appear in more than one table in order to indicate a relationship between the tables.

From the business example discussed earlier, we concluded that two tables would be sufficient to store the data about **Customers** and their bank **Accounts**. We now give the step-by-step instructions for creating these two tables in Access. There are a number of ways to create a table in Access. Access provides *wizards* that guide the user through creating a table by suggesting names for tables and columns. The other main way to create a table is by using the *Design View* to manually define the columns (fields) and their data types. While using the wizards is a fast way to create tables, the user has less control over the column names (fields) and data types. In this tutorial, we will describe the steps to create a table using the *Design View*. Students are encouraged to experiment on their own with using the Create Table wizard.

15.5 Creating a Table Using the Design View

To create a table in Access using the Design View, make sure the Tables tab is displayed (that is, Access should be set to work with tables rather than with queries, forms, reports, etc.) and perform the following steps:

1. For Access '97, Click on the New button and highlight *Design View* in the dialog that appears:

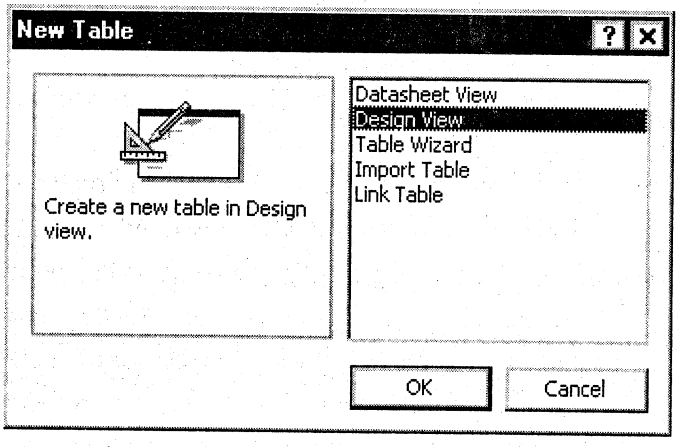


Figure 15.6 - Source: www.ccshops.com

- Then click on the OK button.
- For Access 2000, double click on the "Create Table in Design View" item.
- For Access 2007, the Create New Table tab should already be highlighted and a new table named table1 created. If this is not the case, click on the *Create* tab and click on the *Table* icon. Then pull down the *View* menu and choose *Design View*.

2. The Table Design View will appear. Fill in the **Field Name**, **Data Type** and **Description** for each column/field in the table. The CustomerID field is filled in below

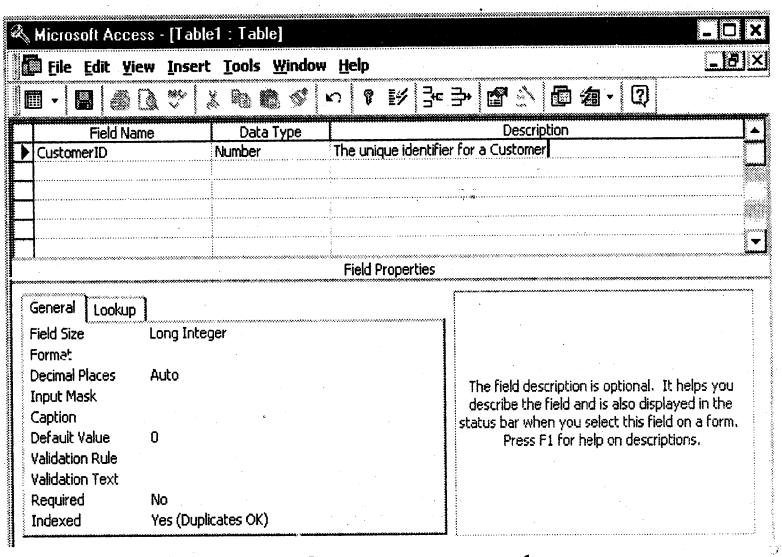


Figure 15.7 Source: www.ccshops.com

Table Design View for Access '97 and 2000

3. Note that the default name given for the table is Table1. In a later step, we will assign an appropriate name for this table.
4. Fill in the information for the fields as follows:

Field Name	Data Type	Description
CustomerID	Number	The Unique Identifier for a Customer
Name	Text	The Name of the Customer
Address	Text	The Address of the Customer
City	Text	The City of the Customer
State	Text	The home State of the Customer
Zip	Text	The Zip Code of the Customer

Table 15.1 Example of Table Design View for Access '97 and 2000

5. A figure showing the design view with the new table definition filled in is given below:

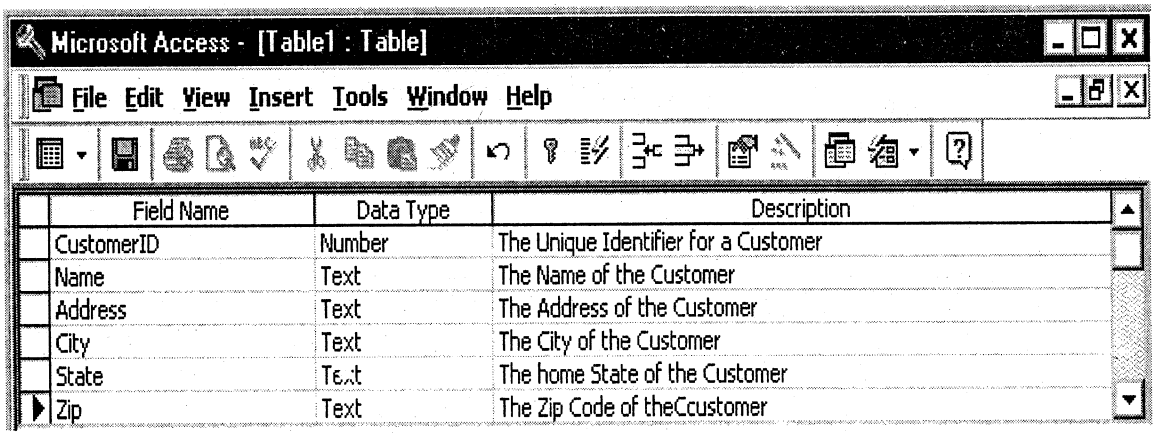


Figure 15.8 - Source: www.ccshops.com

6. Now that all of the fields have been defined for the table, a Primary Key should be defined. Click on the **CustomerID** field with the *Right* mouse button and choose Primary Key from the pop-up menu

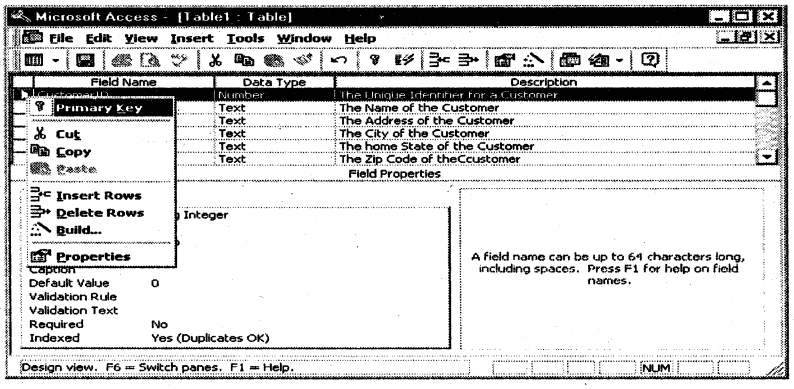


Figure 15.9 - Source: www.ccshops.com

Notice that a small key appears next to the field name on the left side.**Note**: To remove a primary key, simply repeat this procedure to toggle the primary key off.

7. As a final step, the table must be saved. Pull down the File menu and choose the Save menu item. A dialog box will appear where the name of the new table should be specified. Note that Access gives a default name such as **Table 1** or **Table2**. Simply type over this default name with the name of the table. For this example, name the table: **Customer** Then click on the OK button.

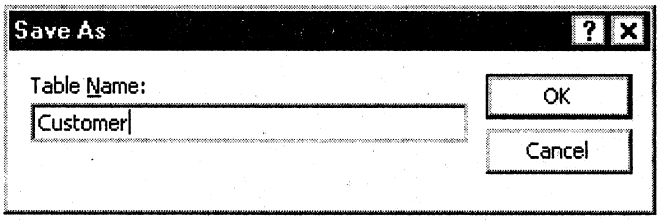


Figure 15.10 - Source: www.ccshops.com

At this point, the new Customer table has been created and saved. Switch back to the Access main screen by pulling down the File menu and choosing the Close menu item. This will *close* the Design View for the table and display the Access main screen. Notice that the new Customer table appears below the Table tab.

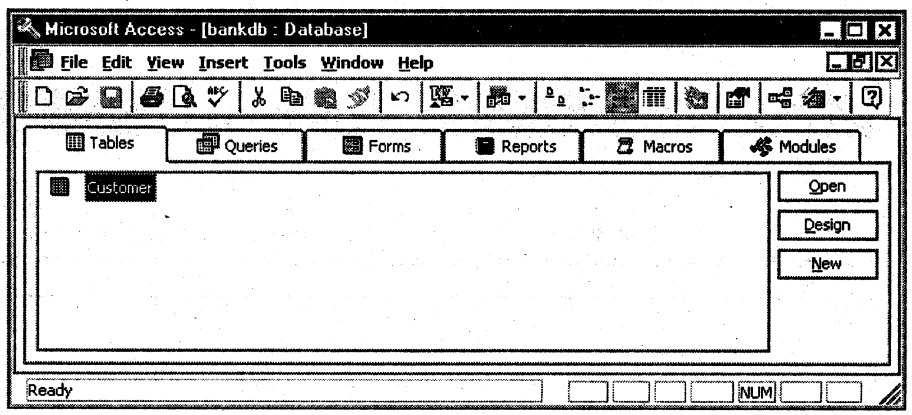


Figure 15.11 - www.technet.microsoft.com

When defining the fields (columns) for a table, it is important to use field names that give a clear understanding of the data contents of the column. For example, does the field CNO indicate a Customer Number or a Container Number ? Field names in Access can be up to 64 characters long and may contain spaces. **However, *the use of spaces in field names and table names is strongly discouraged*.** If you wish to make field names easier to read, consider using an underscore character

to separate words. However be certain no spaces appear before or after the underscore. The following table summarizes some different ways to give field names:

Description	Bad	Good
Unique identifier for a customer	CID	CustomerID or Customer_ID
Description for a product	PDESC	ProductDescription
Employee's home telephone number	Employee_home_telephone _number	HomePhone
Bank account number	BA#	AccountNumber

Table 15.2 - Example of Table Design View for Access '97 and 2000

15.6 Example of Creating Table

Create the *Accounts* table by following the same steps used to create the Customer table.

1. Click on the New button and highlight *Design View* in the dialog box that appears. Then click on the OK button.
2. The Table Design View will appear. Fill in the **Field Name**, **Data Type** and **Description** for each column/field in the Accounts table.

Field Name	Data Type	Description
CustomerID	Number	The Unique Identifier for a Customer
AccountNumber	Number	The Unique Identifier for a Bank Account
AccountType	Text	The type of account (Checking, savings, etc.)
DateOpened	Date	The date the account was opened
Balance	Number	The current balance (money) in this account (in $US)

Table 15.3 - Example of Creating Table

A figure showing the design view with the new table definition filled in is given below:

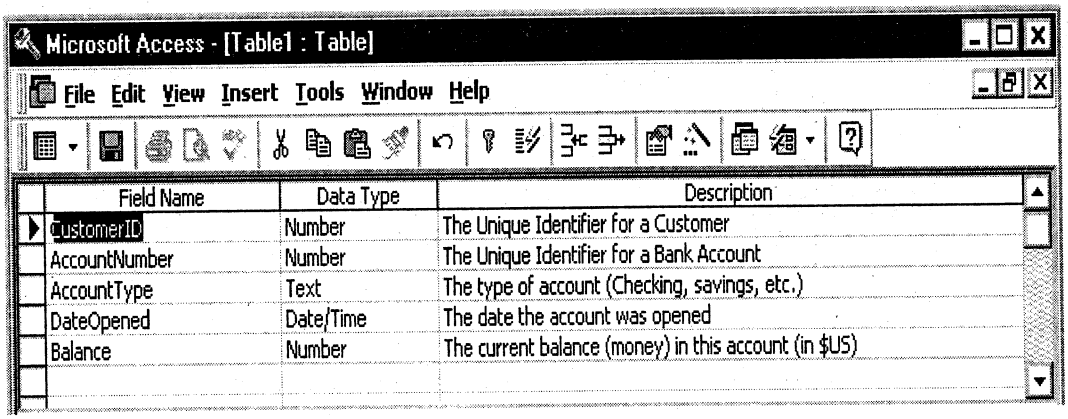


Figure 15.12 - www.technet.microsoft.com

Define a Primary Key for the Accounts table. Click on the **AccountNumber** field with the *Right* mouse button and choose Primary Key from the pop-up menu.

3. Save the new Accounts table by pulling down the File menu and choosing the Save menu item. Fill in the name of the table: **Accounts** Then click on the OK button.

15.6.1 Viewing and Adding Data to a Table:

Data can be added, deleted or modified in tables using a simple spreadsheet-like display. To bring up this view of a single table's data, highlight the name of the table and then click on the Open button. In this view of the table, shown in the figure below, the fields (columns) appear across the top of the window and the rows or records appear below. This view is similar to how a spreadsheet would be designed.

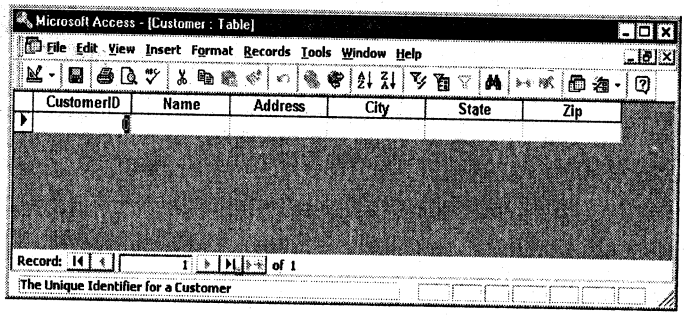


Figure 15.13 - www.technet.microsoft.com

Note at the bottom of the window the number of records is displayed. In this case, since the table was just created, only one blank record appears. To add data to the table, simply type in values for each of the fields (columns). Press the Tab key to move between fields within a record. Use the up and down arrow keys to move between records. Enter the data as given below:

CustomerID	Name	Address	City	State	Zip
1001	Mr. Smith	123 Lexington	Smithville	KY	91232
1002	Mrs. Jones	12 Davis Ave.	Smithville	KY	91232
1003	Mr. Axe	443 Grinder Ln.	Broadville	GA	81992
1004	Mr. & Mrs. Builder	661 Parker Rd.	Streetville	GA	81990

Table 15.4 Example of Viewing and Adding Data to a Table:

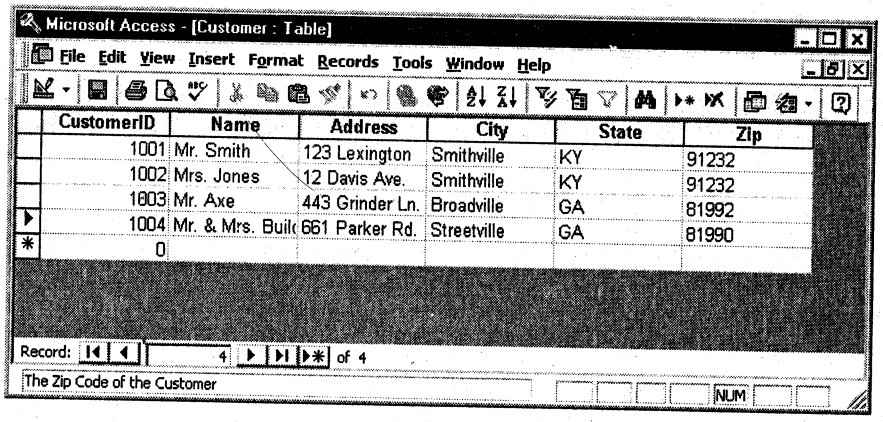


Figure 15.14 - Source: academictutorials.com

- To save the new data, pull down the File menu and choose Save.
- To navigate to other records in the table, use the navigation bar at the bottom of the screen:



- To modify existing data, simply navigate to the record of interest and tab to the appropriate field. Use the arrow keys and the delete or backspace keys to change the existing data.

- To delete a record, first navigate to the record of interest. Then pull down the Edit menu and choose the Delete menu item.
- To close the table and return to the Access main screen, pull down the File menu and choose the Close menu item.

15.6.2 Adding Data to a Table

For this, open up the Accounts table and add data for the seven accounts shown in diagram,to enter the data exactly as shown including the capitalization of the data in the AccountType field. e.g., type Savings instead of savings or SAVINGS.

Note that when entering the dates, type in the full four digits for the year. By default, Access only displays the last two digits of the year; however, all four digits are stored in the table. Be sure to save the data when you are done. The figure below shows the Accounts table and data as it should appear when you are done with this exercise.

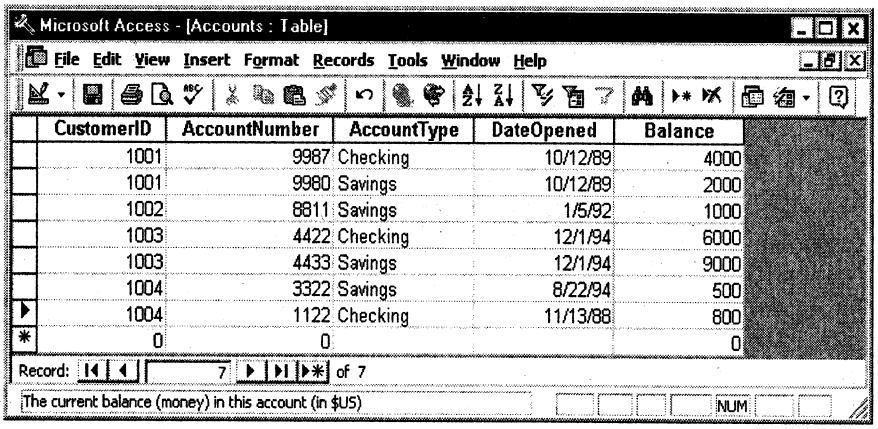


Figure 15.15 www.technet.microsoft.com

At this point in the tutorial, we have created two tables, Customers and Accounts, and added data to each one. In the subsequent sections, we will cover how to query and report on the data in the tables and how to create a user-friendly data entry form using the Access wizards.

Self Assessment: 15.1

1. Classify the following
   - Table design view
   - Primary key
2. How can define primary key for particular field.
3. Discuss How can add the data into the table.
4. Design a data base table for personnel use using any real life example.

15.7 Creating Relationships Between Tables

Recall that one of the main characteristics of relational databases is the fact that all tables are related to one another. In the Bank database thus far, the Customers table is related to the Accounts table by virtue of the CustomerID field appearing in both tables. Access has a means to make this relationship explicit using the Relationships screen. Access uses this information when designing reports, forms and queries that require more than one table to be displayed.

To get started, display the Relationships screen by pulling down the Tools menu and selecting the Relationships menu item. The blank Relationships screen will appear as follows:

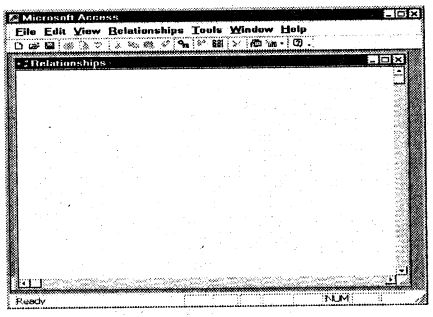
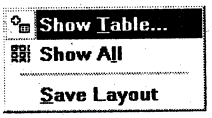


Figure 15.16 - Source: academictutorials.com

The next step is to display all of the tables on the relatinoships screen. Right click anywhere on the Relationships screen and select the Show Tables... option from the



When the Show Table dialog box appears, highlight both the Customers table and the Acounts table as shown below and then click on the Add button.

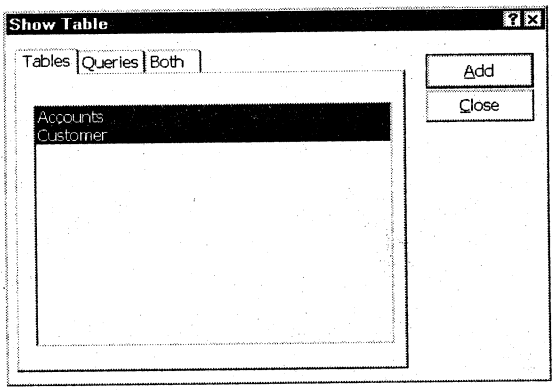


Figure 15.17 - Source: academictutorials.com

Then click on the Close button to close this dialog box. The Relationships screen will now reappear with the two tables displayed as below:

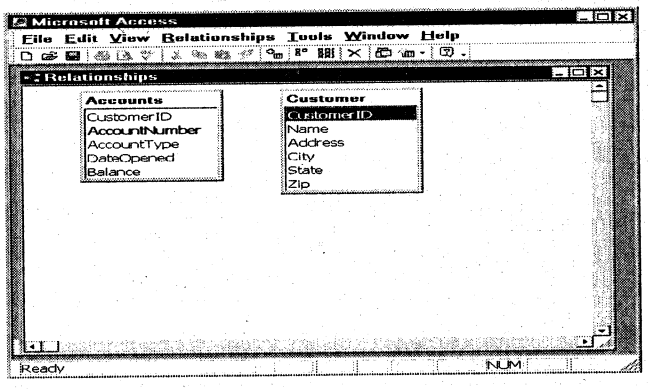


Figure 15.18 - Source: academictutorials.com

To connect the Customers table with the Accounts table to form a relationship, click on the CustomerID field in the Customers table and drag it over on top of the CustomerID field on the Accounts table. Upon releasing the mouse button, the Edit Relationships dialog box will appear as below:

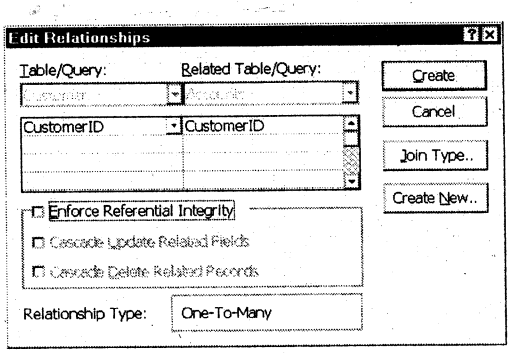


Figure 15.19 - Source: academictutorials.com

Access will do its best to determine the Relationship Type (almost always *One-to-Many*). For this example, Access knows that CustomerID is a key of the Customer table so it chooses this field as the "One" side. This makes the Accounts table the "Many" side as *One* customer may have *Many* accounts. One additional step to be taken is the check off the box labeled "Enforce Referntial Integrity". This option puts constraints into effect such that an Accounts record can not be created without a valid Customer and Access will also prevent a user from deleting a Customer record if a related Accounts record exists. At this point, click on the Create button to create the relationship. The Relationships screen should reappear with the new relationship in place as follows:

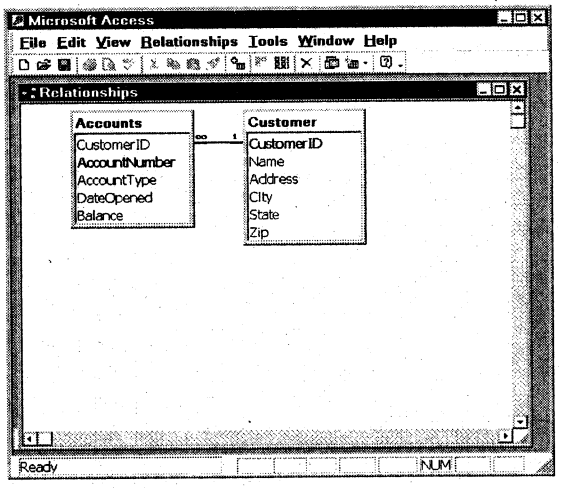


Figure 15.20 - Source: academictutorials.com

15.8 Review of Creating and Viewing Tables

Creating a new table requires the following steps:

1. Click on the **Tables** tab on the Access main screen
2. Click on the New button.
3. Choose the **Design View** and click the OK button.
4. Fill in the name, data type and description of each of the fields in the table.
5. Designate a primary key by clicking on one of the fields with the right mouse button and then choose Primary Key from the pop-up menu.
6. Save the table by pulling down the File menu and choosing Save.
7. Close the new table by pulling down the File menu and choosing Close.

To change the design of an existing table (e.g., to add, change or delete a field):

1. Click on the **Tables** tab on the Access main screen
2. Highlight the name of the table to be modified and click on the Design button.
3. Make the necessary changes.
4. Save the table by pulling down the File menu and choosing Save.
5. Close the table by pulling down the File menu and choosing Close.

To add, delete or change data in an existing table:

1. Click on the **Tables** tab on the Access main screen
2. Highlight the name of the table to be modified and click on the Open button.
3. Make the necessary changes to the data.
4. Save the table data by pulling down the File menu and choosing Save.
5. Close the table by pulling down the File menu and choosing Close.

To create or edit relationships between tables:

1. Pull down the Tools menu and select the Relationships menu item.
2. To display tables, right click and choose Add Tables
3. To create new relationships, drag a key field from one table and drop it on the associated field in another table
4. To edit an existing relationship, double click on the relationship line.

To delete an existing relationship, click on the relationship line and press the delete key.

CustomerID	**Name**	**Address**	**City**	**State**	**Zip**
Number	***Character***	***Character***	***Character***	***Character***	***Character***
1001	Mr. Smith	123 Lexington	Smithville	KY	91232
1002	Mrs. Jones	12 Davis Ave.	Smithville	KY	91232
1003	Mr. Axe	443 Grinder Ln.	Broadville	GA	81992
1004	Mr. & Mrs. Builder	661 Parker Rd.	Streetville	GA	81990

Table 15.5 - Example of Accounts Table:

Income Table

CustomerID	**AccountNumber**	**Transaction_Date**	**Amount**
Number	***Number***	***Date***	***Number***
1001	9987	11/6/1989	3400.00
1001	9980	10/7/1989	12000.00
1002	8811	13/02/1992	1100.00
1003	4422	11/2/1994	1600.00
1003	4433	2/09/1994	900.00
1004	3322	05/20/1994	5120.00
1004	1122	10/30/1988	808.00

Table 15.6 - Example of Income Table:

Expenditure Table

CustomerID	AccountNumber	Transaction_Mode	Transaction_Date	Amount
Number	*Number*	*Character*	*Date*	*Number*
1001	9987	DD	11/6/1989	3400.00
1001	9980	Cheque	10/7/1989	12000.00
1002	8811	Cheque	13/02/1992	1100.00
1003	4422	Cash	11/2/1994	1600.00
1003	4433	DD	2/09/1994	900.00
1004	3322	Cash	05/20/1994	5120.00

Table 15.7 - Example of Expenditure Table:

The Customer table has 6 columns (CustomerID, Name, Address, City, State and Zip) and 4 rows (or records) of data. The Accounts table has 5 columns (CustomerID, AccountNumber, AccountType, DateOpened and Balance) with 7 rows of data.

The Income table has 4 columns (CustomerID, AccountNumber,

Transaction_Date,Amount.)with 7 rows of data.

The Expenditure table has 5 columns (CustomerID, AccountNumber, Transaction_Mode,Transaction_Date,Amount) with 6 rows of data.

- Each of the columns conforms to one of three basic *data types*: Character, Number or Date.

In some database implementations other data types exist such as Images (for pictures or other data). However, the above three data types are most commonly used.

15.9 Application Development With Microsoft Access

Let's define what we will be doing:

- **Application:** a series of programs or computer codes that execute tasks that a user wants done.

  Maintaining a list of your friends' addresses and phone numbers is a personal application. Producing the weekly payroll for 100 employees of a business is a commercial application. Running a computer model to forecast tomorrow's weather is a scientific application.

- **Development:** design, create, make, build all the parts of the application. **Analyze:** talk to the client (the user) to find-out what he wants. If you don't have a user handy, use your imagination and prior knowledge to guess what a user would want. **Design:** create a **model** of the system. A model is like a blueprint to a builder. It is a drawing or a description of some kind of what the system will look like when finished. When you determine how things will work and how problems will be solved. You do that **before** youstarttowritecomputercode.

  Create: write the application using the software - Access, in this case. And while you're creating you're also testing and debugging to make sure that what you create works the way it's supposed to work.

- **Microsoft Access:** Access is part of Microsoft Office. However, it is not included in the basic suite with Word and Excel. You need to get **Microsoft Office Professional Edition** to have Access. Obviously, if you intend to do this tutorial we have to assume that you have access to Access. It really is impossible to do otherwise.We are using Access 2000. You could do just as well with Access 97. Any application created in Access 2000 can be converted to the previous version of Access and any application created in Access 97 can be used in Access 2000. The sample applications are all in Access 2000.

The "Video Store"

To illustrate how to use Access in a commercial application we'll use a marketing that almost everyone is somewhat familiar with: the local video rental store. Let's say that the store, **Mike's Video**, is going to open for business in a few weeks and the owner, Mike, wants to have a database application ready to go for opening day. You, **the Analyst**, will sit down with Mike and you will question him on what he wants to get from the computer application. Then you will draw the plans for the application, which we call **the model**, and you will check with him again to make sure you haven't forgotten anything. Only then will you actually start to write the application in Access.

15.10 Techinal Requirements Design

Now we look at what we should put in so that the application works as smoothly as possible with the computer - speed, error-checking, flexibility for future growth, standard design practices. Here are the things that you have to identify:

1. The **primary key** for each table: the field that will identify each individual in a unique way. Customers: First name? No - there are thousands with the same First name. Same with Last Name. And City, and State, etc. Phone number might be a candidate but, you may have 2 memberships in one family with the same phone. So we'll create a new field. We'll assign a unique ID to each customer when he registers. Since the ID doesn't have to be anything in particular we'll make it **autonumber**, meaning that the first customer will automatically get ID=1, the second will be ID=2, etc.Then we do the same for Movies. The **prime directive** for database design: **Every table must have a primary key.**
2. **Lists**: any field that contains a limited list of items. Obviously not First name or Last name. But **State** contains a list of 50 items. Identifying it as a List will help us down the line. It will avoid errors: with a list you select from the list instead of keying-in the state; if you want Maine, you select "ME" and you don't risk entering "MA" by mistake. And, if items are added to the list, it can be done easily. That probably won't happen too often with State (maybe Canada, eh!) but it will be more frequent with other fields. Other List fields will include: Sex, Credit card name, Movie Category, Rating, Language. The rule is: **any field that can be a list, should be.**
3. **Default values**: the most common value for a field. If you know that 70% of customers are from Springfield, make the default for City = "Springfield". When you come to enter City for the customer, 70% of the time you will just do Enter to accept the default value. It helps cut down on mistakes.

Naming convention: a standard format for field names in your application. For example, I use the first letter of the table name as a prefix for field name

15.11 Commercial Requirements Design

This is the part where we identify what has to be done to make the application perform all the commercial functions it has to have. First, a word of warning: Since you're just beginning with this, we'll keep the exercise simple. We know that there are many functions that you can do in the video store: rent DVDs, rent VHS movies, rent games, buy previously-viewed movies, buy popcorn, chips and cola, rent machines, etc. We won't cover all of those. Which is what you should be doing when you do it for real: design the **core application** and get it working then, add other functions to it. Our core application is to track the rentals of movies, DVDs and games. We'll leave the popcorn and Pepsi for another session. The first thing you will discover is that there are 2 **entities** that you are working with. An **entity** is something you keep data on, an object that acts on other objects. In this application they are: **Customers** and **Movies**. We'll use the term "Movies" to describe our products even if they are DVDs or games or whatever. Now, take out your pencil and paper and make a list of all the data, we call them **fields**, that you have to keep for each entity.

15.12 Summary

Microsoft Access is a Relational Database Management System (RDBMS), designed primarily for home or small business usage.Access is known as a *desktop* database system because it's functions are intended to be run from a single computer. This is in contrast to a *server* database application (such as SQL Server), where it is intended to be installed on a server, then accessed remotely from multiple client machines.Microsoft (or MS) Access is a software package that you install just like any other software package, and is bundled as part of the Microsoft Office suite.

15.13 Abbreviations Used

RDBMS	:	A database consisting of relations.
Relationship	:	A association between two entities or rows.
Primary Key	:	A Candidate Key selected to be the key of a relation.
Candidate Key	:	An attribute or group of attributes that identifies a unique row in relation. One of the candidate keys is chosen to be the primary key.
Foreign Key	:	A attribute that is a key of one or more relations other than the one in which it appears. Used to represent relationship.

15.14 Key Words

- Primary Key - Each table should include a column or set of columns that uniquely identifies each row stored in the table. This is often a unique identification number, such as an employee ID number or a serial number. In database terminology, this information is called the **primary key** of the table.
- ONE-TO-MANY Relationship- the Suppliers and Products tables in the product orders database. A supplier can supply any number of products. It follows that for any supplier represented in the Suppliers table, there can be many products represented in the Products table. The relationship between the Suppliers table and the Products table is, therefore, a one-to-many relationship.

- Number - may only store numbers, possibly with a decimal point.
- Character - may store numbers, letters and punctuation. Access calls this data type **Text**.
- Date - may only store date and time data.

15.15 Hint / Key of SAQs

1. The **Tables** tab on the Access main screen the New button. the **Design View** and click the OK button. Fill in the name, data type and description of each of the fields in the table. Designate a primary key by clicking on one of the fields with the right mouse button and then choose Primary Key from the pop-up menu..Save the table by pulling down the File menu and choosing Save. Close the new table by pulling down the File menu and choosing Close
2. Unique key.
3. Data can be added, deleted or modified in tables using a simple spreadsheet-like display. To bring up this view of a single table's data, highlight the name of the table and then click on the Open button. In this view of the table, shown in the figure below, the fields (columns) appear across the top of the window and the rows or records appear below. This view is similar to how a spreadsheet would be designed

15.16 Questions for Practice

1. What is a database system ?What is its need?
2. What is good database Design ?
3. Create A Database Diagram?
4. Determine the purpose of your database ?
5. Define the following :
   (i) Primary key
   (ii) Candidate key
   (iii) Foreign key
6. How can Creating the table relationships?

15.17 Reference/Suggested Books

1 **Michael R. Groh, Joseph C. Stockman, Gavin Powell, and Cary N. Prague," Access 2003 Bible",** Publisher Wiley

2 **Laurie Ulrich Fuller, Ken Cook, John Kaufeld ,"Access 2003 For Dummies" ,** Publisher Wiley

3 **Matthew MacDonald ,"Access 2003 For Starters: The Missing Manual",** Publisher O'Reilly

Unit - 16

Ms-access Create Database In Marketing, Finances And Personal Areas

Outline of the Unit:

16.0 Objectives

16.1 Introduction

16.2 Technical Requirements Design

16.3 Database Table

16.4 Identifying The Table

16.5 Relationships and Datatypes

16.6 Working with Date Grid

16.7 Ensuring The Accuracy of Data

16.8 Summary

16.9 Keywords

16.10 Abbreviations

16.11 Self Assessment Question

16.12 Reference/Suggested Books

16.0 Objectives

After studying this unit, you will be able to:

- How to make Database table. And insert into data.
- The Use of Database in the day to day life.
- By the End of this unit the students will be able to create data base,insert data into data table,and the basic ideas regarding the data tables,entities,relationship,keys etc.

16.1 Introduction

The first thing you will discover is that there are 2 **entities** that you are working with. An **entity** is something you keep data on, an object that acts on other objects.

In this application they are: **Customers** and **Movies**. We'll use the term "Movies" to describe our products even if they are DVDs or games or whatever.

Now, take out your pencil and paper and make a list of all the data, we call them **fields**, that you have to keep for each entity. You should get something like this:

Why do you need the customer's DOB? If you want to analyze your sales by **age** you have to have it. Also, maybe you'll want to send your best customers a card on their birthday. It would be a nice touch! Same with sex. You need it to analyze by gender and maybe orient your publicity towards certain target groups. This assumes that you can get the information. When you ask the customer originally to fill-in a **membership form** you will ask for that information. If the customer refuses to

give it, that's OK. You don't make a federal case out of it. But 95% of people will give you what you ask for on the form. For the movies, you keep what might be important if it's not too much trouble to obtain it. Maybe customers will want to know what movies starring "Tom Cruise" you have. Or Spielberg movies. Maybe there is a Film Studies program at a college nearby and they will want to know which Hitchcock movies from the 1960s you carry. The idea of **Sales Analysis** is that if you know your customers, you know their needs and you give them what they want, they'll come back as customers. The more customers you have, the more money you make. Simple, isn't it! So, the database is designed to store as much description of the customer and of the product as possible. We can then use that information to build customer profiles and to track daily or weekly or monthly sales and identify patterns. As soon as something is starting to go off-track, the manager can take corrective action.

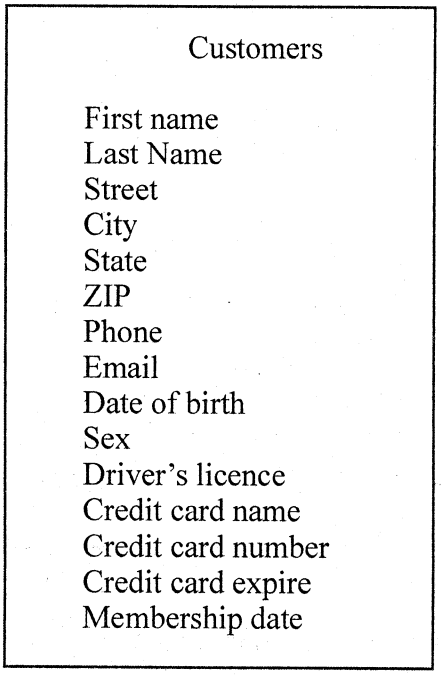


Figure 16.1 - Source: www.lisisoft.com

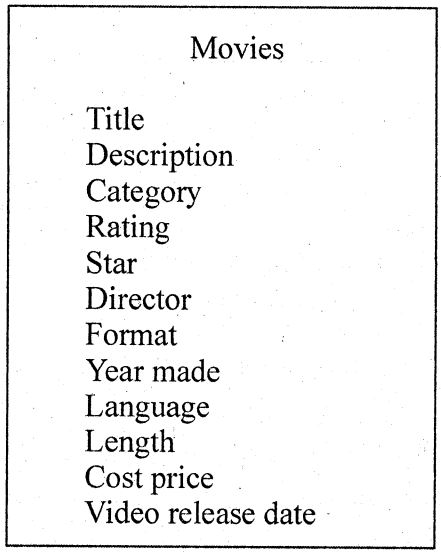


Figure 16.2 - Source: www.lisisoft.com

This is just the beginning in your career path to bigger and better databases. Right now on the market there are databases containing many **terabytes** of information (a terabyte = 1,000 gigs). There are applications called **Data warehousing** and **Data mining** that dig through those mountains of data looking for shopping trends, customer buying patterns, etc. This is going to be BIG!

16.2 Technical Requirements Design:

Now we look at what we should put in so that the application works as smoothly as possible with the computer - speed, error-checking, flexibility for future growth, standard design practices.Here are the things that you have to identify:

1. The **primary key** for each table: the field that will identify each individual in a unique way. Customers: First name? No - there are thousands with the same First name. Same with Last Name. And City, and State, etc. Phone number might be a candidate but, you may have 2 memberships in one family with the same phone. So we'll create a new field. We'll assign a unique ID to each customer when he registers. Since the ID doesn't have to be anything in particular we'll make it **auto number**, meaning that the first customer will automatically get ID=1, the second will be ID=2, etc. Then we do the same for Movies.The **prime directive** for database design: **Every table must have a primary key.**
2. **Lists**: any field that contains a limited list of items. Obviously not First name or Last name. But **State** contains a list of 50 items.

   Identifying it as a List will help us down the line. It will avoid errors: with a list you select from the list instead of keying-in the state; if you want Maine, you select "ME" and you don't risk entering "MA" by mistake. And, if items are added to the list, it can be done easily. That probably won't happen too often with State (maybe Canada, eh!) but it will be more frequent with other fields.

   Other List fields will include: Sex, Credit card name, Movie Category, Rating, Language.
   The rule is: **any field that can be a list, should be.**
3. **Default values**: the most common value for a field. If you know that 70% of customers are from Springfield, make the default for City = "Springfield". When you come to enter City for the customer, 70% of the time you will just do Enter to accept the default value. It helps cut down on mistakes.

- **Naming convention**: a standard format for field names in your application. For example, I use the first letter of the table name as a prefix for field name: c_custID for customer ID, c_Fname for customer first name.

  The reason is that eventually, when you get into many tables, you will run into duplicate field names. If you create a Supplier table, the Supplier may also have a First name. When you program the application it will be a lot easier if you can tell one from another at a glance: **c_Fname** will be Customer_First_name and **s_Fname** will be Supplier_First_name.

16.3 DATA Base Table:

- **The new "MikeVideo" database**

To your keyboards. **Start Access!**

Do you want to open an existing database or create a new one. If this is your first session, you want to **create a new database**. And, because you want to learn something from the ground up, you **won't use the wizards,** pages and projects which are the database-creation templates.

Once you've mastered the concept, then you can use the shortcuts and let Access guide you through the process.

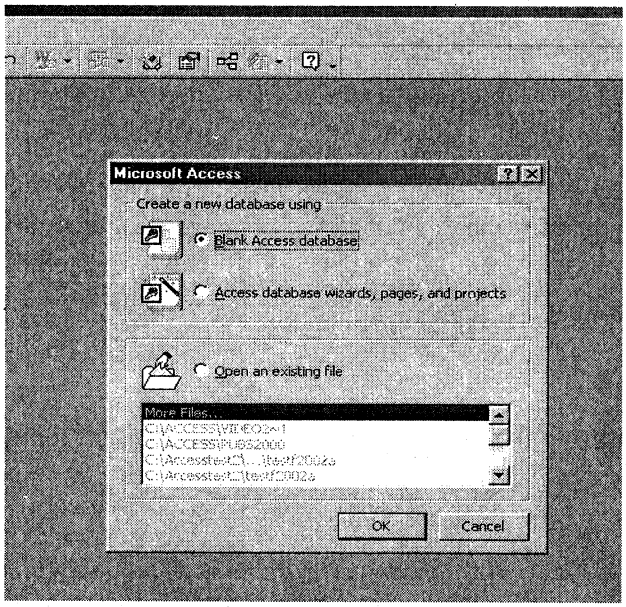


Figure 16.3 - Source: www.codeproject.com

And again, to make it interesting, just choose General Database.

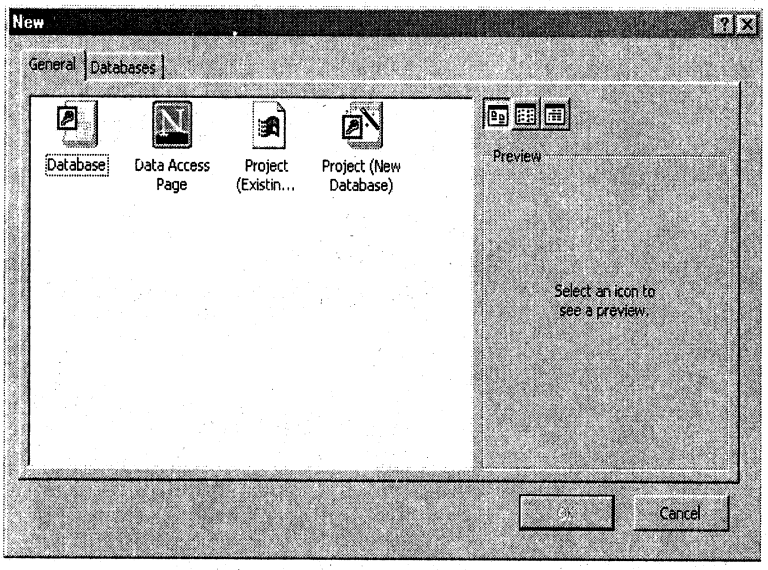


Figure 16.4 - Source: www.codeproject.com

Choose a name for the database and store it in a folder.

In Access, a database, no matter how many tables or forms or reports it contains, is stored in a single file. That file has the extension: **.mdb** (for Microsoft **d**atabase). When you want to move or copy or delete the database, all you have to do is work with the one file.

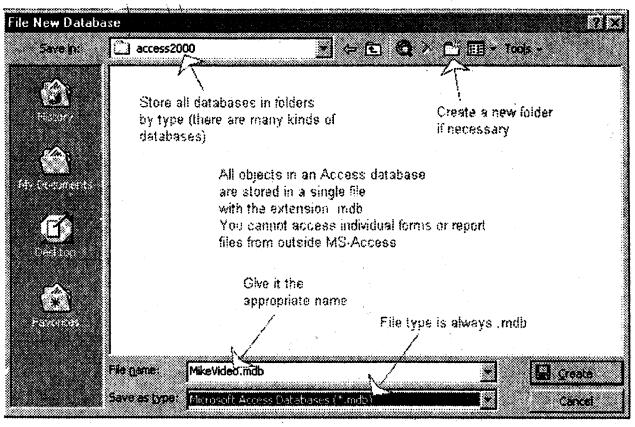


Figure 16.5 - Source: www.opengatesw.net

So far, you have an empty database.The first object you create to define the database is the **table**. A table is the description of an entity. It is used to store the data. When you create the table you first describe its **structure**. A table in Access is sort of like a spreadsheet in Excel: it consists of rows and columns. Only, it is more organized than a spreadsheet and that organization will later allow you to retrieve the data in all kinds of ways.

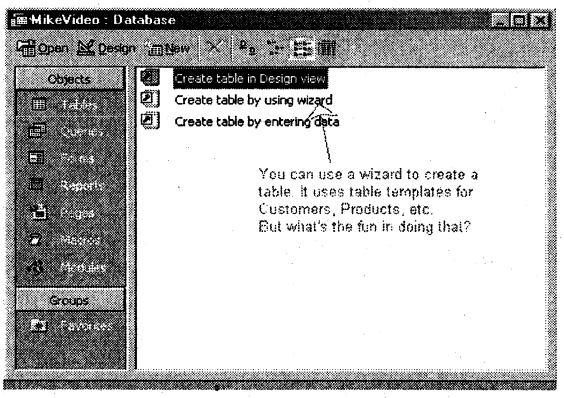


Figure 16.6 - Source: www.opengatesw.net

The **design view** of the table is meant to define the **structure**.You name all the columns (in technical jargon they would be called **attributes of the entity**). Remember to use the prefix for the table, in this case **c_** because it's the **C**ustomers table.

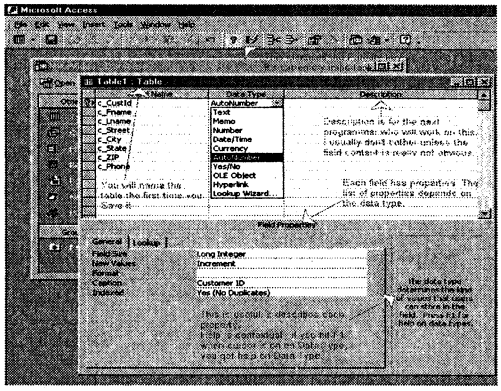


Figure 16.7 - Source: www.opengatesw.net

Then, choose a **Data Type** for each column.

The Data Type defines what kind of data will be contained: text, numbers, URL, dates, etc. This lets the system know how much memory to reserve and also, what you are allowed to do to the data. For example, if you specify that a column is a "Number" type, you won't be allowed to put "XYZ" in it.

To see the data types available, click on the Data Type column and do F1 (the Help function). Here's what you should get:

And here are the basic rules on how to use Datatype:

- When you define a **primary key field** and it doesn't matter what the format is, use **AutoNumber**. If the identifier is formatted, like A9-1234, use **Text**.
- When the data is a **date** of any kind, Date of birth, Date hired, Invoice date, etc., you have to use the **Date/Time** data type.
- Most fields will be **Text**. Even a phone number (it contains a dash), or department number that happens to be 101.
- Use **Number** only for fields that will be used in calculations (+ - * /) like quantities or salaries. If it does not have to be calculated, use **Text**. Even if the Department_number is 101, define it as text: it's not the number one hundred and one, it's the characters "1""0""1". Believe me, it will make your life easier.
- Use **Memo** when the Text field may be too big. If you are doing a Patients table for a Doctor, the **Diagnosis** field should be Memo.
- Whenever a field has only a yes/no answer, use the **Yes/No** type. For example: Paid?, Member?, Active?

Before starting to enter data, you should define the data formats in the **Windows Control Panel**.Access gets its formatting information from Windows. If you want dates to automatically display as YYYY-MM-DD, as you should, you set that property in Windows. The same for currency and number formats. Different countries have different ways of displaying those types so, you set them for your country in the Windows environment.

The **Properties** at the bottom will usually be acceptable for the data type you selected. But, to simplify things later there is one property you should indicate: **Caption**. The **Properties** at the bottom will usually be acceptable for the data type you selected.But, to simplify things later the is one property you should indicate: **Caption**. The Caption is the name that will show for the column on forms and reports and so on. If there is no caption, the Field Name is used. So, if you want forms to show "Customer ID" instead of c_custID, define the caption.

Now, complete the Table, as defined in the **model** from Lesson 2, adding all the fields required. Before you save the Table, make sure the **Primary key** is identified. To do that, click on the grey button to the left of c_CustID and that should select the whole row. Then click on the **key in the toolbar**. That should put a little key symbol on the grey button, identifying that field as the Primary key.Save the table and, if this is the first Save, it will ask you to name it (don't keep Table1 as a name!).

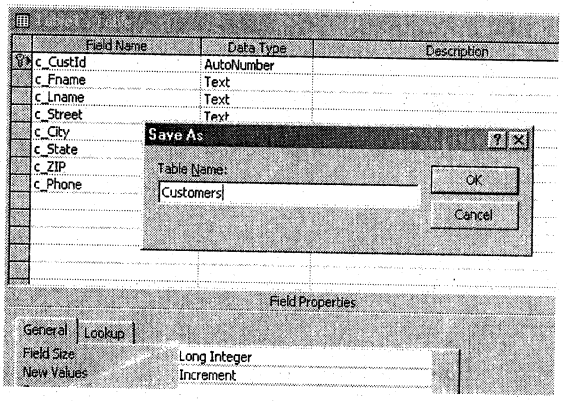


Figure 16.8 - Source: www.access-databases.com

Finally, **repeat the whole process with the Movies table** and you will be well on your way.

16.4 Identifying the Tables

These are the tables you should have.

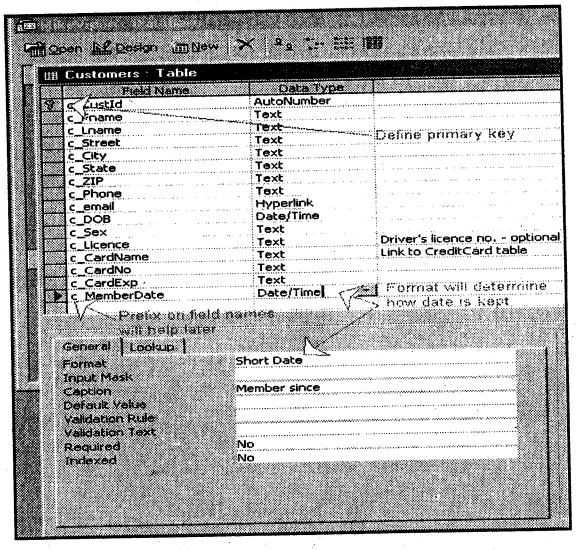


Figure 16.9 - Source: www.access-databases.com

Note that there are several fields in both tables that refer to Links to other table. The reason for that is that Relationships are very powerful in database design.Let's look at the case of credit cards in the Customer table.

If you have to keep a record of the customer's credit card name, number and expiry date you will create 3 fields in the table. Obviously, card number and date will be individual but, you may have 2,000 customers with Visa. When you enter the customer's record you could just type "Visa" for the card name. But what if the person keying the data keys "Viza" instead, or " Visa", or "Vissa", or ..... If, later on you have to have a list of all customers with a "Visa" card, all those entered incorrectly won't show-up.And what if Visa decided to change its name to VizaCard? You would have to go through the records and change 2,000 customers.

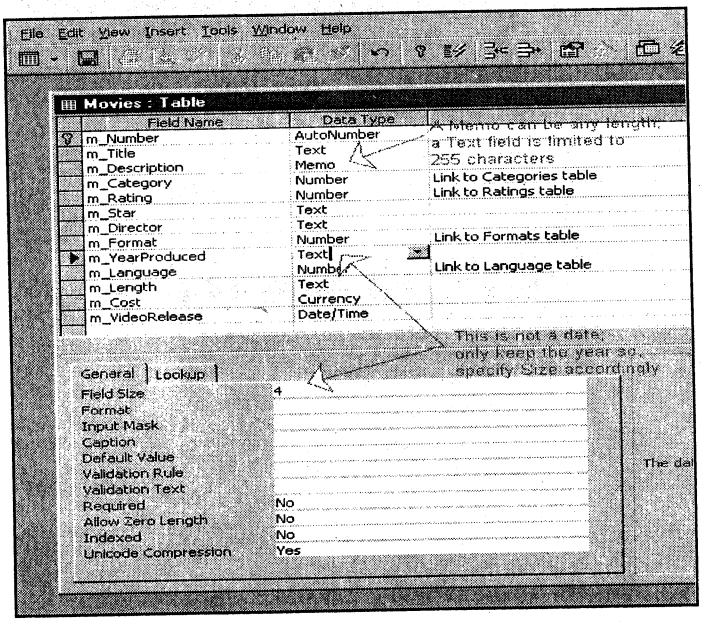


Figure 16.10 - Source: www.access-databases.com

The solution to those problems is: don't key the card name into the record, select the name from a list, and the list will come from another table.In this case, we create a CreditCard table and it will contain only a list of credit cards that we will accept. The customer record won't actually contain the credit card name, it will contain a pointer to the CreditCard table. If ever a card company changes its name, we only need to change the name in the CreditCard table and all customers who point to that name will automatically be changed.

The solution to those problems is: don't key the card name into the record, select the name from a list, and the list will come from another table. In this case, we create a CreditCard table and it will contain only a list of credit cards that we will accept. The customer record won't actually contain the credit card name, it will contain a pointer to the CreditCard table. If ever a card company changes its name, we only need to change the name in the CreditCard table and all customers who point to that name will automatically be changed.

16.5 Relationships and Datatypes:

One crucial point you have to keep in mind when describing relationships: the link is **always** from the primary key of one table to a field in another table. The primary key can be any type field - in CreditCards it's a Text(50) field. The other end of the relationship **must contain a field of the same type and size**. So, in the Customers table, c_CardName must also be a Text(50) field.

In the other tables we'll look at in a minute, the primary key is defined as an AutoNumber field. AutoNumber is not a type, it's a function. The **data type is Number** and the **Length is Long integer**. In those relationships the other end of the link must also be defined as a Number field.

In all relationships involving an AutoNumber, the other field **must be a Number**. In the Language table l_No is AutoNumber so, m_Language in Movies is Number Long integer. A common mistake is to try to link two AutoNumber fields together.

- The CreditCard table doesn't have to be complicated, as you can see:

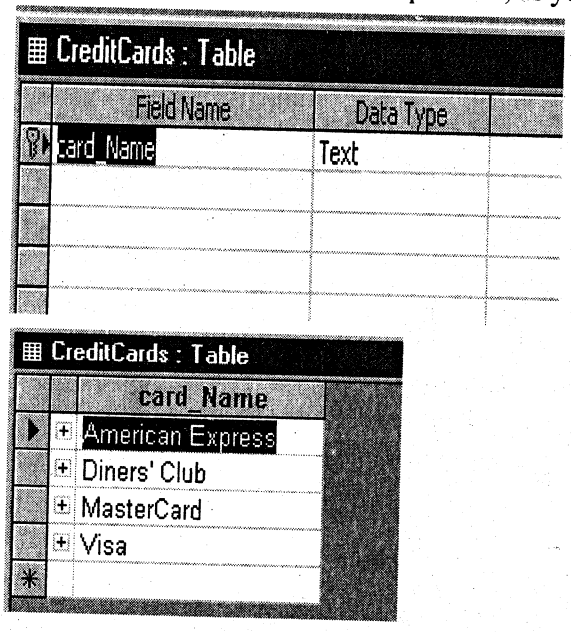


Figure 16.11 - Source: www. codefixer.com

To create the Relationship, hit the Relationships button on the toolbar:

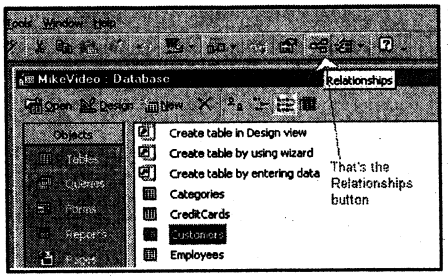


Figure 16.12 - Source: www. codefixer.com

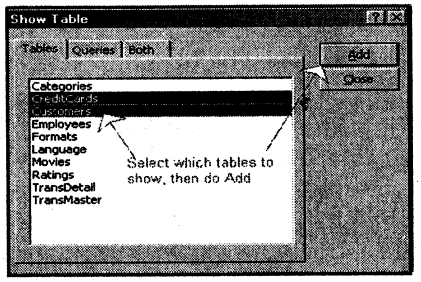


Figure 16.13 - Source: www. codefixer.com

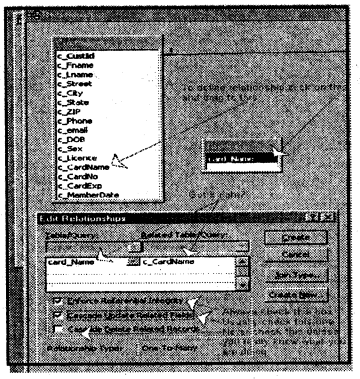


Figure 16.14 - Source: www. codefixer.com

Referential integrity: this is important; it means that you can't enter a credit card that is not in the CreditCard table; this keeps the data honest; you almost always want to do this.

Cascade update: if a card name changes, all customer records will be updated automatically to reflect the change; that's OK - usually you want this to happen.

Cascade delete: if you delete a credit card name from the CreditCard table, all customer records holding that card will be deleted; **you don't want that to happen**; don't check this box.

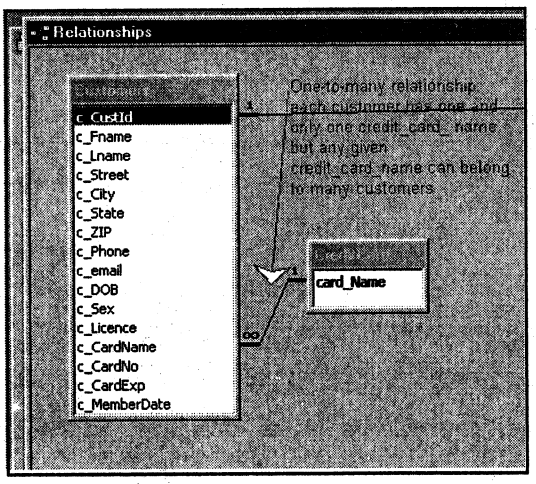


Figure 16.15 - Sourse: www. msdn.microsoft.com

Now, apply the same idea to the Movies table.

The fields: Category, Rating, Language, Format can all be stored in other tables and linked to Movies.The same principles will apply. If you add a new category, you add it only once to the Categories table. If a category name changes, you change it once, in the Categories table.

The only difference in those tables is that we've given each item in the list a number: 1 = Action, 2 = Romance, etc. The list will still work the same as the CreditCard table.

For example, the Language table:

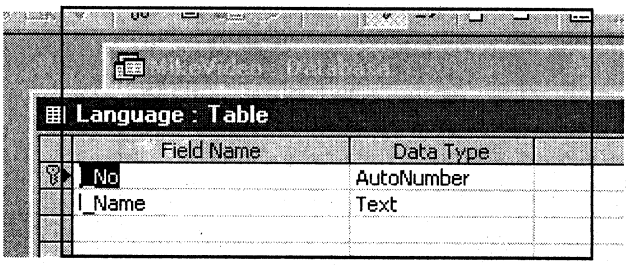


Figure 16.16 - Sourse: www. msdn.microsoft.com

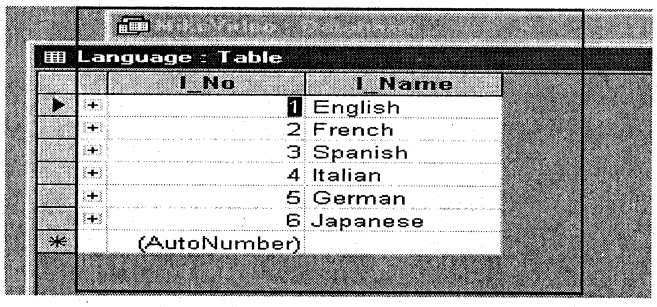


Figure 16.17 - Sourse: www. msdn.microsoft.com

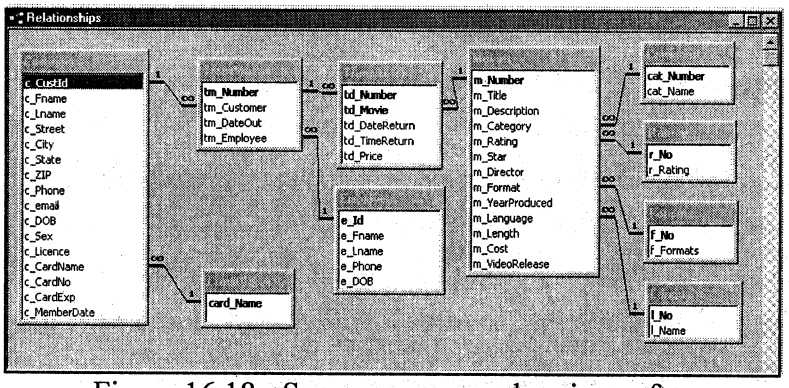


Figure 16.18 - Sourse: www. msdn.microsoft.com

16.6 Working with Data Grid:

When you have a large quantity of data to input, the data grid is not a bad way to go. You normally won't use this technique for day-to-day operations - we will create forms for that - but it is useful at startup.

You will have to modify some of the properties of the fields in the table to make the best use of all the functions. It is recommended to test the changes on a few entries at first.

You get the data grid when you click **Open** on a Table in the Database window.

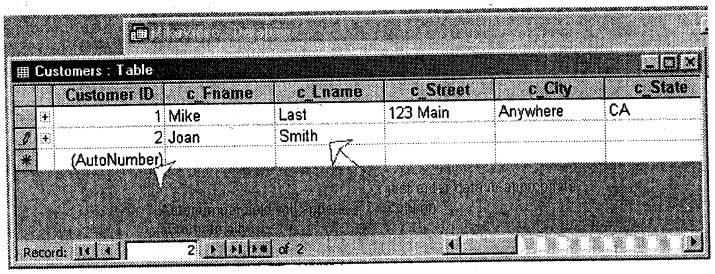


Figure 16.19 - Sourse: www. msdn.microsoft.com

The data grid acts like a spreadsheet. For people used to working with Excel it should look quite familiar. Even the tools used to manipulate the data are similar to those used for the spreadsheet.

16.7 Ensuring the Accuracy of DATA

AutoShapes basically include everything that can be inserted from the Drawing toolbar except pictures and clipart.

Default values and Validation are very important. They ensure that the information that gets into the database is as exact as possible.If there is a field where you see you will enter the same data more than 50% of the time, use a Default. It will display automatically and you only have to tab over it to accept it. If you have to change it, you just enter a new value over the default. A **Validation rule** is a check on the accuracy of the input. Sex can only be "M" or "F", for example. If a field had to be less tha 100 you would code the validation rule as: < 100.

If the operator makes a mistake on a validated field and there is no **Validation text**, chances are the system will display a weird error message ("You commited a fatal error! You will die!" can be somewhat intimidating.) The validation text is your way of telling the operator what he should have done.

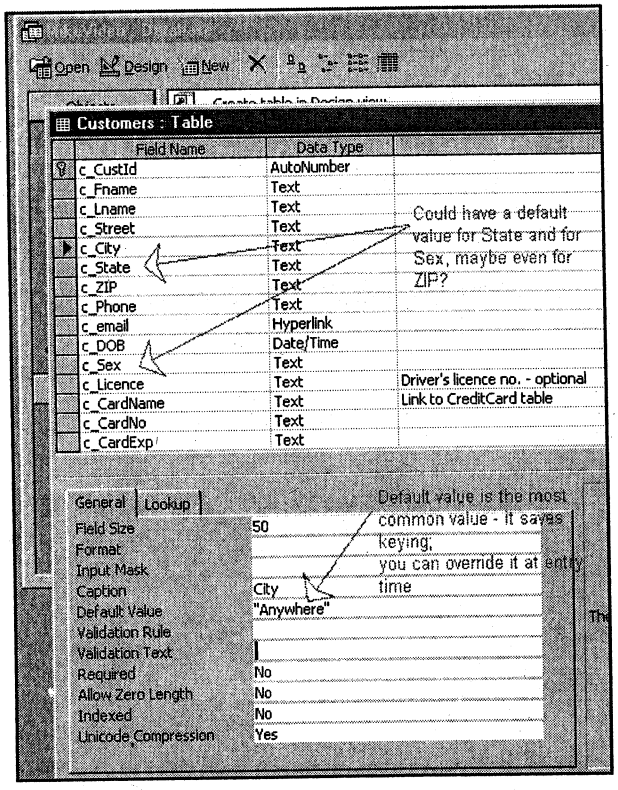


Figure 16.20 - Sourse: www. msdn.microsoft.com

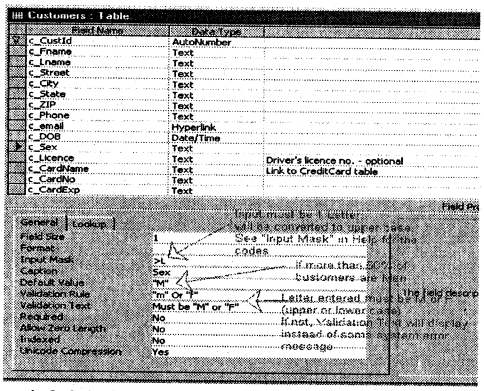


Figure 16.21 - Sourse: www. msdn.microsoft.com

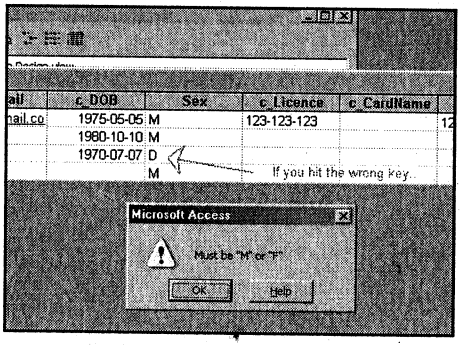


Figure 16.22 - Source: www.ccshops.com

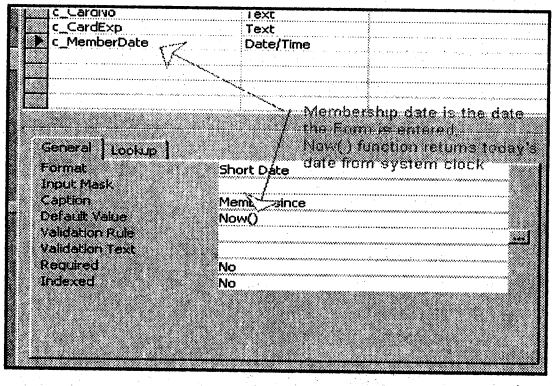


Figure 16.23 - Source: www.ccshops.com

Choosing the input from a list is a lot more exact than keying it. The table containing the list should already have been created. Just select the table.

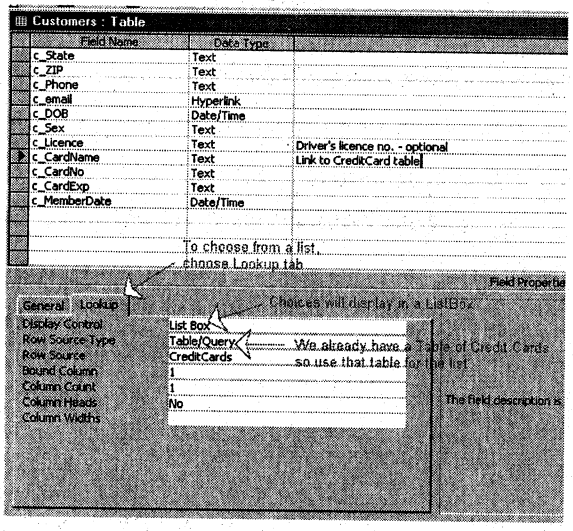


Figure 16.24 - Source: www.ccshops.com

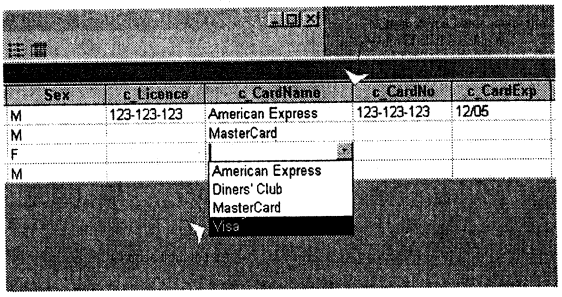


Figure 16.25 - Source: www.ccshops.com

If the table for the list contains more than one column (Language, for example), **Column count** will be 2 and **Bound column** will be 1. Bound column is the position of the column that will be saved in "Movies". The list will show "Language number" and "Language" but it is column 1, Language number that is saved.

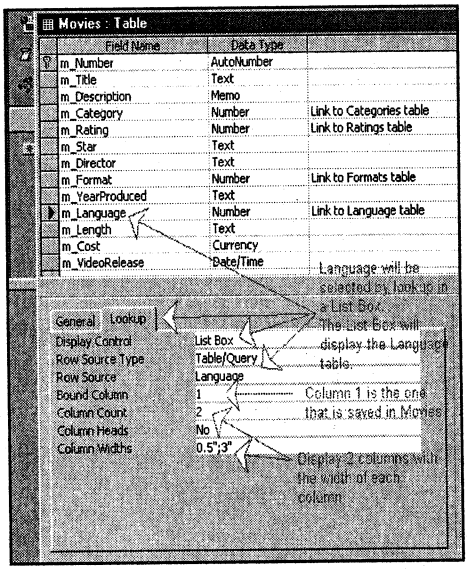


Figure 16.26 - Source: www.access-databases.com

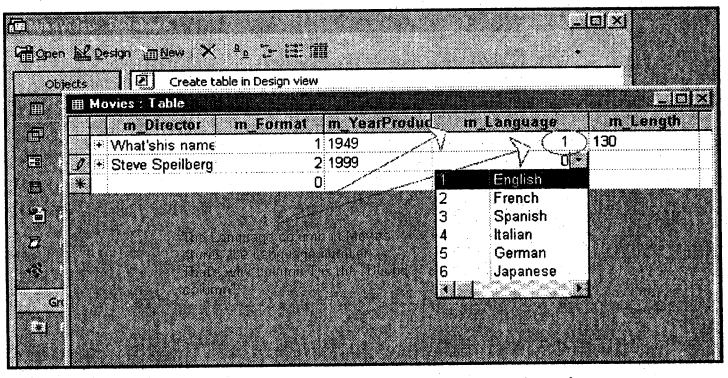


Figure 16.27 - Source: www.access-databases.com

Self Assessment Questions 16.1

1. Classify the following
   - Table design view
   - Two Types of time.
2. How can define primary key for particular field.
3. Discuss How can add the data into the table.

16.8 Summary

A **database** is a collection of objects that allow you to store data, organize it and retrieve it in any way you want ...What this means is that, with Microsoft Access you create structures called **tables** that allow you to organize the data so that it's easy to find later, you create **forms** that let you input the data into the tables and then you create **reports** that print selected information from the tables.

For example, if you run a store, you would create a **Customers table**, a **Products table** and an **Invoices table**. Then, when you open an account for a new customer you would have a **Customer form** to input a customer's data into the Customers table and an **Order form** to input the purchase information. Later, you could print any number of **Sales reports**, grouping and arranging the information from the Invoices, Customers and Products tables to analyze daily or weekly or monthly sales in all kinds of combinations.

16.9 Key Words

Alternate Key	:	A Candidate Key which is not primary key.
Attribute	:	A Column of a relation.
Base Table	:	A table having an independent existence; represented in storage by a distinct stored file.
Data Independence	:	Ability to modify a scheme definition within a database without affecting other scheme definitions.
Data Redundancy	:	Duplication of data.
Database	:	Collection of interrelated data.Database System A computer based recordkeeping system.
Degree	:	Number of attributes in a relation.
Domain	:	A pool of values from which the actual values appearing in a given column Logical Data Independence : The property of being able to change the overall logical structure of the database without changing the application program's view to data.
Physical Data Independence	:	The property of being able to change the physical structure of the data without changing the logical structure.
Physical Database	:	A database in the form in which it is stored on the storage media, including pointers or other means of interconnecting it.
Primary Key	:	Set of one or more attributes that can uniquely identify tuples within a relation.
Relational Algebra	:	A language providing a set of operators for manipulating relations.
Referential Integrity	:	A relationship constraint in foreign key values. a referential integrity constraint specifies that the value of a foreign key must be subset of the value of the primary key to which it refers.
Tuple	:	A row of a relation.

16.10 Abbreviations

DBMS (Data Base Management System)

DDL (Data Definition Language)

DML (Data Manipulation Language)

16.11 Self Assessment Questions

1. What is a database? And what is its need?
2. A database is to contain information about persons and skills. At a particular time the following persons are represented in the database, and their skills are as indicated.

Person	*Skills*
Anuj	Programming
Bhawna	Operating and Programming
Chetan	Engineering and Programming
David	Operating and Engineering

   For each person, the database contains various personal details, such as address. For each skill it contains an identification of the appropriate basic training course, an associated job grade code, and other information. The database also contains the date each person attended each course, where applicable (the assumption is that attendance at the course is essential before the skill can be said to be acquired).

   Sketch a relational view for this data.

3. A database is to contain information concerning sales representatives, sales areas, and products. Each representative is responsible for sales in one or more areas; each area has one or more responsible representatives. Similarly, each representative is responsible for sales of one or more products, and each product has one or more responsible representatives. Every product is sold in every area; however, no two representatives sell the some product in the same area. Every representative sells the same set of products in every area for which that representative is responsible. Design a suitable relational structure for this data.

16.12 Reference /Suggested Books

www.access-databases.com

www.ccshops.com

www.msdn.microsoft.com

www.codeproject.com

www.lisisoft.com

ISBN13/978-81-8496-296-3