MP-203

Vardhaman Mahaveer Open University, Kota

Management Information System

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CONTENTS

Management Information System

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Unit – 1 : Management Information System - Concept

Unit Structure:

1.0 Objectives

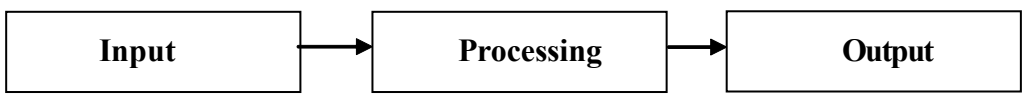
After going through this unit you would be able to:

- Understanding the concept of systems.
- To Study the various types of systems.
- To Study the information system.
- Understand the concept of Management Information System.
- Understand the need and value of information for an organization.
- Understand the significance of MIS in decision making.
- Understand the nature, scope, and importance of MIS.
- Bring out the main features of Management Information System.

1.1 Introduction

System is collection of component connected to each other to achieve common goal to accomplish a specified purpose. In other word everywhere around us we have some of the other system. System can be define a entity collection of part called entities related to each other to perform a pre define task or common objective any faulty component will affect performance of the system in achieving the objective of the system. For examples we touch and feel various physical objects with the help of nervous system which consist of our brain, spinal cord, naves, sensitive cell in our skin which work together to give us idea of the object smooth, rough, oily etc.

System can be represented as three basic component as shown.



Here the relationship of the various component used in the processing describe objective achieved in the form of generated output for a given input. It means the component, their relationship and objective are the essential element to describe the system. If any of these three element gets changed the performance of the system get effected resulting disorder in the system.

The definition of system can be applied to businesses also its various component are manufacturing, marketing, finance, which work for the profit that benefits the employees and stack holders. A system may consist of subsystem also like manufacturing subsystem consist of various plant, machinery etc.. Information systems play a crucial role in the management of any contemporary enterprise such as small, medium or large organization, a profit making or a social service set up, a public or private sector undertaking, a manufacturing or a service organization, a local or a global corporation, and an upcoming or an established business house. The fast changing scene of liberalization, competition and globalization combined with a never before seen emphasis on quality, timeliness, innovation, customer orientation and efficiency puts a premium on accurate , superfast, and timely dissemination of information across the globe. The unprecedented developments in computing and communication technologies have indeed made such demands translatable into realizable goals. Thus, a large portion of the world population has its stake in information systems. Invariably such systems are computer based. One of the computer based system which is used as a controller, organizer, and director in an organization is a 'Management Information System'.

The Management Information System (MIS) is an integrated man-machine system that provides information to support the planning and control functions of managers in an organization. MIS can also be defined as the combination of human and computer based resources that results in collection, storage, retrieval, communication and use of data for efficient management of operations and for business planning.

MIS is something more than just a computer system. Before the evolution of computers, MIS techniques existed to supply users with information that would permit them to arrive at an effective decision. The computer has added new dimensions such as speed, accuracy and data processing of massive data that permit the consideration of more alternative in a decision.

1.2 System Concept

A system is a group of interrelated components working together towards a common goal by accepting inputs and producing outputs in an organized transformation process.

A system has three basic interacting components:

(i) Input involves capturing and assembling elements that enter the system to be processed. For example raw materials, energy, data, and human effort must be secured and organized for processing.

(ii) Processing involves transformation process that convert input into output. Examples are a manufacturing process, the human breathing process and data calculations.

(iii) Output involves transferring elements that have been produced by the transformation process to their ultimate destination. For example finished products, human services and management information must be transmitted to their users.

The systems concept can be made even more useful by including two additional components: Feedback and control. Feedback is data about the performance of a system. Control is a major system function to control the performance of the system.

In this we monitor and evaluate feedback to determine whether the system is moving toward the achievement of its goal. It then makes any necessary adjustments to the input and processing components of the system to ensure that proper output is produce.

Feedback is frequently included as part of the concept of the control function because of the essential role feedback plays in control.

Detecting feedback with sensors of some kind.

Measuring the size, quantity, direction, or intensity of the feedback.

Comparing the results to the established standards of proper performance.

Transmitting control signals that initiate corrective actions to adjust the activities of other system components and

Bringing system performance "under control," that is, back within an acceptable range of performance that leads to the attainment of system goals.

A system is surrounded by environment and the line which separate environment from system is called system boundary.

1.2.1 Types of system

System can be classified into various category on the basis of nature, output, environment as follow:

1) Deterministic and Probabilistic System: A deterministic system is a system which works according to predetermined set of rule / activity. The behavior of the system can be predicted. Systems were result cannot be determined exactly but only with probability. Example computer control process is deterministic system. Where as performance of the operator control process is probabilistic.

2) Open and Closed System : Closed system is that system in which any happening in the environment does not effect on the performance of the system. For example prior to 1991 Indian economy is closed system. When any event or activity in the environment effect the performance of the system is called open system. For example demand of a product increases in the absences of availability its competitor products.

3) Natural and Man-made System : A system which consist of all the natural entity is called natural system for example ecology. Manmade system a system created by human being is called manmade system for example transporting system, manufacturing system etc.

4) Tangible and Intangible System : A system which consist of physical object is called tangible system for example in manufacturing system conversion of raw material in finished goods. A system which consist of intangible objects is called intangible system. For example flow of information in the manufacturing system is intangible system. Computer system is classic example of tangible system were operating system and programs represent intangible system.

It is important to understand information systems in the context of their use in information processing. The processing of data to make it more usable and meaningful. thus transforming it into information. Data is raw facts and figures and defined as raw facts or observations, typically about physical phenomena or business transactions. More specifically, data are objective measurements of the attributes (the characteristic) of entities (such a people. places. things. and events). Information can be defined as processed data. The process that converts data into a meaningful and useful context for specific end users called information. the basis of decision making is information where as to argue for the decision we need to support it with data. information has got time value where as data remains data only ir-respect of time. In today's environment the success of business depends on the information available for decision making. Therefore businesses needs a system which provide information as per their requirement of the businesses.

1.3 Information System Model

An information system is collection of hardware (machines and media). software (programs and procedures) and people were (specialists and end users) to perform data input, processing output. storage and control activities that convert data resources into information products.

This information system model will help you tie together many of the facts and

concepts involved in the study of computer-based information systems. It emphasizes three major concepts.

(1) Hardware (machines and media), software (programs and procedures). and people (specialists and end users) are the primary resources needed to accomplish information processing activities in information systems.

(2) Data resources are transformed into a variety of information products by the information processing activities of information systems.

(3) Information processing consists of the basic system activities of input, processing, output, storage and control.

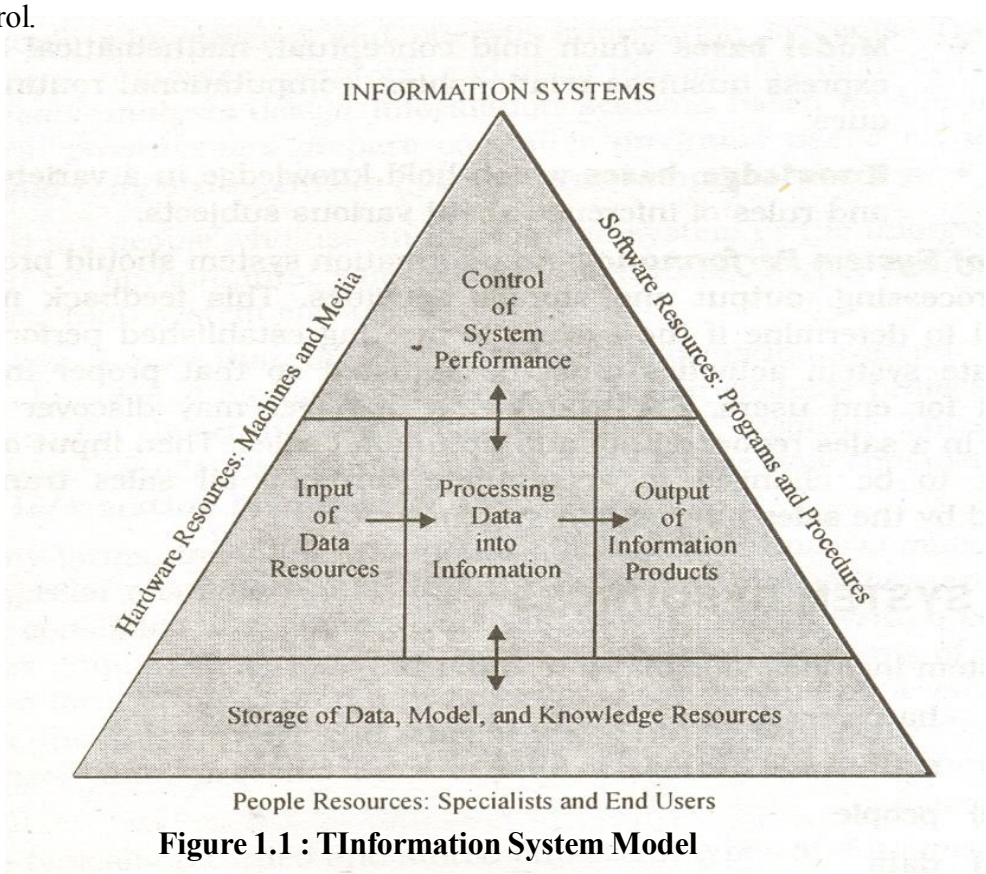


Figure 1.1 : TInformation System Model

(i) Input of Data Resources: Data about business transactions and other events must be captured and prepared for processing by the basic data entry activities of recording and editing. End users typically record data about transactions on some type of physical medium such as a paper form. or enter it directly into a computer system. This usually includes a variety of editing activities to assure they have recorded data correctly. Once entered, data may be transferred onto a machine-readable medium such as magnetic disk or tape, OCR,OMR's etc until needed for processing.

(ii) Processing of Data into Information: Data is manipulated by such activities as Calculating, Comparing, Sorting, Classifying, and Summarizing etc. These activities organize. analyze and manipulate data. Thus converting it into information for end users. The quality of any data stored in an information system must also be maintained by a continual process of correcting and updating activities.

(iii) An Output as Information Products: Information in various forms is transmitted to end users and made available to them in the output activity. The goal of information systems is the production appropriate information products for end users. Common information products are video displays. paper documents and audio responses that provide us with messages, forms, reports, listings, graphics displays etc. We use these information products to improve our personal and professional performances as we work in organizations and live in society.

(iv) Storage of Data, Model and Knowledge Resources: Storage is a basic system component of information systems. Storage is the information system activity in which data and information are retained in an organized manner for later use. For example. just as written text material is organized into words, sentences, paragraphs and documents stored data is commonly organized into fields. records. files and databases. .

Data and information are vital organizational resources that can be stored in information systems in the following forms:

Databases which hold processed and organized data.

Model bases which hold conceptual, mathematical and logical models that express business relationships, computational routines or analytical techniques.

Knowledge bases which hold knowledge in a variety of forms such as facts and rules of inference about various subjects.

(v) Control of System Performance: An information system should produce feedback about its input, processing, output and storage activities. This feedback must be monitored and evaluated to determine if the system is meeting established performance standards. Then appropriate system activities must be adjusted so that proper information products are produced for end users. For example, a manager may discover that subtotals of sales amounts in a sales report do not add up to total sales. Then input or processing procedures will have to be changed to accumulate correctly all sales transactions captured and processed by the sales information system.

(vi) Hardware Resources: The concept of hardware resources includes all physical devices and materials used in information processing. Specifically, it includes not only machines, such as computers and calculators but also all data media that is, all tangible objects on which data is recorded: from sheets of paper to magnetic disks. Examples of hardware in computer-based information systems are: Large mainframe computers, minicomputers, and microcomputer systems, Computer workstations which use a keyboard for input of data, a video screen or printer for output of information, and magnetic or optical disks for storage.

In recent time Telecommunications network has incorporated as separate set of hardware resources, which consist of computers, workstations, communications processors and other devices interconnected by a variety of telecommunications media to provide communication power throughout an organization.

(vii) Software Resources: The concept of software resources includes all sets of information- processing instructions. The generic concept of software includes not only the sets of operating instructions called programs which direct and control computer hardware. but also the sets of information-processing instructions needed by people which are called procedures. The following are examples of software: System software such as an operating system program which manages and supports the operations of a computer system.

Application software which are programs that direct processing for a particular use of computers by end users. Examples are an inventory program. A payroll program and a word processing program, that the information systems provide an organization with sup business operations, management decision making and strategic advantage.

(viii) Procedures and Methods: Which are operating instructions for the people who will use an information system, Examples are instructions for filling out a paper form or using a software package.

(ix) People Resources: People are required for the operation of all information systems. These people resources include specialists and end users. Specialists are people who develop and operate Information systems. They include systems analysts, programmers, computer operators, and 'other managerial. technical and clerical personnel. Basically, systems analysts design information systems based on the Information requirements of end users; programmers prepare computer programs based on the specifications of systems analysts; and computer operators operate large computer systems.

End users (or users) are people who use an Information system or the Information such a system produces. They can be accountants, salespersons, engineers, clerks, customers, or managers.

(x) Data Resources: Data is more than the raw material of information systems. The concept of data resources has been broadened by managers and information systems professionals. They realize that data and information constitute a valuable organizational resource. Thus. data and information stored in databases, model bases and knowledge bases are now considered to be part of the data resources or information resources of an organization.

1.3.1 Quality of Information

The information systems provide information to be use by various user. The decision based on this information effected by quality of information use for decision making. The information quality can be define with the help of following attributes

Accurate: Accurate information is free from errors

Complete: Complete information contains all important fact.

Economical: Information should also be relatively economical to produce.

Flexible: The information should be flexible enough to serve Varity of purposes

Reliable: Information should be dependable.

Relevant: Information should be for given criteria.

Simple: Information should simple to understand.

Timely: Information should be delivered when it is needed.

Verifiable: Information should be verifiable.

1.4 Definition

The definition of the term 'Management Information System' has been varies from person to person. It has more than one definition, some of which are given below-

1) The MIS is defined as a system which provides information to support decision making process in the organization.
2) The MIS is defined as a system based on the database of the organization evolved for the purpose of providing information to the people in the organization.
3) According to Coleman and Riley 'an MIS (a) applies to all management levels; (b) is linked to an organizational subsystem; (c) Functions to measure performance, monitor progress, evaluate

alternatives or provides knowledge for change or collective action, and (d) is flexible both internally and externally'.

4) According to Schwartz, ' MIS is a system of people, equipment procedures, documents and communication that collects, validates, operates, stores, retrieves, and present data for use in planning , budgeting , accounting, controlling and other management process'.

5) Thomas R. Prince defined MIS as 'an approach that visualizes the business organization a single entity composed of various inter- related and inter – dependent sub systems looking together to provide timely and accurately information for management decision making, which leads to the optimization of overall enterprise goals'.

6) Frederick B. Cornish defined MIS as 'structure to provide the information needed when needed and where needed. Further, the system represents the internal communication network of the business providing the necessary intelligence to plan, execute and control.

Value of Information

Information is an organization's resources, without information business cannot survive. It is said that a good decision is "90% information and 10% inspiration". Information is the catalyst of management and the ingredient that helps in the management functions such as planning, operating, directing, and controlling.

Need for Information

Information is considered as the lifeblood of the organization. It plays an important and effective role in managing the day-to-day affairs of a business organization. Business managers at top level and at operational level are generally confronted with complex problems which are emerging as a result of high rate of growth, change in business size, and development in the field of technical, change in consumer's preferences and change in brand loyalties, intense degree of competition nationally and internationally, and changing government policies and regulations etc..

To overcome with the all stated complex problems and to have an effective planning and control system, management in each business organization needs information regarding finance, production, marketing, etc.

There is also need to comply with competition, technological development and changing government policies and legislation. All of these situations require the provision of vital information so that the management can react at the right time by the most suitable strategy.

1.5.2 Objectives of Management Information System

An effective MIS has the following objectives

- Facilitate the decision making process by furnishing information in the proper time frame. This helps the decision – maker to select the best course of action.
- Provide requisite information at each level of management to carry out their functions.
- Help in highlighting the critical factors to the closely monitored for successful functioning of the organization.
- Provide a system of people, computers, procedures, interactively query facilities, documents for collecting, sorting, retrieving and transmitting information to the users.
- Support decision – making in both structured and unstructured problem environments.

1.5.3 Characteristics of Management Information System

A Management Information Systems has the following characteristics:

1. **Comprehensive:** Management Information System is comprehensive in nature. It includes a complex system involving interrelated and interdependent sub-systems that involve transaction processing systems as well as information processing systems that are designed for decision making and control at different levels in the organization.
2. **Integrated:** MIS integrates various subsystems so that meaningful information is made available where and when needed. For this data is processed through various sub systems.
3. **Relevant Information:** It works towards making available only the relevant information so that the managers are not unnecessarily over-burdened with the slang of numbers.
4. **Conforms to the Style and Qualities of the Manager:** MIS is organization specific and to be more precise manager specific. It is so designed that the information that is made available to the manager is most conductive to the style and characteristics of the manager. For instance, information provided to the technical personnel is designed in a different way than to non-technical personnel. Similarly, information to middle level managers shall be designed differently as compared to the information made available to the top level managers.
5. **Co-ordinated:** MIS involves co-ordination of various sub-systems to ensure that various activities like collection of data, processing of data, intelligence and decision support system are operated in a planned way so that the information is used most efficiently and effectively.
6. **Selective Sharing:** MIS emphasizes on the selective sharing of data i.e. , it decides which user shall have access to which kind of data.

1.5.4 Functions of Management Information System

Management Information System is set up by an organization with the prime objective to obtain management information used by its managers in decision-making. Thus, MIS must perform following functions in order to meet its objectives.

1. **Data Collection**: MIS collect data from various internal and external sources of an organization. Collection of data can be done manually or through computer terminals. End users typically, record data about transactions on some physical media such as paper form, or enter it directly into a computer system.
2. **Data Processing**: The collected data is processed to convert it into the required management information. Processing of data is done by such activities as computing, comparing, sorting, classifying and summarizing. These activities organize, analyze and manipulate data using various statistical, mathematical tools.
3. **Storage of Information:** After data collection and processing the third function of MIS is to store processed or unprocessed data for future use.
4. **Repossession of Information:** According to the requirement of user MIS repossess information from its stores.
5. **Dissemination of Information:** As per the requirement of management users the repossess information is disseminated to the users in the organization. It could be periodic, through reports or online through computer terminals. The various functions performed by MIS is shown in Fig 1.4

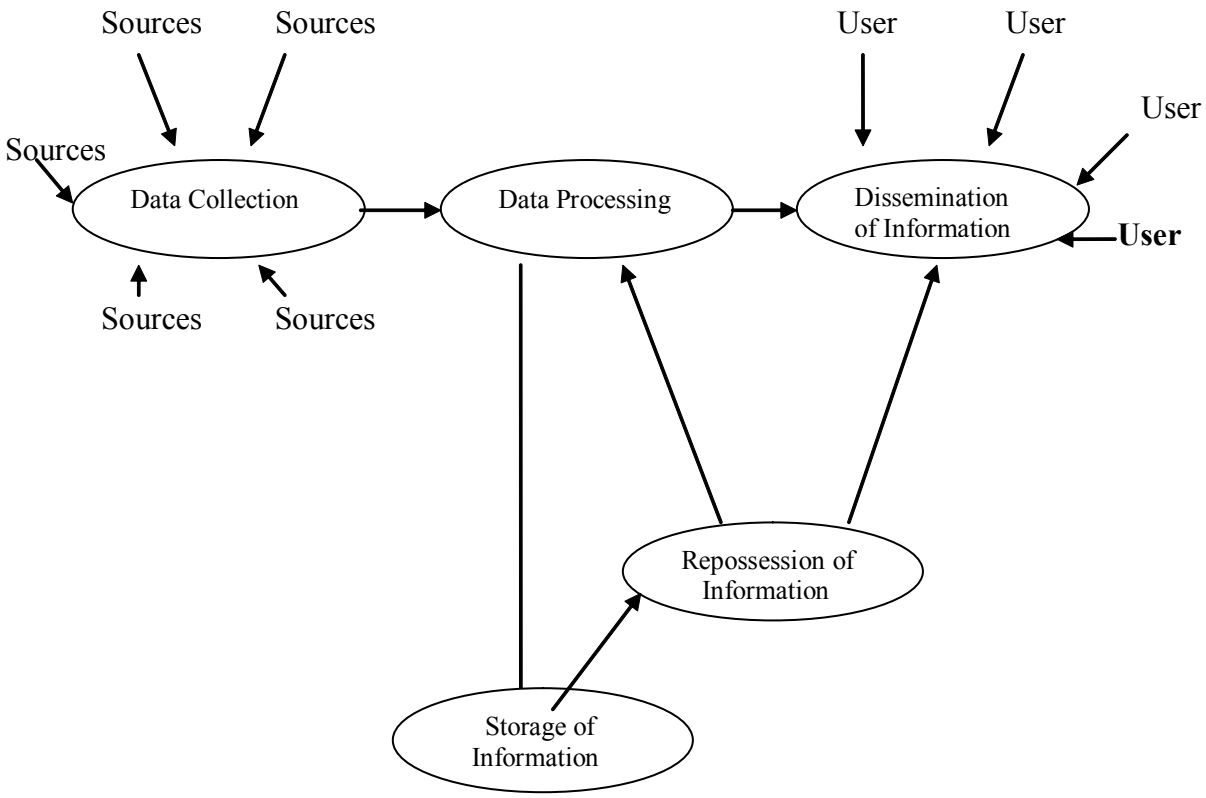


Fig 1.4 : Functions of MIS

1.5 Management Information System: A Concept

A Concept of MIS took many years to evolve. In the early years, the concept of MIS was to process data from the organization and presents it in the form of reports at regular intervals. The system was largely capable of handling the data from collection to processing. It was more complicated, requiring each individual to pick and choose the processed data and use it for his requirements. This concept was further modified when a distinction was made between data and information. The information is a product of an analysis of data. This concept is similar to a raw material and the finished product. What are needed are information and not a mass of data. However, the data can be analyzed in a number of ways, producing different shades and specifications of the information as a product. It was, therefore, demanded that the system concept be an individual- oriented, as each individual may have a different orientation towards the information. This concept was further modified, that the system should present information in such a form and format that it creates an impact on its user, infuriating a decision or an investigation. Soon after it was realized that even though such an impact was a welcome modification, some sort of selective approach was necessary in the analysis and reporting. Hence, the concept of exception reporting was imbibed in MIS. As the environment is dynamic and competitive, the concept was again evolved that the system should be capable of handling a need based exception reporting. This need maybe either of an individual or a group of people. This called for keeping all data together in such a form that it can be accessed by anybody and can be processed to suits his or her needs. The concept is that the data is one but it can be viewed by different individuals in different ways. This gave rise to the concept of DATABASE, and the MIS based on the DATABASE proved much more effective.

Over a period of time, when these conceptual developments were taking place, the concept of the end user computing using multiple databases emerged. This concept brought a fundamental change in MIS. The

change was devolution of the system and the user of the information becoming independent of computer professionals. When this becomes a reality, the concept of MIS changed to a decision making system. The job in a computer department is to manage the information resource and leave the task of information processing to the user.

In today's world the concept of MIS is a system which handles the databases, provides computing facilities to the end user and gives a variety of decision making tools to the user of the system. This concept gives high regard to the individual and his ability to use information. While analyzing the data; it relies on many academic disciplines such as theories, principles and concepts from the Management Science, Psychology and Human Behavior. These academic disciplines are used in designing the MIS, evolving the decision support tools for modeling and decision - making. MIS uses the concept of management Information System can be evolved for a specific objective if it is evolved after systematic planning and design. It calls for an analysis of a business, management views and policies, organization culture and the culture and the management style. The information should be generated in this setting and must be useful in managing the business. This is possible only when it in conceptualized as system with an appropriate design. The MIS, therefore, relies heavily on the systems theory offers solutions to handle the complex situations of the input and output flows. It uses theories of communication which helps to evolve a system design capable of handling data inputs, process, and outputs with the lest possible noise or distortion in transmitting the information form a source to a destination. It uses the principles of system Design, viz., an ability of continuous adjustment or correction in the system in line with the environmental change in which the MIS operates. Such a design help to keep the MIS tuned with the business managements needs of the organization. The concept, therefore, is a blend of principle, theories and practices of the Management, Information and System giving rise to single product known as Management Information System (MIS). The diagrammatic representation of conceptual view of the MIS is shown as a pyramid in Fig. 1.2

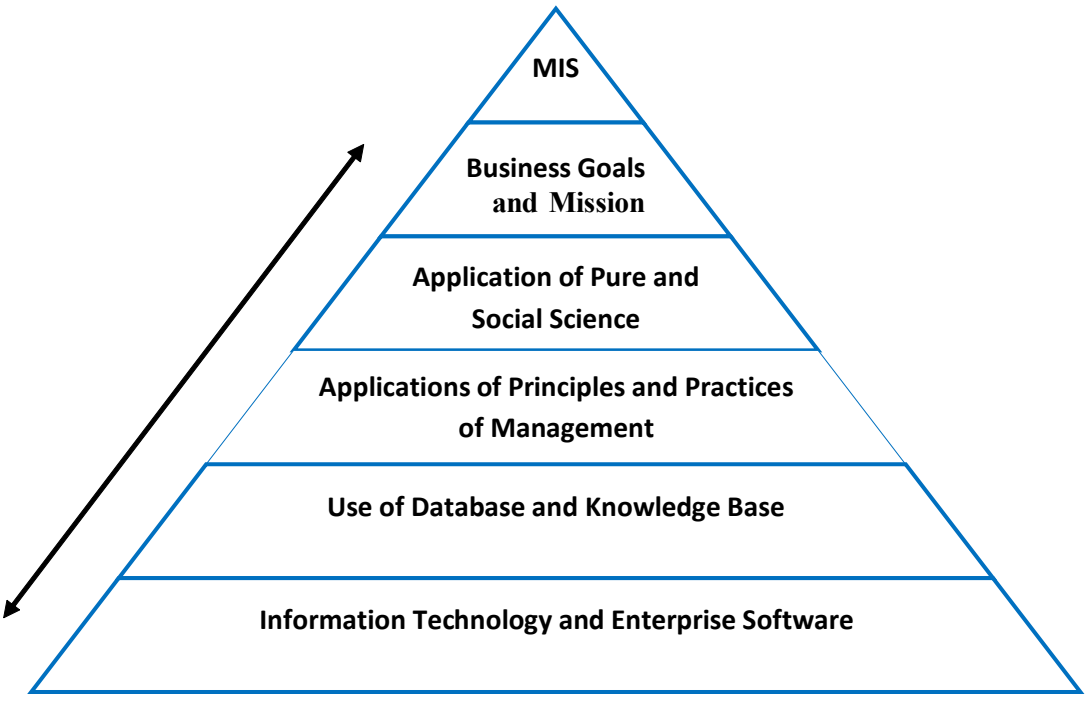


Figure 1.2 : Conceptual View of MIS

Fig 1.2 Conceptual View of MIS interesting point. You can position the text box anywhere in the document. Use the Text Box Tools tab to change the formatting of the pull quote text box.]

The physical view of the MIS can be seen as an assembly of several subsystems based on the databases in the organization. These subsystems range from data collection, transaction processing and validating, processing, analyzing and storing the information in databases. The subsystems could be at a functional level or a corporate level. The physical view of MIS is shown in Fig. 1.3.

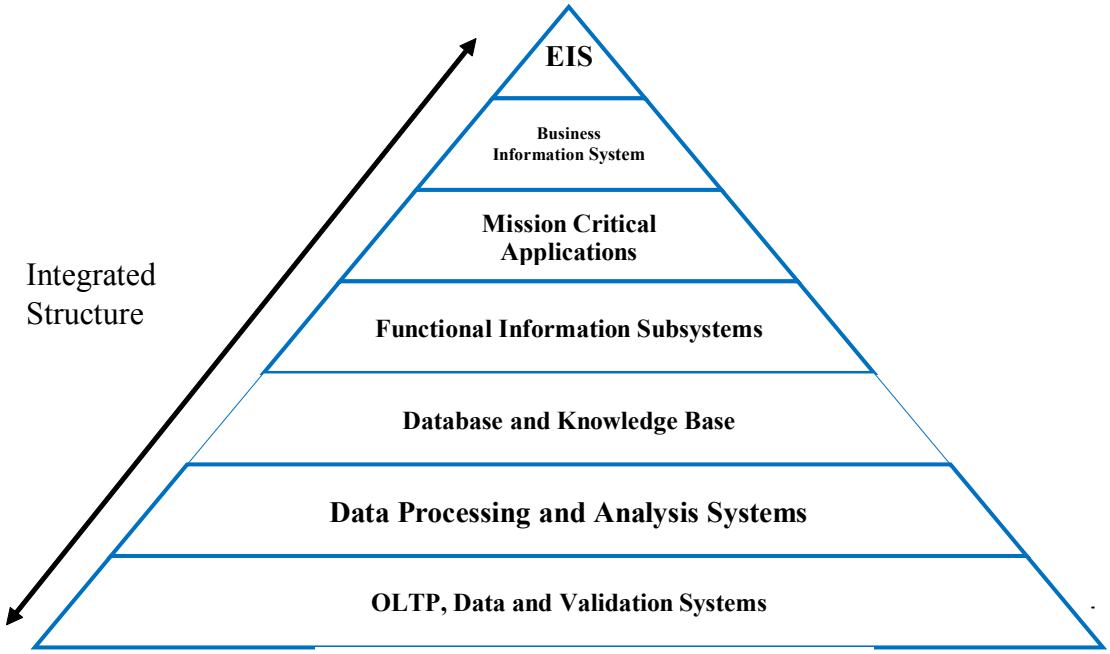


Figure 1.3 : Physical view of MIS

1.5 Importance of Management Information System

In today's scenario MIS plays a pivotal role in an organization. Organizations world wide makes extensive use of MIS. It is the process of collection and storing of the data useful for the organization. Executives retrieve these data when required and process them for generating information. In short it can be said that it is a tool to assembling & accumulating facts & figures of all the important business processes. Following are the some major importance of MIS:

- The organization that uses MIS is able to record, process, route & tabulate all important business transactions. As & when need arises the organization is able to incorporate the needed changes & improvements in the area of concern.
- It helps in minimizing risk in decision making.
- It helps the HRD manager in order to find out the requirement of the human resource , their wages and salary.
- The top management analyses whether its resources are being utilized optimally.
- A two way communication flow is greatly enhanced by the MIS. The management freely tells the job responsibilities to its employees. The employees in return discuss their doubts & grievances.
- MIS supports the planning & controlling function of managers in the organization. Managers use past/historical data as well as the current data to analyze the performance & hence apply controlling measures.

- MIS encourages decentralization in the organization. Decentralization is possible when there's a system to measure operations at the lower levels.
- It brings coordination. It facilitates integration of specialized activities by keeping each department aware of the problems & requirements of other departments.

Hence, because of the above - cited reasons, MIS is considered to be of vital importance, sometimes regarded as the nerve centre of an organization. In other words, today organizations cannot survive and grow without properly planned, designed, implemented and maintained MIS. MIS also enables even small enterprises to more than offset the economies of scale enjoyed by their bigger competitors and thus helps in providing a competitive edge over other enterprises**.**

1.5.1 Nature of Management Information System

As we know that the concept of MIS is interdisciplinary in nature, thus because of this nature, MIS is neither termed as a pure science nor an art; rather it is considered as a combination of both. The following points can summarize the nature of MIS:

1) **Report Orientation** - In the early years the function of MIS was to process data from the organization and present in the form of reports at regular intervals. But after sometimes the difference between data and information merged. Information being the finished product and was prepared after processing the raw data because of this fact the concept the concept of MIS is further modified, as information rather than voluminous it has become according to the requirement of the user. Data can be analyzed by different persons separately giving various shapes to the information.
2) **Action oriented –** This concept was further modified due to the need that the information should be such that it leads to some action, decision, investigation or research.
3) **Exception Oriented –** After having action oriented nature of MIS was realized that there must be some specific or selective approach to the action or the analysis of data. Thus, the concept of exception oriented was introduced, in this MIS is related to the exceptional situation of business rather than routine matters.
4) **Data Base Orientation –** As we know that our environment is dynamic in nature, so the change in every system is must. The concept was then evolved that the system should be cabable of handling a need based exception reporting. This need may be of individual, group or organizational. To fulfill this need, a common database is prepared which can be used by each and every individual accordingly. Thus, the concept of MIS based on databases is emerged and proven to be effective.
5) **Academic Discipline Orientation –** As MIS is based on the information gathered for analyzing the data. While analyzing the data it relies on many academic disciplines like theories, principles, and concepts from management and computer science.

1.5.6 Scope of Management Information System

The scope of MIS is better understood if each part of the term MIS is separately explained in detail.

Mstands for Management (focusing on the ultimate use of such information systems for managerial decision making.)

Istands for Information (stressing on processed data in the context in which it is used by end users and System (emphasizing a fair degree of integration and a holistic view.)

1) **Management –** It has been viewed as a function, a process, a profession, and a class of people. It has also been described as an art; and as a science. And along with material, capital and labour, management is considered as a resource. Infact, management is a process of achieving an organization's goals and objectives by judiciously making use of resources of men, materials, machines, money, methods, messages and moments.

The basic functions, which a manager performs in an organization are –

i. Planning – It is a process of foreseeing the future in advance. It bridges a gap between where we are and where we want to be.

ii. Organizing – It refers to the formal grouping of people and activities to facilitate achievement of the firm's objective. It is needed for assigning responsibilities, jobs, and hierarchy among personnel.

iii. Staffing - It is the process of putting a right person at the right job and at the right time. The two functions, i.e. organizing and staffing should not be confused because of their close relationship. Organizing focuses on the structure and process of allocating jobs; whereas staffing pertains to the people in the jobs. Thus, organizing is job oriented, whereas staffing is worker oriented.

iv. Directing – It is the process of activating the plans, structure and group efforts in the desired direction. It is needed for implementation of plans by providing desired leadership, motivation and proper communication.

v. Controlling – Control is the means of checking the progress of plans and correcting any deviations that may occur along the way. Controlling is a process which involves:

- Fixing standards for measuring work performance,
- Measurement of actual performance,
- Comparing actual with standards and finding out deviations, if any,
- Taking remedial actions

2) **Information –** It is the second component of the term Management Information System and considered as a valuable resource required by the management in order to run a business organization. Information can be defined as the data which is organized and presented at a time and place so that the decision maker may take appropriate action. The conversion of data into information, which leads to decision is shown in figure 1.5

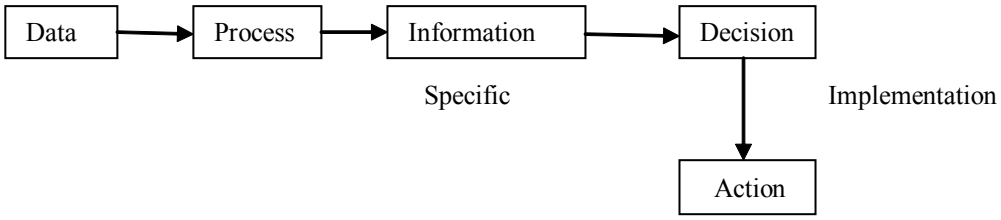


Figure 1.5 : Conversion of Data into Information

From Fig. 1.3, it is clear that information consists of data (raw facts) that has been processed, and on the basis of the processed information a necessary action has been taken by decision makers.

For planning, information requirements of decision makers can be classified into three broad categories –

Environmental Information: Environmental information can be further classified and described as follows-

(i) Government Policies : Information about Government policies or financial and tax affairs, political stability, etc.

(ii) Economic Trends: Information about economic indicators like employment, productivity, capital investment, etc.

(iii) Factors of Production: Information about the source, cost location, availability, accessibility and productivity of the major factors of production such as labour , material, and capital.

Competitive Information: Competitive information can be further classified and described as follows-

(i) Industry Demand: Demand forecast of the industry for the product manufactured or about the area in which the firm is operating.

(ii) The Competition: Information about competing firms for forecasting own product demand and making decisions and plans to achieve the forecast.

Internal Information: It aimed at identification of firm's strengths and weaknesses. It includes the following-

(i) Sales Forecast: Since all other internal plans of the firm are guided by the sales plan, it is considered as the dominant planning premises internal to the firm.

(ii) The Financial Plan: Information on financial and budget plan is important because it represents a quantitative and time bound commitment about the allocation of total resources.

(iii) Policies: Long term basic policies on product range, marketing, finance and about personnel do no permit flexibility in developing alternative courses of action in the short run.

3) System – A system is a group of elements or components joined together to fulfill certain functions. In a large context, a system is a grouping of procedures, processes, methods, routines techniques, etc. united in some form of regulated interaction to form an organized whole. The systems are either natural or man made. The set of elements for a system may be understood as Input, Process and Output, It is shown in figure 6.

1)

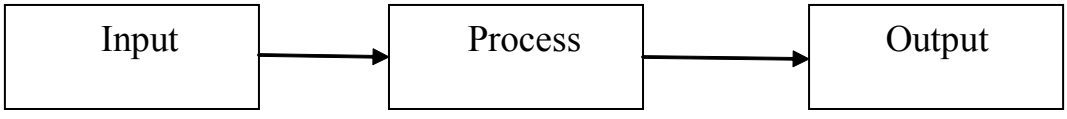


Fig. 1.5 : Elements of System

A system is made up of sub-systems. A subsystem which may be composed of further sub-sytems. However, a system itself is a part of a super system. This could be termed as the environment in which the system operates. This relationship is shown in figure 1.7.

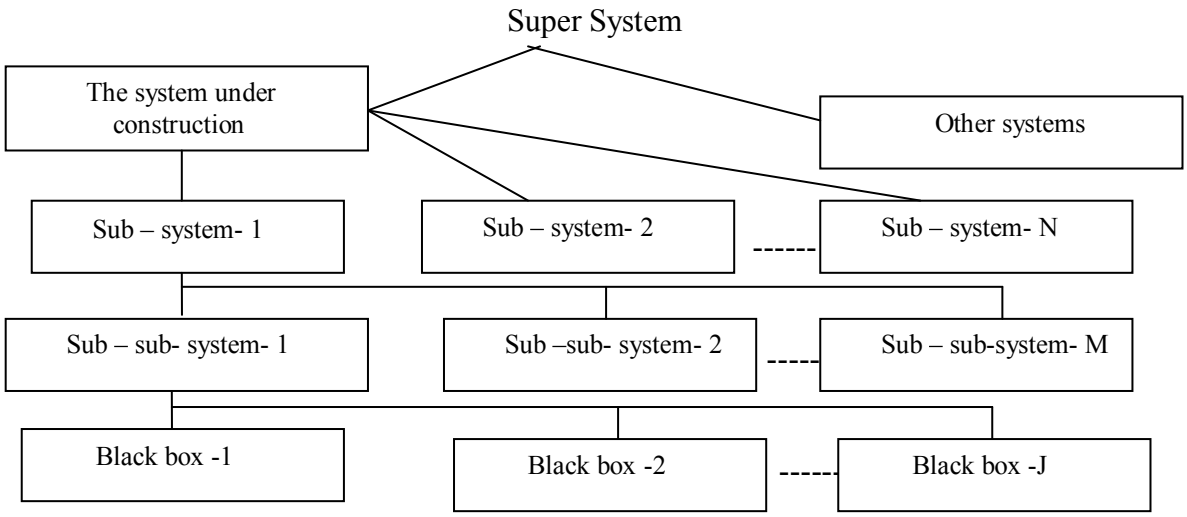


Figure 1.6 : System and its Components

The above example is of an industrial system. It has various sub systems such as production subsystem, marketing sub system, personnel sub system and financial sub system. These sub systems in turn are composed of further sub systems. For example, a production sub system could consist of sub system of production control, material control, quality control, etc. Again, the material sub- sub – system can be further divided into black boxes such as purchasing stores, transportation , inspection, etc. This industrial system is a part of the large economic system of the country which may be called as the super system.

Now, combining the terms viz. management, information, and system, it could be seen that management information systems are sets of related processes, activities, individuals or entities interacting together to provide processed data to the individual managers at various levels in different functional areas.

1.5.7 Advantages of MIS

The following are some of the benefits that can be attained for different types of management information systems.

- Companies are able to highlight their strengths and weaknesses due to the presence of revenue reports, employees' performance record etc. The identification of these aspects can help the company improve their business processes and operations.
- Giving an overall picture of the company and acting as a communication and planning tool.
- MIS has to be designed and managed in such way that it aggregates information, monitors the company's activities and operations and enhances communication and collaboration among employees. This ensures better planning for all activities and better ways to measure performance, manage resources and facilitate compliance with industry and government regulations. Control helps in forecasting, preparing accurate budgets and providing the tools and vital information to employees, top management and business partners.
- The availability of the customer data and feedback can help the company to align their business processes according to the needs of the customers. The effective management of customer data can help the company to perform direct marketing and promotion activities.

- Information is considered to be an important asset for any company in the modern competitive world. The consumer buying trends and behaviors can be predicted by the analysis of sales and revenue reports from each operating region of the company.
- It facilitates planning: MIS improves the quality of plants by providing relevant information for sound decision - making. Due to increase in the size and complexity of organizations, managers have lost personal contact with the scene of operations.
- It Minimizes information overload : MIS change the larger amount of data in to summarized form and there by avoids the confusion which may arise when managers are flooded with detailed facts.
- MIS Encourages Decentralization: Decentralization of authority is possibly when there is a system for monitoring operations at lower levels. MIS is successfully used for measuring performance and making necessary change in the organizational plans and procedures.
- It brings Co ordination: MIS facilities integration of specialized activities by keeping each department aware of the problem and requirements of other departments. It connects all decision centers in the organization.
- It makes control easier: MIS serves as a link between managerial planning and control. It improves the ability of management to evaluate and improve performance. The used computers has increased the data processing and storage capabilities and reduced the cost.
- MIS assembles, process, stores, Retrieves, evaluates and disseminates the information.

1.6 Summary

Information or collection of information has come to play a vital role in human beings and its processing contributes heavily to the success or failure of their different activities. While managing a business this becomes further more important as it acts as bases of decision making. Information acts as a past experience which helps to predict the unknown future so that a definite course of action is chosen with the advent of very large business and heavy quantum of business activity. It has become an important task to manage this heavyvolumes of information so that it can prove to be helpful for management decision making. For managing, controlling and directing information in an appropriate manner MIS is required. MIS is an acronym of three letters, i.e. M – Management; I- Information; and S- System. Management is to plan, organize, staff, direct and control business resources to achieve predetermined objectives. For taking coherent decisions, information is an essential input. Information consists of data that is gathered and processed so that some inferences can be drawn from it. This information is retrieved as and when required so that manager can use it for performing his functions and take decisions. System is a set of interrelated elements joined together to achieve a common objective and has input, process, output, feedback and control elements. Thus, MIS is a man / machine system consisting of people, machines, procedures, databases and data models as its elements. The concept of MIS is interdisciplinary in nature. It is neither a pure science nor an art; rather a combination of both. MIS is a good example of physical as well as conceptual information system, which finds application in diverse field of management. MIS captures data from various sources; process it to convert this data into information and disseminates it to the decision makers in an organization.

1.7 Key Words

- **Data**: Facts and figures which are relatively meaningless to the user.
- **Dissemination**: Distribution of information according to the requirement of users.
- **Information**: It is a tangible or intangible entity that serves to reduce the uncertainty about some state or event.
- **Management**: It is an integrated set of functions, processes, approaches and other skills to be used for mobilizing and utilizing resources for achieving predetermined objectives in an changing environment.
- **Staffing**: It is one of the managerial function which performs the task of putting right person at the right time and at the right place.
- **System:** Group of elements or components joined together to fulfill certain functions.
- **Sub- System**: Simply a system within a system. This means that system exists on more than one level and can be composed of subsystems or elemental parts.
- **Super System**: When a system is a part of larger system, the larger system is the super system.
- **Programmed Decision:** Means when a problem is solved by a predefined algorithm or procedure
- **Non- Programmed**: Means no predefined program and algorithm are used to solve problem.

  Decision
- **Semi – Programmed Decision**: Means that at least one but not more than two of the above stages can be handled by a predetermined procedure.
- **Repossession**: to retrieve information according to user requirements.

1.8 Self Assessment Test

1. Briefly define system. What are their characteristics?
2. Define types of system. Give suitable example
3. Briefly discuss the concept of system and their classification.
4. Define Information System. Explain Information System Architecture.
5. Explain Classification of Information System.
6. Why is MIS looked upon as a strategic need of management today?
7. Give various characteristics of MIS.
8. What do you understand by programmed, non – programmed and semi- programmed decisions?
9. Define MIS and discuss its objectives.
10. Write a short note on the importance of MIS.
11. Take an organization of your knowledge and give a physical as well as conceptual view of MIS.
12. 'The concept of MIS is interdisciplinary in nature'. Explain this with suitable examples.

1.9 References

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Unit - 2 : Structure and Classification of MIS

Unit Structure:

2.0 Objectives

After reading this unit, you will be able to understand

- The MIS structure
- The Classification of MIS & its advantages and disadvantages
- Importance of MIS in an organization
- Understand Changing role of Information Systems
- Innovative use of information system
- Understand market competition
- Understand concept of value chain

2.1 Introduction

A **Management Information System** (**MIS**) provides information needed to manage organizations efficiently and effectively. Management information systems involve three primary resources: people, technology, and information. Management information systems are distinct from other information systems in that they are used to analyze operational activities in the organization. Academically, the term is commonly used to refer to the group of information management methods tied to the automation or support of human decision making, e.g. decision support systems, expert systems, and executive information systems.

An organized approach to the study of the information needs of an organization's management at every level in making operational, tactical, and strategic decisions. Its objective is to design and implement procedures, processes, and routines that provide suitably detailed reports in an accurate, consistent, and timely manner.

In a Management Information System, Modern, computerized systems continuously gather relevant data, both from inside and outside an organization. This data is then processed, integrated, and stored in a centralized database (or data warehouse) where it is constantly updated and made available to all who have the authority to access it, in a form that suits their purpose.

Information system includes hardware's, software's, procedures, information technology etc, which is very important set of technology that support business operation, collaboration, business decision making in the demanding environment. Information technology can change the way of businesses is being perform as they are viewed more strategically in recent years.

2.2 Management Information System Structure

In order to understand the importance of MIS one must understand and appreciate the role that MIS plays in an organization. One can visualize an organization as a balance sheet or a function of financial statements, i.e., as a financial entity or as an organization chart delineating the decision –making hierarchy levels and formal communication channels. While both views are correct, the latter view is more appropriate for understanding an organization's MIS.

Anthony in his seminal work elaborated on this view of an organization as its hierarchy of decision– making. He focused on the managerial aspects of an organization and classified the management process into three distinct levels as under:

- **Strategic Management Information System**
- **Management Control and Tactical planning**
- **Operational Planning & Control**
- **Transaction Processing and Inquiry Response**

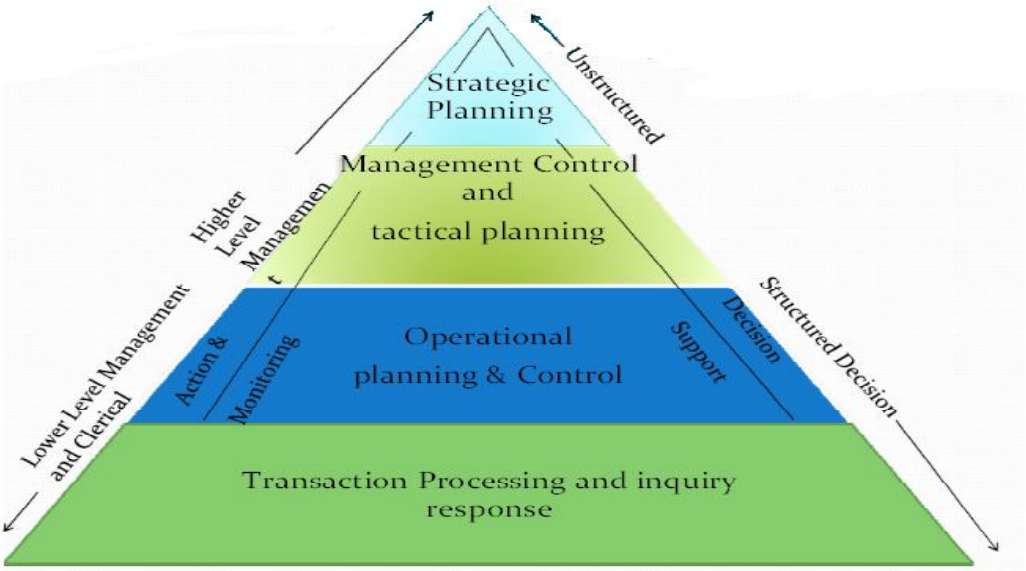

Figure 2.1 : MIS Pyramid Structure

The three level of management activity can be differentiated on the basis of the planning horizon for each level. Strategic planning deals with long-reange considerations. The decisions to be made are concerned with the choice of business direction, market strategy, product mix, etc. Management control and tactical planning has a medium- term planning horizon. It includes acquisition and organization of resources, structuring of work, and acquisition and training of personnel. It is reflected in the capital expenditure budget, the three-year staffing plan, etc. Operational planning and control is related to short term decisions for current operations. Pricing, production levels, inventory levels, etc.. are results of operational planning and control activities.

A particular manager may have responsibility for a mix of management activities, but proportions shift with management level. For instance, a shop floor supervisor will spend most of his or her time on operational planning and control. An executive vice president will devote, by comparison, more time to strategic planning.

The activities and information processing for the three levels are interrelated. For example, inventory control at the operational level depends on accurate processing of transactions; at the level of management control, decisions made about safety stock and reorder frequency are dependent on correct summarization of results of operations; at the strategic level, results in operations and management control are related to strategic objectives, competitor behavior, and so forth to arrive at inventory strategy. There is a marked contrast between characteristics required of information for strategy planning and for operational control, with management control and tactical planning being somewhat in the middle. Figure 2.2 shows the differences for seven information characteristics. Given these differences, information system support for strategic planning should be quite different from information system support for operational should be quit different from information system support for operational control.

I) Strategic Management Information System

Strategic planning is an organization's process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this strategy. This requires focusing on the objectives and goals of the organization, on changes in the objectives, on the resource requirement to fulfill the objectives and on the guiding principles and policies that will govern the acquisition, use and disposal of resources to attain the objectives. In short , this role is the must important role in the management hierarchy and the decision taken by managers in this role have a far-reaching impact on the organization. Managers in this role set the direction in which the organization will travel. In terms of hierarchy, this lies at the top.

The strategic plan is specific but not detailed, because although specific goals may be established for the distant future, detailed methods for achieving these goals must be related to current environment (including competitive) conditions. The long –term goals of the strategic plan provide the constraints for setting intermediate and short- term goals. Therefore, as shown in Figure 2.2, the strategic plan ties together the development plan (short-range plan). The development plan focuses on the growth of the company through internal or external expansion. The operations plan is the one-year plan that links together in full detail the functional plans with project or program plans.

The first step in any planning is "needs research" to determine the relation-ship of the system to its environment. "Whom does the organization serve?" is the question that must be answered first.

Strategic Management Information System	Definition of goals, policies and general guidelines charting course for organization. Determination of organizational objectives.
Management Control and Tactical Planning	Acquisition of resources. Acquisition tactics, plant location, new products. Establishment and monitoring of budgets.
Operational Planning & Control	Effective and efficient use of existing facilities and resources to carry out activities with in budget constraints.

Figure 2.2

II) Management Control and Tactical Planning

This requires focusing on the objectives and goals of the organization, on changes in the objectives, on the resources requirements to fulfill the objectives and on the guiding principles and policies that will govern the

acquisition, use and disposal of resources to attain the decisions taken by managers in the role have a far-reaching impact on the organization. Managers in this role guidance from the strategic planning hierarchy and control the activities of the organization such that the goals set by the higher level are attained in an efficient and effective manner. The impact of the managers in this role in medium term and degree.

A **tactical plan** is concerned with what the lower level units within each division must do, how they must do it, and who is in charge at each level. Tactics are the means needed to activate a strategy and make it work. Tactical plans are concerned with shorter time frames and narrower scopes than are strategic plans. These plans usually span one year or less because they are considered short-term goals. Long-term goals, on the other hand, can take several years or more to accomplish. Normally, it is the middle manager's responsibility to take the broad strategic plan and identify specific tactical actions.

III) Operational Planning & Control:-

This requires that directives as set by the immediate higher hierarchy is followed and that specific task are carried out effectively and efficiently. The decisions at this level have very little impact in the organization. The organization behaves in a routine nature where the parameters of the decision-making process are well laid and certain.

Even after the operations system has been successfully designed and placed in to actual use, considerable managerial discretion remains. This is because decisions must be made on a shorter term basis – month to month, day to day even hour to hour as to how the system will be operated and controlled. Operational planning and control decisions involve scheduling and control of labor, materials, and capital input to produce the desired quantity and quality of output most efficiently.

Operational planning and control are based on forecasts of future demand for the output of the system. But even with the best possible forecasting and the most finely tuned operations system, demand cannot always be met with existing system capacity in a given time period. Unexpected market trends, new product developments, or competitors' actions can throw the forecasts off, and problems in the operations system can reduce capacity. At these times, shorter term managerial decisions must be made to allocate system capacity to meet demand. This is what the hostelling system at Ernst & Young makes possible. At these times, as well, managers must also think about the longer term implications of the changes in demand and capacity needs. United Parcel Services (UPS) and Federal Express are two organizations where long term trends in package volumes are the ever present concerns of managers.

Management function	**Strategic planning**	**Management control**	**Operational control**
Planning	Long-range, high impact	Medium range, Medium impact	Short range, low impact
Organization	General framework	Departmental level	Small unit level
Staffing	Key senior people	Medium level, tactical level	Operational level
Directing	General and long range directives	Tactics	Routine activities
Controlling	Aggregate level	Periodic control and controlling exceptions	Regular and continuous Supervision

Figure 2.3 : Information Requirements by Level of Management Activity

Figure 2.3 illustrates Anthony's idea of an organization's hierarchy from the perspective of managerial activities. As is clear, it is a three-level pyramid with very distinct levels. Each level has its own set of task and decisions to take which have a varying impact on the organization as a whole. For example, if we want to classify the decisions of a manufacturing firm, the strategic planning will encompass the annual production planning, annual budgeting, setting up of new plants and/ or installation of new machinery to upgrade the production process and other such activities. Management control activities would include monthly production planning, maintenance planning and scheduling. Operational control on the other will deal with routine daily tasks of managing and supervising shifts to exercise control over the process so that the monthly plans and schedules as made by the management control level managers are met.

IV) Transaction Processing and Inquiry Response

Transaction processing is substantially more significant in terms of processing time, data volume, etc., than strategic planning. Transaction processing systems provide the base for all other internal information support. This concept of the large transaction processing base and a fairly small strategic planning component can be visualized as a pyramid (figure1.2). the lower part of the pyramid describes structured, well defined procedures and decisions, while the top part of the pyramid represents more use to clerical personnel and lower- level managers, while the higher levels apply primarily to top management.

An information system that processes data arising from the occurrence of business transactions are as follows:

- 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 transaction that occur vary from organization to organization.
- Transaction processing, the set of procedures foe handling the transactions, often includes the activities like calculation, storage and retrieval, classification, summarization, sorting.
- Transaction processing procedures are often called standard operating procedures.

2.3 Classification of Management Information System

MIS is classified into various types. The classification depends on the following aspects -

(a) **Functionality** : Various management activities like the one which deals with scheduling, planning, resource allocation, product design, processes, competitive strategy are the functional classification of MIS.

(b) **Utility** : Some of the processes like artificial intelligence, generating management related information, providing aid in decision making, necessary support systems, executive information system are the utility classification of MIS.

(c) **Areas of Application** : Depending upon the area where MIS could be used MIS is classified as Banking IS, Insurance IS, Production IS, Data warehouse IS, Public IS etc.

(d) **Processing Type**: Depending upon the type of management service in processing a data to generate

information, MIS is classified into various processing types like online transactions, Batch processing, distributed processing, multiprocessing etc.

(e) **Frequency of usage**: A MIS system is a system in which there is a constant need for review of the system. A mechanism can be built in the system to look into its performance and the outcome of such performed tasks may be assessed. This may be done periodically at fixed interval of time. Such mechanisms are categorized under MIS classification of frequency.

Conceptually, the applications of management information system that are implemented in today's business world can be classified in several different ways. For example, several types of management information system can be classified as either operations or management information system. Figure 2.4 illustrates this conceptual classification of information system applications. Information systems are categorized this way to spotlight the major roles each plays in the operations and management of a business. Let's look briefly at some examples of such information systems categories.

2.3.1 Operation Support System: -

Information systems have always been needed to process data generated by, and used in, business operations. Such operations support systems produce variety of information products for internal and external use. However they do not emphasize producing the specific information products that can be best used by managers. Further processing by management information system is usually required. The role of a business firm's operations support system is to efficiently process business transactions, control industrial processes, support enterprise communication and collaboration, and update corporate databases. (Figure 2.5).

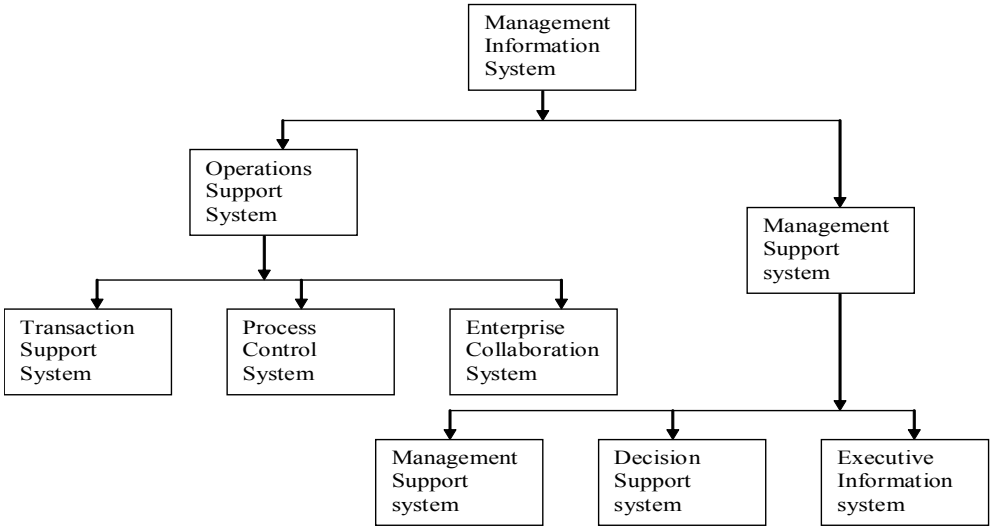

Figure : 2.4

1. Transaction Support System: Transaction Support System are an important example of operations support systems that record and processing data resulting from business transactions. They process transaction in two basic ways. In batch processing, transactions data are accumulated over a period of time and processed periodically. In real time (or online) processing, data are processed immediately after a transaction occurs. For example, point –of– sale (POS)systems at many retail stores use electronics cash register terminals to electronically capture and transmit sales date over telecommunications links to regional computer centers for immediate (real – time) or nightly (batch) processing.

2. Process Control System: Process Control System monitors and control physical processes. For example, a petroleum refinery uses electronic sensors linked to computers to continually monitor chemical processes chemical processes and make enhance team and make instant (real – time) adjustments that control the refinery process.

Management Support System
• **Transaction processing system**. Process data resulting from business transaction, update operational databases, and produce business documents. Examples: sales and inventory processing and accounting systems.
• **Process control system**. Monitors and control industrial processes. Examples: petroleum refining, power generation, and steel production system.
• **Enterprise collaboration system**. Support team, workgroup, and enterprise communications and collaboration. Examples: e-mail, chat and videoconferencing groupware systems.

Figure 2.5

3. Enterprise Collaboration System: Enterprise collaboration systems enhance team and workgroup communication and productivity, and include applications that are electronic mail to send and receive electronic messages, and videoconferencing to hold electronic meetings to coordinate their activities.

2.3.2 Management Support System

When information system applications focus on providing information and support for effective decision making by managers they are called management support system. Providing information and support for decision making by all types of managers and business professionals is a complex task. Conceptually, several major types of information systems support a variety of decision making responsibilities. Figures.2.5

Management Support System
• **Management information system**. Provide information in the form of prespecified reports and displays to support business decision making. Examples: sales analysis, production performance, and cost trend reporting systems.
• **Decision support system**. Provide interactive ad hoc support for the decision-making processes of managers and other business professionals. Examples: product pricing, profitability forecasting, and risk analysis system.
• **Executive information system**. Provide critical information from MIS, DSS, and other sources tailored to the information needs of executives. Examples: systems for easy access to analyses of business performance, actions of competitors, and economic developments to support strategic planning.

Figure 2.6

1. **Management Information System** : Management information system (MIS) provides information in the form of reports and displays to managers and many business professionals for example, sales managers may use their networked computers and Web browsers to get instantaneous displays about the sales results of their products and to access their corporate intranet for daily sales analysis reports that evaluate sales made by each salesperson.
2. **Decision Support System :** Decision support systems(DSS) give direct computer support to managers during the decision making process, for example, an advertising manager may use a DSS to performs a what - if - analysis as part of a decision to determine where to spend advertising dollars. A production manager may use a DSS to decide how much product to manufacture based on the expected sales associated with a future promotion and the location and availability of the raw material necessary to manufacture the products.
3. **Executive Information Systems :** Executive information systems (EIS) provide critical information from a wide variety of internal and external sources in easy - to – use displays to executives and managers. For example, top executives may use touch screen terminals to instantly view text and graphics displays that highlights key areas of organizational and competitive performance.

2.3.3 Databank Information System:-

Databank information systems refer to creation of a database by classifying and storing data which might be potentially useful to the decision-maker. The information provided by the databank is merely suggestive. The decision-maker has to determine contextually the cause and effect relationships. MIS designs based on the databank information system are better suited for unstructured decisions. The responsibility of this information system is to observe, classify, and store any item of data which might be potentially useful to the decision maker. Examples of the kind of data that might be recorded in such a database for a given village, region, or area are as follows:

- Number of farms
- Number of units of land (hectares, fedans, acres)
- Average farm size
- Amounts of selected farm inputs applied annually
- Production per year on a unit of land for selected crops
- A second example of data that might be recorded in a database (this time involving data internal to the organization) is as follows:
- Number of extension staff by category and assigned to a particular village, region, or area
- Number of work hours devoted by staff to selected concerns for a particular village, region, or area
- Total extension salary costs and other expenses by village, region, or area
- Number of demonstrations conducted for selected farm technologies by village, region, or area
- Number of on-farm trials conducted for selected farm technologies by region or area
- Number of radio, TV, and print media releases regarding selected farm technologies by time period and region or area.

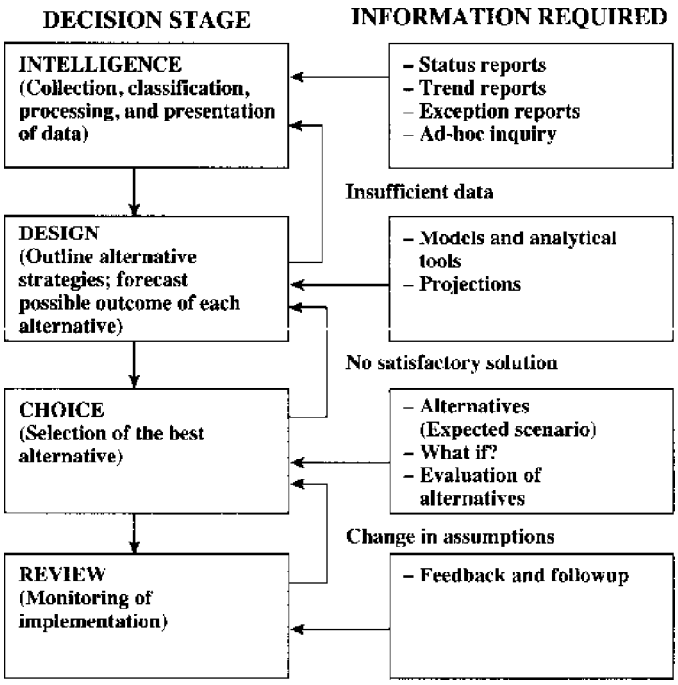

Figure 2.6 : Role of information in the decision process

Each of these databases can be summarized and converted to single tabular presentations of information of interest to management. When information from two or more time periods is compared, trends can be observed.

2.3.4 Predictive Information System:-

Predictive information systems provide source and data along with predictions and inferences. The decision-maker can also enquire as to 'what if a certain action is taken?' and whether the underlying assumptions are true. This type of MIS is useful for semi-structured decisions.

This system moves beyond pure data collection and the determination of trends over time. Predictive information systems provide for the drawing of inferences and predictions that are relevant to decision making. If data from the above examples were to be used in this way, it is possible to obtain information useful for making predictions or for drawing inferences. For example, tables containing the following information for a given village, region, or area might be produced:

- The ratio between the number of farms and the various categories of extension staff members
- The ratio between the amount of farmland and the various categories of extension staff members
- Amount of extension financial operating resources allocated per year to selected farmer problems or concerns
- Amount of extension financial resources, both salary and operating expenses, allocated per year to selected extension approaches to solving different farmer problems or concerns

Information obtained from these kinds of analyses is normally summarized in a two-way tabular format. And likewise, the information often is compared over time. Managers can then use such information to make predictions, for example to forecast costs of particular undertakings for budgeting purposes or as a basis for predicting results if a given change is made, such as change in the number of demonstrations with a given change in staffing.

2.3.5 Decision-Making Information System

Decision-making information systems provide expert advice to the decision-maker either in the form of a single recommended course of action or as criteria for choice, given the value system prevailing in the organization. The decision-maker has just to approve, disapprove or modify the recommendation. Decision-making information systems are suitable for structured decisions. Operations research and cost-effectiveness studies are examples of decision-making information systems. A computerized information system used to support decision-making in an organization or business. A DSS enables users to sift through and analyze massive reams of data and compile information that can be used to solve problems and make better decisions.

This system goes one step further in the process of decision making and incorporates the value system of the organization or its criteria for choosing among alternatives. An extension organization's values are many and varied. They include concerns for resolving farmer problems, increasing and providing for stability of farmer incomes, and improving the quality of farm life. But they also including and providing for stability of farmer incomes, and improving the quality of farm life. But they also include an intent to provide well for staff members (training, adequate salaries, etc.) and to aid in the process of bringing about rural economic development.

Table 1. Information Groups in India's Agricultural Extension System.

Levels	Groups	Types of Information Needed
Central	Extension commissioner, joint commissioners, directors, joint directors, etc. of the directorate of extension, ministry of agriculture	(1) Information on human resources, plans, and budgets for various extension services (2) Statewide monitoring and evaluation of activities completed
State	Director of agriculture, additional director, joint directors, etc. of the state department of agriculture	(1) District wide information on extension programs, activities, expenditures, etc (2) Research-extension linkages and coordination with other allied departments such as animal husbandry and horticulture
District	District agricultural officers (DAO's)	(1) Information on extension resources and constraints at subdivision and block levels (2) Training requirements of staff at subdivision and block levels
Subdivision	Sub divisional agricultural officers	(1) Field demonstration programs, activities planned and implemented by subject-matter specialists (SMS's) (zone) at the block level (2) Technical program and constraints identified at the block level
Block (county)	Agricultural extension officers	(1) Performance of VEW's in terms of achievements in extension activities (2) Field-level problem of assessment of beneficiaries' response to various extension programs

Information regarding these various attributes helps managers to make more enlightened decisions. Examples of ways that an extension organization uses information from a decision-making information system are as follows:

- Change in specific farm outputs (yields, practices) following selected extension activities
- Change in staff productivity following selected interventions (in-service training, better transport, etc)
- Comparison of relative costs and relative effectiveness of alternative extension delivery methods
- Analysis of economic returns to farmers who adopt recommended practices as compared to those who do not.

2.3.6 Decision-Taking Information System:-

Decision-Taking Information Systems integrate predictive information and decision-making systems. Examples of decision-taking information systems are not usually found in an extension organization. This is a decision system in which the information system and the decision maker are one and the same. Management is so confident in the assumptions incorporated in the system that it basically relegates its power to initiate action to the system itself. Airplanes carry automatic pilot systems, which are an example of a decision-taking system. Once activated, the system itself keeps the plane on course and at the proper speed and altitude (according to parameters determined by the pilot). Another example of decision-taking information systems is found in modem factory production. In automobile production, continuous inventories of parts are maintained by computer as cars move down an assembly line. Orders are placed automatically by the computer when additional parts are needed. This is done without the intervention of a manager.

The choice of an appropriate management information system (MIS) category primarily depends on the nature of the decisions it supports. While unstructured decisions may use MIS-category (I), the highly structured ones, such as production schedules in an industry, may use MIS-category (iv). Further, Banerjee and Sachdeva (1995) observe that "as the deep structure of the decision problem becomes more and more understood, we may move to higher level of MIS i.e., from MIS-category (I) to MIS-category (ii); and MIS-category (ii) to MIS-category (iii); and so on."

2.4 Importance of MIS in Organization

MIS workers use computers to organize and compile databases full of company information. Management and information systems (MIS) have taken an ever increasing role in the processes of businesses in the Internet age. After companies collect data about their customers, inventory and sales volume, MIS workers take the raw data and turn it into usable information that top-level management can use to steer the company.

Production Process

- Mechanical or chemical steps used to create an object, usually repeated to create multiple units of the same item. Generally involves the use of raw materials, machinery and manpower to create a product.
- Management and information systems technologies monitor the production and operations of a business. Using databases, MIS tell managers and decision makers the amount of inventory in stock, important information about customers, accounting information and any other data that is entered into the company's computer system. MIS also "cleans" the company's data and removes any incorrect or erroneous input. For example, if text is entered into a number field, an MIS controller will fix that input.

Business Strategy

- The systematic analysis of the factors associated with customers and competitors (the external environment) and the organization itself (the internal environment) to provide the basis for maintaining optimum management practices. The objective of strategic managements to achieve better alignment of corporate policies and strategic priorities.
- MIS employees provide data to decision makers within the company that assists with strategic decisions. MIS control the raw data that companies import from sales, services and other business. From that data, managers decide what inventory they should purchase, what products are selling the best and what demographic buys the product. Managers then make decisions concerning the company's future based on the information MIS provides. For example, if a company sells tires, but truck owners do not purchase from the company, managers will focus on car tire inventory.

Competency

- A company's greatest strengths, also called their "competency," can become clear with the help of MIS. When data is compiled and analyzed by the MIS department, the company sees what they do best. For example, if a company produces car parts, but based on its MIS data some of the parts are difficult to produce with little expected return revenue, the company could choose to cease making those parts and instead focus on the parts they make best.

Simulations

- Acting out or mimicking an actual or probable real life condition, event, or situation to find a cause of a past occurrence (such as an accident), or to forecast future effects (outcomes) of assumed circumstances or factors. A simulation may be performed through

(1) solving a set of equations (a mathematical model),

(2) constructing a physical (scale) model,

(3) Staged rehearsal,

(4) Game (such as war-game), or a computer graphics model (such as an animated flowchart). Whereas simulations are very useful tools that allow experimentation without exposure to risk, they are gross simplifications of the reality because they include only a few of the real-world factors, and are only as good as their underlying assumptions.

- The MIS department is responsible for creating hypothetical models that predict where a business could be in the future. Data is used from past quarters to create simulations about potential revenue, expenses, employee recruitment and growth. Investors use growth projection information to determine the value of a company in the future. MIS workers help the company brace for good times and bad with estimates based on complied data.

2.5 The Impact of the Management Information System

Since businesses have existed, managers have needed to obtain, organize and analyze information. The means by which managers handle business data to serve their interests is referred to as their information systems. Though the concept of an information system for the management of business data has undergone numerous changes in form and design, its relevance and impact on the successful management of an organization has never been greater.

- **History**

  Originally, the acquisition of current market and operational data was handled by word of mouth. Larger firms organize and managed data manually; smaller operations may have opted to manage information mentally; choosing to save money on paper and quill. Late in the 20th century, as the speed, amount and quality of this information began increasing at a greater rate than ever, computer engineers and IT specialists began designing brands and protocols that could quickly collect and analyze relevant business intelligence and disseminate the information to the appropriate parties.

- **Significance**

  This newest iteration of management information systems (MIS) has impacted modern businesses in several significant ways. First, MIS offers the ability of seamlessly translating and sharing important information between all levels and business divisions. Second, it offers management the ability to enable employees to take a greater role in the servicing of end consumers and be profitable operations of the business as a whole. Third, information is more readily available, more accurate and easier to use. Finally, modern MIS eliminates unnecessary redundancy and repetition of effort.

- **Design**

  To ensure that your management information system will be relevant and provides you greatest level of benefit, it must be designed specifically for your business entity. Although many software packages can provide a level of utility to a business enterprise, it is important that the system that a business implements addresses the informational needs and usage behavior of every individual who will participate in the operational effort. This means that any enterprise, whether large or small, must clearly understand its information needs to maximize the benefit of any system it chooses to implement.

- **Benefits**

  Management information systems, implemented and used correctly, can build in a great deal of operational efficiency and accuracy. In the business world, this equates to competitive advantage. In addition, with greater access to accurate information, those employees that serve as the customers' point of contact with the business are empowered to offer a greater level of service to those consumers. This, too, is a competitive edge. Finally, the appropriate usage of a company's management information system can result in more productive business decisions that have tremendous positive impact on the company's bottom line.

- **Considerations**

  While management information systems may offer a great deal of benefit, if implemented and used correctly, it is not unheard of for a well-designed system to be misused or subject to human error. Some business leaders have made the mistake of believing that once they have found the most appropriate system and brought it online, all their informational concerns will have been addressed. Unfortunately, though MIS can reduce the occurrence of human error, it cannot eliminate it. Initial education on the system and continual periodic training on its usage and optimization will be necessary if a company expects to continue to derive the greatest benefit from its management information system.

The impact of MIS on the functions is in its management. With a good MIS support, the management of marketing, finance, production and personnel becomes more efficient, the tracking and monitoring the functional targets becomes easy. The functional managers are informed about the progress, achievements

and shortfalls in the activity and the targets. The manager is kept alert by providing certain information indicating the probable trends in the various aspects of business. This helps in forecasting and long-term perspective planning. The manager" attention is brought to a situation which is exceptional in nature, inducing him to take an action or a decision in the matter. A disciplined information reporting system creates a structured database and a knowledge base for all the people in the organization. The information is available in such a form that it can be used straight away or by blending and analysis, saving the manager's valuable time.

The MIS creates another impact in the organization which relates to the understanding of the business itself. The MIS begins with the definition of a data entity and its attributes. It uses a dictionary of data, entity and attributes, respectively, designed for information generation in the organization. Since all the information systems use the dictionary, there is common understanding of terms and terminology in the organization bringing clarity in the communication and a similar understanding of an event in the organization.

The MIS calls for a systemization of the business operations for an effective system design. This leads to streamlining of the operations which complicate the system design. It improves the administration of the business by bringing a discipline in its operations everybody is required to follow and use systems and procedures. This process brings a high degree of professionalism in the business operations.

Since the goals and objective of the MIS are the products of business goals and objectives, it helps indirectly to pull the entire organization in one direction towards the corporate goals and objectives by providing the relevant information to the people in the organization.

A well designed system with a focus on the manager makes an impact on the managerial efficiency. The fund of information motivates an enlightened manager to use a variety of tools of the management. It helps him to resort to such exercises as experimentation and modeling. The use of computers enables him to use the tools and techniques which are impossible to use manually. The ready-made packages make this task simpler. The impact is on the managerial ability to perform. It improves the decision making ability considerably.

Information Technology provides several advantages to the organization; one such advantage is the ability of IT to link and enable employees (Dewett & Jones, 2001). Electronic communication increases the overall amount of communication within a firm. The most important aspect is that people from the various units of a corporation can interact with each other and thus horizontal communication is promoted. All the obvious advantages of quicker information availability is the outcome of this function of IT but it must also be remembered that too much electronic communication leads to increased alienation of employees due to increased impersonality. Relating to this, IT also increases boundary spanning. An individual can access any information in any part of the organization with the aid of the appropriate technology. This eliminates the need for the repetition of information and thus promotes non-redundancy.

Its ability to store information means that the organization does not have to rely solely on the fallibility of human error, which is subject to error and erosion (Dewett & Jones, 2001). Information can be stored, retrieved and communicated far more easily and effectively. However, IT can often lead to information overload, meaning that managers have to sift through an insurmountable amount of stored data and thus hindering timely decision-making. This problem is not as serious as first thought, though. Information overload is not an IT problem but more of a documentation problem. Furthermore, management tends to adapt to IT problems once it gets used to the idea of the new technologies.

The following are the impact of MIS on any organization.

- ❖ MIS improves the performance and productivity of the organization.

- ❖ It helps in the management of marketing, finance, production and improves the skills of the employees.
- ❖ It helps the employees to monitor the various department functions.
- ❖ It gives the reports regarding progress, achievements and the errors in the day to day functioning.
- ❖ It is used to control the various operations involved in the smooth functioning of the organization.
- ❖ It helps to improve the discipline of the employees.
- ❖ It helps to regulate the operation which complicates the day to day functioning.
- ❖ It helps to yield good results by experimentation and modeling.

2.6 Management information System Risk

The risk associated with decisions made by company managers in relation to the overall interest of shareholders and the company at large. In many cases poor decisions or decisions made my management for the benefit of the management result in the destruction of shareholder wealth.

1) Risks Associated With MIS

Risk reflects the potential, the likelihood, or the expectation of events that could adversely affect earnings or capital. Management uses MIS to help in the assessment of risk within an institution. Management decisions based upon ineffective, inaccurate, or incomplete MIS may increase risk in a number of areas such as credit quality, liquidity, market/pricing, interest rate, or foreign currency. A flawed MIS causes operational risks and can adversely affect an organization's monitoring of its fiduciary, consumer, fair lending, Bank Secrecy Act, or other compliance-related activities. Since management requires information to assess and monitor performance at all levels of the organization, MIS risk can extend to all levels of the operations. Additionally, poorly programmed or non-secure systems in which data can be manipulated and/or systems requiring ongoing repairs can easily disrupt routine work flow and can lead to incorrect decisions or impaired planning.

2) Assessing Vulnerability to MIS Risk

Reported can distort information and trend analysis. In addition, because data collection and reporting processes will change over time, management must to function effectively as an interacting, interrelated, and interdependent feedback tool for management and staff, MIS must be "useable." The five elements of a useable MIS system are: timeliness, accuracy, consistency, completeness, and relevance. The usefulness of MIS is hindered whenever one or more of these elements are compromised.

- **Timeliness**: - To simplify prompt decision making, an institution's MIS should be capable of providing and distributing current information to appropriate users. Information systems should be designed to expedite reporting of information. The system should be able to quickly collect and edit data, summarize results, and be able to adjust and correct errors promptly.

- **Accuracy**: - A sound system of automated and manual internal controls must exist throughout all information systems processing activities. Information should receive appropriate editing, balancing, and internal control checks. A comprehensive internal and external audit program should be employed to ensure the adequacy of internal controls.

- **Consistency**: - To be reliable, data should be processed and compiled consistently and uniformly. Variations in how data is collected and establish sound procedures to allow for systems changes. These procedures should be well defined and documented, clearly communicated to appropriate employees, and should include an effective monitoring system.

• **Completeness**: - Decision makers need complete and pertinent information in a summarized form. Reports should be designed to eliminate clutter and voluminous detail, thereby avoiding "information overload."

• **Relevance**: - Information provided to management must be relevant. Information that is inappropriate, unnecessary, or too detailed for effective decision making has no value. MIS must be appropriate to support the management level using it. The relevance and level of detail provided through MIS systems directly correlate to what is needed by the board of directors, executive management, departmental or area mid-level managers, etc. in the performance of their jobs.

2.7 Changing role of Information System in business

Since the business has started using computer the role of computer has change with time. In 50's computer is use as business accounting machine, In 60's as a EDP department to provide departmental processing capability to the business organization, In 70's we have centralized MIS system with one database and processing program, In 80's we have sharing of resources across the geography through enterprise resource planning(ERP), In 90's the integration is further extended to end user to end user with the help of Internet, Intranet, Extranet etc.

Information systems perform three vital roles in business firms. Business applications of IS support an organization's business processes and operations, business decision making, and strategic competitive advantage. Major application categories of information systems include operations support systems, such as transaction processing systems, process control systems, and enterprise collaboration systems; and management support systems, such as management information systems, decision support systems, and executive information systems. Other major categories are expert systems, knowledge management systems, strategic information systems, and functional business systems. However, in the real world, most application categories are combined into cross-functional information systems that provide information and support for decision making and also performing operational information processing activities.

There are a seemingly endless number of information software but the main reason for all business applications are represented in three fundamental role of information system figure 2.7. They are found in the three vital roles that information systems can perform for a business enterprise

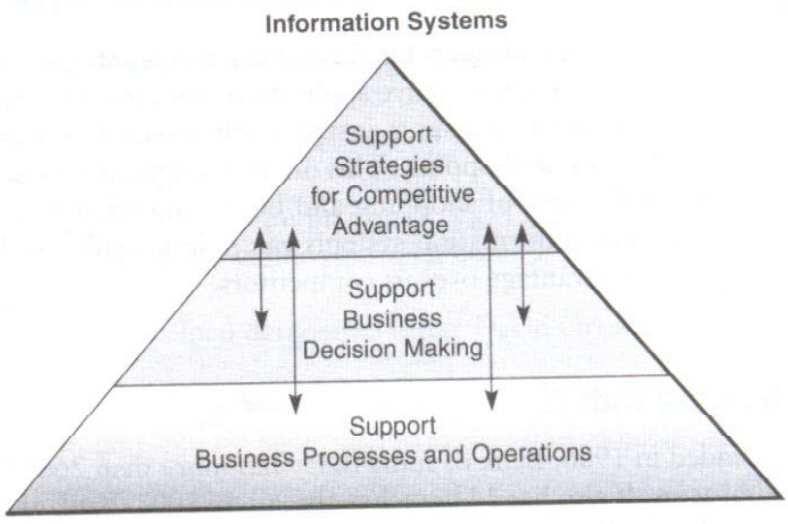

Figure 2.7

The above diagram represents the interaction of various information system in the organization. A information systems are designed to support business processes and operations may also be provide data/ Information to, or accepting data/ Information from, systems focused on business decision making or achieving competitive advantage. i.e. all the information system use in the business organization they share data/ information among them. Today's organizations are constantly striving to achieve integration of their systems to allow information to flow freely through them, which adds even greater flexibility and business support than any other individual information system could provide.

2.8 Competitive Advantage

The information systems and information technology evolution has shifted product/ process orientation to customer centric product and services. The information revolution is sweeping through the economy. The reduction of cost of obtaining processing and transmitting data/ information enable every organization to look for new method and ways to generate specialized use of data and information resulting, competitive advantage over its competitors. This is also essential because lower cost of computerization and automation enables everybody to computerize its activity. Therefore all the organization become at par in terms of use of computer and information system. Information technology is changing the way business organization operates. It is effecting the business organization creates their products and services.

The consistent effort to achieve a measurable competitive advantage in an industry or marketplace occupies a significant portion of an business resources. Creative and innovative marketing, research and development, and process reengineering, among many other activities, are used to gain that elusive and sometimes indescribable competitive advantage over rival firms.

The term competitive advantage is often used when referring to a firm that is leading an industry in some identifiable way such as sales, revenues, or new products. Information technology is no longer an afterthought in forming business strategy, but it is actual cause and driver to develop innovative product and services. The emerging role of information systems applications in business is to provide effective support of a business strategy for gaining competitive advantage. This strategic role of information systems involves using information technology to develop products, services, and capabilities that give a business major advantage over the competitive forces it faces in the global market.

2.9 Porter's Five Forces Model

A business can survive and succeed in the long run only if it successfully develops strategies to confront market forces that shape the structure of competition in its industry. These forces are describe by Michael Porter's classic model of competition that any business that wants to survive and succeed must effectively has to develop and implement strategies to counter five forces as shown in figure.

(1) The rivalry of competitors within its industry

(2) The threat of new entrants into an industry and its markets

(3) The threat posed by substitute products that might capture market share,

(4) The bargaining power of buyer/ customers,

(5) The bargaining power of suppliers.

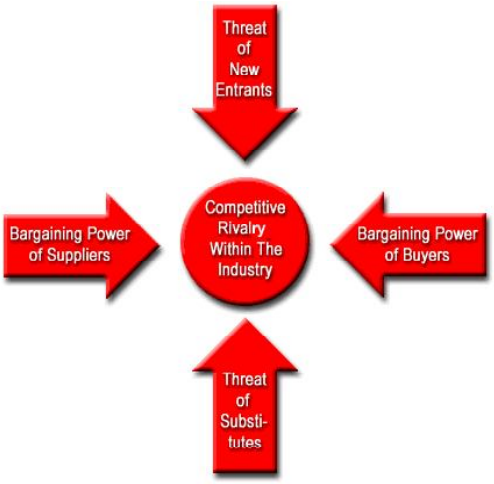

Figure 2.8

1. The rivalry of competitors within its industry

Competition is inevitable characteristic of the business and competitors share a natural rivalry among them. This rivalry requires a constant effort to gain competitive advantage in the marketplace. This ever-present competitive force requires significant resources on the part of a firm in terms of product quality, price, innovation etc.

Industry rivalry mean the intensity of competition among the existing competitors in the market. Intensity of rivalry depends on the number of competitors and their capabilities. **Industry rivalry is high when**:

- There are number of small or equal competitors and less when there's a clear market leader.
- Customers have low switching costs
- Industry is growing
- Exit barriers are high and rivals stay and compete
- Fixed cost are high resulting huge production and reduction in prices

These situations make the reasons for advertising wars, price wars, modifications, ultimately costs increase and it is difficult to compete.

(2) The threat of new entrants into an industry and its markets

A **new entry of a competitor** into your market also weakens your power. **Threat of new entry depends upon entry and exit barriers**. Threat of new entry is high when:

- Capital requirements to start the business are less
- Few economies of scale are in place
- Customers can easily switch (low switching cost)
- Your key technology is not hard to acquire or isn't protected well
- Your product is not differentiated

There is variation in attractiveness of segment depending upon entry and exit barriers. That segment is more attractive which has high entry barriers and low exit barriers. Some new firms enter into industry and low performing companies leave the market easily. When both **entry and exit barriers** are high then profit margin is also high but companies face more risk because poor performance companies stay in and fight it out. When these barriers are low then firms easily enter and exit the industry, profit is low. The worst

condition is when entry barriers are low and exit barriers are high then in good times firms enter and it become very difficult to exit in bad times.

(3) The threat posed by substitute products that might capture market share,

Threat of substitute products means how easily your customers can switch to your competitors product. Threat of substitute is high when:

- There are many substitute products available
- Customer can easily find the product or service that you're offering at the same or less price
- Quality of the competitors' product is better
- Substitute product is by a company earning high profits so can reduce prices to the lowest level.

In the above mentioned situations, **Customer can easily switch to substitute products**. So substitutes are a threat to your company. When there are actual and potential substitute products available then segment is unattractive. Profits and prices are effected by substitutes so, there is need to closely monitor price trends. In substitute industries, if competition rises or technology modernizes then prices and profits decline.

(4) The bargaining power of buyer/ customers,

Bargaining Power of Buyers means, How much control the buyers have to drive down your products price, Can they work together in ordering large volumes. **Buyers have more bargaining power when:**

- Few buyers chasing too many goods
- Buyer purchases in bulk quantities
- Product is not differentiated
- Buyer's cost of switching to a competitors' product is low
- Shopping cost is low
- Buyers are price sensitive
- Credible Threat of integration

Buyer's bargaining power may be lowered down by offering differentiated product. If you're serving a few but huge quantity ordering buyers, then they have the power to dictate you.

(5) The bargaining power of suppliers.

Bargaining Power of supplier means how strong is the position of a seller. How much your supplier have control over increasing the Price of supplies. **Suppliers are more powerful when**

1. Suppliers are concentrated and well organized
2. a few substitutes available to supplies
3. Their product is most effective or unique
4. Switching cost, from one suppliers to another, is high
5. You are not an important customer to Supplier

When suppliers have more control over supplies and its prices that segment is less attractive. It is best way to make win-win relation with suppliers. It's good idea to have multi-sources of supply.

Michael Porters five forces model provides useful input for SWOT Analysis and is considered as a strong tool for industry competitive analysis.

Strategies: A business can counter the threats of these competitive forces that they face by implementing following category of competitive strategies.

Cost Leadership Strategy: Becoming a low-cost producer of products and services in the industry or finding ways to help suppliers or customers reduce their costs or increase the costs of competitors.

Differentiation Strategy: Developing ways to differentiate a firm's products and services from those of its competitors or reduce the differentiation advantages of competitors. This strategy may allow a firm to focus its products or services to give it an advantage in particular segments or niches of a market.

Innovation Strategy: Finding new ways of doing business. This strategy may involve developing unique products and services or entering unique markets or market niches. It may also involve making radical changes to the business processes for producing or distributing products and services that are so different from the way a business has been conducted that they alter the fundamental structure of an industry.

Growth Strategies: Significantly expanding a company's capacity to produce goods and services, expanding into global markets, diversifying into new products and services, or integrating into related products and services.

Alliance Strategies: Establishing new business linkages and alliances with customers, suppliers, competitors, consultants, and other companies. These linkages may include mergers, acquisitions, joint ventures, forming of "virtual companies," or other marketing, manufacturing, or distribution agreements between a business and its trading partners.

It is worth to mentioned here that these strategies are not mutually exclusive. A business organization can adopt one or more of the above strategy to develop competitive advantage. The business may also merge these strategies depending on the time and nature of competition in the market. For example, implementing a system that allows customers to track their consignment could be considered a form of differentiation if the other competitors in the marketplace do not offer this service. If they do offer the service, however, online order tracking would not serve to differentiate one organization from another.

Strategy	**Company**	**Strategic Use of Information Technology**	**Business Benefits**
Cost Leadership	Dell.com Baazi.com Ebay.com	Online bill to order, Online seller billing, Online option	Lowest cost producer Buyer set price Option set prices
Differentiation	OLX Service Gati Logistics	End user e-commerce Personalized Services	Increasing Market Share
Innovation	Federal Express Amazon.com Kabadibazar.com	Online tracking of consignment Online unmatched services	Market leadership Unparallel choice
Growth	Wal-Mart Citi Corp	Ordering through network Strong Intranet	Cost effective supply Market Leadership
Alliance	Reliance P&G Cisco	Computerize Inventory System Online manufacturing system	Increase sells Reduced holding cost Market Leadership

2.10 Information Technology for Strategic Advantage

Information technology has been used to generate strategic competitive advantage in changing dynamic environment. The way of performing business has been totally change with the help of information technology. We can perform business from different geography simultaneously communication technology and centralized databases. Now the requirement for having a office in a prime location has been removed with the help of offering office service through a website. Table below discusses the some of the area where Information technology playing crucial role.

Lower Costs	Use IT to substantially reduce the cost of business processes. Use IT to lower the costs of customers or suppliers.	Manufacturing plant Computerized assembly Inventory management
Differentiate	Develop new IT features to differentiate products and services. Use IT features to reduce the differentiation advantages of competitors. Use IT features to focus products and services at selected market niches.	Development of new features in product & services 24X7 support system
Innovate	Create new products and services that include IT components. Develop unique new markets or market niches with the help of IT. Make radical changes to business processes with IT that dramatically cut costs; improve quality, efficiency, or customer service; or shorten time to market.	Development of new product and services for example mobile banking. Personalized services Customized services
Promote Growth	Use IT to manage regional and global business expansion. Use IT to diversify and integrate into other products and services.	Extending business domain and activity Reliable delivery of services
Develop Alliances	Use IT to create virtual organizations of business partners. Develop inter enterprise information systems linked by the Internet and extranets that support strategic business relationships with customers, suppliers, subcontractors, and others.	Smarter integration with business partner

Business organization can investing information technology to lock in customers and suppliers and lock out competitors by developing strong relationship with the help of sharing of hardware, software resources. This will require to share your IT expertise with your customer and supplier increasing their dependency on your business. This can also be possible with the help of increasing quality of product and services to the customer and supplier in the business distribution, marketing, sales and services related activity. The another area where investment in information technology will allow a customer dependent on continuous use of innovative system and mutually beneficial enter price information system. This will result in user reluctance to pay cost in terms of money, time, effort, inconvenience that could take to switch to it competitor.

2.11 The Value Chain

Every business organization is looking for a way to gain competitive advantage and has developed strategic information systems to help them in achieving it. This advantage is for the time being and applicable to that frame of time. It is important to remember that no matter how it is achieved competitive advantage doesn't last forever. That means organization has to continuously look for new areas were competitive advantage could be achieve. Rightly said by Arie de Geus, head of strategic planning for Royal Dutch Shell, "The ability to learn faster-than your competitors may be the only sustainable competitive advantage in the future."

The value of a company lies in creating customer focus product/ services through its ability to help them loyal, anticipate their future need, responsive to their concern. This focus on customer value recognized that quality becomes the primary factor towards customer perception of value rather than price. Companies are developing new methods and use of information technology to create more value to their products and services. The value can be brought in every stage of process which convert raw material through finished goods to consume it by end user.

The **value chain** concept given by Michael Porter viewed conversion process as a sequence of many activity as shown in figure. The figure shows that a business firm is a series or chain or network of basic activities that add value to its products and services resulting adding a value to customer as well as business. In the value chain model Porter classify business activity into two category Primary activity and support activity. Primary activity include those business activity which are directly related with core manufacturing of product or delivery of the services to the customer. Business support processes includes all the business activity that support day-to-day operation of the business and indirectly contribute to the product/ services of the business.

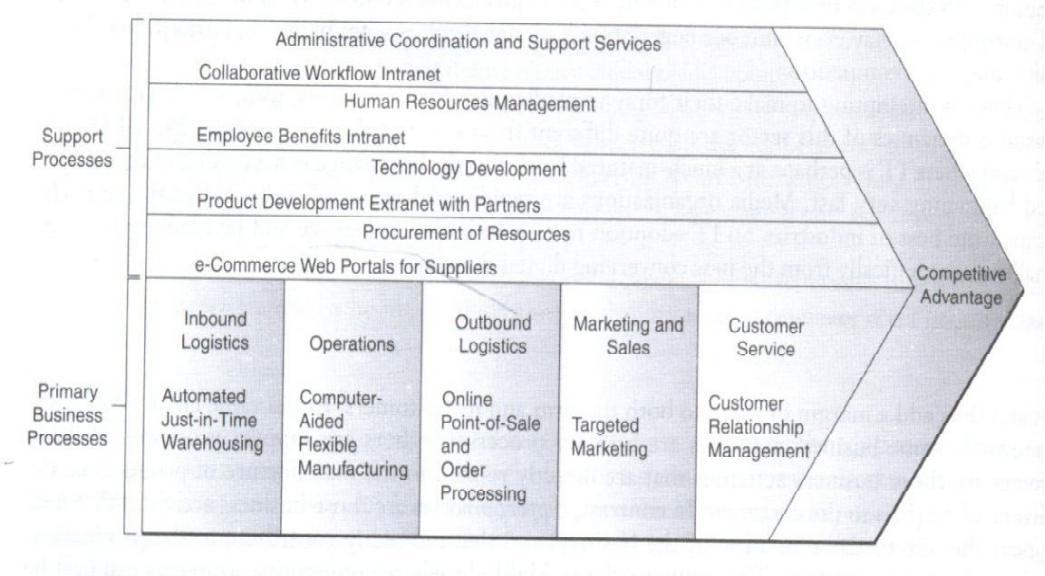

Figure 2-9

These primary and secondary activities highlights the processes where use of innovative practices and technology can be use to create more value during the manufacturing. In the figure primary activity can be integrated with the help of information technology. The inbound logistics uses just-in-time inventory procuring system results in saving of inventory cost. In operations, computer aided design and manufacturing (CAD & CAM) helps organization to efficiently complete the manufacturing process along with flexibility in manufacturing. The out bond logistics helps a dealer to monitor the sales and delivery of their orders with the help of order processing and tracking system. The marketing and sales team can make use of point of sale terminals, materials planning system, ordering system to unable them in achieving their target in time. Customer relationship management (CRM) helps the organization to manage relation with the end user throughout the purchase and post purchase activity.

The secondary support activity also help business organization to facilitate more value through their activity. The collaborative work flow system develop through networks for proper administration, coordination help business organization for seamless integration of various activity. Human resource information system and knowledge management system help organization to manage their human resource more efficient and effectively. The integration various business partner through the network allows the organization to create new technological development in the line of customer expectation. The use of common software by various vendor and suppliers gives one face to the procurement of resources which essential for flow less production of products and services.

2.12 Strategic Information System

When all the organization start using computer for their business operation they become at par in terms of product and services. A business organization had to look for new ways of using information system to create a competitive edge over its fellow organizations. Strategic information gives business organization this competitive edge. SIS can be defined as information system that provides a business with competitive products and services that give it a strategic advantage over its competitors in the market. It is a information system that promotes business innovation, improve business process and build strategic information system for the business.

The business innovation and improvement in business process is possible through business process reengineering (BPR), a concept of 80's. BPR talks about fundamental rethinking and radical redesign of business process which results in improvement in cost, quality, time. The merging of information technology with BPR principle has resulted in development of many strategic information systems like ERP. Information technology plays major role in developing innovative support system in designing of work flow, job requirement and deciding the organization structure. SIS helps a manager to manage a network of people, knowledge, finances and physical resources of the organization in meeting out the challenge and opportunity of the environment.

2.13 Summary

MIS is a system, typically computer-based, that collects and processes data (information) and provides it to managers at all levels that use it for decision making, planning, program implementation, and control. MIS is comprised of all the components that collect, manipulate, and disseminate data or information. It usually includes hardware, software, people, communications systems such as telephone lines, and the data itself. The activities involved include inputting data, processing of data into information, storage of data and information, and the production of outputs such as management reports.

The three level of management activity can be differentiated on the basis of the planning horizon for each level. Strategic planning deals with long-range considerations. The decisions to be made are concerned with the choice of business direction, market strategy, product mix, etc. Management control and tactical planning has a medium- term planning horizon. It includes acquisition and organization of resources, structuring of work, and acquisition and training of personnel. It is reflected in the capital expenditure budget, the three-year staffing plan, etc. Operational planning and control is related to short term decisions for current operations. Pricing, production levels, inventory levels, etc.. are results of operational planning and control activities.

Databank information systems refer to creation of a database by classifying and storing data which might be potentially useful to the decision-maker. The information provided by the databank is merely suggestive. The decision-maker has to determine contextually the cause and effect relationships. MIS designs based on the databank information system are better suited for unstructured decisions. The responsibility of this information system is to observe, classify, and store any item of data which might be potentially useful to the decision maker.

MIS workers use computers to organize and compile databases full of company information. Management and information systems (MIS) have taken an ever increasing role in the processes of businesses in the Internet age. After companies collect data about their customers, inventory and sales volume, MIS workers take the raw data and turn it into usable information that top-level management can use to steer the company.

Since businesses have existed, managers have needed to obtain, organize and analyze information. The means by which managers handle business data to serve their interests is referred to as their information systems. Information Technology provides several advantages to the organization; one such advantage is the ability of IT to link and enable employees (Dewett & Jones, 2001). Electronic communication increases the overall amount of communication within a firm. The most important aspect is that people from the various units of a corporation can interact with each other and thus horizontal communication is promoted. An individual can access any information in any part of the organization with the aid of the appropriate technology. This eliminates the need for the repetition of information and thus promotes non-redundancy.

Management decisions based upon ineffective, inaccurate, or incomplete MIS may increase risk in a number of areas such as credit quality, liquidity, market/pricing, interest rate, or foreign currency. A flawed MIS causes operational risks and can adversely affect an organization's monitoring of its fiduciary, consumer, fair lending, Bank Secrecy Act, or other compliance-related activities. Since management requires information to assess and monitor performance at all levels of the organization, MIS risk can extend to all levels of the operations.

2.14 Key Words

- **Information:** It is collection of facts gathered by various means to draw a conclusion. It is representation of knowledge such as data, facts or opinions including textual, numerical, graphical, audio-visual aids.
- **Management Information System**: MIS is a system, typically computer-based, that collects and processes data (information) and provides it to managers at all levels that use it for decision making, planning, program implementation, and control.
- **Integrated:** resembling a living organism in organization or development.
- **Capital Investments**: The term Capital Investment has two usages in business. **Firstly**, Capital Investment refers to money used by a business to purchase fixed assets, such as land, machinery, or

buildings. **Secondly**, Capital Investment refers to money invested in a business with the understanding that the money will be used to purchase fixed assets, rather than used to cover the business' day-to-day operating expenses.

- **Efficiency:** A level of performance that describes a process that uses the lowest amount of inputs to create the greatest amount of outputs. Efficiency relates to the use of all inputs in producing any given output, including personal time and energy.
- **Intelligence:** Intelligence has been defined in different ways, including the abilities for abstract thought, understanding, communication, reasoning, learning, retaining, planning, and problem solving.
- **Awareness:** Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects or sensory patterns.
- **Decision- Making**: The thought process of selecting a logical choice from the available options.
- **Planning:** The process of setting goals, developing strategies, and outlining tasks and schedules to accomplish the goals.
- **Organization**: A social unit of people, systematically structured and managed to meet a need or to pursue collective goals on a continuing basis. All organizations have a management structure that determines relationships between functions and positions, and subdivides and delegates roles, responsibilities, and authority to carry out defined tasks. Organizations are open systems in that they affect and are affected by the environment beyond their boundaries.
- **Staffing**: The selection and training of individuals for specific job functions, and charging them with the associated responsibilities.
- **Directing:** A basic management function that includes building an effective work climate and creating opportunity for motivation, supervising, scheduling, and disciplining.
- **Controlling:** The basic management function of (1) establishing benchmarks or standards, (2) comparing actual performance against them, and (3) taking corrective action, if required.
- **Transaction processing:** Updating the appropriate database records as soon as a transaction (order, payment, etc.) is entered into the computer. It may also imply that confirmations are sent at the same time.
- **Strategic planning**: It is a management tool for organizing the present on the basis of the projections of the desired future. That is, a strategic plan is a road map to lead an organization from where it is now to where it would like to be in five or ten years.
- **Databank:** Organized collection of data or information on one or more subjects, or for a particular purpose. Diaries, files, or record books (however small) are data banks.
- **Timeliness:** In general, timeliness of a contract is deemed a warranty an incidental point and not a central point like a condition. Therefore, a failure to adhere to a time schedule would amount to a breach of warranty (for which the injured party may sue for damages) and not a breach of condition (for which the injured party may terminate the contract). If adherence to a schedule is vital, it must be made a specific condition by using precise wording (such as the traditional phrase, "Time is of the essence").
- **Competency:** Competence is the acquisition of knowledge skills and abilities at a level of expertise sufficient to be able to perform in an appropriate work setting (within or outside academia).

- **Simulations:-** Acting out or mimicking an actual or probable real life condition, event, or situation to find a cause of a past occurrence (such as an accident), or to forecast future effects (outcomes) of assumed circumstances or factors. A simulation may be performed through (1) solving a set of equations (a mathematical model), constructing a physical (scale) model, (3) staged rehearsal, (4) game (such as war games), or a computer graphics model (such as an animated flowchart). Whereas simulations are very useful tools that allow experimentation without exposure to risk, they are gross simplifications of the reality because they include only a few of the real-world factors, and are only as good as their underlying assumptions.
- **MIS Risk:** Risk management information systems (RMIS) are typically computerized systems that assist in consolidating property values, claims, policy, and exposure information and provide the tracking and management reporting capabilities to enable you to monitor and control your overall cost of risk.

2.15 Self Assessment Test

1. What do you mean by Management Information System? Describe Structure of Management Information System.
2. What is the importance of Management Information System? Explain briefly.
3. What do you mean by Management Information System? Classify the Management Information System using suitable example.
4. Write short note on
   a) Databank information system
   b) Transaction Processing and inquiry response
   c) Strategic Management Information System
   d) Operational planning & control
   e) Management control and Tactical planning
5. Explain in your own words impact & future of MIS in business.
6. What is the importance of management information system in an organization? Explain in detail.
7. What is decision support system? How it helps in any organization to achieve his goal in business area.
8. Explain the process of MIS.
9. What is the impact of the management information system on organization?
10. What is MIS risk? Explain with suitable Example.
11. What is Decision Support System (DSS)? Explain the difference between DSS and MIS.
12. Discuss the concept strategic information system.
13. How the role of information system has changes with respect to time. Illustrate
14. Explain Michael Porter five-forces model.

15. Describe the strategy used in competitive environment by an organization.

16. What is the value chain concept discuss the primary and support activity of value chain.

17. Explain the following MIS terms in detail:

    a) Executive information system

    b) Operation support system

    c) Enterprise collaboration system

    d) Management support system

2.16 References

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Unit – 3 : Database Management

Unit Structure:

3.0 Objectives

After studying this unit, you should be able to :

- Understand the definition and need of Database Management System
- Understand the differences between the traditional File System approach and modern Database Management System approach
- Understand the layered database structure
- Awareness of different database models.
- An ability to use Structured Query Language
- Understand importance of normalization.
- Get an introductory understanding of some advanced database techniques such as object-relational databases and design, distributed databases, database administration (security, backup and restore, tuning) and data warehousing.

3.1 Introduction

Information and data are different. Information is understood by a person. Data are values stored on a passive medium like a computer disk. The purpose of a database management system (DBMS) is to bridge the gap between information and data - the data stored in memory or on disk must be converted to usable information.

The basic processes that are supported by a DBMS are:

• Specification of data types, structures and constraints to be considered in an application

• Storing the data itself into persistent storage

• Manipulation of the database

• Querying the database to retrieve desired data

• Updating the content of the database

A database is a model of a real world system. The contents (sometimes called the extension) of a database represent the state of what is being modeled. Changes in the database represent events occurring in the environment that change the state of what is being modeled. It is appropriate to structure a database to mirror what it is intended to model.

3.2 Database Management System

Definitions:

• **Def 1**: A shared collection of logically related data, designed to meet the information needs of multiple users in an organization.

• **Def 2**: A data structure that stores metadata, i.e. data about data. More generally we can say an organized collection of information.

• **Def 3**: A collection of related information about a subject organized in a useful manner that provides a base or foundation for procedures such as retrieving information, drawing conclusions, and making decisions.

• **Def 4**: The term **database** is often used, rather loosely, to refer to just about any collection of related data. Elmasri & Navathe say that, in addition to being a collection of related data, a database must have the following properties:

➢ It represents some aspect of the real (or an imagined) world, called the **mini world** or **universe of discourse**. Changes to the mini world are reflected in the database. Imagine, for example, a UNIVERSITY mini world concerned with students, courses, course sections, grades, and course prerequisites.

➢ It is a logically coherent collection of data, to which some meaning can be attached. (Logical coherency requires, in part, that the database not be self-contradictory.)

➢ It has a purpose: there is an intended group of users and some preconceived applications that the users are interested in employing.

• **Def 5**: DBMS contains information about a particular enterprise

➢ Collection of interrelated data

➢ Set of programs to access the data

➢ An environment that is both *convenient* and *efficient* to use

3.3 Database Applications

Database systems have become an essential component of life in modern society, in that many frequently occurring events trigger the accessing of at least one database: bibliographic library searches, bank transactions, hotel/airline reservations, grocery store purchases, etc., etc.

Traditional vs. more recent applications of databases:

The applications mentioned above are all "traditional" ones for which the use of rigidly-structured textual and numeric data suffices. Recent advances have led to the application of database technology to a wider class of data. Examples include **multimedia** databases (involving pictures, video clips, and sound messages) and **geographic** databases (involving maps, satellite images).

Among others, the major areas where Databases find their applications are:

- 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

3.4 Files-The Traditional Approach

Traditional file based system is basically a file based system, in which we handle database functions such as updating, insertion ,deletion adding new files to database etc.

- Information are stored in data files
- Each file is a sequence of records

Sno Lname Position NIN Bno

SG14 Ford Deputy WL220658D B3

SG37 Beech Snr Asst WL432514C B3

SL21 White Manager WK440211B B5

Eg., if each record contains 100 bytes of data, then

the 1st record occupies the 1st 100 bytes in the file,

the 2nd record occupies the 2nd 100 bytes in the file. Ex of a traditional File-based Systems

An example: DreamHome, A property agent company

- No need of external storage

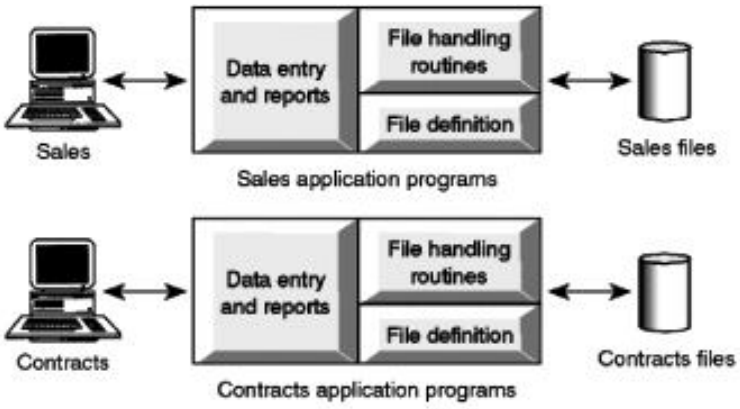


Figure 3.1

No need for technical staff to handle the database. - Processing speed is high as compare to dbms.

BUT... - less security. - more redundancy - lower integrity - high complexity when updating the database

3.5 Databases-The Modern Approach

A logical group of related files that stores data and the associations among them.

Files vs. DBMS

a) Drawbacks of using file systems to store data:

1. **Data redundancy and inconsistency:** Multiple file formats, duplication of information in different files
2. **Difficulty in accessing data:** Need to write a new program to carry out each new task
3. **Data isolation:** Multiple files and formats
4. **Integrity problems:** Integrity constraints (e.g. account balance > 0) become "buried" in program code rather than being stated explicitly. Hard to add new constraints or change existing ones
5. **Atomicity of updates:** Failures may leave database in an inconsistent state with partial updates carried out. Example: Transfer of funds from one account to another should either complete or not happen at all
6. **Concurrent access by multiple users:** Concurrent accessed needed for performance. Uncontrolled concurrent accesses can lead to inconsistencies. Example: Two people reading a balance and updating it at the same time
7. **Security problems:** Hard to provide user access to some, but not all, data. Database systems offer solutions to all the above problems

3.6 Database Hierarchy

3.6.1 Schemas, Instances, and Database State

One must distinguish between the *description* of a database and the database itself. The former is called the **database schema**, which is specified during design and is not expected to change often.

The actual data stored in the database probably changes often. The data in the database at a particular time is called the **state** of the database, or a **snapshot**.

- **Schema** is also called **intension**.

- **State** is also called **extension**.

This is similar to types and variables in programming languages.

Schema – The logical structure of the database e.g., the database consists of information about a set of customers and accounts and the relationship between them. Analogous to type information of a variable in a program.

Instance – The actual content of the database at a particular point in time. Analogous to the value of a variable.

3.6.2 Three-Schema Architecture

This idea was first described by the ANSI/SPARC committee in late 1970's. The goal is to separate (i.e., insert layers of "insulation" between) user applications and the physical database. It is an ideal that few real-life DBMS's achieve fully.

- **Internal/physical schema**: describes the physical storage structure (using a low-level data model)
- **Conceptual schema**: describes the (logical) structure of the whole database for a community of users. Hides physical storage details, concentrating upon describing entities, data types, relationships, user operations, and constraints. Can be described using either high-level or implementational data model.
- **External schema** (or user views): Each such schema describes part of the database that a particular category of users is interested in, hiding rest of database. Can be described using either high-level or implementational data model. (In practice, usually described using same model as is the conceptual schema.)

These are also called as levels of abstraction.

Users (including application programs) submit queries that are expressed with respect to the external level. It is the responsibility of the DBMS to **transform** such a query into one that is expressed with respect to the internal level (and to transform the result, which is at the internal level, into its equivalent at the external level).

Example: Select students with GPA > 3.5.

Q: How is this accomplished? A: By virtue of **mappings** between the levels:

- **external/conceptual** mapping (providing **logical** data independence)
- **conceptual/internal** mapping (providing **physical** data independence)

There is another way to look at the **Data Abstraction.** It provides the insulation between programs and data. Two types of abstraction:

(i) **Program-Data Independence**: In traditional file processing, the structure of the data files accessed by an application is "hard-coded" in its source code. (E.g., consider a student file in a C program which uses array of structures: it gives a detailed description of the records in a file.)

If, for some reason, we decide to change the structure of the data (e.g., by adding another field Blood Group), **every** application in which a description of that file's structure is hard-coded must be changed!

In contrast, DBMS access programs, in most cases, do not require such changes, because the structure of the data is described (in the system catalog) separately from the programs that access it and those programs consult the catalog in order to ascertain the structure of the data (i.e., providing a means by which to determine boundaries between records and between fields within records) so that they interpret that data properly.

In other words, the DBMS provides a conceptual or logical view of the data to application programs, so that the underlying implementation may be changed without the programs being modified. (This is referred to as *program-data independence*.)

Also, which access paths (e.g., indexes) exist are listed in the catalog, helping the DBMS to determine the most efficient way to search for items in response to a query.

(ii) **Multiple Views of Data:** Different users (e.g., in different departments of an organization) have different "views" or perspectives on the database. For example, from the point of view of A.O's Office , student data does not include anything about which courses were taken or which grades were earned. (This is an example of a **subset** view.)

As another example, a Registrar's Office employee might think that PERCENTAGE is a field of data in each student's record. In reality, the underlying database might calculate that value each time it is called for. This is called **virtual** (or **derived**) data.

A view designed for an academic advisor might give the appearance that the data is structured to point out the prerequisites of each course. A good DBMS has facilities for defining multiple views. This is not only convenient for users, but also addresses security issues of data access.

Example: University Database

- Conceptual scheme:

_ *Students(sid: string, name: string, login: string,age: integer, gpa:real)*

_ *Courses(cid: string, cname:string, credits:integer)*

_ *Enrolled(sid:string, cid:string, grade:string)*

- Physical scheme:

_ Relations stored as unordered files.

_ Index on first column of Students.

- External Scheme (View):

_ *Course_info(cid:string,enrollment:integer)*

3.6.3 Data Independence

Data independence is the capacity to change the schema at one level of the architecture without having to change the schema at the next higher level. We distinguish between **logical** and **physical** data independence according to which two adjacent levels are involved. The former refers to the ability to change the conceptual schema without changing the external schema. The latter refers to the ability to change the internal schema without having to change the conceptual.

Logical Data Independence:

The capacity to change the conceptual schema without having to change the external schemas and their associated application programs.

Physical Data Independence:

The capacity to change the internal schema without having to change the conceptual schema.

For an **example of physical data independence**, suppose that the internal schema is modified (because we decide to add a new index, or change the encoding scheme used in representing some field's value, or stipulate that some previously unordered file must be ordered by a particular field). Then we can change the mapping between the conceptual and internal schemas in order to avoid changing the conceptual schema itself.

Not surprisingly, the process of transforming data via mappings can be costly (performance-wise), which is probably one reason that real-life DBMS's don't fully implement this 3-schema architecture.

Applications depend on the logical schema. In general, the interfaces between the various levels and components should be well defined so that changes in some parts do not seriously influence others.

• A data model is a collection of tools for describing

– Data

– Data relationships

– Data semantics

– Data constraints

• Examples of data models are:

• Relational model

• Entity-Relationship data model (mainly for database design)

• Object-based data models (Object-oriented and Object-relational)

• Semi structured data model (XML)

• Other older models:

– Network model

– Hierarchical model

- **A Sample Relational Database**

customer_id	*customer_name*	*customer_street*	*customer_city*
192-83-7465	Johnson	12 Alma St.	Palo Alto
677-89-9011	Hayes	3 Main St.	Harrison
182-73-6091	Turner	123 Putnam Ave.	Stamford
321-12-3123	Jones	100 Main St.	Harrison
336-66-9999	Lindsay	175 Park Ave.	Pittsfield
019-28-3746	Smith	72 North St.	Rye

(a) The *customer* table

account_number	*balance*
A-101	500
A-215	700
A-102	400
A-305	350
A-201	900
A-217	750
A-222	700

(b) The *account* table

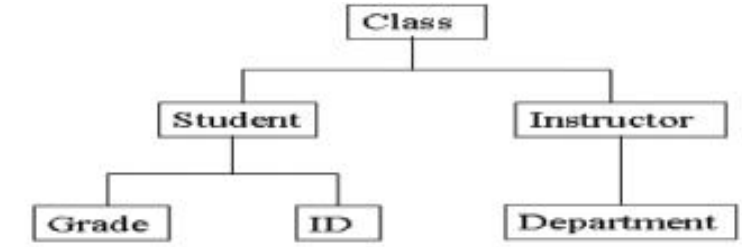
customer_id	*account_number*
192-83-7465	A-101
192-83-7465	A-201
019-28-3746	A-215
677-89-9011	A-102
182-73-6091	A-305
321-12-3123	A-217
336-66-9999	A-222
019-28-3746	A-201

(c) The *depositor* table

Figure 3.2

3.7.1 Hierarchical Model

In a Hierarchical model you could create links between these record types; the hierarchical model uses Parent Child Relationships. These are a 1: N mapping between record types. This is done by using trees, like set theory used in the relational model, "borrowed" from maths. For example, an organization might store information about an employee, such as name, employee number, department, salary. The organization might also store information about an employee's children, such as name and date of birth. The employee and children data forms a hierarchy, where the employee data represents the parent segment and the children data represents the child segment. If an employee has three children, then there would be three child segments associated with one employee segment. In a hierarchical database the parent-child relationship is one to many. This restricts a child segment to having only one parent segment. Hierarchical DBMSs were popular from the late 1960s, with the introduction of IBM's Information Management System (IMS) DBMS, through the 1970s.



Advantages

- Simplicity
- Data Security and Data Integrity
- Efficiency

Disadvantages

- Implementation Complexity
- Lack of structural independence
- Programming complexity

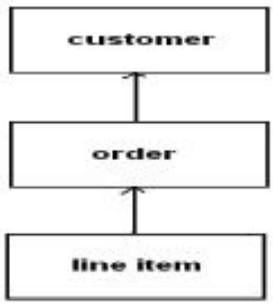


Figure 3.7

The figure above is a Customer-order-line item database:

There are three data types (record types) in the database: customers, orders, and line items. For each customer, there may be several orders, but for each order, there is just one customer. Likewise, for each order, there may be many line items, but each line item occurs in just one order. (This is the schema for the database.) So, each customer record is the root of a tree, with the orders as children. The children of the orders are the line items. Note: Instead of keeping separate files of Customers, Orders, and Line Items, the DBMS can store orders immediately after customers. If this is done, it can result in very efficient processing.

Problem: What if we also want to maintain Product information in the database, and keep track of the orders for each product?

Now there is a relationship between orders and line items (each of which refers to a single product), and between products and line items. We no longer have a tree structure, but a directed graph, in which a node can have more than one parent.

In a hierarchical DBMS, this problem is solved by introducing pointers. All line items for a given product can be linked on a linked list. Line items become "logical children" of products. In an IMS database, there may be logical child pointers, parent pointers, and physical child pointers

3.7.2 Network Model

A member record type in the Network Model can have that role in more than one set; hence the multivalent concept is supported. An owner record type can also be a member or owner in another set. The data model is a simple network, and link and intersection record types (called junction records by IDMS) may exist, as well as sets between them . Thus, the complete network of relationships is represented by several pair wise sets; in each set some (one) record type is owner (at the tail of the network arrow) and one or more record types are members (at the head of the relationship arrow). Usually, a set defines a 1:M relationship, although 1:1 is permitted. The CODASYL network model is based on mathematical set theory.

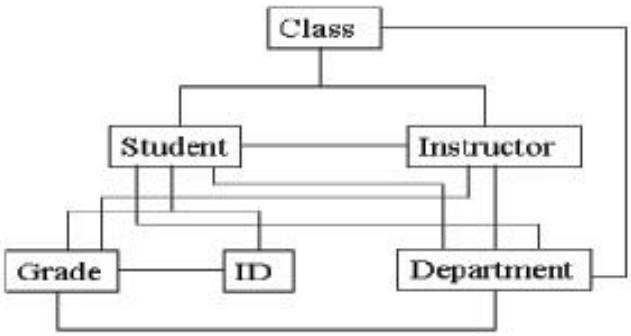


Figure 3.4

Advantages

- Conceptual Simplicity
- Ease of data access
- Data Integrity and capability to handle more relationship types
- Data independence
- Database standards

Disadvantages

- System complexity
- Absence of structural independence

Instead of trees, schemas may be acyclic directed graphs.

In the network model, there are two main abstractions: records (record types) and sets. A set represents a one-to-many relationship between record types. The database diagrammed above would be implemented using four records (customer, order, part, and line item) and three sets (customer-order, order-line item, and part-line item). This would be written in a schema for the database in the network DDL.

Network database systems use linked lists to represent one-to-many relationships. For example, if a customer has several orders, then the customer record will contain a pointer to the head of a linked list containing all of those orders.

The network model allows any number of one-to-many relationships to be represented, but there is still a problem with many-to-many relationships. Consider, for example, a database of students and courses. Each student may be taking several courses. Each course enrolls many students. So the linked list method of implementation breaks down (Why?)

The way this is handled in the network model is to decompose the many-to-many relationship into two one-to-many relationships by introducing an additional record type called an "intersection record". In this case, we would have one intersection record for each instance of a student enrolled in a course.

This gives a somewhat better tool for designing databases. The database can be designed by creating a diagram showing all the record types and the relationships between them. If necessary, intersection record types may be added. (In the hierarchical model, the designer must explicitly indicate the extra pointer fields needed to represent "out of tree" relationships.) In general, these products were very successful, and were considered the state of the art throughout the 1970s and 1980s. They are still in use today.

But — there are still some problems.

There is an insufficient level of data abstraction. Database designers and programmers must still be cognizant of the underlying physical structure.

Pointers are embedded in the records themselves. That makes it more difficult to change the logical structure of the database. Processing is "one record at a time". Application programs must "navigate" their way through the database. This leads to complexity in the applications. The result is inflexibility and difficulty of use.

Performing a query to extract information from a database requires writing a new application program. There is no user-oriented query language. Because of the embedded pointers, modifying a schema requires modification of the physical structure of the database, which means rebuilding the database, which is costly.

3.7.3 Relational Model Concepts

Domain: A (usually named) set/universe of *atomic* values, where by "atomic" we mean simply that, from the point of view of the database, each value in the domain is indivisible (i.e., cannot be broken down into component parts).

Examples of domains

• SSN: string of digits of length nine

• Name: string of characters beginning with an upper case letter

• GPA: a real number between 0.0 and 4.0

• Sex: a member of the set { female, male }

• Dept_Code: a member of the set { CMPS, MATH, ENGL, PHYS, PSYC, ... }

These are all *logical* descriptions of domains. For implementation purposes, it is necessary to provide descriptions of domains in terms of concrete **data types** (or **formats**) that are provided by the DBMS (such as String, int, boolean), in a manner analogous to how programming languages have intrinsic data types.

- **Attribute**: the *name* of the role played by some value (coming from some domain) in the context of a **relational schema**. The domain of attribute A is denoted dom(A).
- **Tuple**: A tuple is a mapping from attributes to values drawn from the respective domains of those attributes. A tuple is intended to describe some entity (or relationship between entities) in the mini world.

  As an example, a tuple for a PERSON entity might be

  { Name —> "Keerthy", Sex —> Male, IQ —> 786 }
- **Relation**: A (named) set of tuples all of the same form (i.e., having the same set of attributes). The term **table** is a loose synonym.
- **Relational Schema**: used for describing (the structure of) a relation. E.g., R(A1, A2, ..., An) says that R is a relation with *attributes* A1, ... An. The **degree** of a relation is the number of attributes it has, here *n*.

  Example: STUDENT(Name, SSN, Address)

  One would think that a "complete" relational schema would also specify the domain of each attribute.
- **Relational Database**: A collection of **relations**, each one consistent with its specified relational schema.

Characteristics of Relations

Ordering of Tuples: A relation is a *set* of tuples; hence, there is no order associated with them. That is, it makes no sense to refer to, for example, the 5th tuple in a relation. When a relation is depicted as a table, the tuples are necessarily listed in *some* order, of course, but you should attach no significance to that order. Similarly, when tuples are represented on a storage device, they must be organized in *some* fashion, and it may be advantageous,

from a performance standpoint, to organize them in a way that depends upon their content.

Ordering of Attributes: A tuple is best viewed as a mapping from its attributes (i.e., the names we give to the roles played by the values comprising the tuple) to the corresponding values. Hence, the order in which the attributes are listed in a table is irrelevant. (Note that, unfortunately, the set theoretic operations in relational algebra (at least how Elmasri & Navathe define them) make implicit use of the order of the attributes. Hence, E & N view attributes as being arranged as a sequence rather than a set.)

The **Null** value: used for *don't know*, *not applicable*.

Interpretation of a Relation: Each relation can be viewed as a **predicate** and each tuple an assertion that that predicate is satisfied (i.e., has value **true**) for the combination of values in it. In other words, each tuple represents a fact.

Keep in mind that some relations represent facts about entities whereas others represent facts about relationships (between entities).

3.8 Database Languages

• Two classes of languages

– **Procedural** – user specifies what data is required and how to get those data

– **Declarative (nonprocedural)** – user specifies what data is required without specifying how to get those data

• SQL is the most widely used non-procedural language

I. Data Manipulation Language (DML)

• Language for accessing and manipulating the data organized by the appropriate data model

– DML also known as query language

– E.g. find the name of the customer with customer-id 192-83-7465

select *customer.customer-name*

from *customer*

where *customer.customer-id* = '192-83-7465'

– E.g. find the balances of all accounts held by the customer with

customer-id 192-83-7465

select *account.balance*

from *depositor*, *account*

where *depositor.customer-id* = '192-83-7465' and

depositor.account-number = account.account-number

II. Data Definition Language (DDL)

• Specification notation for defining the database schema

Example: create table *account* (*account_number* char(10),

branch_name char(10

balance integer)

• DDL compiler generates a set of tables stored in a *data dictionary*

– Data dictionary contains metadata (i.e., data about data) also called database schema.

– Integrity constraints

• Domain constraints

• Referential integrity (e.g. *branch_name* must correspond to a valid branch in the *branch* table)

– Authorization

III. Data *storage and definition* language

• Specifies the storage structure and access methods used

IV. Application programs generally access databases through one of

– Language extensions to allow embedded SQL

– Application program interface (e.g., ODBC/JDBC) which allow SQL queries to be sent to a database

3.9 Database Users

Users are differentiated by the way they expect to interact with the system

• **Application programmers** – interact with system through DML calls

• **Sophisticated users** – form requests in a database query language

• **Specialized users** – write specialized database applications that do not fit into the traditional data processing framework

• **Naïve users** – invoke one of the permanent application programs that have been written previously

– Examples, people accessing database over the web, bank tellers, clerical staff

• **Database Administrator**

– Coordinates all the activities of the database system

• has a good understanding of the enterprise's information resources and needs.

– Database administrator's duties include:

• Storage structure and access method definition

• Schema and physical organization modification

• Granting users authority to access the database

• Backing up data

• Monitoring performance and responding to changes

• Database tuning

3.10 Data Storage and Querying

1. Storage management

2. Query processing

3. Transaction processing

1. Storage Management

• Storage manager is a program module that provides the interface between the low-level data stored in the database and the application programs and queries submitted to the system.

• The storage manager is responsible to the following tasks:

– Interaction with the file manager

– Efficient storing, retrieving and updating of data

• Issues:

– Storage access

– File organization

– Indexing and hashing

2. Query Processing

i. Parsing and translation

ii. Optimization

iii. Evaluation

• Alternative ways of evaluating a given query

– Equivalent expressions

– Different algorithms for each operation

• Cost difference between a good and a bad way of evaluating a query can be enormous

• Need to estimate the cost of operations

– Depends critically on statistical information about relations which the database must maintain

– Need to estimate statistics for intermediate results to compute cost of complex expressions

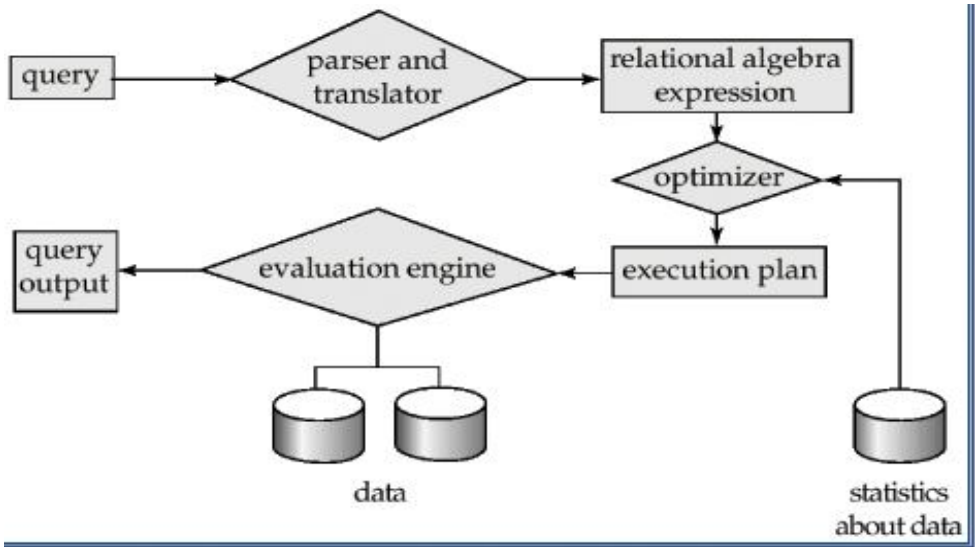


Figure 3.5

3.11 Database Structure

(a) Overall System Structure

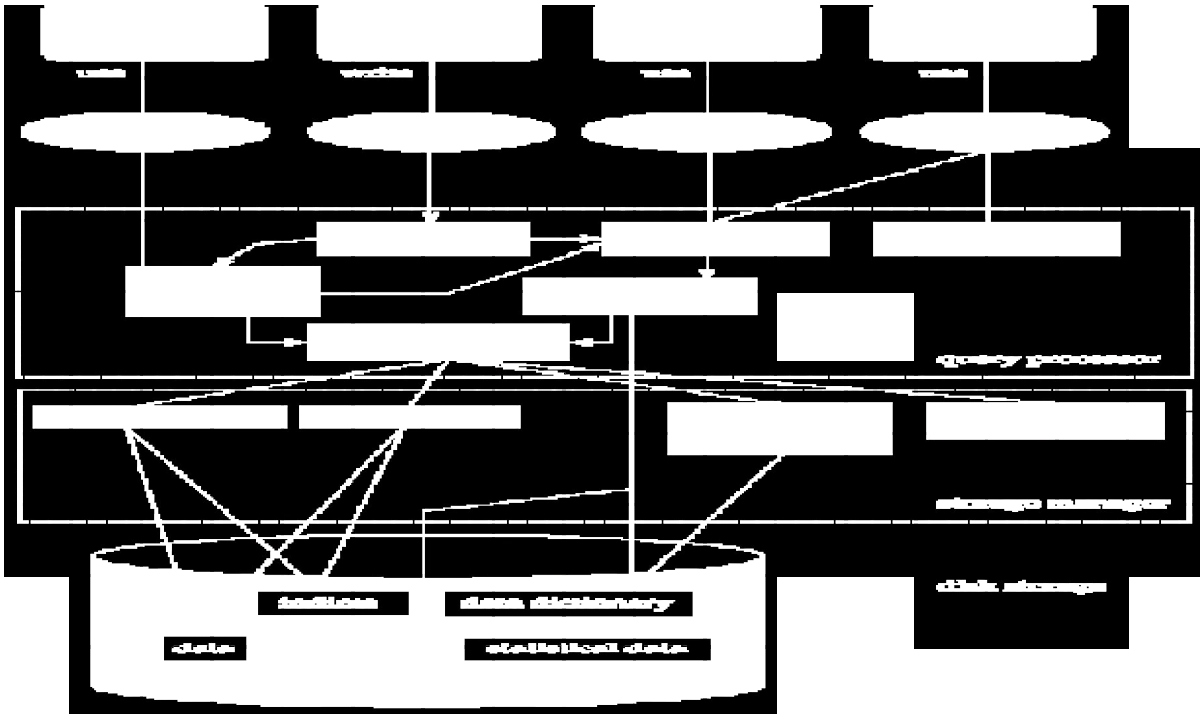


Figure 3.6

The architecture of a database systems is greatly influenced by

the underlying computer system on which the database is running:

• Centralized

• Client-server

• Parallel (multiple processors and disks)

• Distributed

(b) Database Application Architectures

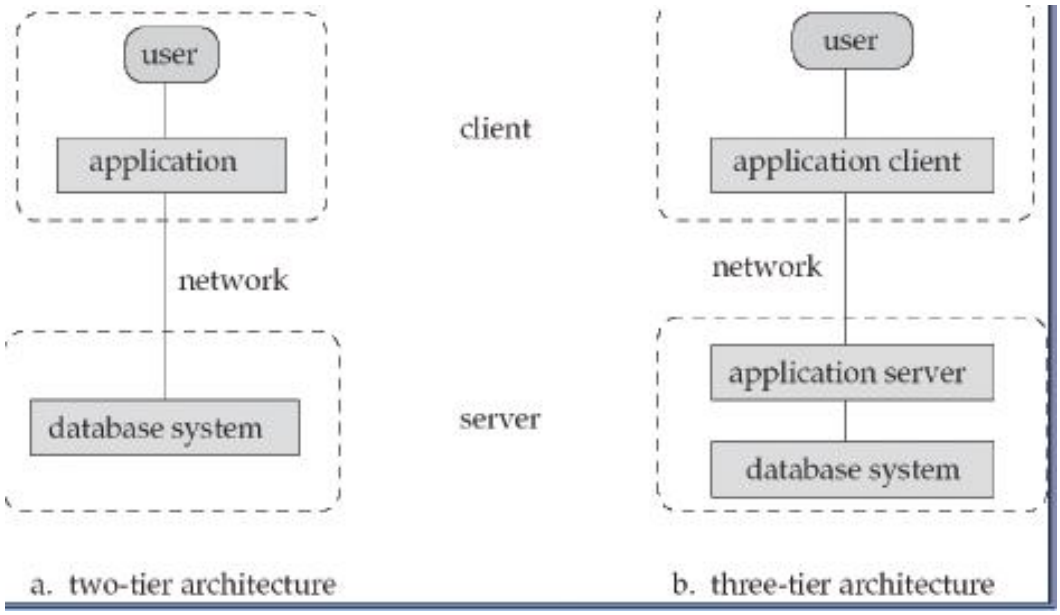


Figure 3.7

3.12 Normalization

Good Database Design i.e.:

• No redundancy of *FACT (!)*

• no inconsistency

• No insertion, deletion or update anomalies

• No information loss

• No dependency loss

The process of decomposing unsatisfactory "bad" relations by breaking up their attributes into smaller relations

• Normalization is used to design a set of relation schemas that is optimal from the point of view of database updating

• Normalization starts from a universal relation schema

I. 1NF or First Normal Form

Attributes must be atomic:

– they can be chars, ints, strings

– they can't be

1. _ tuples

2. _ sets

3. _ relations

4. _ composite

5. _ multivalued

Considered to be part of the definition of relation

II. 2NF or Second Normal Form

Second normal form (2NF) is a relation that is in first normal form and every non—key attribute is fully functionally dependent on the key.

The normalization of 1NF relations to 2NF involves the removal of partial dependencies. If a partial dependency exists, we remove the functional dependent attributes from the relation by placing them in a new relation along with a copy of their determinant.

III. 3NF or Third Normal Form

R is in 3NF if every nonprime attribute of R is

- fully functionally dependent on every key of R, and
- non transitively dependent on every key of R.

Obtaining 3NF

- Split off the attributes in the FD that causes trouble and move them, so there are two relations for each such FD
- The determinant of the FD remains in the original relation

Table 10.1
Summary of Normal Forms Based on Primary Keys and Corresponding Normalization

Normal Form	Test	Remedy (Normalization)
First (1NF)	Relation should have no multivalued attributes or nested relations.	Form new relations for each multivalued attribute or nested relation.
Second (2NF)	For relations where primary key contains multiple attributes, no nonkey attribute should be functionally dependent on a part of the primary key.	Decompose and set up a new relation for each partial key with its dependent attribute(s). Make sure to keep a relation with the original primary key and any attributes that are fully functionally dependent on it.
Third (3NF)	Relation should not have a nonkey attribute functionally determined by another nonkey attribute (or by a set of nonkey attributes). That is, there should be no transitive dependency of a nonkey attribute on the primary key.	Decompose and set up a relation that includes the nonkey attribute(s) that functionally determine(s) other nonkey attribute(s).

Figure 3.8

3.13 Advances in Database Technology

3.13.1 Object-Relational Databases

An **Object-Relational Database** (**ORD**), or **object-relational database management system** (**ORDBMS**), is a database management system (DBMS) similar to a relational database, but with an object-oriented database model: objects, classes and inheritance are directly supported in database schemas and in the query language. In addition, it supports extension of the data model with custom data-types and methods.

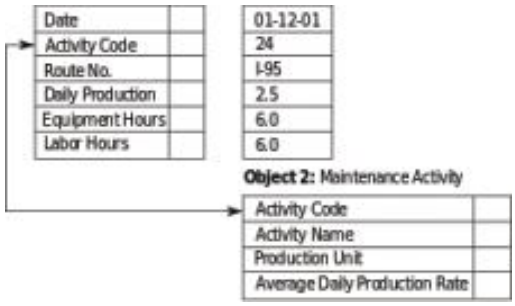


Figure 3.9 : Example of an Object-Oriented Database Model.

An object-relational database can be said to provide a middle ground between relational databases and *object-oriented databases* (OODBMS). In object-relational databases, the approach is essentially that of relational databases: the data resides in the database and is manipulated collectively with queries in a query language; at the other extreme are OODBMSes in which the database is essentially a persistent object store for software written in an object-oriented programming language, with a programming API for storing and retrieving objects, and little or no specific support for querying.

3.13.2 Distributed Databases

A distributed database is a database in which storage devices are not all attached to a common CPU. It may be stored in multiple computers located in the same physical location, or may be dispersed over a network of interconnected computers.

Collections of data (e.g. in a database) can be distributed across multiple physical locations. A distributed database can reside on network servers on the Internet, on corporate intranets or extranets, or on other company networks. The replication and distribution of databases improves database performance at end-user worksites.

To ensure that the distributive databases are up to date and current, there are two processes: replication and duplication. Replication involves using specialized software that looks for changes in the distributive database. Once the changes have been identified, the replication process makes all the databases look the same. The replication process can be very complex and time consuming depending on the size and number of the distributive databases. This process can also require a lot of time and computer resources. Duplication on the other hand is not as complicated. It basically identifies one database as a master and then duplicates that database. The duplication process is normally done at a set time after hours. This is to ensure that each distributed location has the same data. In the duplication process, changes to the master database only are allowed. This is to ensure that local data will not be overwritten. Both of the processes can keep the data current in all distributive locations.

Besides distributed database replication and fragmentation, there are many other distributed database design technologies. For example, local autonomy, synchronous and asynchronous distributed database technologies. These technologies' implementation can and does depend on the needs of the business and the sensitivity/ confidentiality of the data to be stored in the database, and hence the price the business is willing to spend on ensuring data security, consistency and integrity.

3.13.3 Database Administrator

A **database administrator** (short form **DBA**) is a person responsible for the design, implementation, maintenance and repair of an organization's database. They are also known by the titles *Database Coordinator* or *Database Programmer*, and is closely related to the *Database Analyst*, *Database Modeller*, *Programmer Analyst*, and *Systems*

Manager. The role includes the development and design of database strategies, monitoring and improving database performance and capacity, and planning for future expansion requirements. They may also plan, co-ordinate and implement security measures to safeguard the database. Some of the advanced database administration operations include security, backup and restore and tuning.

3.13.3.1 Database Security

Database security concerns the use of a broad range of information security controls to protect databases (potentially including the data, the database applications or stored functions, the database systems, the database servers and the associated network links) against compromises of their confidentiality, integrity and availability. It involves various types or categories of controls, such as technical, procedural/administrative and physical. *Database security* is a specialist topic within the broader realms of computer security, information security and risk management.

Security risks to database systems include, for example:

- Unauthorized or unintended activity or misuse by authorized database users, database administrators, or network/systems managers, or by unauthorized users or hackers (e.g. inappropriate access to sensitive data, metadata or functions within databases, or inappropriate changes to the database programs, structures or security configurations);
- Malware infections causing incidents such as unauthorized access, leakage or disclosure of personal or proprietary data, deletion of or damage to the data or programs, interruption or denial of authorized access to the database, attacks on other systems and the unanticipated failure of database services;
- Overloads, performance constraints and capacity issues resulting in the inability of authorized users to use databases as intended;
- Physical damage to database servers caused by computer room fires or floods, overheating, lightning, accidental liquid spills, static discharge, electronic breakdowns/equipment failures and obsolescence;
- Design flaws and programming bugs in databases and the associated programs and systems, creating various security vulnerabilities (e.g. unauthorized privilege escalation), data loss/corruption, performance degradation etc.;
- Data corruption and/or loss caused by the entry of invalid data or commands, mistakes in database or system administration processes, sabotage/criminal damage etc.

Many layers and types of information security control are appropriate to databases, including:

Access control

Auditing

- Authentication
- Encryption
- Integrity controls
- Backups

? Application security

Traditionally databases have been largely secured against hackers through network security measures such as firewalls, and network-based intrusion detection systems. While network security controls remain valuable in this regard, securing the database systems themselves, and the programs/functions and data within them, has arguably become more critical as networks are increasingly opened to wider access, in particular access from the Internet. Furthermore, system, program, function and data access controls, along with the associated user identification, authentication and rights management functions, have always been important to limit and in some cases log the activities of authorized users and administrators. In other words, these are complementary approaches to database security, working from both the outside-in and the inside-out as it were.

3.13.3.2 Backup and restore

Sometimes it is desired to bring a database back to a previous state (for many reasons, e.g., cases when the database is found corrupted due to a software error, or if it has been updated with erroneous data). To achieve this a **backup** operation is done occasionally or continuously, where each desired database state (i.e., the values of its data and their embedding in database's data structures) is kept within dedicated backup files (many techniques exist to do this effectively). When this state is needed, i.e., when it is decided by a database administrator to bring the database back to this state (e.g., by specifying this state by a desired point in time when the database was in this state), these files are utilized to **restore** that state.

3.13.3.3 Database tuning

Database tuning describes a group of activities used to optimize and homogenize the performance of a database. It usually overlaps with query tuning, but refers to design of the database files, selection of the database management system (DBMS), operating system and CPU the DBMS runs on.

The goal is to maximize use of system resources to perform work as efficiently and rapidly as possible. Most systems are designed to manage work efficiently, but it is possible to greatly improve performance by customizing settings and the configuration for the database and the DBMS being tuned.

3.13.4 Data warehouse

In computing, a **data warehouse** (**DW**) is a database used for reporting and analysis. The data stored in the warehouse is uploaded from the operational systems. The data may pass through an operational data store for additional operations before it is used in the DW for reporting.

A data warehouse maintains its functions in three layers: staging, integration, and access. *Staging* is used to store raw data for use by developers. The *integration* layer is used to integrate data and to have a level of abstraction from users. The *access* layer is for getting data out for users.

Data warehouses can be subdivided into data marts. Data marts store subsets of data from a warehouse.

This definition of the data warehouse focuses on data storage. The main source of the data is cleaned, transformed, catalogued and made available for use by managers and other business professionals for data mining, online analytical processing, market research and decision support. However, the means to retrieve and analyze data, to extract, transform and load data, and to manage the data dictionary are also considered essential components of a data warehousing system. Many references to data warehousing use this broader context. Thus, an expanded definition for data warehousing includes business intelligence tools, tools to extract, transform and load data into the repository, and tools to manage and retrieve metadata.

3.14 Summary

- DBMS is used to maintain, query large datasets.
- Benefits include recovery from system crashes, concurrent access, quick application development, data integrity and security.
- Levels of abstraction give data independence.
- A DBMS typically has a layered architecture.
- DBAs hold responsible jobs and are well-paid! J
- DBMS R&D is one of the broadest, most exciting areas in CS.

3.15 Key Words

- **Database –** Collection of data
- **Schema** – the logical structure of the database
- **Database Administrator -** Coordinates all the activities of the database system
- **Instance** – the actual content of the database at a particular point in time.
- **Data independence -** the capacity to change the schema at one level of the architecture without having to change the schema at the next higher level.
- **Logical Data Independence -** The capacity to change the conceptual schema without having to change the external schemas and their associated application programs.
- **Physical Data Independence -** The capacity to change the internal schema without having to change the conceptual schema.
- **Data Model** - collection of concepts for describing data.
- **Tuple** A tuple is a mapping from attributes to values drawn from the respective domains of those attributes.
- **Relation**: A set of tuples all of the same form

3.16 Self Assessment Test

Short Answer

1. What is Normalization?
2. What is revoke command?

3. What is Transaction?

4. What are the main functions of DBA?

5. What is meant by data independence?

6. What are advantages of views?

7. What is relational schema?

8. What is DDL?

9. What is data model?

10. Write about Naïve users?

11. What is DBMS?

Long answer

1. Describe the three schema architecture. Why do we need mapping b/w schema levels?

2. Design a conceptual data base design for health insurance system.

3. Compare and contrast Relational model and Hierarchical model.

4. Draw and explain the DBMS component modules.

5. What are advantages of DBMS?

6. What are the functions of DBA?

7. Write about architecture of DBMS.

8. Explain about various database users.

9. What are various capabilities of DBMS?

10. What is the difference b/w logical data independence and physical data independence?

3.17 References

- Database System Concepts by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill
- Fundamentals of Database Systems Volume 2 by Ramez Elmasri, Sham Navathe, Pearson Education India
- An Introduction to Database Systems by C.J.Date, A.Kannan,S.Swamynathan, Pearson Education India
- Database management systems by Raghu Ramakrishnan, Johannes Gehrke, McGraw-Hill

Unit – 4 : MIS and Computers

Unit Structure:

4.0 Objectives

After reading this unit, you will be able to understand

- What is an information system and what is MIS
- Role of computers in MIS
- The basics of computer system
- Data communication in MIS
- Where is data stored and how data is retrieved
- What is a DBMS and DBMS language
- Methods for organizing data in files
- Data transaction in an organization
- Validation of data
- Methods for processing transactions
- Document preparation
- Communication in an organization
- Controlling information processing

4.1 Use of Computers in MIS

Today the need of updated information has become inevitable to arrive at an effective decision in all walks of life. A significant part of an executive's working and personal time is spent on recording, searching, absorbing and communicating information. The information must be collected, stored and retrieved in various fields so that it could be usefully exploited as and when needed. The information system is a support system

for an organization. That part of the information system designed to support organizational operations is an operational support system, the part designed to support decision making is a decision support system (DSS), and the part that supports knowledge work is a knowledge work support system.

Information System Requirements include the determination of information requirements and formation of an information system plan, strategies for information requirements determination, database requirements, and user interface requirements.

The management Information System (MIS) is an integrated man-machine system that provides to support the planning and control functions of managers in an organization. MIS can also be defined as the combination of human and computer-based resources that results in the collection, storage, retrieval, communication and use of data for efficient management of operations and for business planning. MIS is something more than just a computer system. Before the evolution of computers, MIS techniques existed to supply users with information that would permit them to arrive at an effective decision. The computer has added new dimensions such as speed, accuracy and processing of massive data that permit the consideration of more alternatives in a decision.

4.2 An Introduction to Computers

Every organization, regardless of its purpose, is concerned with processing of facts or data for its smooth and efficient functioning. With the ever-increasing amount of data to be processed in shortest possible time, organizations felt the need of faster, cheaper and more efficient methods of processing data. To fill this gap, various types of automated devices were developed and foremost among them was the introduction of the electronic computer in the later half of the twentieth century. Nowadays, the computers have come up in such a big way that their presence is felt in our personal and professional lives in one form or another.

A **computer** is a programmable machine designed to sequentially perform arithmetic or logical operations without human intervention. The particular operation sequence can be altered readily, allowing the computer to work out for more than one type of problem. On some computing platforms an important computer function is the accepting of input from human operators and the output of results are formatted for human requirement. It can perform long and complex calculations, and analyze complex scientific or mathematical data. On the other hand, even the most sophisticated computers cannot have power to think. Intelligence and creativity are still exclusive and endearing quantities of the human mind.

4.2.1 COMPUTER TYPES

Types of computers are classified according to how a particular Computer functions, these are:

1. **Analog computers** – It uses analog signals that are represented by a continuous set of varying voltages and are used in scientific research centers, hospitals and flight centers.
2. **Digital computers** – With digital type of computers data is represented by counting discrete signal of (0 0r 1) or off state and on state. They are high speed programmable; they compute values and stores results and give very precise results. But the problem is that they are too slow and incapable of large scale mathematical operation.
3. **Hybrid computers** – Hybrid computer types are very unique, in the sense that they combined both analog and digital features and operations. Hybrid computers operate by using digital to analog converter and analog to digital converter.

   Digital computers can further be classified into different types based on reliability, memory size and processing speed, these are:

a) The Mainframe Computer – These are computers used by large organizations like meteorological surveys and statistical institutes for performing bulk mathematical computations. They are core computers which are used for desktop functions of over one hundred people simultaneously.

b) The Microcomputer – These are the most frequently used computers better known by the name of "Personal computers". This is the type of computer meant for public use. Other than Desktop Computer the choice ranges as follows:

- Personal Digital Computer
- Tablet PC
- Laptops
- Hand Held Computer

c) The Mini computer – Mini computers like the mainframe computers are used by business organization. The difference being that it can support the simultaneous working of up to 100 users and is usually maintained in business organizations for the maintenance of accounts and finances.

d) Super Computers – It is somewhat similar to mainframe computers and is used in economic forecasts and engineering designs.

e) Workstation – A powerful, single-user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and a higher-quality monitor.

Fig 4.1 Illustrate different types of computers – organization-wide, work-group, and personal information systems.

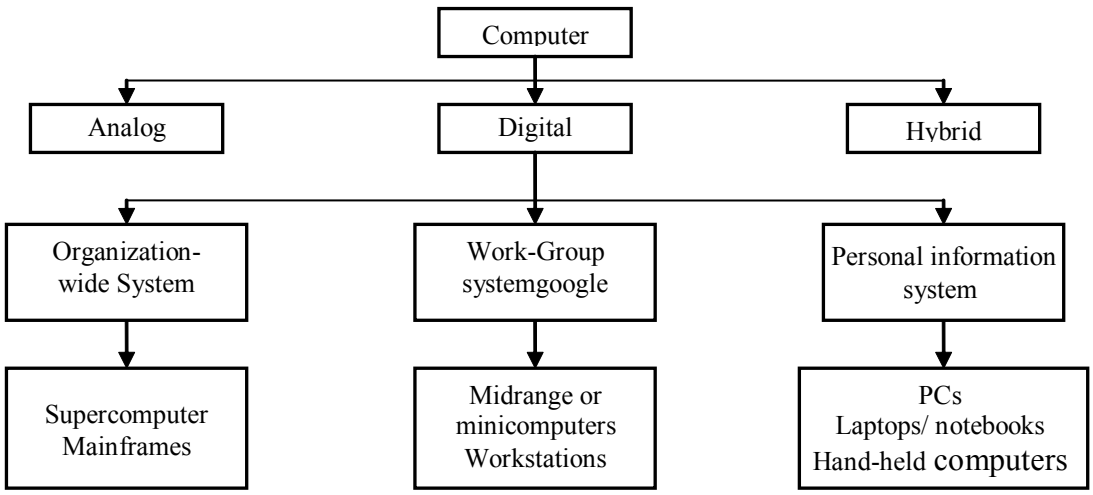


Figure 4.1

Organization–wide systems provide an overall view of an organization; work-group systems allow groups of decision makers to provide and exchange information; and personal information systems are designed to meet the individual needs.

4.2.2 DATA REPRESENTATION

Data Representation refers to the methods used internally to represent information stored in a computer. Computers store lots of different types of information, these are:

- Numbers
- Text
- Graphics of many varieties (stills, video, animation)
- Sound

4.2.3 HARDWARE COMPONENTS

Modern computers are electronic and digital. The actual machinery wires, transistors, and circuits are called hardware; the instructions and data are called software. All general-purpose computers require the following hardware components:

1. Input unit
2. Central Processing Unit (CPU)
3. Secondary storage
4. Output unit
5. Communication devices

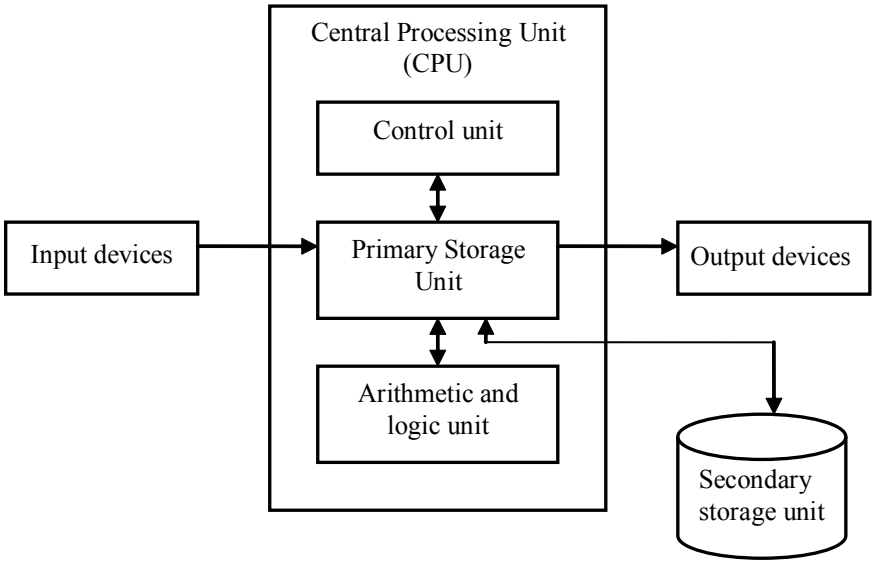


Figure 4.2

These parts are interconnected by busses, often made of groups of wires.

Inside each of these parts are thousands to trillions of small electrical circuits which can be turned "off" or "on" by means of an electronic switch. Each circuit represents a bit (binary digit) of information so that when the circuit is on it represents a "1", and when off it represents a "0" (in positive logic representation).

1. Input Devices

An input device is any peripheral (piece of computer hardware equipment) used to provide data and control signals to an information processing system such as a computer or other information appliance. Some input devices are**:**

Key Board – It is the most commonly used device used for direct (human) input into computers. A keyboard typically has characters printed on the keys and each press of a key typically corresponds to a single written symbol.

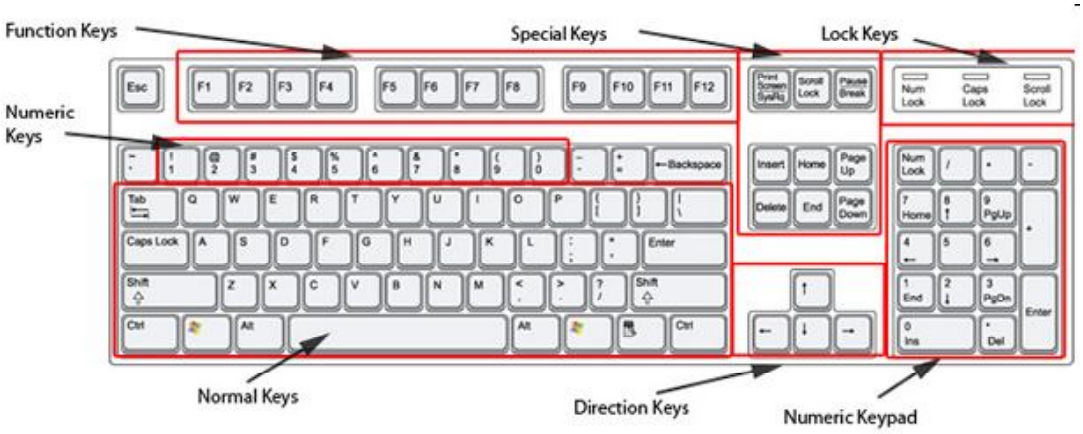


Figure 4.3

Mouse – Mouse is a pointing device that functions by detecting two-dimensional motion relative to its supporting surface. The mouse's motion typically translates into the motion of a cursor on a display, which allows for fine control of a graphical user interface. Mouse Types: Mechanical, Optical, Laser, Cordless.

Light Pen

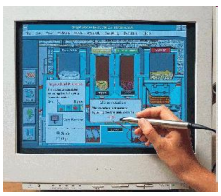


Figure 4.4

A Light Pen is a pointing device shaped like a pen and is connected to a VDU. The tip of the light pen contains a light-sensitive element which, when placed against the screen, detects the light from the screen enabling the computer to identify the location of the pen on the screen. It allows the user to point to displayed objects, or draw on the screen, in a similar way to a touch screen but with greater positional accuracy.

Graphics tablet

Figure 4.5

A **graphics tablet** (or **digitizer**, **digitizing tablet**, **graphics pad**, **drawing tablet**) is used to capture data or handwritten signatures, to trace an image. It consists of a flat surface upon which the user may "draw" or trace an image using an attached stylus, a pen-like drawing apparatus.

Trackball

Figure 4.6

A trackball is a pointing device consisting of a ball held by a socket containing sensors to detect a rotation of the ball about two axes—like an upside-down mouse with an exposed protruding ball. The user rolls the ball with the thumb, fingers, or the palm of the hand to move a cursor.

Touchscreen – A touchscreen is an electronic visual display that can detect the presence and location of a touch within the display area. It can also sense other passive objects, such as a stylus. These are common in devices such as all-in-one computers, tablet computers, and smartphones, personal digital assistant (PDA), mobile phones, and video games.

Speech recognition – Speech recognition (also known as automatic speech recognition or computer speech recognition) converts spoken words to text.

Image scanner – In computing, an image scanner often abbreviated to just scanner is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image. Types of Scanners: Drum scanner, Flatbed Scanner, Hand Scanner, 3 D Scanner.

2. Central processing unit (CPU)

CPU is the heart of the computer; this is the component that actually executes instructions. It consists of control unit, the arithmetic logic unit (ALU) and the memory.

Control unit – The control unit (often called a control system or central controller) manages the computer's various components; it reads and interprets (decodes) the program instructions, transforming them into a series of control signals which activate other parts of the computer.

Arithmetic logic unit (ALU) – The ALU is capable of performing two classes of operations: arithmetic and logic. The set of arithmetic operations that a particular ALU supports may be limited to addition and subtraction, or might include multiplication, division, trigonometry functions such as sine, cosine, etc., and square roots.

Memory – A computer's memory can be viewed as a list of cells into which letters, numbers, even computer instructions can be placed or read. Each cell has a numbered "address" and can store a single number. In almost all modern computers, each memory cell is set up to store binary numbers in groups of eight bits (called a byte). The CPU contains a special set of memory cells called registers that can be read and written to much more rapidly than the main memory area. Computer main memory comes in varieties:

a) **Random-access memory or RAM** – RAM can be read and written to anytime the CPU commands it. Its contents are erased when the computer power is turned off.

b) **Read-only memory or ROM** – ROM is pre-loaded with data and software that never changes, therefore the CPU can only read from it. ROM retains its data indefinitely. It is typically used to store the computer's initial start-up instructions. Software stored in ROM is often called **firmware**, because it is notionally more like hardware than software.

c) **Flash memory** – It blurs the distinction between ROM and RAM, as it retains its data when turned off but is also rewritable. It is typically much slower than ROM and RAM.

d) **Cache memories** – Generally computers with cache are designed to move frequently needed data into the cache automatically, often without the need for any intervention on the programmer's part. These are slower than registers but faster than main memory.

3. Secondary storage

It is also known as external memory or auxiliary storage and it differs from primary storage in that it is not directly accessible by the CPU. Secondary storage is non-volatile it does not lose the data when the

device is powered down. Data stored on secondary storage devices are retrieved and put into primary memory, where it is processed, and then is transferred back to secondary storage. There are two types of secondary storage:

- **Sequential storage** – Data can be accessed and retrieved only in the order in which it was stored in the system. e.g. magnetic tape.
- **Direct access storage** – Data can be retrieved in any order and is essential where information must be processed as it arrives. e.g. Magnetic disk (Floppy disks and hard disks), Hard disk and CD-ROM (compact disc-read only memory).

Memory Structure in Computer

- **Memory consists of bits (0 or 1) -** a single bit can represent information.
- **Bytes (= 8 bits)** - a single byte can represent $256 = 2^8$ pieces of information.
- **Words (= 2, 4, or 8 bytes)** - a 2 byte word can represent 256^2 pieces of information.
- **Byte addressable** - each byte has its own address.

4. Output devices

An output device displays the result in the form of text or graphic or sound from the computer, it may be a softcopy or hardcopy.

Computer monitor: A monitor or display (sometimes called a visual display unit) is an electronic visual display for computers. The monitor comprises the display device, circuitry, and an enclosure. The first computer monitors used Cathode ray tubes (CRTs), which was the dominant technology until they were replaced by LCD monitors in the 21st Century. The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD) thin panel, while older monitors use a cathode ray tube.

Printer: In computing, a printer is a peripheral which produces a text and/or graphics of documents stored in electronic form, usually on physical print media such as paper or transparencies. **Major types of printer:**

a) **Impact printer** – Impact printer produces text and images when tiny wire pins on print head strike the ink ribbon by physically contacting the paper. There are two types of impact printers:
   (i) Dot-Matrix Printers
   (ii) Daisy-wheel Printers

b) **Non-impact printer** – Non-impact printer produces text and graphics on paper without actually striking the paper. There are three types of non-impact printers:
   (i) Laser Printers
   (ii) Ink-Jet Printers
   (iii) Thermal

Plotters: Plotter is an output device used to produce graphical output and is employed for plotting graphs, charts and other design on paper. **There are two types of plotters.**

1. **Flat bed plotters** – In a Flat bed plotter, the paper is fixed on a flat rectangular surface and plots the corresponding graphical information. The pen holding mechanism is designed to hold more than one pen.

2. **Drum plotter** – In Drum plotter, the paper on which graphs have to be plotted is placed over a drum which rotates back and forth and pen-holding mechanism, which moves only in horizontal direction, writes on the paper.

Speakers: Speaker gives you sound output from your computer. Some speakers are built into the computer and some are separate. Speakers can be used to communicate error codes, in Presentation slides and to hear audio during video conferencing.

5. Communication devices

It allows users which are separated by distance and time to communicate electronically and can transmit text, images, graphics, voice, and video. MODEM (Modulator- Demodulator) is used as a communication devices which converts digital signals to analog signals and vice-versa. The speed with which a modem sends and receives data is measured in bps (bits per second). Modems transfer data at 9600bps to 28,800 bps rates. Some modems come with fax capabilities, called faxmodems. These are discussed in detail later in data communication system section.

4.2.4 COMPUTER SOFTWARE

Software is the general term for various kind of programs used to operate and manipulate computers and related devices. The software developed in an organization can monitor sales volume, generate reports, monitors employee attendance, process marketing information, and tracks inventory, and so on.

Software Types – The types of software you will encounter depend primarily on the types of computers and networks you use and on what specific tasks you want to accomplish. Fig. 4.3 shows that application software includes a variety of programs that can be subdivided into general-purpose and application – specific categories. System software consists of programs that manage and support a computer system and its information processing activities that can be subdivided into System management programs and System development programs.

General-purpose application programs are programs that perform common information processing jobs for end users. For example, word processing programs, spreadsheet programs, database management programs, and graphic programs are popular with microcomputer users for home, education, business, scientific and many other purposes. Because they significantly increase the productivity of end users, they are sometimes known as productivity packages. Other examples include Web browsers, electronic mail, and groupware, which help support communication and collaboration among workgroups and teams.

Application-Specific software packages are available to support specific applications of end users in business and other fields. For example, business application software supports the reengineering and automation of business processes with strategic e-business applications like customer relationship management, enterprise resource planning, and supply chain management. Other examples are software packages those Web-enable applications in electronic commerce, or in the functional areas of business like human resource management and accounting and finance. Still other software empowers managers and business professionals with decision support tools like data mining, enterprise information portals, or knowledge management systems.

System management programs are the programs that manage the hardware, software, network, and data resources of computer systems during the execution of various information processing jobs of users. Examples of important system management programs are operating systems, network management programs, database management systems, and system utilities.

System development programs help users develop information system programs and procedures and prepare user programs for computer processing. Major software development programs are programming language translators and editors, and a variety of CASE (Computer aided software engineering) tools and other programming tools. Fig. 4.4 shows how the two software categories are related:

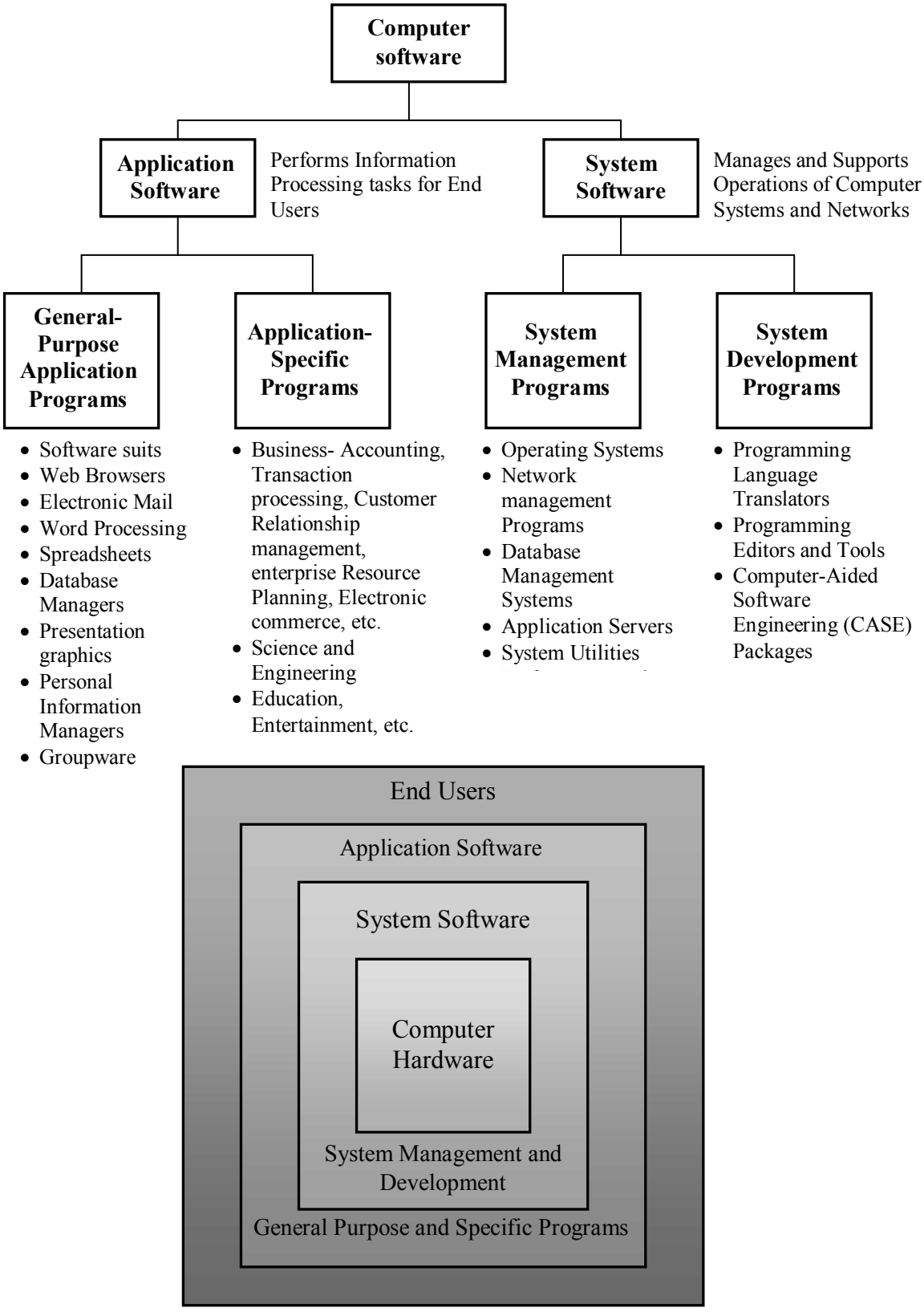


Figure 4.7

Software Suits and Integrated Packages – Most widely used productivity packages come bundled together as software suits such as Microsoft Office, Lotus SmartSuite, Corel WordPerfect Office, and Sun's StarOffice. Each suit integrates software packages for word processing, spreadsheets, presentation graphics, database management, and personal information management.

Web Browsers and electronic mail – A browser like Microsoft Explorer or Netscape Navigator is the linked resource of the World Wide Web and the rest of the Internet, as well as corporate intranets and extranets. Once limited to surfing the Web, browsers are becoming the universal software platform on which end users launch into information searches, e-mail, multimedia file transfer, discussion groups, and many other internet applications. Electronic mail has changed the way people work and communicate. E-mail software is now component of top software suits and web browsers. Free e-packages like Microsoft HotMail and Netscape WebMail are available to internet users from online services and Internet Service providers.

Operating System – Operating system manages the computers processes, functioning as an interface between the user, the software that processes the firm's data, and the hardware. Major functions of an operating system include:

- Processor management
- Memory management
- Input/Output management
- File management
- Schedule jobs
- Maintain system security
- Handle interrupts
- Maintain usage records
- Enable multiple user resource sharing
- Interpretation of commands and instructions
- User interface to communicate with the system
- Allocate resources
- Load programs

Operating system environment

Batch processing is also known as serial, sequential, off line, or stacked job processing. It is based on the idea of automatic job-to-job transaction facility provided by almost all operating systems. Programs given to the computer are automatically processed without user's interaction.

Multiprogramming is a computing environment in which multiple users can run multiple programs on a single-CPU computer at the same time. The CPU switches between the programs; however, at any given time is executing any one program.

Multiprocessing system has a number of processes that process data and instructions, unlike systems that have only one CPU. It is ideally suited for complex and computationally intensive programs that require extensive processing.

Time sharing refers to the allocation of computer resources in a time dependent fashion to several programs simultaneously. In it direct access to the CPU is provided to a number of independent, relatively low speeds, online, simultaneously usable stations.

Programs

Systems being used in organizations are driven by programs. A program is a set of stepwise instructions given to a computer to accomplish various tasks. Programmers write software using special languages, called programming languages. The process of writing a program is referred to as programming.

Programming language – Programming languages provide various ways of specifying programs for computers to run. Unlike natural languages, programming languages are designed to permit no ambiguity and to be concise. They are purely written languages and are often difficult to read aloud. They are generally either translated into machine code by an assembler or a compiler before being run, or translated directly at run time by an interpreter.

1. Low-level languages – Low-level programming languages are sometimes divided into two categories: first generation (Machine languages), and second generation (assembly languages). Low-level programming languages tend to be unique to a particular type of computer.

a) Machine language provides a way of entering instructions into a computer (whether through switches, punched tape, or a binary file).

b) Assembly language is a more human readable view of machine language. Instead of representing the machine language as numbers, the instructions and registers are given names (typically abbreviated words, or mnemonics, e.g. **ld means "load"**). An assembly language program (i.e. a text file) is translated to machine language by an assembler.

2. Higher-level languages – High level languages are usually "compiled" into machine language (or sometimes into assembly language and then into machine language) using another computer program called a compiler. High level languages are less related to the workings of the target computer than assembly language, and more related to the language and structure of the problem(s) to be solved by the final program.

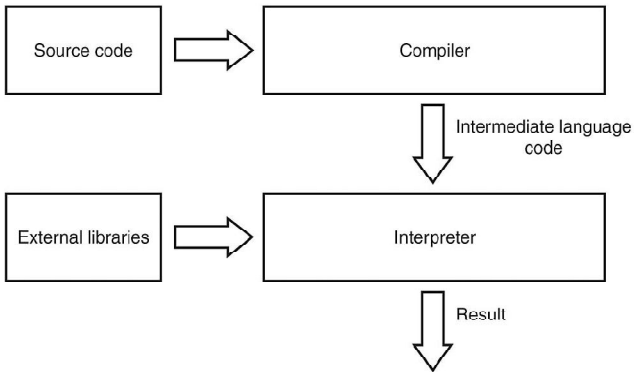


Figure 4.8

Program design – Program design of small programs is relatively simple and involves the analysis of the problem, collection of inputs, using the programming constructs within languages, devising or using established procedures and algorithms, providing data for output devices and solutions to the problem as applicable. As problems become larger and more complex, features such as subprograms, modules, formal documentation,

and new paradigms such as object-oriented programming are encountered. Large programs involving thousands of line of code and more require formal software methodologies.

4.3 Data Communication System

MIS techniques existed to supply users with information that would permit them to arrive at an effective decision. For efficient management of operations and for business planning; communication of data from one point to another is very important. The computer has added new dimensions for data communication due to speed, accuracy and processing of massive data that permit the consideration of more alternatives in a decision.

Data communication is the movement of coded data and information from one point to another by means of electrical or electromagnetic devices, fibre-optic cables, or microwave signals.

A single terminal is linked to a computer. The terminal can be the sender and the computer can be the receiver, or vice-versa. Telephone circuit is the most common channel being used for the data communication and a device MODEM (modulator-demodulator) is used to convert the electrical signals of the computing equipment to the electronic signals of the telephone circuit, and vice-versa.

Telecommunication system components – A basic telecommunication system consists of five primary units that are always present in some form; these are shown in the fig. 4.5.

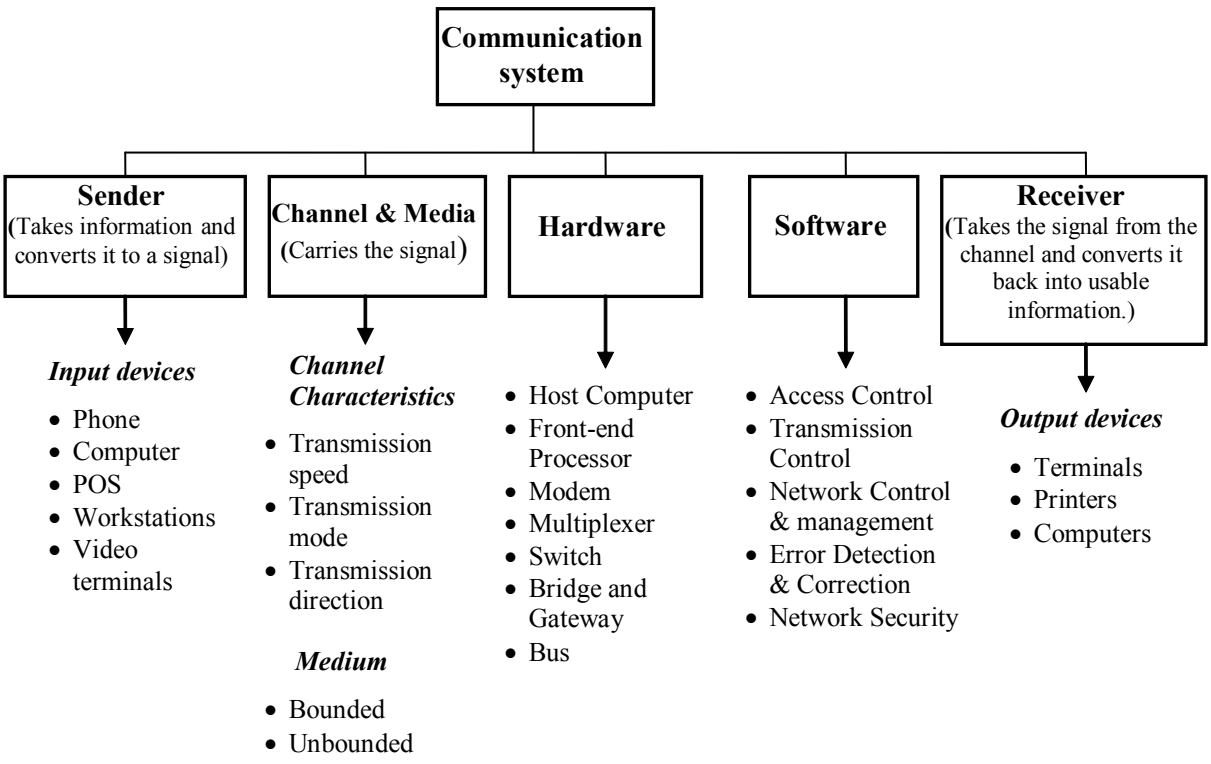


Figure 4.9

Telecommunication channels

Transmission rate is the capacity of a telecommunication channel depending on the bandwidth. **In transmission mode**, data are transmitted over the network. There are two modes of data transmission synchronous and asynchronous. **Synchronous transmission** transmits a group of characters at a time, whereas **asynchronous transmission** transmits one character at a time. **Transmission direction** may be a **simplex circuit** where all signals can flow in only one direction. These systems are often employed in

broadcast networks, where the receivers do not need to send any data back to the transmitter/broadcaster; A **half-duplex (HDX)** system provides communication in both directions, but only one direction at a time (not simultaneously). Typically, once a party begins receiving a signal, it must wait for the transmitter to stop transmitting, before replying. An example of a half-duplex system is a two-party system such as a "walkie-talkie". A **full-duplex (FDX)**, or sometimes **double-duplex** system, allows communication in both directions, and, unlike half-duplex, allows this to happen simultaneously. Land-line telephone networks are full-duplex, since they allow both callers to speak and be heard at the same time. A **point-to-point** connection refers to a communications connection between two nodes or endpoints. An example is a telephone call, in which one telephone is connected with one other, and what is said by one caller can only be heard by the other.

Telecommunication media: Many transmission media are used as communications channels. Transmission media are classified as one of the following:

- Guided (or bounded)—waves are guided along a solid medium such as a transmission line. Examples of guided media include phone lines, twisted pair cables, coaxial cables, and optical fibers.
- Wireless (or unguided)—transmission and reception are achieved by means of an antenna. Examples of this include microwave, radio or infrared.

Data communication hardware

Host computer – The host performs the data processing for the network. The incoming messages are handled in the same manner as data received from any other type of input unit. After the processing, messages can be transmitted back to the front-end processor for routing.

Front-end processor – The front end processor is a mini computer that acts as a buffer between the client device and the host computer. It increases the operating efficiency of the network by taking care of routine tasks such as coordinating peripherals and enabling error-free transmission.

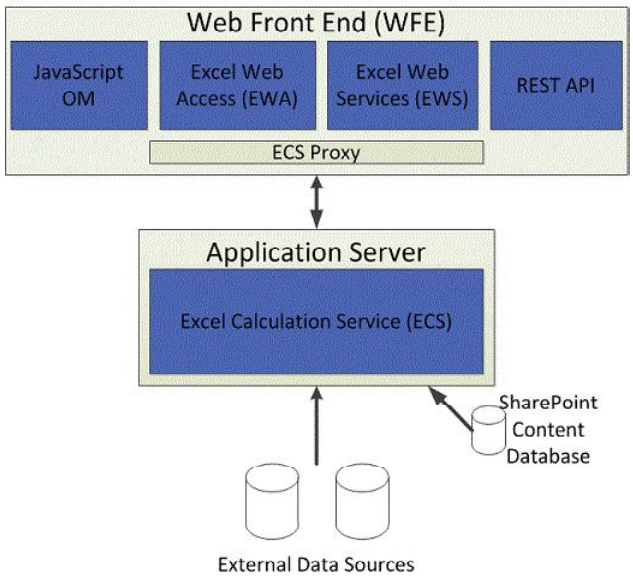


Figure 4.10

Multiplexing – It is a method by which multiple analog message signals or digital data streams are combined into one signal over a shared medium. The aim is to share an expensive resource. The multiplexed signal is transmitted over a communication channel, which may be a physical transmission medium. The multiplexing divides the capacity of the low-level communication channel into several higher-level logical channels, one for each message signal or data stream to be transferred. A reverse process, known as demultiplexing, can extract the original channels on the receiver side. A device that performs the multiplexing is called a multiplexer (MUX), and a device that performs the reverse process is called a demultiplexer (DEMUX).

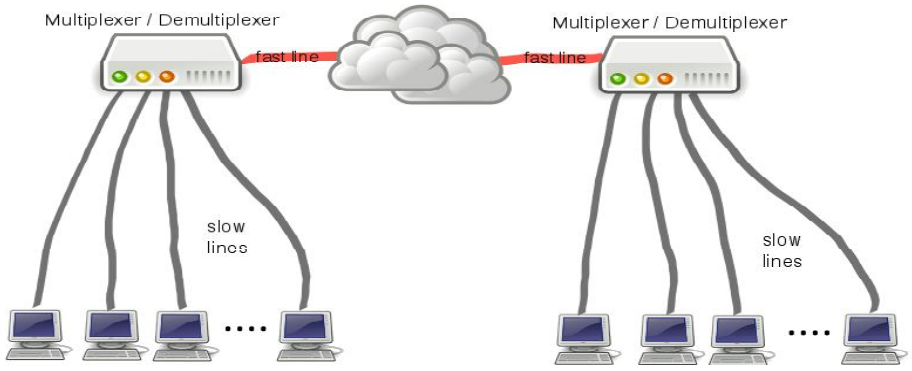


Figure 4.11

Switch – An electronic device which determines the data transmission path by making connections. Switches can control the transmission path across national or local network.

Bridge and gateway – A device that links two or more compatible networks. Bridge allows information to be sent between users on different networks. Gateways enable PCs on LANs to access a mainframe computer.

Network topology – It is the layout pattern of interconnections of the various elements (links, nodes, etc.) of a computer or biological network. Network topologies may be physical or logical. Physical topology refers to the physical design of a network including the devices, location and cable installation. Logical topology refers to how data is actually transferred in a network as opposed to its physical design. The study of network topology recognizes seven basic topologies:

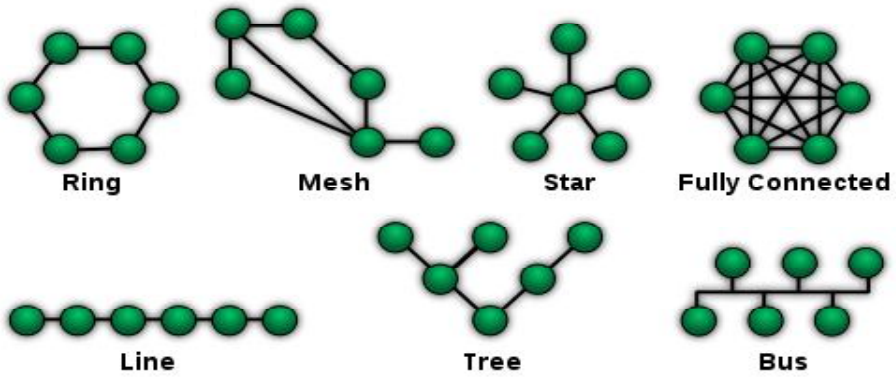


Figure 4.12

Switching – It is basically of two types: Circuit switching and Packet switching. **Circuit switching** is a methodology of implementing a telecommunications network in which two network nodes establish a dedicated communications channel (circuit) through the network before the nodes may communicate. The circuit guarantees the full bandwidth of the channel and remains connected for the duration of the communication session. The circuit functions as if the nodes were physically connected as with an electrical circuit. **Packet switching** is a virtual circuit switching technology that emulates circuit switching, in the sense that the connection is established before any packets are transferred, and packets are delivered in order.

Communication networks

There are five types of communication networks:

a) **Private Branch Exchanges (PBXs)** – PBX is an electronic switching device located in the organization that automatically switches between the organisation's telephone lines and that of the city's Central Telephone department and, therefore, acts like a small telephone exchange. PBX has ability to coordinate, control, and communicate data among various devices on the network.

b) **Integrated Services Digital Networks (ISDNs)** – **ISDN** is a set of communications standards for simultaneous digital transmission of voice, video, data, and other network services over the traditional circuits of the public switched telephone network. Since it is a digital network, it eliminates the need for a modem to convert analog signals to digital signals and vice-versa.

c) **Local Area Networks (LANs)** – LAN is a computer network that interconnects computers in a limited area such as a home, school, computer laboratory, or office building. ARCNET, Token Ring and other technology standards have been used in the past, but Ethernet over twisted pair cabling, and Wi-Fi are the two most common technologies currently used to build LANs.

d) **Wide Area Networks (WANs)** – WAN is a telecommunication network that covers a broad area (i.e., any network that links across metropolitan, regional, or national boundaries).

e) **Value Added Networks (VANs)** – The public data networks that add value to the basic communication services provided by common carriers by offering specialized services are termed as value-added networks.

4.4 Distributed Systems

The word distributed in terms such as "distributed system", "distributed programming", and "distributed algorithm" originally referred to computer networks where individual computers were physically distributed within some geographical area. The terms are nowadays used in a much wider sense, even referring to autonomous processes that run on the same physical computer and interact with each other by message passing.

In an organization the computers interact with each other in order to achieve a common goal. A **distributed system** consists of multiple autonomous computers that communicate through a computer network. Distributed computing refers to the use of distributed systems to solve computational problems. In distributed computing, a problem is divided into many tasks, each of which is solved by one or more computers.

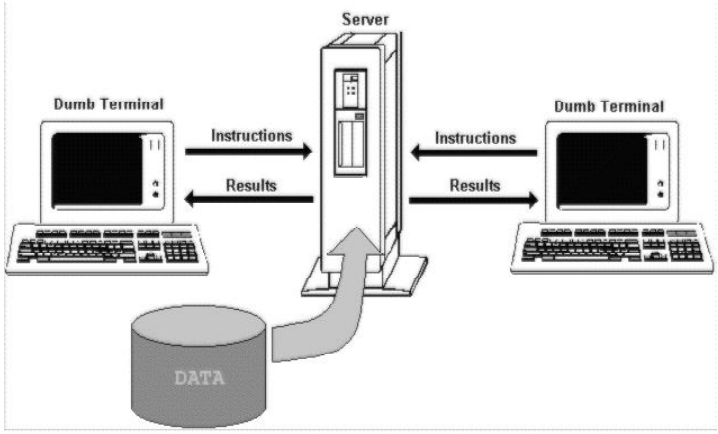


Fig. 6.9

Figure 4.13

In distributed computing, each processor has its own private memory (distributed memory). Information is exchanged by passing messages between the processors. There are two main reasons for using distributed systems and distributed computing. First, the very nature of the application may require the use of a communication network that connects several computers. For example, data is produced in one physical location and it is needed in another location. Second, there are many cases in which the use of a single computer would be possible in principle, but the use of a distributed system is beneficial for practical reasons. For example, it may be more cost-efficient to obtain the desired level of performance by using a cluster of several low-end computers, in comparison with a single high-end computer. A distributed system can be more reliable than a non-distributed system, as there is no single point of failure. Moreover, a distributed system may be easier to expand and manage than a monolithic uniprocessor system.

Examples of distributed systems and applications of distributed computing include the following:

- Telecommunication networks:
  - Telephone networks and cellular networks.
  - Computer networks such as the Internet.
  - Wireless sensor networks.
  - Routing algorithms.
- Network applications:
  - World Wide Web and peer-to-peer networks.
  - Massively multiplayer online games and virtual reality communities.
  - Distributed databases and distributed database management systems.
  - Networks file systems.
  - Distributed information processing systems such as banking systems and airline reservation systems.
- Real-time process control:
  - Aircraft control systems.

- Industrial control systems.

- Parallel computation:
  - Scientific computing, including cluster computing and grid computing and various volunteer computing projects; see the list of distributed computing projects.
  - Distributed rendering in computer graphics.

4.5 Client–Server Computing

The client–server model has become one of the central ideas of network computing. The client–server model is a computing model that acts as distributed application which partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients. Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system. A server machine is a host that is running one or more server programs which share their resources with clients. A client does not share any of its resources, but requests a server's content or service function. Clients therefore initiate communication sessions with servers which await incoming requests.

Figure 4.14 Schematic Clients-server interaction

The client–server characteristic describes the relationship of cooperating programs in an application. The server component provides a function or service to one or many clients, which initiate requests for such services. Functions such as email exchange, web access and database access, are built on the client–server model. Users accessing banking services from their computer use a web browser client to send a request to a web server at a bank. That program may in turn forward the request to its own database client program that sends a request to a database server at another bank computer to retrieve the account information. The balance is returned to the bank database client, which in turn serves it back to the web browser client displaying the results to the user. The client–server model has become one of the central ideas of network computing. Specific types of clients include web browsers, email clients, and online chat clients. Specific types of servers include web servers, ftp servers, application servers, database servers, name servers, mail servers, file servers, print servers, and terminal servers. Most web services are also types of servers.

4.6 Data Resource Management

Data Concepts –Before considering the use of files or the database approach, it is important to understand how data are represented. In this section critical definitions are covered, including the abstraction of data from the real world to the storage of data in files. Firms have traditionally organized their data in a hierarchy that consists of:

a) Field – The smallest logical entity for data storage is called field. It cannot be subdivided into meaningful

units. In a payroll you found such elements as, employee number, name, designation, department, basic pay, house rent, conveyance allowance, union fund income tax, etc. are all fields.

b) Records – The next step in the hierarchy is the record. A record consists of all the fields relating to a particular object or activity for example, relevant data of an employee working in account departments.

c) File/Table – All the records of same type are organized into a file. A file is collection of data record that relate to a particular subjects, for example, purchase journal, sales journal, cash journal etc. when we talk about accounts department.

d) Database – A **database** is an organized collection of files. IT is an integrated collection of logically related records or objects. The data stored in a database are independent of the application programs using them and of the type of secondary storage devices on which they are stored. For example, a personnel database consolidates data formerly segregated in separate files such as payroll files, personnel action files, and employee skills files.

e) Metadata – The information that describes data is referred to as metadata. Metadata describes the name given and the length assigned each data item. Metadata also describes the length and composition of each of the records.

Database				
Database field				
Customer	**City**	**State**	**Country**	
123456	San Jose	CA	USA	
123457	Rockville	MD	USA	**Record**
123458	Singapore		Singapore	
123459	Memphic	TN	USA	
123460	Buenos Aires		Argentina	

Figure 4.15

Database management language

Structured Query Language (SQL) is a programming language designed for managing data in relational database management systems (RDBMS). Originally based upon relational algebra its scope includes data insert, query, update and delete, schema creation and modification, and data access control.

Data manipulation language – The Data Manipulation Language (DML) is the subset of SQL used to add, update and delete data. INSERT adds rows (formally tuples) to an existing table, UPDATE modifies a set of existing table rows, DELETE removes existing rows from a table, MERGE is used to combine the data of multiple tables. It combines the INSERT and UPDATE elements.

Data definition language – The Data Definition Language (DDL) is also a subset of SQL. It manages table and index structure. The most basic items of DDL are: CREATE; creates an object (a table, for example) in the database, ALTER modifies the structure of an existing object in various ways, for example, adding a column to an existing table or a constraint, TRUNCATE deletes all data from a table in a very fast way, deleting the data inside the table and not the table itself. It usually implies a subsequent COMMIT operation, i.e., it cannot be rolled back. DROP deletes an object in the database, usually irretrievably, i.e., it cannot be rolled back.

Methods for organizing data in files

A number of methods are available to organize data in files. The choice of the method is based on the factors such as storage media, access methods, processing techniques, etc. Some file organization methods are:

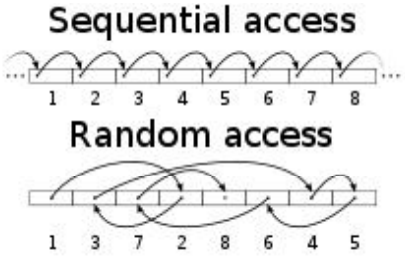


Figure 4.16

Sequential access – A sequential file contains records organized by the order in which they were entered means that a group of elements (e.g. data in a memory array or a disk file or on magnetic tape data storage) is accessed in a predetermined, ordered sequence. The order of the records is fixed. Records in sequential files can be read or written only sequentially. After you have placed a record into a sequential file, you cannot shorten, lengthen, or delete the record. However, you can update (REWRITE) a record if the length does not change. New records are added at the end of the file. If the order in which you keep records in a file is not important, sequential organization is a good choice whether there are many records or only a few.

Random access – **Random access** (sometimes called **direct access**) is the ability to access an element at an arbitrary position in a sequence in equal time, independent of sequence size. For relative files, records are accessed according to the value you place in the relative key. For an example a CD (random access—you can skip to the track you want).

Indexed-sequential file organization – In an ISAM system, data is organized into records which are composed of fixed length fields. Records are stored sequentially, originally to speed access on a tape system. A secondary set of hash tables known as indexes contain "pointers" into the tables, allowing individual records to be retrieved without having to search the entire data set. The key improvement in ISAM is that the indexes are small and can be searched quickly, thereby allowing the database to access only the records it needs. Additionally modifications to the data do not require changes to other data, only the table and indexes in question. When an ISAM file is created, index nodes are fixed, and their pointers do not change during inserts and deletes that occur later (only content of leaf nodes change afterwards).

Database models – A database model is the method of organizing data and represents the logical relationship among data elements in the database.

a) **Hierarchical model** – In the Hierarchical model different record types (representing real-world entities) are embedded in a predefined hierarchical (tree-like) structure. This hierarchy is used as the physical order of records in storage. Record access is done by navigating through the data structure using pointers combined with sequential accessing.

b) **Network model** –In this model a hierarchical relationship between two record types (representing real-world entities) is established via the set construct. Each record in a database can have multiple parents, that is the relationship among data elements can be many-to-many. Data elements in a network model are also linked through pointers. In network data model a child can have a number of parents. This model is more general and powerful than the hierarchical, and has been the most popular before being

replaced by the Relational model. In the relational model, related records are linked together with a "key".

c) **Relational model** – The purpose of the relational model is to provide a declarative method for specifying data and queries: users directly state what information the database contains and what information they want from it, and let the database management system software take care of describing data structures for storing the data and retrieval procedures for answering queries.

4.7 Data Warehouse and Data Mining

In computing, a **data warehouse** (**DW**) is a database used for reporting and analysis. The data stored in the warehouse is uploaded from the operational systems. The data may pass through an operational data store for additional operations before it is used in the DW for reporting.

A data warehouse maintains its functions in three layers: staging, integration, and access. Staging is used to store raw data for use by developers. The integration layer is used to integrate data and to have a level of abstraction from users. The access layer is for getting data out for users. Data warehouses can be subdivided into data marts. Data marts store subsets of data from a warehouse. This definition of the data warehouse focuses on data storage. The main source of the data is cleaned, transformed, catalogued and made available for use by managers and other business professionals for data mining, online analytical processing, market research and decision support. However, the means to retrieve and analyze data, to extract, transform and load data, and to manage the data dictionary are also considered essential components of a data warehousing system. Many references to data warehousing use this broader context. Thus, an expanded definition for data warehousing includes business intelligence tools, tools to extract, transform and load data into the repository, and tools to manage and retrieve metadata.

Data mining (the analysis step of the **knowledge discovery in databases** process, or KDD), a relatively young and interdisciplinary field of computer science is the process of discovering new patterns from large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics and database systems. The goal of data mining is to extract knowledge from a data set in a human-understandable structure and involves database and data management, data preprocessing, model and inference considerations, interestingness metrics, complexity considerations, post-processing of found structure, visualization and online updating.

The actual data-mining task is the automatic or semi-automatic analysis of large quantities of data to extract previously unknown interesting patterns such as groups of data records, unusual records and dependencies. This usually involves using database techniques such as spatial indexes. These patterns can then be seen as a kind of summary of the input data, and used in further analysis or for example in machine learning and predictive analytics. For example, the data mining step might identify multiple groups in the data, which can then be used to obtain more accurate prediction results by a decision support system. Neither the data collection, data preparation nor result interpretation and reporting are part of the data mining step, but do belong to the overall KDD process as additional steps. Data mining involves six common classes of tasks:

- **Anomaly detection** (Outlier/change/deviation detection) – The identification of unusual data records, that might be interesting or data errors and require further investigation.
- **Association rule learning** (Dependency modeling) – Searches for relationships between variables.
- **Clustering** – is the task of discovering groups and structures in the data that are in some way or another "similar", without using known structures in the data.

- **Classification** – is the task of generalizing known structure to apply to new data. For example, an email program might attempt to classify an email as legitimate or spam.
- **Regression** – Attempts to find a function which models the data with the least error.
- **Summarization** – providing a more compact representation of the data set, including visualization and report generation.

4.8 Transaction Processing

Transaction processing is a fundamental organizational activity. Without transaction processing, normal organizational functioning would be impossible, and the data for management activities would not be available. Without a transaction processing system sales order would not be filled, bills would not be paid; manufacturing parts would not be ordered. When computers were not used, transaction processing was performed physically or with mechanical machines; data processing using computers has not changed the basic function but it changed the complexity and speed of transaction processing.

For the application of computer and communication technology, **Office automation** is a popular term to office functions. It supports management and professionals work along with clerical office work. Document preparation, message and document communications and public data services are three office automation technologies explained here.

Transaction Processing Cycle

Transaction processing cycle begins with a transaction which is recorded in some way. By using an online terminal transactions are recorded to a computer directly. Transaction recording is usually the trigger to create a transaction document. For updating of master files the data from the transaction is required frequently; this updating might be performed parallel with the processing of transaction documents or by a subsequent computer run.

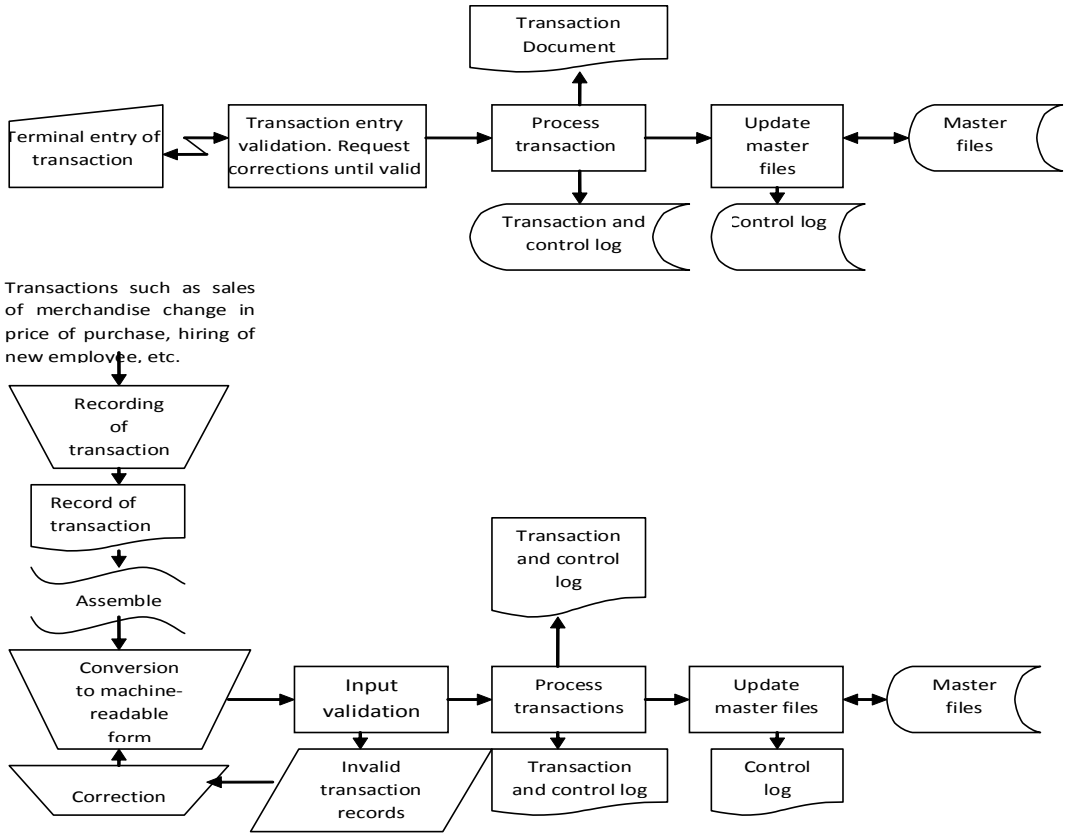


Figure 4.17

Transaction	Initial data capture method	Comments
A sales order taken during a sales visit	Manual recording	A sales order is prepared by the salesperson
A telephoned sales order	Terminal entry	Order taker at telephone enters order at terminal.
Purchase order	Manual recording or terminal entry	A purchase order is prepared manually and then typed for use, purchasing agent enters orders data on visual display terminal using order form, or purchasing agent uses terminal to enter order directly into vendor's computer without use of a manual form.

When a transaction is recorded manually, a copy of the document is usually used for data preparation. Special data preparation equipment may be used offline to create machine readable records for subsequent batch entry into the computer or the data from the document may be entered directly. Some examples of data preparation are:

Data preparation method	Explanation
Keydisk	Data is entered via a keyboard and stored on diskette, cassette, or fixed disk. Replaces data preparation using keypunch where the machine-readable record was on a card.
Optical character recognition (OCR)	Records data in machine readable form using a special typewriter font or block lettering in a fixed format.
Magnetic ink character recognition (MICR)	Magnetically encoded characters are encoded on the document using a special MICR input device. Major applications are checks and deposit slips.

Data validation is testing of input data records to verify for their correctness and completeness which cannot be accomplished with complete assurance, but reasonable validation is generally possible. Validation tests must be applied against each data item or set of items and it may possibly consist of the following:

Validation test	Comments
Missing data	Test for existence of data item; there is an error if it is always required and is missing.
Valid size for item	There is an error if there are too few or too many characters.
Class or composition error	There is an error if data should be numeric and has alphabetic or special characters, or the reverse.
Range or reasonableness test	Test for values that fall in the acceptable range or are reasonable for the type of transaction (for example, negative pay amount is not reasonable).
Invalid value	If there are only a small number of valid values (such as class codes), an item can be checked to see if it is in the valid set.
Comparison with stored data	Compare with data in the file (for example, compare input of payment made with payment due from file).

Numeric codes such as identification numbers can be validated for size, range, and composition of characters. An additional validation technique for these codes, which is very effective in detecting input errors, is a check digit. A check digit is redundant digit derived by computations on the identification number and then

made a permanent part of the number. When input data items have been validated, the valid records are processed. There are three major reasons for producing transaction documents or other transaction output:

1. **Informational** – To report, confirm, or explain proposes or completed action.
2. **Action** – To direct a transaction to take place.
3. **Investigational** – For background information or reference by recipient.

Action documents include shipping orders, purchase orders, manufacturing orders, checks, and customer statements. These documents instruct someone to do something. For example a purchase order instructs a vendor to ship, a check instructs a bank to pay, etc. when action is taken, and the completed action (or lack of completion) is reported back to the organizational unit initiating the action.

A customer designed to initiate action and then be returned to use in processing the completion of the transaction is known as a turnaround document. Examples are optically readable documents, stubs, or punched cards included with customer billings with the request that they be returned with the payment as shown in the following figure. The turnaround document assists in positive identification and reduces errors because the document with the required feedback information is already prepared, often in machine-readable form.

When transactions are processed, a listing of data about each transaction is usually prepared. The listing includes control totals for the number of transactions processed, total dollar amount of transactions, etc. It provides a means of processing reference and error control.

Methods for processing transactions

There are three different methods commonly used for processing transactions and updating master files:

1. Periodic data preparation and periodic batch processing (usually termed batch processing)
2. Online entry with subsequent batch processing
3. Online entry with immediate processing (termed online processing).

When computers were first used for transaction processing, technical limitations required that periodic data preparation and periodic batch processing be utilized. Online entry and immediate processing are now common place. The choice of methods should reflect the underlying process being supported. If the process is periodic (as with payroll), batch processing is adequate. Batch processing of transactions can be very efficient in terms of data preparation and processing of transactions, especially when they are processed against a sequential file. One major disadvantage of periodic batch processing is the delay in detecting and correcting errors.

When transactions are entered at an online terminal, the transactions is entered directly into the computer and validated immediately. The processing itself may be performed immediately or at a subsequent time as with periodic batch processing. In online entry with subsequent batch processing, the computer is used for direct data entry and validation, but valid transactions are stored for later periodic batch processing. In online entry with immediate processing, the transaction is validated online and then processed immediately if valid. A response with the result of processing or a confirmation of completion of processing is generally provided to the user at the input terminal.

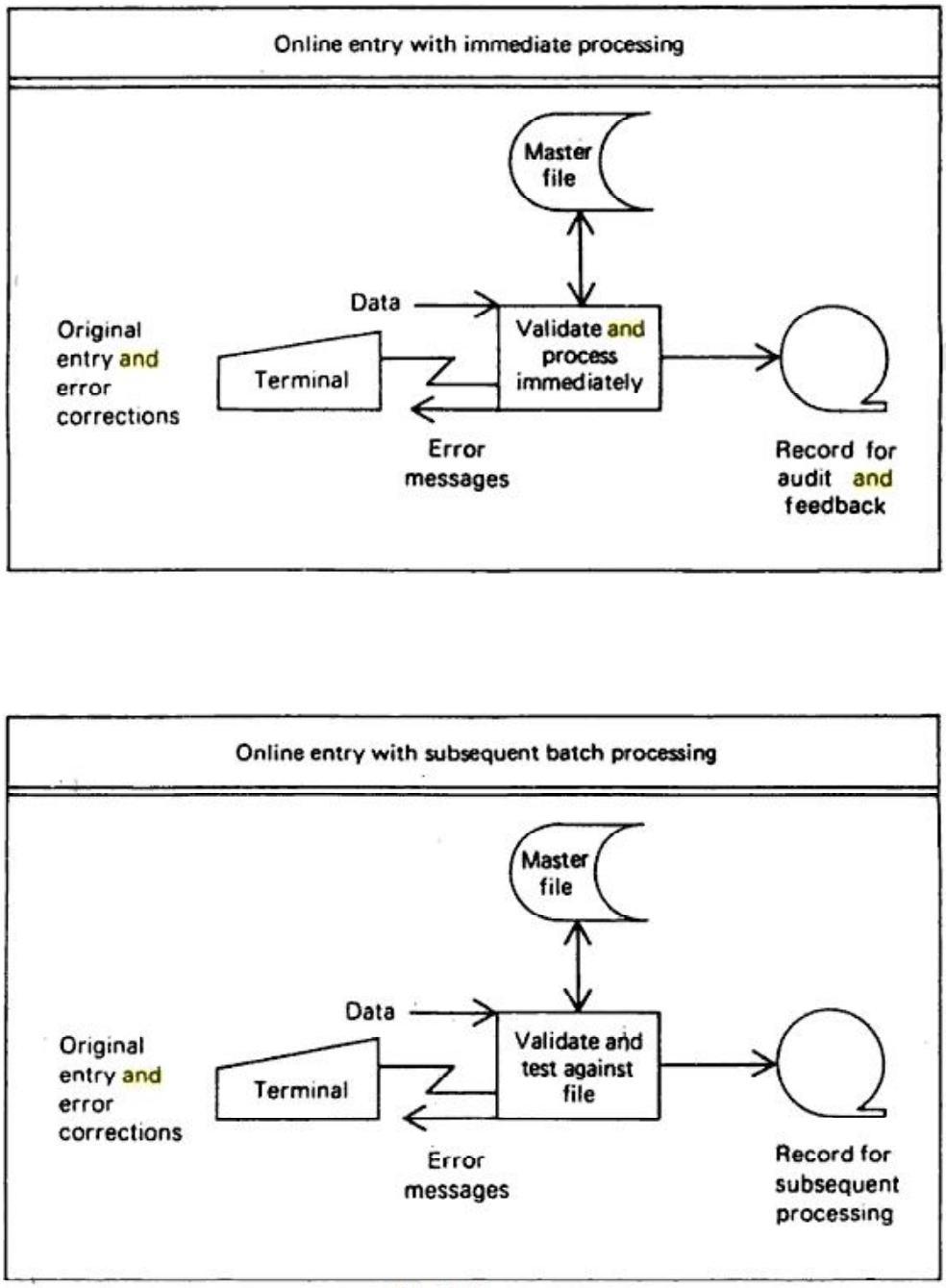


Figure 4.18

Control for transaction processing

Control of the transaction processing begins with the design of the document for initially recording the transaction. In the flow of control in batch processing, it is best to establish a control total ofthe documents before data preparation. It may include record count, financial total and etc. The control total is input with the data and checked by computer as part of data validation, processing, and output. Computer programs and control personnel make control total during processing; users check controls on output against control totals for data they submitted for processing. Some examples of problems and controls will illustrate how control is handled.

Problem	Control procedure
Transaction is lost- never gets processed	Feedback to terminal to verify processing
Computer system goes down when transactions are in process	Procedures to manually process transactions and introduce them into system when computer is again working

Retrieval in transaction processing

Many online systems use data retrieval software to support transaction processing. Inquiries associated with a transaction processing system tend to be fairly structured, so that they may be programmed to use a standard set of commands that can be mastered fairly easily. In some systems, commands can be assigned to special function keys on the keyboard so that the operator needs only to press a single key rather than type in a command. Terminals that are only to be used for inquiries, such as terminals for customer use on a bank floor, may be specially designed with only one function keys.

4.9 Document Preparation

Document preparation facilities aid in the production of text (words) rather than processing of transactions. Typically, document preparation software is used on microcomputers or word processing systems (special purpose microcomputers), although document preparation software is also available on large mainframe computers with operation a terminal.

Word and Text Processing

Word processing generally refers to the computer-assisted preparation of documents and correspondence. Text is entered via a keyboard and displayed on a visual display screen. Special commands are used to set the document to the appropriate formats. Error correction can be performed very easily on the screen, and edit functions such as searching for character string or moving paragraphs (electronic "cut and paste") are provided.

Document filing

If documents are coded in machine-readable form by word processing and stored in computer storage, it would seem to be a simple task to replace paper-based files with a computer-based filing system. Computer-based filling systems have the advantage, besides space savings, of permitting easily modifiable cross-reference indexes.

Computer graphics

The use of computer for graphics requires a graphic software package and a high resolution visual display terminal (VDT). A graphic picture is created by programming single bits of the screen called pixels. The greater the number of pixels on the screen, the higher the resolution and clearer the picture. Graphic illustrations of numeric comparisons and trends, in the form of bar charts, line charts, pie charts, etc. have long been used in articles and presentations. Each type of graph has appropriate and in appropriate uses. For instance, pie charts are appropriate for showing parts of whole but not for time series or comparisons of two or more different items. Computer technology provides a low-cost method of graphic presentation. Computer based graphics improved productivity and quality of analysis and decision making. Computer aided design is the use of graphics in engineering design: calculations and measurements are input to design software which presents and manipulate graphical representations that previously were drawn by hand.

Composition and Reproduction

The printers available with word processors range from matrix printers (with low to high resolution) to letter quality printers with output comparable to high quality electric typewriters. Two examples of high quality output methods illustrate this feature of office automation:

Output method	Comments
Laser printer	Different font types, justification, type size are the features to provide high quality output and laser printer have high speed and low cost.
Compositor	Text in machine readable form can be coded with sample instructions for photocomposition. The simple codes are replaced by compositor codes using computer search and replace operations.

4.10 Message and Document Communication

Data communication facilities can replace much paper-based informal communication, such as memos and telephone calls. As the cost of data transmission decreases and the availability of alternatives transmission media increases, these facilities are expected to find more use in office information processing. Communications networks such as local area networks and public packet switching can also be utilized for transmission of documents and messages from one location to another.

Document Distribution

A single word processor may have communications capabilities added to it through a modem or local area network so that it can communicate with other word processors and so that documents can be transmitted from one location to another. Word processors can be "clustered" around a single communications controller so that documents can be transmitted from one point to other point. The advantage of document distribution via a communication network is the speed of transmission across a widely dispersed geographic area. Although shared-resource communicating word processing systems are relatively expensive, the cost and speed of document transmission compared to mail service makes them cost-effective in many situations.

Facsimile Transmission

It is an alternative method for transmitting documents across geographically dispersed areas. It transmits the actual image on a page. In facsimile transmission, a facsimile machine at the sending station scans a page from left to right, top to bottom, translating the areas of change from light to dark into coded signals that are transmitted. A similar machine at the receiving end, connected via communication facilities, reproduces the page image. Its primary disadvantage is slow transmission rate.

Computer based message system

A computer based message system, also known as electronic message system or electronic mail is a simple, fast and less costly but powerful software package for sending, reading and forwarding messages. A user types the message to be sent and then type a simple command to send it to one or more receivers. Predefined distribution list can be used to distribute a message to many people without having to enter individual names each time. Each user of a computer based message system has an electronic "mailbox" in computer storage to hold the message. Some commercial services compete directly with regular mail systems for distribution to points outside the organization. For internal messages, computer-based message systems are utilized primarily in place of internal memos and telephone conversations. They are generally used by the person initiating the communication rather through an intermediary such as a secretary. Another alternative for

message system is electronic voice store-and-forward. Using a special device or set of codes entered into the telephone, the user speaks a message which is translated into a digital pattern and stored in a receiver's electronic mailbox in the central computer.

4.11 Information Processing Control

Organizational control procedures are designed to ensure that the information services conform to organizational objectives and policies and that information provided is complete and correct.

Information system management and control

Information systems management has the responsibility for management and control of the development and operation of the overall information system of the organization. The following are some examples of activities associated with this responsibility:

- Maintenance of qualified staff (selection, training, and evaluation)/
- Acquisition of appropriate hardware and software.
- Scheduling and control of work of development staff.
- Control over software resources of the installation (documentation, controls, etc.).
- Control over maintenance (correction and revisions) of existing applications.
- Control over database (definition, authorization for access, etc.).
- Establishment and enforcement of guidelines, standards, and technical support for user facilities.

Control functions for information processing

There are two types of controls associated with the information processing, these are:

General control functions – These are internal to information system operations and ensure that applications are run correctly and the facilities are operational. These controls include Scheduling control for online systems, internal timesharing, library control for program and data files and documentation, database control for creation, updating, and use of databases, access control for physical access to computers through terminals, backup and recovery procedures.

Application control procedures – To ensure that processing is accurate and no data is lost or mishandled during processing. Outside independent checks of applications processing procedures are important to the assurance of integrity and organizational control.

Guidelines for End-User computing Facilities

Users in an organization may obtain their own hardware and software. In essence, the organization may have many computer processing installations. One issue is the role of the central information services function in terms of organizational control over multiple operations facilities. It can have, for example, completed authority over user facilities or can have only an advisory and monitoring role. The latter is generally more consistent with the concept of and user computing.

The advisory and monitoring role may include obtaining agreement on and enforcement of acquisition of equipment and services. For instance, instead of dictating hardware brands, the system department may provide a set of standard guidelines for acquisition. Ideally, these guidelines are derived from an overall master plan for information resources and are designed to ease the transition to that plan. Users have choices within these limits.

The organizational standards for user installations will usually conform to standards for hardware, software or communications already in place. For instance, a company may have invested in a network that only handles one type of communication protocol; any hardware acquired must adhere to that protocol in order to interface with the network. As another example, a company may choose a standard operating system for all personal computers in order to allow sharing of software. Only personal computers that utilize that operating system are approved for acquisition.

Another important support role is training. The responsibilities for supplying training either internally or through access to outside resources new language or package or for general user understanding of the information system resource. An ongoing training resource as a consulting service is effective for meeting user training requirements on an as-needed basis.

One strategy that combines ongoing training and other types of adhoc technical support is the information center; this is a separate function, usually under the management of information system, of trained experts specializing in very high level language and personal computers. Users can make use of the information center facility, which also contains equipment resources, for training and consulting on their projects. They may also call on the information center experts to design short programs for meeting adhoc requirements or do search on new products.

4.12 Information System Availability Controls

The information system represents a valuable asset of the organization. Its value is as a total system, and the loss of any of its parts can impair the value of the whole. Safeguarding availability of the information system hardware, software and data is therefore an important organizational concern.

Physical Facilities Control

The equipment in a computer installation has a value ranging from a few thousand to several millions dollars depending on the size of installation. The magnetic tape and magnetic disk packs have only a modest intrinsic value, but the data they contain has a high value to the organization. In many cases, the data on the tapes and disks has a value to outsiders – for example, prospect lists, employee lists, and mailing lists.

Because of the risk of damage from unauthorized access and the potential loss from theft or destruction of data files, programs, procedures, etc., access to the computer facility is generally restricted. Organizational controls for security and protection include division of duties(so that a single person does not have complete control over the include division of an application), internal and external audit review, restricted access by operation to program documentation, and restricted access to data files and program files. This latter control is exercised through the use of a Liberian who keeps track of the files and makes them available only to authorized personnel.

With distributed systems, it is harder to provide physical security around each installation. However, each site represents a smaller investment in hardware than a central site. Availability provision in a distributed system should include authorization procedures for switching processing to alternate locations in case one local site is not functioning. The capability to continue processing at all sites except the nonfunctioning one is called fail-soft protection and is a major advantage of distributed systems over centralized processing, where if the computer "goes down" all processing ceases. Protection for physical facilities also includes fire and flood protection and fireproof values.

Terminal Access Control

In systems using online processing and communication networks, there should be protection against illegal

access. The terminals represents access to computer processing capabilities and stored data; therefore there should be controls over access to the device itself, various locks to prevent unauthorized physical availability, and password control for authorization prior to actual use. Password control is included in the feature of the computer's operating system or in special security software. The control usually consists of one or more access passwords which the user must accurately supply before access to the system programs and data is permitted. Password protection may also be placed on individual files and record types, so that only users knowing a file password may access or update records in that file portion of the database.

Backup and Recovery

Provisions are required to recover from events such as errors or failures, fire, natural disaster, malicious damage, or accident that destroys equipment, software, or data. The general approach to recovery is backup by creating copies of the files. Examples of backup and recovery provisions are:

- Backup copies of data and software stored off premises.
- Arrangements for backup site and facilities and backup supply of forms and other supplies.
- Backup and recovery plan.

Diskettes or cassettes with data should be copied each night (or other appropriate frequency). The backup copies should be stored in a secure location.

4.13 Summary

The chapter provides an overview of MIS and computers that how computers are used in MIS. Hardware, software, and communication facilities are required for information system development and operation. A basic computer system consists of input and output devices, central processing unit and software for both system operations and specific applications. A computer is directed by software instruction called a program and the procedure to write programs is called programming. Communication is an important element in many existing systems. Distributed systems are elements in trend to more closely tie processing facilities and data to the location of use.

Transaction processing is a fundamental procedure required for operations. The data from transaction processing results in transaction documents and also provides the data for managerial reports and analyses. There are three main approaches for transaction processing: batch processing, online processing, and online data entry with periodic processing of batches of data. The choice of method depends on the technology available and the characteristics of the applications. The controls audit trail, data entry controls, data validation and various types of control totals ensure correct and complete processing of transactions.

Office automation includes a variety of capabilities. The chapter focuses on document preparation and message and document communication. Document preparation can be performed using word processing or text processing software and can be filed electronically. Computer graphics can be prepared using workstations and inserted in text. Extensions of word and text processing are composition and reproduction.

Message and document communication can be accomplished efficiently using computer-based message system or voice store-and-forward systems. Public data networks facilitate message and document transmission.

Information systems Control require both general-controls and application level controls. Information system needs to be safeguarded that include protection for physical facilities and access controls for terminals. Backup of data files provide a basis for recovery.

4.14 Key Words

- **The management Information System (MIS):** It is an integrated man-machine system that results in the collection, storage, retrieval, communication and use of data for efficient management of operations and for business planning to support managers in an organization.
- **Components of Information:** Technology are hardware, software, data and people.
- **Peripheral:** A piece of computer hardware equipment.
- **CPU:** Central processing unit; component that actually executes instructions.
- **MODEM (Modulator- Demodulator):** It is used as a communication device which converts digital signals to analog signals and vice-versa.
- **Browser:** It is the linked resource of the World Wide Web and the rest of the Internet, as well as corporate intranets and extranets.
- **E-mail (Electronic Mail):** It allows user to send and receive messages anytime and anywhere in the world. It is popular as it is fast, flexible and reliable
- **Chatting:** It refers to live discussions conducted on the Internet between two or more users with the help of computers connected through a network.
- **Intranet:** It is a private computer network maintained by an organization for internal communication
- **Switch:** It determines the data transmission path by making connections.
- **Bridge:** It allows information to be sent between users on different networks.
- **Gateways:** It enables PCs on LANs to access a mainframe computer.
- **Distributed system:** It consists of multiple autonomous computers that communicate through a computer network.
- **Data warehouse (DW):** It is a database used for reporting and analysis.
- **Office automation:** It supports management and professionals work along with clerical office work.
- **Facsimile Transmission:** It is an alternative method for transmitting documents across geographically dispersed areas.

4.15 Self Assessment Test

1. What is the difference between analog and digital computer?
2. Describe advantages and disadvantages of distributed computing?
3. Explain what is client-server computing?
4. What do you mean by data warehouse and data mining?
5. Define the following terms:
   a) Audit trail
   b) Batch processing
   c) Turnaround document
6. Explain transaction processing cycle.

7. Describe how a personal microcomputer system might be controlled and backup and recovery provided?

8. Describe the control requirements for a human resource database application with an adhoc inquiry facility purchased by the personnel department for execution on their own minicomputer.

9. How errors are located in a program and what the error removal techniques?

10. Explain various information systems availability controls.

11. What do you mean by facsimile transmission

4.16 References

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UNIT – 5 : ERP Systems

Unit Structure:

5.0 Objectives

After reading this unit, you will be able to understand

- What is an enterprise resource planning
- What ERP is about and how it works
- Extending the capabilities of ERP
- Enterprise resource planning solutions
- Current state of enterprise resource planning
- How ERP effect organizations, its stakeholders, departments, employment and etc.
- Various ERP software tools
- Considerations for selecting the right system
- Various steps in implementing ERP
- What is an enterprise information system, its characteristics, capabilities, data access and use
- Benefits of EIS

5.1 Introduction to ERP

There are many different systems in a large company's "back office," including planning, manufacturing, distribution, shipping, and accounting. Enterprise resource planning (ERP) is a system that integrates all of these functions into a single system, designed to serve the needs of each different department within the

enterprise. ERP is more of a methodology than a piece of software, although it does incorporate several software applications, brought together under a single, integrated interface.

ERP is a way to integrate the data and processes of an organization into one single system. Usually ERP systems will have many components including hardware and software, in order to achieve integration, most ERP systems use a unified database to store data for various functions found throughout the organization. Enterprise resource planning (ERP) is a company-wide computer software system used to manage and coordinate all the resources, information, and functions of a business from shared data stores.

An ERP system has a service-oriented architecture with modular hardware and software units or "services" that communicate on a local area network. The modular design allows a business to add or reconfigure modules (perhaps from different vendors) while preserving data integrity in one shared database that may be centralized or distributed.

The term ERP originally referred to how a large organization planned to use organizational wide resources. In the past, ERP systems were used in larger more industrial types of companies. However, the use of ERP has changed and is extremely comprehensive, today the term can refer to any type of company, no matter what industry it falls in. In fact, ERP systems are used in almost any type of organization - large or small.

In order for a software system to be considered ERP, it must provide an organization with functionality for two or more systems. While some ERP packages exist that only cover two functions for an organization (QuickBooks: Payroll & Accounting), most ERP systems cover several functions.

Today's ERP systems can cover a wide range of functions and integrate them into one unified database. For instance, functions such as Human Resources, Supply Chain Management, Customer Relations Management, Financials, Manufacturing functions and Warehouse Management functions were all once stand alone software applications, usually housed with their own database and network, today, they can all fit under one umbrella - the ERP system.

5.2 Understanding ERP

ERP covers a multitude of topics, all integral parts of a very expansive and comprehensive process. In learning what it's about and how it works, there are some central features one must understand.

Business Process Reengineering

ERP is about leveraging a company's information, as well as the information resources of partner companies, in the pursuit of more efficient ways of doing business. In general, a company's business processes already leverage existing resources and information availability optimally in order to achieve the most efficient operation possible. But by reconfiguring information resources, combining and extending applications, and partnering with other companies in the sharing of information, new possibilities emerge in terms of how business processes (such as manufacturing, order processing, and inventory control) may be implemented. Making business systems better is a central ERP objective.

Database Integration

Most traditional businesses store information by business function. Financial information is in an accounting database, customer data is in a customer database, and so on. ERP calls for the integration of databases into a super-database that enables logical links between records that traditional applications would not require but that process-oriented ERP applications do require. Often, ERP platform software simply creates convenient and easily maintained bridges between existing databases rather than requiring the awkward generation of new databases from old.

Enhanced User Interfaces

ERP applications, in general, cease to be stand-alone and become steps in a process. Often, a user interface will initiate down-line processes, in addition to its primary function, in highly efficient ways (such as the triggering of updates in down-line databases when a record is changed in the database the user interface is using). It is also often the case that ERP-integrated databases offer wider reporting options via application interfaces than conventional systems do. It is important to learn what options are useful and how this extended reporting may be enabled.

Data Transport Between Companies

As the Internet continues to blossom, the sharing of strategic information between partner companies and logistical data between companies partnered in supply chains is increasingly important. The enhanced databases and interfaces of an ERP-based company are made all the more valuable if partner companies are invited to the party. So a broad and detailed knowledge of the various data communication options is essential to an ERP designer.

Extended and Distributed Applications

What exactly does it mean to extend an application or to share in a distributed application? Basically, a conventional information system is much like a farm covered with ponds: you go to a particular pond and scoop out a bucket of water in order to water your plants. In an ERP environment, the ponds are all converted into an irrigation system: the water is routed to the section of the farm where it's needed. And this includes sharing water with neighbouring farms. An extended application has ancillary functions; a distributed application accommodates many users—even if the users have different needs and are all making use of different portions of database records. It is essential to understand how to facilitate this varied use of common data and to familiarize yourself with how a particular development environment can enable it.

ERP Characteristics

Enterprise Resource Planning systems typically include the following characteristics:

- An integrated system that operates in real time (or next to real time), without relying on periodic updates.
- A common database, which supports all applications.
- A consistent look and feel throughout each module.
- Installation of the system without elaborate application/data integration by the Information Technology (IT) department.

ERP Components

- Transactional database
- Management portal/dashboard
- Business intelligence system
- Customizable reporting
- External access via technology such as web services
- Search

- Document management
- Messaging/chat/wiki
- Workflow management

5.3 How to Extend the Capabilities of ERP

To be and remain competitive, today's businesses require the ability to have a full and up-to-date view of their business—whenever they need it. To achieve this, you need an integrated business environment and automated processes that can consolidate the data from your ERP and CRM systems with your other business applications, quickly and simply

Integrating your ERP with your CRM, and integrating ERP and CRM with your company's other internal systems and with systems external to your business may help you to extend functionality by automating business processes such as:

- Automating manual communication with your trading partners
- Connecting your e-commerce site to your ERP
- Handling service requests via the Web
- Allowing your customers to submit their orders via the Web
- Facilitating EDI transactions
- Sharing data across systems and/or combining processes
- Consolidating a chart of accounts
- Synchronizing your company's data across multiple sites
- Logging your incoming email

Enterprise Resource Planning Solutions

Ideally, ERP delivers a single database that contains all data for the software modules, which would include:

- **Manufacturing:** Engineering, bills of material, scheduling, capacity, workflow management, quality control, cost management, manufacturing process, manufacturing projects, manufacturing flow
- **Supply chain management:** Order to cash, inventory, order entry, purchasing, product configurator, supply chain planning, supplier scheduling, inspection of goods, claim processing, commission calculation
- **Financials:** General ledger, cash management, accounts payable, accounts receivable, fixed assets
- **Project management:** Costing, billing, time and expense, performance units, activity management
- **Human resources:** Human resources, payroll, training, time and attendance, rostering, benefits
- **Customer relationship management:** Sales and marketing, commissions, service, customer contact and call centre support
- **Data warehouse and various self-service interfaces:** for customers, suppliers, and employees

- **Access control:** user privilege as per authority levels for process execution
- **Customization:** to meet the extension, addition, change in process flow

The Current State of Enterprise Resource Planning

ERP evolved from manufacturing resource planning (which originated from material resource planning).The functioning of ERP has gained much prominence and utility with the intervention of web enabled and open source technologies. ERP II the latest advancement in ERP software deserves special mention.

ERP has a significant impact right from the time it is conceived in the organization. It paves way for restructuring which would not have otherwise happened in organizations sticking to traditional and conventional values. ERP is an eye-opener for organizations because they get to realize the fine distinction involved in modifying the business processes. Organizations now disclose vital information in the public domain, which was otherwise, considered confidential and not meant for dissemination.

ERP has undoubtedly become an important business application to all industries. It has almost become a must for all organizations irrespective of the type of business manufacturing or service .If companies feel that coordination and enterprise communication are their only problems they don't have any other alternative but to go for ERP, provided they want to make profits and remove the existing setbacks.

Needles to say ERP has helped companies in monetary and non-monetary aspects if they are keen in utilizing it to the core and take the necessary steps to overcome the setbacks. However ERP needs lot of improvement (this statement included the latest versions also). ERP is an effective application. It will be great if one can bring an ERP system that id devoid of the drawbacks from the existing ones. The latest intrusions namely open source and web enabled technologies has increased the effectiveness of the application. However they are not enough (technically speaking). ERP applications should be designed to make the maximum use of internet so that the user can access data from any part of the world just by a click of the mouse. This has further deepened the future of ERP. ERP's future is yet to reach saturation.

Formerly ERP was purely restricted to fortune 500 companies, in the sense only they could afford to invest on them. This put the small and Medium Industries at a large disadvantage. They were not able to make use of the application to gain the necessary benefits. ERP's future seemed to be dooming on them.

However this drawback has been removed after the intervention of open source facilities. The concept of outsourcing has helped in removing the difficulties faced by small and medium enterprises.

The ERP vendors are targeting this market effectively. However both the vendor and the companies in this segment have to remember that there are lot of competition in this sector and one is not likely to succeed unless he serves the best product. ERP has thrown open opportunities for many companies to trade with foreign counter parts in the name of outsourcing, implementation and deployment of the existing ones. It has contributed lot to the economy. Academics also boast their own share of ERP relations. It has promoted lot of employment and educational opportunities. India happens to be a key beneficiary in this aspect.

5.4 Effect of ERP on Organisations

ERP (Enterprise Resource Planning) systems are used in the organizations for information integration and aligning & streamlining their processes for delivering high value to the customers. Through its very use, it influences manager's jobs and the organization structure as well.

ERP has significant impact on the organizations and has tremendously changed the way of manager's job and organization structures. ERP implementation on five dimensions of Manager's job (autonomy, use of

power, delegation, people skills and privileged information), five dimensions of organizational structure (specialization, formalization, centralization, standardization and complexity of work flow) and on the flexibility of organization has been effected by the use of ERP in organisations of all levels.

ERP systems have become the system of choice for the majority of publicly traded companies and have radically changed the way accounting information is processed, analyzed, audited, and disseminated. In this study, we examine whether ERP system implementations have impacted the decision usefulness of accounting information. We find that ERP adoptions lead to a trade-off between increased information relevancy and decreased information reliability for external users of financial statements. After implementing the system, firms concurrently experience both a decrease in reporting lag and an increase in the level of discretionary accruals. Contrary to expectations, adopting more ERP modules did not augment these effects. These results should be of interest to financial statement preparers initially adopting or implementing new versions of ERP applications, auditors serving clients with ERP systems, and regulators overseeing the financial markets and consolidation in the ERP industry.

While ERP has been around for little more than a decade, more companies are now seeing the benefits of using it. Many companies in the Middle East and Africa have failed to utilize the benefits of ERP, and the reason for this deals with procedure rather than cost. Many of these companies have used the same methods for many years, and are unwilling to switch to something new. At parieto-occipital sites, in both experiments, the repeated possible and impossible non-target items elicited less positive ERP waveforms than did first presentations beginning at about 300 ms. The briefly reduced frontal negativity to repeated items is consistent with familiarity arising from a facilitation of access to conceptual, semantic and visuo-spatial representations during object categorization. The polarity of the parieto-occipital effect was the reverse of what is usually found in stimulus repetition tasks, although it is consistent with earlier work using similar visual stimuli. It is interpreted as reflecting the availability of a newly formed representation (i.e., token) of the object just experienced.

ERP Impact on Organizations

ERP implementation can positively affect the process capital of a company; process capital can positively affect customer capital and customer capital ultimately affects business performance. Companies implementing ERP can build process capital to meet the challenges of the competitive market environment.

ERP'S impact on its stakeholders

Impact of ERP on the role of managers or organization or stakeholders can be best studied and understood if the subject is analyzed right from the implementation stage. Nevertheless it has a strong influence on the business process itself as soon as it is gripped and decides major issues for employees, customers and other stake holders. It is better to analyze it in this context rather than debating on "How will ERP impact the accounting Profession?"

Impact during the Implementation Process

ERP has a significant impact right from the time it is conceived in the organization. Firstly it facilitates the members in the organization to arrive at a consensus though after a detailed and deliberate discussion. It paves way for restructuring which would not have otherwise happened in organizations sticking to traditional and conventional values. ERP is an eye-opener for such organizations because they get to realize the nuances and edge involved in modifying the business process. This would not have happened but for the intervention of ERP. Organizations disclose vital information in the public domain which was otherwise considered confidential and not meant for dissemination. All this happens in the implementation process as this it is the

time the seeds sown (FOR ERP Intervention) gets shaped in this phase. Nevertheless the impact of ERP on managers is noteworthy.

Impact on Departments

It brings about interactions and tends to nurture healthy relationships among departments in organizations which would have otherwise remained isolated. The problems of coordinations faced by each department are made known to the company. They can arrive at a better means of doing things on such group discussions. It is therefore necessary to study the impact of ERP on all departments rather than restrict it to issues like "How will ERP impact the accounting profession"?

Impact on the organization as a whole

The ERP consultant will able to identify the flaws and guide the organization in devising better procedures. It helps organizations to adapt and adjust to change right from the implementation process.

Impact on Employment

It throws job opportunities to many individuals, whom the organizations hire at the implementation process. They even realize the need to retain them on permanent rolls once ERP goes full-fledged in the organization. The good news is that it gives another room of employment for the existing IT professionals in the country. They were able to update themselves on ERP modules and continue serving the organization in terms of enhancing user interface with ERP applications.

Impact on the nature of Job and information access

ERP has directly and indirectly helped to redefine functions in the organization. Anything that people wanted to know about the company was available by a click of the mouse. There was no more relying on the department of internal communications even for single information. Outsiders don't have the hassle of obtaining permission and following stringent procedures to access information. IT has helped vastly and so it is not necessary to ask exclusive questions like "How will ERP impact the accounting Profession"?

Impact on the individual employees

ERP provided more freedom, authority and responsibility to the individual employees which were mutually beneficial to the management. Each employee became more aware of his/her function while ERP has given the confidence to execute it individually and successfully Above all it resulted in transparency and accountability. The tasks of employees became totally independent as ERP succeeded in doing away the need of exclusive interdepartmental dependence in order to elicit information. This has resulted in easing the process of handling and answering customer queries and undertaking clientele orders.

Shifting paradigm

The impact of this evolution on accounting and management information systems (MIS) has been substantial, even revolutionary. However, the impact hasn't been limited to these areas. All areas of the organization have had to evolve with changing organizational paradigms.

One of the fundamental organizational changes that ERP systems have created is a demand for more strategic staff and fewer clerical staff. Given the inherent integration of transaction processes connected to ERP systems, users need to understand at least one step before and one step after their own job functions, both inside and outside the ERP system. ERP systems are configured around key business processes outside the system itself, which means users have to understand these connections and work with them to create an efficient organization.

Optimal ERP system configuration and transactional processing requires that the implementation integrate business processes and train the users in the integrated transactional processes of the system. This process creates an expanded organizational knowledge and greater functional capabilities for the system users.

The rigorous requirements that ERP systems place on their users is evident in the people focus of the implementation models and methodology of IT consulting firms. Many of these firms consider the relative importance of resource allocation and effort as follows: people—50%, process—35%, technology—15%. Hence training with, and user understanding of, the ERP system is paramount.

These considerations have obvious impacts on the HR function. An ERP system implementation is a large scale change management initiative. Organizational processes are reviewed, documented and rationalized, often in a "current state/future state" analysis, or as part of a business process re-engineering plan. Management must manage the change efficiently and effectively. HR must work closely with management, the project manager and any external consultants, to ensure these considerations are addressed.

5.5 ERP systems and ADC Tools

Enterprise Resource Planning (ERP) integrated application software systems and Automated Data Collection (ADC) tools are experiencing resurgence. Existing users are expanding their use of existing functionality, and new users are acquiring one or both applications to meet business requirements. This increased interest has been driven by customer requirements

ERP systems are a well-established IT application in today's medium to large multi-national organizations. They have evolved into fully integrated supply chain tools, including customer relationship management (CRM), business-to-business transaction support, vendor-managed inventory tools and customer self-service interfaces and portals.

Starting in November 1992, the client/server ERP applications began appearing from no-name or lesser name software manufacturers such as Platinum Software, PeopleSoft, Oracle Financials, Baan and SAP. These distributed software and GUI interfaced applications grew at the expense of the mainframe ERP systems. The most notable of the client/server ERP players - SAP and Oracle Financials - stand alone as today's ERP application market share leaders. However, now they too are threatened by new technology paradigms from software as a service (SaaS) competitors and open source software.

Typically, ERP systems provide multi-instance database management as well as configuration and version (or 'customization') management for the underlying database schema, the user interface, and the numerous application programs associated with them. The sheer size and the tremendous complexity of these systems make them difficult to deploy and maintain. Despite the worldwide success of systems like SAP R/3 and Baan IV, the underlying architectures, data models, transaction mechanisms and programming techniques are to a large degree unknown to computer scientists.

5.5.1 SAP Software

The **SAP ERP** application is an integrated enterprise resource planning (ERP) software manufactured by SAP AG that targets business software requirements of midsize and large organizations in all industries and sectors. It allows for open communication within and between all company functions. SAP ERP consists of several modules including: utilities for marketing and sales, field service, product design and development, production and inventory control, human resources, finance and accounting. SAP ERP collects and combines data from the separate modules to provide the company or organization with enterprise resource planning.

SAP Faces Integration Challenge:

SAP is the undisputed market leader in ERP software business. It stands for System Application and Products in Data Processing, formed in 1952 in Germany by five engineers from IBM. It has a customer base of around 89,000 in over 120 countries. SAP leads the ERP market with a share of 25%. India emerged as the fastest growing market for SAP in 2008. SAP is the first to market the next generation "Service Oriented Architecture". Most of the Fortune 500 companies run their business on SAP including IBM, Microsoft.

This is the major challenge faced by SAP. Suppose my enterprise is generating a lot of data from a number of businesses. I have data from my Call center division in a different format , I have data from my Technical division in a different format ,I have from my procurement division in a different format . I have got relational as well as non- relational data, data from e-mails .Each of my division is purchasing software's from different vendors, working in varied formats. When we look at management of this varied data, it is a complex task in itself. Suppose a person from Call Center division wants to look at the data from Technical Division or a person from Sales department wants to look at the data from procurement division. There has to be a standard Report format to present this data. The chain of this data goes on increasing. Integration costs are high. There is a lot of pressure on IT to reduce and to minimize the transaction cost.

SAP R/3 Client Server and Modules

SAP is an integrated system where all the functionality to run an enterprise is provided by one single system. It provides workflow and seamless integration of different business processes which provides consistency of business information. SAP has divided the functionality of each division into modules, each module dedicated to a specific division.

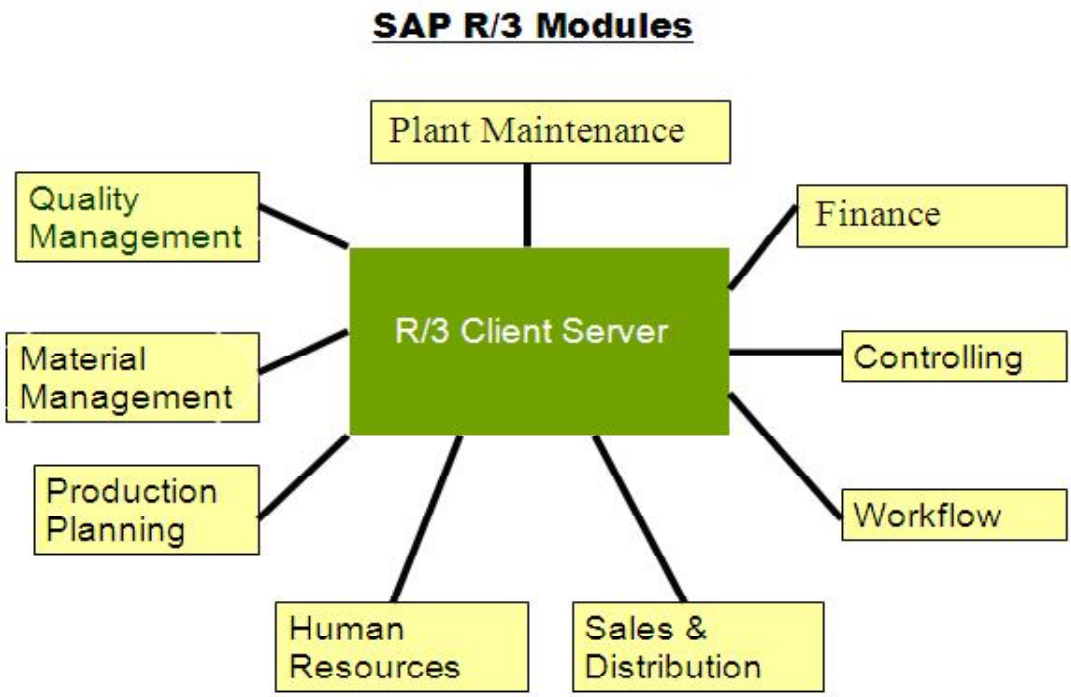

Figure 5.1

SAP R/3 is working on a Client Server Architecture. In this architecture data is centrally located and is entered only once and all the various modules of my enterprise can share this data. The various modules can be split into Financials, Logistics, and HRM having the sub modules Quality Management, Material Management, Production Planning, Sales & Distribution and Plant Maintenance. Customers are free to

choose among the different modules. In this manner they can customize the business processes as per their business needs.

Although there can be major benefits for customers of SAP ERP, the implementation and training costs are expensive. Many companies experience problems when implementing SAP ERP software, such as: failing to specify their operation objectives, absence of a strong commitment or positive approach to change, failing to deal with organizational differences, failing to plan the change to SAP ERP properly, inadequate testing. All these factors can mean the difference between having a successful implementation of SAP ERP or an unsuccessful one.

If SAP ERP is implemented correctly an enterprise can go from its old calculations system to a fully integrated software package. Potential benefits include: efficient business process, inventory reduction, and lead time reduction.

SAP ERP systems effectively implemented can have cost benefits. Integration is the key in this process. Independent studies have shown that deployment and maintenance costs of a SAP solution can greatly vary depending on the organization. Deploying SAP itself can also involve a lot of time and resources.

SAP systems - including client systems - communicate with each other using SAP-specific protocols (e.g., RFC and DIAG) and the http and https protocols. These systems do not have encrypted communications out of the box; however, SAP does provide a free toolkit for server-to-server communications. With the recent acquisition of relevant parts of SECUDE, SAP can now provide cryptography libraries with SAP ERP for Secure Network Communications and Secure Socket Layer.

5.5.2 Baan Software

Baan was a vendor of enterprise resource planning (ERP) software that is now owned by Infor Global Solutions. The Baan Corporation was created by Jan Baan in 1978 in Barneveld, Netherlands, to provide financial and administrative consulting services. Baan gained its popularity in the early nineties. Baan software is famous for its Dynamic Enterprise Modeler (DEM), technical architecture and its 4GL language. Baan 4GL and Tools nowadays is still considered to be one of the most efficient and productive database application development platforms. Baan became a real threat to market leader SAP after winning a large Boeing deal in 1994.

Product version

- Triton 1.0 to 2.2d, 3.0 to last version of Triton is 3.1bx, then the product is renamed to Baan
- Baan 4.0 (last version of BaanIV is BaanIVc4 SP30) & Industry extensions (A&D,...)
- Baan 5.0 (last version of BaanV is Baan5.0 c SP26)
- Baan 5.1, 5.2 (for specific customers only)
- SSA ERP 6.1 /Infor ERP LN 6.1 / Infor10 ERP Enterprise
- Infor ERP Ln 6.1 supports Unicode and comes with additional language translations.
- Supported Platform and Database (Server)

Server Platform:

Windows Server, Linux, IBM AIX, Sun Solaris, HP-UX, AS400(Obsolete), OS390 (Obsolete)

Database:

Oracle, DB2, Informix, MS SQL Server, MySQL (Obsolete since year 2010), Bisam (Obsolete), Btam (Obsolete)

Standard Modules

- **Baan IV modules:**

Common (tc), Finance (tf), Project (tp),Manufacturing (ti),Distribution (td),Process (ps),Transportation (tr),Service (ts),Enterprise Modeler (tg),Constraint Planning (cp),Tools (tt),Utilities (tu), Baan DEM (tg)

- **ERP Ln 6.1 modules:**

Enterprise Modeler (tg), Common,Taxation (tc),People(bp), Financials (tf),Project (tp),Enterprise Planning (cp),Order Management (td), Electronic Commerce (ec),Central Invoicing (ci),Manufacturing (ti),Warehouse Management (wh),Freight Management (fm), Service (ts), Quality Management (qm), Object Data Management (dm), Tools (tt)

Baan Virtual Machine - Bshell

Bshell is the core component of Baan application server. It is a process virtual machine to run Baan 4GL language. Bshell were ported to different server platforms and make Baan program scripts platform independent. For example, a Baan session developed on Windows platform can be copied to Linux platform without re-compiling the application code. Bshell is similar to nowaday's Java VM or .Net CLR.

5.5.3 Tally's Software

It is mainly used for vouchers, financial statements, and taxation in many industries, and has specialised packages for retail businesses. More advanced capabilities are found in its ERP package.

Tally Software is developed with a core proprietary engine with a SDK Wrapper. Most of Tally's Interaction Forms and Reports are developed using Tally Definition Language TDL. Customization of Tally Application can be done using this TDL SDK.

5.5.4 PeopleSoft ERP Software

PeopleSoft responded by providing systems that could run a wide variety of standardized modules for human resource management, supply chain management, customer relations management and accounting. The suite of solutions have achieved wide acclaim since its launch more than a decade ago for developing ground breaking HR practices as well as streamlining costs and resources which has enabled Peoplesoft to maintain their loyal following today. The popularity of Peoplesoft ERP systems spread beyond the world of manufacturing as implementation demand rose among university systems and government offices. But as with many large ERP providers at this time, Peoplesoft systems were expansive, cumbersome and prone to failure during the implementation stage.

5.5.5 Oracle Corporation's E-Business Suite

Oracle Corporation's E-Business Suite, also known as Applications/Apps or EB-Suite/EBS) consists of a collection of enterprise resource planning (ERP), customer relationship management (CRM), and supply-chain management (SCM) computer applications either developed by or acquired by Oracle. The software utilizes Oracle's core Oracle relational database management system technology. The E-Business Suite

(current version: 12.1) contains several product lines, including:

- Oracle CRM
- Oracle Financials
- Oracle HRMS
- Oracle Mobile Supply Chain Applications
- Oracle Order Management
- Oracle Procurement
- Oracle Project Portfolio Management
- Oracle Quotes
- Oracle Transportation Management
- Oracle Warehouse Management Systems
- Oracle Inventory
- Oracle Enterprise Asset Management

5.5.6 Automated Data Collection Tools

Automated Data Collection Tools (ADC)/barcoding tools, employ fixed and portable barcode scanners that read labels as products pass through the production cycle, so that transactional and product data is wirelessly transmitted via a wireless network to radio antennae, which seamlessly update the ERP system.

Often a secondary implementation to an ERP installation, ADC/barcoding tools effectively leverage the existing capabilities of ERP systems. While these tools are also not a new development (the first barcode was actually scanned in 1972), there is now an increased demand for them, particularly now that they may include radio frequency identification (RFID) tags, which provide an efficient solution for regulatory and customer food/product security requirements, particularly in high volume environments.

In the same manner that ERP systems can be viewed as leveraging the human capital of an organization, ADC tools have leveraged the inherent capabilities of ERP systems, which are often described as integrated, "real-time" systems. The reality is that while ERP systems are capable of real-time reporting for an organization's MIS, data capture often isn't automated. ADC tools form the last link in this information chain, turning "real time" into "real, real time." Thus the accounting assertion that there need be a trade-off between relevance (timeliness) and reliability (accuracy) of financial information is no longer the case.

These developments have also enhanced quality assurance (QA) capabilities and compliance effectiveness. With the timely and accurate tracking of supplier and customer lots in real time, efficient and effective lot tracking and mock recall protocols are also possible. This is a major boost for the product and process components of any food/product security program, for instance.

It's interesting to note that in the same manner that inventory items are barcoded and scanned by ADC tools, so too can employee ID badges, as the employee moves within the plant or work centre. Not only does this enhance the people and plant components of a security program, but it can be interfaced with the ERP system to produce additional labour reports. In many labour-intensive plants, accurate labour reporting is difficult to attain. With this tool, labour variances can be analyzed.

5.6 Selecting the right system

To derive the benefits of an ERP implementation, a number of considerations must be evaluated. These include considering:

- Both the current and future/growth business requirements (scalability);
- The appropriate trade-off between application software complexity and related user needs (usually a mid-market vs. high-end software application acquisition decision);
- An assessment of the "time-to-benefit" for key business processes in the organization's strategic plans;
- The key metrics that indicate relative application software complexity and time to benefit, such as the historical ratio of consulting dollars to initial license fees (the application software vendor and/or consulting firm can provide this);
- The software version of the application being selected (leading edge vs. bleeding edge);
- The stability of the software vendor;
- The ability of the organization to devote sufficient resources (people, amount of dedicated project time per person, minimum funding) over time;
- The involvement of key users in the planning process (when key players "plan the battle" they don't "battle the plan");
- Producing a specific, measurable, achievable, realistic, time-oriented project plan and budget; and
- Selecting application software certified implementation consultants with relevant industry experience.

Given that each application is provided by a different software vendor, it's crucial that the ERP system and its integrated ADC tool have significant, successful implementation history together.

A second important proviso is that the appropriate procedures and controls must exist both inside and outside the system, including appropriate levels of user training and system familiarity, with the ERP system, the ADC tool, and their integration. With a tight integration of these applications there are fewer change management challenges when, for instance, implementing an ADC solution subsequent to the initial ERP implementation (the standard sequence of events).

The substantial benefit to accounting and MIS of ERP systems, ADC tools, and more recently RFID, will continue to be simultaneously relevant and reliable data. At the same time, organizations will be able to devote more of their human resources to strategic challenges.

5.7 Implementing ERP

Enterprise Resource Planning also known, as ERP is a term usually used with a system or software that is intended to manage all the information and functions of a company from shared data storages. Irrespective of the size of the company, whether it is a multi-million dollar company or small business company, the objective of the system selection is to get a system that can fully support the functionality of the business process and provide significantly better profit at the end of the day. ERP attempts to integrate all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs.

Before ERP, there is Material Requirement Planning (MRP); later Manufacturing Resource Planning (MRP2). The different between ERP, MRP and MRP2 is ERP intend to combine/cover all the aspect in the business unit regardless of its business process and characters. Whereas MRP and MRP2 only focusing on the material planning throughout the whole process without involving all others department such as Finance, Human Resource, Purchasing, Manufacturing etc.

ERP vanquishes the old standalone computer systems in Finance, HR, Manufacturing and Warehouse, then replacing them with a single unified software program divided into software modules that roughly approximate the old standalone systems. Finance, Manufacturing, HR and the warehouse still get their own software, except now the software is linked together using the same database so that someone in finance can look into the warehouse software to see if an order has been shipped.

Most vendors ERP software is flexible enough that you can install some modules without buying the whole package. Many companies, for example, will just install an ERP finance or HR module and leave the rest of the functions for another day.

Careful planning, right timing and methodology selection is vital in ERP implementation. With the right decision, the company will reap the benefit not only during the implementation but also during the life of ERP system.

Figure 5.2

Implementing ERP systems are extremely complex and take months and even years to implement. If your stakeholders understand the long-term benefits of the system, they are much more willing to accept any perceived temporary steps backward.

An enterprise resource planning (ERP) software project can be daunting for first-timers or veterans handling a migration.

A common malady for some stakeholders is to become complacent with the status quo. You often hear, "We like what we have. It works for us." This mindset is predominantly on campuses with strong IT departments, and older, home-grown legacy systems that still function quite well. Typically they have been designed to do exactly what the functional departments want them to do. In these cases, it's easy to believe

that an ERP does not meet their needs. This sentiment will continue throughout the implementation unless you proactively sell constituents on the many advantages of the new ERP.

Tougher competition in the marketplace is generating the need to better optimize resources, improve profitability and keep customers satisfied. Companies are increasingly implementing Enterprise Resource Planning (ERP) software solutions to improve operations and provide faster customer response.

Choosing an ERP solution that meets your specific business requirements will enable you to have a smoother implementation. If the software package is written for your industry, you won't have to custom design a solution. Customized solutions are time consuming to implement and add unnecessary cost. One of the top reasons ERP implementations fail is because the software doesn't meet basic industry specific business requirements. However; purchasing an ERP application is only half the battle. A well designed implementation plan is the key to success.

5.7.1 Process preparation

Implementing ERP typically requires changes in existing business processes. Poor understanding of needed process changes prior to starting implementation is a main reason for project failure. It is therefore crucial that organizations thoroughly analyze business processes before implementation. This analysis can identify opportunities for process modernization. It also enables an assessment of the alignment of current processes with those provided by the ERP system. Research indicates that the risk of business process mismatch is decreased by:

- Linking current processes to the organization's strategy;
- Analyzing the effectiveness of each process;
- Understanding existing automated solutions.

ERP implementation is considerably more difficult (and politically charged) in decentralized organizations, because they often have different processes, business rules, data semantics, authorization hierarchies and decision centers. This may require migration of some business units before others, delaying implementation to work through the necessary changes for each unit, possibly reducing integration (e.g. linking via Master Data management) or customizing the system to meet specific needs.

A potential disadvantage is that adopting "standard" processes can lead to a loss of competitive advantage. While this has happened, losses in one area are often offset by gains in other areas, increasing overall competitive advantage.

5.7.2 Configuration

Configuring an ERP system is largely a matter of balancing the way the customer wants the system to work with the way it was designed to work. ERP systems typically build many changeable parameters that modify system operation. For example, an organization can select the type of inventory accounting—FIFO or LIFO—to employ, whether to recognize revenue by geographical unit, product line, or distribution channel and whether to pay for shipping costs when a customer returns a purchase.

5.7.3 Customization

ERP systems are theoretically based on industry best practices and are intended to be deployed "as is". ERP vendors do offer customers configuration options that allow organizations to incorporate their own business rules but there are often a functionality gap remaining even after the configuration is complete. ERP

customers have several options to reconcile functionality gaps, each with their own pros/cons. Technical solutions include rewriting part of the delivered functionality, writing a homegrown bolt-on/add-on module within the ERP system, or interfacing to an external system. All three of these options are varying degrees of system customization, with the first being the most invasive and costly to maintain. Alternatively, there are non-technical options such as changing business practices and/or organizational policies to better match the delivered ERP functionality.

The following five steps are treated as the key behind successful ERP implementation:

1) STRATEGIC PLANNING

Project team: Assign a project team with employees from sales, customer service, accounting, purchasing, operations and senior management. Each team member should be committed to the success of the project and accountable for specific tasks, i.e. developing a timeline, finalizing objectives, formulating a training plan. Make sure you include first line workers as well as management on your team. Base the selection on the knowledge of the team not status of the employee.

Examine current business processes: Have the team perform an analysis on which business processes should be improved. Gather copies of key documents such as invoices, batch tickets and bill of lading for the analysis. To start the team discussion, consider questions such as:

- Are your procedures up to date?
- Are there processes that could be automated?
- Are personnel spending overtime processing orders?
- Do your sales force and customer service personnel have real-time access to customer information?

The team members should also conduct interviews with key personnel to uncover additional areas of improvement needed.

Set objectives: The objectives should be clearly defined prior to implementing the ERP solution. ERP systems are massive and you won't be able to implement every function. You need to define the scope of implementation. Ideally, the scope should be all inclusive. But practically, it is very difficult to implement. Examples of objectives would include:

- Does the solution reduce backlogs?
- Can the solution improve on-time deliveries?
- Will you be able to increase production yields?

Develop a project plan: The team should develop a project plan which includes previously defined goals and objectives, timelines, training procedures, as well as individual team responsibilities. The end result of the project plan should be a "to do" list for each project team member.

2) PROCEDURE REVIEW

Review software capabilities: Dedicate 3-5 days of intensive review of the software capabilities for the project team. Train on every aspect of the ERP software to fully educate the team on capabilities and identify gaps. Determine whether modifications are needed prior to employee training.

Identify manual processes: Evaluate which processes that are manual and should be automated with the ERP system.

Develop standard operating procedures (SOPs): for every aspect of your business. These procedures should be documented. Make sure that you modify the document as your SOPs change. This is a huge task, but it is critical to the success of your implementation. Examples of SOPs:

- How do you handle global price changes?
- What are the processes for inputting new customer records?
- How do you currently handle the paperwork on drop shipments?
- How do we add a new product or formula?

3) DATA COLLECTION & CLEAN-UP

Convert data: You can't assume 100% of the data can be converted as there may be outdated information in the system. Determine which information should be converted through an analysis of current data.

Collect new data: Define the new data that needs to be collected. Identify the source documents of the data. Create spreadsheets to collect and segment the data into logical tables (Most ERP systems will have a utility to upload data from a spreadsheet to their database).

Review all data input: After the converted and manually collected data is entered into the ERP database, then it must be reviewed for accuracy and completeness. Data drives the business, so it is very important that the data is accurate.

Data clean-up: Review and weed out unneeded information such as customers who haven't purchased in a while or are no longer in business. Now is the time for improving data accuracy and re-establishing contact with inactive customers.

4) TRAINING AND TESTING

Pre-test the database: The project team should practice in the test database to confirm that all information is accurate and working correctly. Use a full week of real transaction data to push through the system to validate output. Run real life scenarios to test for data accuracy. Occurring simultaneously with testing, make sure all necessary interfaces are designed and integration issues are resolved to ensure the software works in concert with other systems.

Verify testing: Make sure the actual test mirrors the Standard Operating Procedures outlined in step 2, and determine whether modifications need to make.

Train the Trainer: It is less costly and very effective if you train the trainer. Assign project team members to run the in-house training. Set up user workstations for at least 2 days of training by functional area. Provide additional tools, such as cheat sheets and training documentation. Refresher training should also be provided as needed on an ongoing basis.

Final Testing: The project team needs to perform a final test on the data and processes once training is complete and make any needed adjustments. You won't need to run parallel systems, if you have completed a thorough testing.

5) GO LIVE AND EVALUATION

Evaluation: Develop a structured evaluation plan which ties back to the goals and objectives that were set in the planning stage. In addition, a post-implementation audit should be performed after the system has been up and running for the first week for reconciliation purposes and three to six

months following to test whether or not the anticipated ROI and business benefits are being realized. Comparing actual numbers with previously established benchmarks will reveal if the software tool does what it is intended to do - add value to the business. It is important to periodically review the system's performance to maximize ROI. Upper management and project team members should be committed for the company to realize the benefits of successful ERP.

5.8 Benefits of ERP

ERP systems are great to help your company streamline your processes. In order to have a successful implementation of your ERP system, you need to make sure you have your information in line to help make the process swift. It doesn't matter whether or not your company deals with paper or plastics, ERP provides your company with the right system and performance that you need. ERP can help your company reduce operating cost and it is a benefit when running company analytics. It improves the coordination of your company's process into one streamlined process where everything can be accessed through one enterprise wide information network.

Organizational processes fall into three levels - strategic planning, management control and operational control. Even though much of ERP success has been in facilitating operational coordination across functional departments, successful implementation of ERP systems benefit strategic planning and management control one way or other.

Help reduce operating costs

ERP software attempts to integrate business processes across departments onto a single enterprise-wide information system. The major benefits of ERP are improved coordination across functional departments and increased efficiencies of doing business. The immediate benefit from implementing ERP systems we can expect is reduced operating costs, such as lower inventory control cost, lower production costs, lower marketing costs and lower help desk support costs.

Facilitate Day-to-Day Management

ERP programs are being developed and updated all the time. With so many different types on the market, companies should make sure they do due diligence and try out different packages before choosing one to use. Some of the programs even offer mobile capabilities so that you can always have a finger on the pulse of your business activities from your pda.

With real time capabilities and the ability to be able to see what is going on with your company as it happens, ERP systems are handy when you deal with high volume. With an ERP system, your company will never have inventory shortages or wasted time spent transferring files. You can test out an ERP system before buying it and see how it will work with your business.

Support Strategic Planning

Strategic Planning is "a deliberate set of steps that assess needs and resources; define a target audience and a set of goals and objectives; plan and design coordinated strategies with evidence of success; logically connect these strategies to needs, assets, and desired outcomes; and measure and evaluate the process and outcomes." (source) Part of ERP software systems is designed to support resource planning portion of strategic planning. In reality, resource planning has been the weakest link in ERP practice due to the complexity of strategic planning and lack of adequate integration with Decision Support Systems (DSS).

Some of the well known beneficiaries include the following sectors:

- **Manufacturing**

  ERP has helped to increase the efficiency and quality of the manufacturing process. The manufacturing process experienced slumps quiet often because of improper communication, miscommunication, wrong communication and even lack of communication. ERP provided solutions to those troubles by coordinating the actions of supply chains, ware house and logistics. It also helped greatly in functions like tracking down the status of the product. Formerly customers were made to run from pillar to post to enquire the status of product or for enquiring a technical problem. The customer service representative would not be in a position to directly reply to these queries. On the contrary he would ask the person from the concerned department. The person would check the details and get back to him be it the status of a product or technical issue. This seemed to be time-consuming and meaningless. The longer the chains of communication greater are the chances of mistakes. CSC ERP finance is software meant for accounting purposes.

- **Software**

  The manufacturing sector has been rated as the largest beneficiary. This sector can be rated as the one who uses ERP easily because it is a product from their species. This does not undermine ERP'S use in Software sector because it becomes easy to manage projects with acute deadlines. ERP industry paper will also reveal that it is easy to train and make people work in this sector than anywhere else.

- **Insurance**

  Enterprise Resource planning has played a vital role in this business by covering three vital areas. Firstly it has provided a common platform for insurers and his agents. This has helped in easing the transactions and keeping an eye on the performance of the agent. This has addressed the difficulties of both the agents and insurers and thus facilitated coordination in the better interests of the business. Secondly it has helped in curbing procedural delays and inefficiencies for which the sector is famous for. This statement can turn out to be truer if the sector is owned and controlled by the government either fully or partially. Of course bureaucracy and redtapism are inborn features in a state's set up but their presence in an insurance industry can do more harm because it calls for dispensing immediate information during lawsuits and pending claims. IBM ERP Insurance is a famous player in this sector.

- **Healthcare**

  The sharing of databases among hospitals seemed to be a great advantage for doctors and patients. This even makes one to exaggerate that a person need not maintain a collection of his medical problems provided that his/her choice of hospital/hospitals has a database of patient records(or commonly shares them by any other means).Even though it is not practical to follow those practices ERP has been a lifesaving measure to patients who are admitted in a hospital in an emergency condition irrespective of the fact that the doctor in charge is aware of his medical history as ERP provides everything. ERP industry analysis here will reveal that confidentiality is affected but the life of a person is to be given the utmost priority.

- **Hospitality**

  ERP has helped a lot in bringing down the operational costs and coordinating the acts of individual

departments. Hotels are well known for the segregation of functions. One can find many small departments like house keeping beverage supply room service etc. Even though these segregations sound small they have a large impact on the organizational structure. ERP offers a common medium to coordinate their actions. The entire action can be controlled in the reception desk. ERP industry paper points the exact benefit as per ERP industry analysis. Besides this textile ERP insurance is equally famous.

5.9 ERP Analysis

ERP calls for different operations and applications in different industries. Each industry has their own drawbacks and plus points in dealing with the enterprise applications. A comparative study will help in analyzing them precisely.

Enterprise resource planning (ERP) software helps integrate management, staff, and equipment, combining all aspects of the business into one system in order to facilitate every element of the manufacturing process. ERP groups traditional company and management functions (such as accounting, human resources [HR], manufacturing management, and customer relationship management [CRM]) into a coherent whole. Manufacturing management also includes inventory, purchasing, and quality and sales management.

ERP systems aid in the control and communication of business activities, such as:

- Efficient handling of order processing and production scheduling
- Management and analyses of business processes within an interactive environment
- Synchronization of departmental activities (e.g., within human resources or finances) with the needs and output from production facilities
- Monitoring, sharing, and tracking of information throughout the organization

Enterprise Resource Planning Evaluation helps in

- Examine how each solution addresses your management and manufacturing requirements.
- Compare systems to see if they offer the functions critical to your industry.
- Analyze each solution's capacity to support your company's growth and operations over time.

The Advantages and Disadvantages of ERP

There are a number of powerful advantages to Enterprise Resource Planning. It has been used to solve a number of problems that have plagued large organizations in the past. At the same time, it is not without a number of disadvantages. Being able to weigh the two will allow a company to decide if this solution will properly meet their needs.

Advantages of ERP

In the absence of an ERP system, a large manufacturer may find itself with many software applications that do not talk to each other and do not effectively interface. Tasks that need to interface with one another may involve:

- Design engineering (how to best make the product)
- Order tracking from acceptance through fulfilment
- The revenue cycle from invoice through cash receipt

- Managing interdependencies of complex Bill of Materials
- Tracking the 3-way match between Purchase orders (what was ordered), Inventory receipts (what arrived), and costing(what the vendor invoiced)
- Accounting for all of these tasks, tracking the Revenue, Cost and Profit on a granular level.

Change how a product is made, in the engineering details, and that is how it will now be made. Effective dates can be used to control when the switch over will occur from an old version to the next one, both the date that some ingredients go into effect, and date that some are discontinued. Part of the change can include labelling to identify version numbers.

Computer security is included within an ERP to protect against both outsider crime, such as industrial espionage, and insider crime, such as embezzlement. A data tampering scenario might involve a terrorist altering a Bill of Materials so as to put poison in food products, or other sabotage. ERP security helps to prevent abuse as well.

Disadvantages of ERP

Many problems organizations have with ERP systems are due to inadequate investment in ongoing training for involved personnel, including those implementing and testing changes, as well as a lack of corporate policy protecting the integrity of the data in the ERP systems and how it is used.

Limitations of ERP include:

- Personnel turnover; companies can employ new managers lacking education in the company's ERP system, proposing changes in business practices that are out of synchronization with the best utilization of the company's selected ERP.
- Customization of the ERP software is limited. Some customization may involve changing of the ERP software structure which is usually not allowed.
- Re-engineering of business processes to fit the "industry standard" prescribed by the ERP system may lead to a loss of competitive advantage.
- ERP systems can be very expensive to install often ranging from 30,000 to 500,000,000 for multinational companies.
- ERP vendors can charge sums of money for annual license renewal that is unrelated to the size of the company using the ERP or its profitability.
- Technical support personnel often give replies to callers that are inappropriate for the caller's corporate structure. Computer security concerns arise, for example when telling a non-programmer how to change a database on the fly, at a company that requires an audit trail of changes so as to meet some regulatory standards.
- ERPs are often seen as too rigid and too difficult to adapt to the specific workflow and business process of some companies—this is cited as one of the main causes of their failure.
- Systems can be difficult to use.
- Systems are too restrictive and do not allow much flexibility in implementation and usage.
- The system can suffer from the "weakest link" problem—inefficiency in one department or at one of the partners may affect other participants.

- ❖ Many of the integrated links need high accuracy in other applications to work effectively. A company can achieve minimum standards, and then over time "dirty data" will reduce the reliability of some applications.
- ❖ Once a system is established, switching costs are very high for any one of the partners (reducing flexibility and strategic control at the corporate level).
- ❖ The blurring of company boundaries can cause problems in accountability, lines of responsibility, and employee morale.
- ❖ Resistance in sharing sensitive internal information between departments can reduce the effectiveness of the software.
- ❖ There are frequent compatibility problems with the various legacy systems of the partners.
- ❖ The system may be over-engineered relative to the actual needs of the customer.

5.10 Extensions in ERP

ERP systems can be extended with third–party software. ERP vendors typically provide access to data and functionality through published interfaces. Extensions offer features such as:

- Archiving, reporting and republishing;
- Capturing transactional data, e.g. using scanners, tills or RFID
- Access to specialized data/capabilities, such as syndicated marketing data and associated trend analytics.
- Advanced planning and scheduling (APS)

5.11 Data migration in ERP

Data migration is the process of moving/copying and restructuring data from an existing system to the ERP system. Migration is critical to implementation success and requires significant planning. Unfortunately, since migration is one of the final activities before the production phase, it often receives insufficient attention. The following steps can structure migration planning:

- Identify the data to be migrated
- Determine migration timing
- Generate the data templates
- Freeze the toolset
- Decide on migration-related setups
- Define data archiving policies and procedures.

5.12 Enterprise information system

An enterprise information system is generally any kind of computing system that is of "enterprise class". This means typically offering high quality of service, dealing with large volumes of data and capable of supporting some large organization ("an enterprise").

Enterprise information systems provide a technology platform that enables organizations to integrate and

coordinate their business processes. They provide a single system that is central to the organization and ensure that information can be shared across all functional levels and management hierarchies. Enterprise systems are invaluable in eliminating the problem of information fragmentation caused by multiple information systems in an organization, by creating a standard data structure.

A typical enterprise information system would be housed in one or more data centers, run enterprise software, and could include applications that typically cross organizational borders such as content management systems.

The word enterprise can have various connotations. Frequently the term is used only to refer to very large organizations. However, the term may be used to mean virtually anything, by virtue of it having become the latest corporate-speak buzzword.

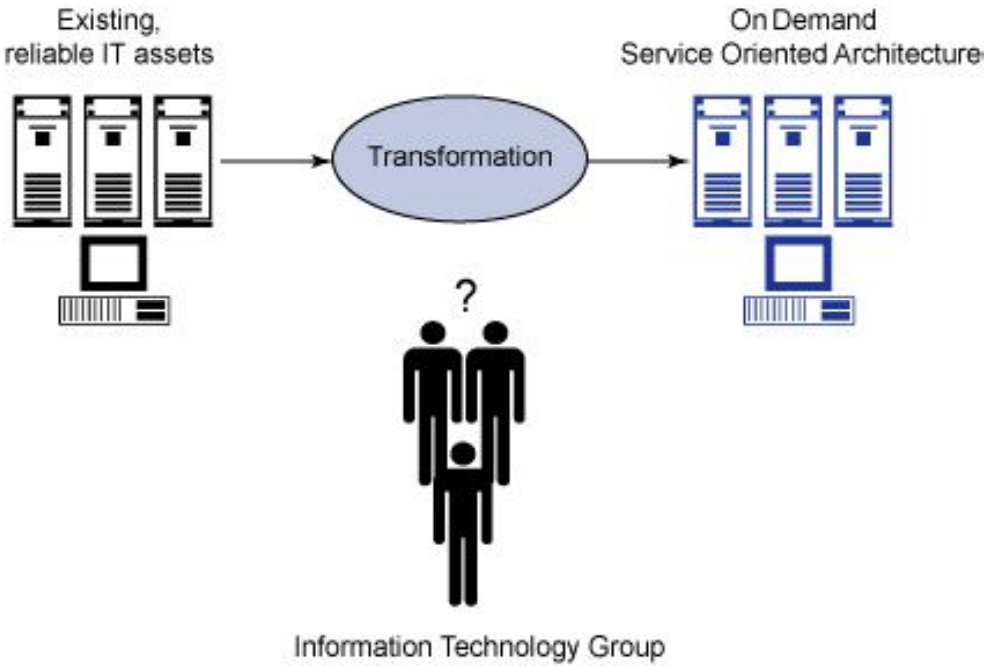

Fig. 5.3 Enterprise Information Systems

By implementing a service-oriented architecture, a corporation can unite employees, partners, and suppliers with the systems and information that enable them to do business more effectively.

Characteristics of Enterprise information systems

- Corporate-wide system
- Not restricted to executives
- Business intelligence
- Supports upper management in discovering problems and opportunities
- Repetitive analysis
- High speed
- GUI based

Capabilities of Enterprise Information System

- Drill-down paths

  - Supported by star or snowflake schemas
- Critical success factors
  - Strategic, managerial, or operational
  - Sources: organizational, industrial, environmental
  - Types of information monitored:
    - Key problem narratives
    - Highlight charts
    - Top level financials
    - Key factors
    - Detailed key performance indicator responsibility reports
- Status Access
  - Relevance of latest data of key indicators
- Analysis
  - Built-in analytical functions
  - Integration with DSS products
  - Analysis by intelligent agents
- Exception reporting
  - Management by exception to standards
- Navigation of information
  - Large amounts of data can be analyzed
- Audio and Visual
  - Use of colors and sounds
- Communications
  - E-mail, GSS, news groups, interface with voice mail

EIS Data Access and Use

- Data usually comes from single warehouse
  - Advanced data visualization
  - Combines multidimensional analysis with OLAP
    - Spreadsheets and graphics
    - Slice and dice
    - Web ready

Enterprise Portals: Corporate portals

- Integrate internal and external applications
- Web-based interface
- Effective distribution of information
- Encourage collaboration
- Data visualization tools
- Customized
- Search engines

Benefits of EIS

Quality of Information • Is flexible • Produces correct information • Produces timely information	• Produces relevant information • Produces complete information • Produces validated information
User interface • Includes a sophisticated graphical user interface (GUI) • Allows secure and confidential access to information • Has a short response time (timely information) • Is accessible from many places • Includes reliable access procedure	• Minimizes keyboard use by including infrared controllers, a mouse, touch pads, and a touch screen • Provides quick retrieval of desired information • Is tailored to the management styles of individual executives • Contains a self-help menu
Technical capability provided • Access to aggregate (global) information • Access to electronic mail • Extensive use of external data • Written interpretations • Highlighting of problem indicators • Hypertext and hypermedia • Ad hoc analysis • Multidimensional presentation and analysis • Information presented in hierarchical form • Incorporation of graphics and text in the same display • Management by exception reports are provided.	• Trends, ratios, and deviations are shown • Access to historical and most current data is provided • Organizations around critical success factors • Provides forecasting • Information produced at various levels of detail (drill down) • Filtering, compressing, and tracking of critical data • Support of open-ended problem explanation
Benefits • Facilitates the attainment of organizational objectives • Facilitates access to information • Allows the user to be more productive • Increase the quality of decision making • Provides a competitive advantage • Saves time for the user • Increases communication capacity	• Increases communication quality • Provides better control in the organization • Allows the anticipation of problems and opportunities • Allows planning • Allows a search for the cause of a problem • Meets the needs of executives

5.13 Summary

Enterprise resource planning (ERP) systems are generic and comprehensive business software systems based on a distributed computing platform including one or more database management systems. ERP delivers a single database that contains all data for the software modules, which would include: Manufacturing, Supply chain management, Financials, Project management, Human resources, Customer relationship management, Data warehouse and various self-service interfaces, Access control and Customization.

Careful planning, right timing and methodology selection is vital in ERP implementation. It involves strategic planning, procedure review, data collection and clean-up, training and testing and go live and evaluation.

Some of the key global ERP software vendors in the market are, SAP, Oracle, Microsoft, & Baan. Tally is a prominent player in the Indian ERP market for small and medium enterprises.

SAP ERP collects and combines data from the separate modules to provide the company or organization with enterprise resource planning. Baan is a good example of enterprise resource planning companies who started in the field early and enjoyed tremendous success. Tally's software is mainly used for vouchers, financial statements, and taxation in many industries, and has specialised packages for retail businesses. PeopleSoft responded by providing systems that could run a wide variety of standardized modules for human resource management, supply chain management, customer relations management and accounting. Oracle Corporation's E-Business Suite consists of a collection of ERP, CRM, and SCM computer applications either developed by or acquired by Oracle. Automated Data Collection Tools (ADC)/barcoding tools, employ fixed and portable barcode scanners that read labels as products pass through the production cycle.

Benefits of ERP includes: reduced operating cost, facilitating day-to-day management, support strategic planning.

Enterprise information systems provide a technology platform that enables organizations to integrate and coordinate their business processes. They provide a single system that is central to the organization and ensure that information can be shared across all functional levels and management hierarchies. In it data usually comes from single warehouse

5.14 Key Words

- **ERP**: Enterprise resource planning is a way to integrate the data and processes of an organization into one single system.
- **CRM**: Customer relationship management (CRM) is a widely implemented strategy for managing a company's interactions with customers, clients and sales prospects.
- **EDI transactions**: Electronic data interchange (EDI) is the structured transmission of data between organizations by electronic means. It is used to transfer electronic documents or business data from one computer system to another computer system
- **MIS**: Management information systems is an integrated man-machine system that results in the collection, storage, retrieval, communication and use of data for efficient management of operations and for business planning to support managers in an organization.
- **ADC tools**: Automated Data Collection (ADC) employ fixed and portable barcode scanners that read labels as products pass through the production cycle, so that transactional and product data is wirelessly transmitted via a wireless network to radio antennae, which seamlessly update the ERP system
- **SAP ERP Software**: It is an integrated enterprise resource planning (ERP) software manufactured by SAP AG, it collects and combines data from the separate modules to provide the company or organization with enterprise resource planning.
- **Baan software**: Baan was a vendor of enterprise resource planning (ERP) software to provide financial and administrative consulting services

- **Tally's software**: It is mainly used for vouchers, financial statements, and taxation in many industries, and has specialised packages for retail businesses.
- **PeopleSoft ERP Software**: It responded by providing systems that could run a wide variety of standardized modules for human resource management, supply chain management, customer relations management and accounting.
- **EIS**: An enterprise information system is generally any kind of computing system that is of "enterprise class". It provides a technology platform that enables organizations to integrate and coordinate their business processes. They provide a single system that is central to the organization and ensure that information can be shared across all functional levels and management hierarchies.

5.15 Self Assessment Test

1. What are the characteristics of ERP?
2. How ERP effect organizations, its stakeholders, departments, employment?
3. Explain various steps in ERP implementation.
4. What are the advantages and disadvantages of EIS system?
5. What is an enterprise information system, its characteristics, capabilities, data access and use?
6. What are the benefits of ERP? Explain various beneficiaries sectors of ERP.
7. Define the following ERP software tools:
   a) SAP
   b) Baan
   c) Tally
   d) PeopleSoft
8. What do you mean by data migration in ERP?

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Unit - 6 : Decision Support Systems

Unit Structure:

6.0 Objectives

After studying this unit, you should be able to understand:

- The concept of Decision Support System
- Components of DSS
- Features of DSS
- Classification of DSS
- Framework of DSS
- Simon's Model

6.1 Introduction

Management information Systems (MIS) is the discipline covering the application of people, technologies, and procedures — collectively called information systems — to solving business problems. Management Information Systems are distinct from regular information systems in that they are used to analyze other information systems applied in operational activities in the organization.

Information Systems provide support for management at all levels : operational control, management control, and strategic planning. This unit focuses on support operations for these three functions. In terms of a

support system, all of the systems described in the unit are decision support systems; planning and control support systems are subsets of the broad concept of DSS. The unit first explains the design of systems which support decision making. A special class of support systems called expert systems is described. This is followed by a discussion of approaches to development of DSS. This unit also explores the elements of a planning support system and notes features that may be included in a control support system.

Academically, the term MIS is commonly used to refer to the group of information management methods tied to the automation or support of human decision making. There are many elements to Management Information Systems (MIS) which include:

- **Data** - The data input to the system must be as accurate as it can be, subject to its costs and timescales for capture. It should then be stored in the most logical way. This often differs from how the data is input. The data then needs to be summarized to create information in a way that best meets the needs of the systems users - this may not necessarily be the most logical way or the easiest or cheapest for the IT team.
- **People** - People are involved both in capturing the data and in exploiting the information. It is important to motivate those who capture the data by highlighting the value that the exploited data brings to the organization.
- **Hardware** - In a small organization, the MIS may run on just the sales or finance director's PC. In larger businesses, it usually runs on a server, shared or dedicated, with Internet or intranet access for those who need it. It is unusual to require specialized software.
- **Software** - the simplest MIS can be built using standard software. However, most MIS use specialized software, which has the most common features of an MIS already built in. The developer configures this by describing the database and its structure, where the data comes from, how to summarize the data and what standard queries will be required. The cost of this software varies widely. The cheapest offers limited functions for one PC. The most expensive is highly functional, providing high performance and many features for hundreds or thousands of users and vast amounts of data.

Without these things effective MIS system would be forfeit to many problems, including Information flaws, which if exploited and proved to be wrong could bring about harsh fines from publishing false information.

Information supports decisions, decisions trigger actions, and actions affect the achievements or performance of the organization. If we can measure the differences in performance, we can trace the impact of information, provided that the measurements are carefully performed, the relationships among variables are well defined, and possible

6.2 Definition (DSS)

The term decision support system (DSS) refers to class of systems which support the process of making decisions. The emphasis is on "support" rather than on automation of decisions. Decision support systems allow the decision maker to retrieve data and test alternative solutions during the process of problem solving.

Decision support systems are a specific class of computerized information system that supports business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

Decision support systems are some new applications that are computerized to act as a support system. This system supports organizational and business decision making in the activities going on in business and other industries. However, the great system that is effective can compile the most important information from documents, business models, and raw data and even help solving problems and making useful decisions. There are many effective decision support systems that can carry out the following requirements. Collecting data from different sources such as inventory data, market research data, sales data, supplier data and others. Applications software and robust tools that are used to report, analyze and monitor the data. Uses in database location and formatting the decision made by business or any report analysis.

6.3 Characteristics of DSS

The concept of decision support systems is based on several assumptions about the role of the computer in effective decision making.

1) The computer must support the manager but not replace his or her judgment. It should therefore neither try to provide the "answers" nor impose a predefined sequence of analysis.

2) The main payoff of computer support is for semi structured problems, where parts of the analysis can be systematized for the computer, but where the decision maker's insight and judgment are needed to control the process.

3) Effective problem solving is interactive and is enhanced by a dialog between the user and the system. The user explores the problem situation using the analytic and information providing capabilities of the system as well as human experience and insights.

The decision support system should provide ease of access to the database containing relevant data and interactive testing of solutions. The designer must understand the process of decision making for each situation in order to design a system to support it.

6.4 Decision Making

The word decision is derived from the Latin root decido, meaning to cut off. The concept of decision, therefore, is settlement, a fixed intention bringing to a conclusive result, a judgment, and a resolution. A decision is the choice out of several options made by the decision maker to achieve some objective in a given situation.

Business decisions are those, which are made in the process of conducting business to achieve its objectives in a given environment. In concept, whether we are talking about business decisions or any other decision, we assume that the decision maker is a rational person who would decide, with due regard to the rationality in decision making.

Decision making can be regarded as an outcome of mental processes (cognitive process) leading to the selection of an appropriate course of action among several alternatives. Every decision making process produces a final choice. The output can be an action or an opinion of choice.

Human performance in decision making terms has been the subject of active research from several perspectives. From a psychological perspective, it is necessary to examine individual decisions in the context of a set of needs, preferences an individual has and values they seek. From a cognitive perspective, the decision making process must be regarded as a continuous process integrated in the interaction with the environment. From a normative perspective, the analysis of individual decisions is concerned with the logic of decision making and rationality and the invariant choice it leads to.

Yet, at another level, it might be regarded as a problem solving activity which is terminated when a satisfactory solution is found. Therefore, decision making is a reasoning or emotional process which can be rational or irrational, can be based on explicit assumptions or tacit assumptions.

Logical decision making is an important part of all science-based professions, where specialists apply their knowledge in a given area to making informed decisions. Some research shows, however, that in situations with higher time pressure, higher stakes, or increased ambiguities, experts use intuitive decision making rather than structured approaches.

A major part of decision making involves the analysis of a finite set of alternatives described in terms of some evaluative criteria. These criteria may be benefit or cost in nature. Then the problem might be to rank these alternatives in terms of how attractive they are to the decision makers when all the criteria are considered simultaneously. Another goal might be to just find the best alternative or to determine the relative total priority of each alternative (for instance, if alternatives represent projects competing for funds) when all the criteria are considered simultaneously. Solving such problems is the focus of multi-criteria decision analysis (MCDA) also known as multi-criteria decision making (MCDM). This area of decision making, although it is very old and has attracted the interest of many researchers and practitioners, is still highly debated as there are many MCDA / MCDM methods which may yield very different results when they are applied on exactly the same data. This leads to the formulation of a decision making paradox.

6.5 Problem Analysis Vs. Decision Making

It is important to differentiate between problem analysis and **decision making**. The concepts are completely separate from one another. Problem analysis must be done first, then the information gathered in that process may be used towards decision making.[4]

Problem Analysis

- Analyze performance, what should the results be against what they actually are
- Problems are merely deviations from performance standards
- Problem must be precisely identified and described
- Problems are caused by some change from a distinctive feature
- Something can always be used to distinguish between what has and hasn't been effected by a cause
- Causes to problems can be deducted from relevant changes found in analyzing the problem
- Most likely cause to a problem is the one that exactly explains all the facts

Decision Making

- Objectives must first be established
- Objectives must be classified and placed in order of importance
- Alternative actions must be developed
- The alternative must be evaluated against all the objectives
- The alternative that is able to achieve all the objectives is the tentative decision
- The tentative decision is evaluated for more possible consequences
- The decisive actions are taken, and additional actions are taken to prevent any adverse consequences from becoming problems and starting both systems (problem analysis and decision making) all over again
- There are steps that are generally followed that result in a decision model that can be used to determine an optimal production plan.
- In a situation featuring conflict, role-playing is helpful for predicting decisions to be made by involved parties.

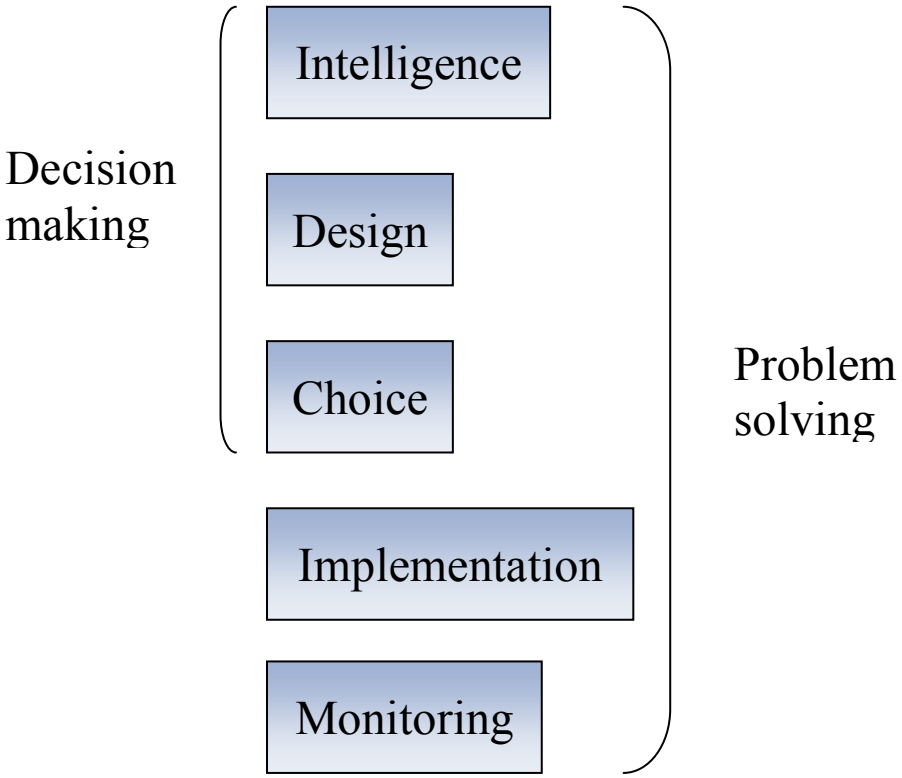

Figure 6.1

ecision Planning

Making a decision without planning is fairly common, but does not often end well. Planning allows for decisions to be made comfortably and in a smart way. Planning makes decision making a lot more simpler than it is. Decision will get four benefits out of planning:

- Planning give chance to the establishment of independent goals. It is a conscious and directed series of choices.

- Planning provides a standard of measurement. It is a measurement of whether you are going towards or further away from your goal.
- Planning converts values to action. You think twice about the plan and decide what will help advance your plan best.
- Planning allows to limited resources to be committed in an orderly way. Always govern the use of what is limited to you (e.g. money, time, etc..)

6.6 Major Characteristics of Business Decision Making

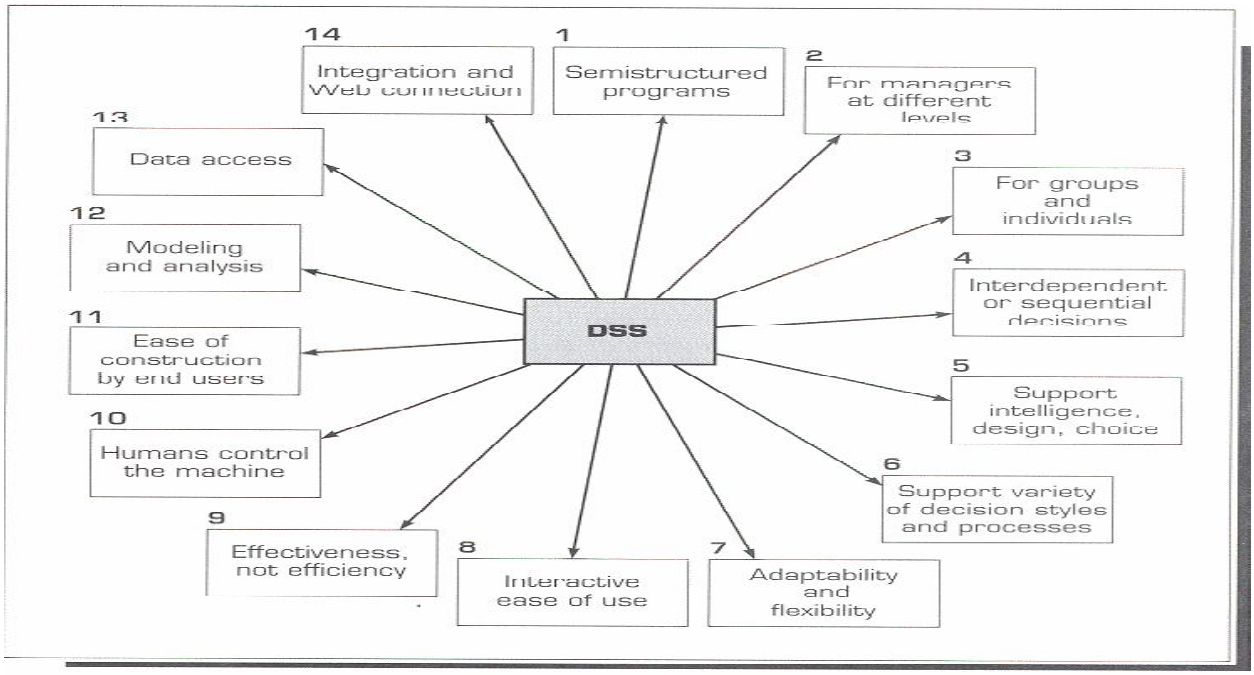

FIGURE 3.1 THE IDEAL CHARACTERISTICS AND CAPABILITIES OF DSS

Figure 6.2 : The major characteristics of a decision making system are

(a) Sequential in nature.

The business decision making is sequential in nature. In business, the decisions are not isolated events. Each of them has a relation to some other decision or situation. The decision may appear as a "snap" decision but it is made only after a long chain of developments and a series of related earlier decision.

(b) Exceedingly complex due to risks and trade offs.

The decision making process is a complex process in the higher hierarchy of management. The complexity is the result of many factors, such as the inter-relationship among the experts or decision makers, a job responsibility, a question of feasibility, the codes of morals and ethics, and a probable impact on business.

(c) Influenced by personal values.

The personal values of the decision maker play a major role in decision making. A decision otherwise being very sound on the business principle and economic rationality may be rejected on the basis of the personal values, which are defeated if such a decision is implemented. The culture, the discipline and the individual's commitment to the goals will decide the process and success of the decision.

(d) Made in institutional settings and business environment.

Whatever may be the situation, if one analyses the factors underlying the decision making process, it would be observed that there are common characteristics in each of them. There is a definite method of arriving at a decision: and it can be put in the form of decision process model.

The decision making process requires creativity, imagination and a deep understanding of human behavior. The process covers a number of tangible and intangible factors affecting the decision process. It also requires a foresight to predict the post-decision implications and a willingness to face those implications. All decisions solve a problem but over a period of time they give rise to a number of other problems.

6.7 Rational Decision Making

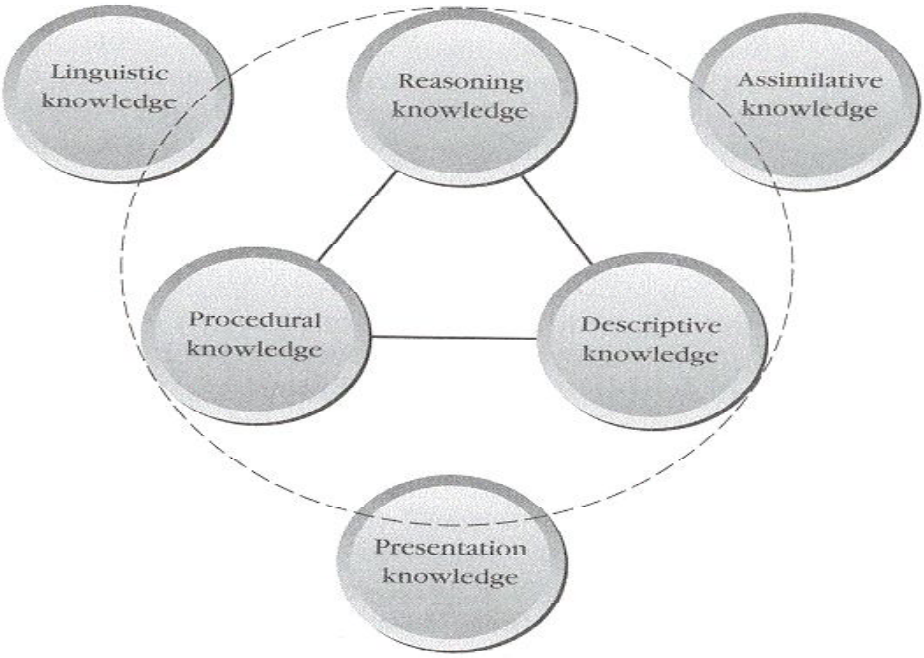

Figure 6.3 : Six Types of Knowledge

A Rational decision is the one which, effectively and efficiently, ensures the achievement of the goal for which the decision is made. If it is raining, it is rational to look for a cover so that you do not get wet. If you are in business and want to make profit, then you must produce goods and sell them at a price higher than the cost of production. In reality, there is no right or wrong decision but a rational or an irrational decision. The quality of decision making is to be judged on the rationality and not necessarily on the result it produces. The rationality of the decision made is not the same in every situation. It will vary with the organization, the situation and the individual's view of the business situation. The rationality, therefore, is a multi-dimensional concept. For example, the business decisions in a private organization and a Public Sector Undertaking differ under the head of rationality. The reason for this difference in rationality is the different objectives of the decision makers. Any business decision if asked to be reviewed by a share-holder, a consumer, an employee, a supplier and a social scientist, will result in a different criticism with reference to their individual rationality.

This is because each one of them will view the situation in different contexts and the motive with the different objectives. Hence, whether a decision is right or wrong depends on a specific rational view.

Simon Herbert differentiates among the types of rationality. A decision, in a given situation is:

- Objectively rational if it maximizes the value of the objective.
- Subjectively rational if it maximizes the attainment of value in relation to the knowledge and awareness of the subject.
- Consciously rational to the extent the process of the decision making is a conscious one.
- Organizationally rational to the degree of the orientation towards the organization.
- Personally rational to the extent it achieves an individual's personal goals.

In other words, so long as the decision maker can explain with logic and reason, the objectivity and the circumstances in which the decision is made, it can be termed as a rational decision.

Whether the rationality applied is appropriate or not could be a point for debate. Gross

Bertram suggests three dimensions of rationality.

1. First, the degree of satisfaction of human interest.
2. Second, the degree of feasibility in achieving the objectives.
3. Third, a consistency in decision making. If a decision maker shows a consistent behavior in the process of decision making, then one can say that he meets the test of the rationality.

The Problems in Making Rational Decisions

(a) Ascertaining the problem

The most common source of mistakes in the management decisions is the emphasis on finding the right answers rather than the right questions.. The main task is to define the right problem in clear terms. The management may define the problem as the .Sales are declining. Actually, the decline of sales is symptomatic; the real problem may be somewhere else. For example the problem may be the poor quality of the product and you may be thanking of improving the quality of advertising.

(b) Insufficient knowledge

For perfect rationality, total information leading to complete knowledge is necessary. An important function of a manager is to determine whether the dividing line is reached between insufficient knowledge and the enough information to make a decision.

(c) Not enough time to be rational

The decision maker is under pressure to make decisions. If time is limited, he may make a hasty decision which may not satisfy the test of rationality of the decision.

(d) The environment may not cooperate

Sometimes, the timing of the decision is such that one is forced to make a decision but the environment is not

conducive for it. The decision may fail the test of rationality as the environmental factors considered in the decision-making turn out to be untrue. For example, in a product pricing, the factor of oil and petroleum product price is considered as stable. But the post decision environment proves the consideration to be wrong.

(e) Other limitations

Other limitations are the need for a compromise among the different positions, misjudging the motives and values of people, poor communications, misappraisal of uncertainties and risks, an inability of a human mind to handle the available knowledge and human behavior.

We use our decision making skills to solve problems by selecting one course of action from several possible alternatives. Decision making skills are also a key component of time management skills.

Decision making can be hard. Almost any decision involves some conflicts or dissatisfaction. The difficult part is to pick one solution where the positive outcome can outweigh possible losses. Avoiding decisions often seems easier. Yet, making your own decisions and accepting the consequence is the only way to stay in control of your time, your success, and your life.

6.8 Types of Decision

The types of decisions are based on the degree of knowledge about the outcomes or the events yet to take place. If the manager has full and precise knowledge of the event or outcome which is to occur, then his problem of the decision making is not a problem. If the manager has full knowledge, then it is a situation of certainty. If he has partial knowledge or a probabilistic knowledge, then it is decision making under risk. If the manager does not have any knowledge whatsoever, then it is decision making under uncertainty.

A good MIS tries to convert a decision making situation under uncertainty to the situation under risk and further to certainty. Decision making in the operations management, is a situation of certainty. This is mainly because the manager in this field has fairly good knowledge about the events which are to take place, has full knowledge of environment, and has predetermined decision alternatives for choice or for selection.

Decision making at the middle management level is of the risk type. This is because of the difficulty in forecasting an event with hundred per cent accuracy and the limited scope of generating the decision alternatives.

At the top management level, it is a situation of total uncertainty of account of insufficient knowledge of the external environment and the difficulty in forecasting business growth on a long-term basis.

A good MIS design gives adequate support to all the three levees of management.

A manager can make two kinds of decision:

1. **Structured** – which are repetitive and need a definite routine and procedure to deal with them, e.g. stock is below 15 %, so an order need to be place with a supplier.
2. **Unstructured** – require knowledge, insight, and evaluation. They may well crop up without warning, and the right decision can be critical.

Nature of Decision

Decision making is a complex situation. To resolve the complexity, the decisions are **classified as programmed and non-programmed decisions.**

If a decision can be based on a rule, method or even guidelines, it is called the programmed decision. If the stock level of an item is 200 numbers, then the decision to raise a purchase requisition for 400 numbers is a programmed-decision-making situation. The decision maker here is told to make a decision based on the instructions or on the rule of ordering a quantity of 400 items when its stock level reaches 200.

If such rules can be developed wherever possible, then the MIS itself can be designed to make a decision and even execute. The system in such cases plays the role of a decision maker based on a given rule or a method. Since the programmed decision is made through MIS, the effectiveness of the rule can be analyzed and the rule can be revived and modified from time to time for an improvement. The programmed decision making can be delegated to a lower level in the management cadre.

A decision support system may present information graphically and may include an expert system or artificial intelligence (AI). It may be aimed at business executives or some other group of knowledge workers. A knowledge worker is anyone who works for a living at the tasks of developing or using knowledge. For example, a knowledge worker might be someone who works at any of the tasks of planning, acquiring, searching, analyzing, organizing, storing, programming, distributing, marketing, or otherwise contributing to the transformation and commerce of information and those (often the same people) who work at using the knowledge so produced.

6.9 Expert System

One of the most practical and widely implemented applications of artificial intelligence in business is the development of expert systems and other knowledge-based information systems. A knowledge based information system (KBIS) adds a knowledge base to the major components found in other types of computer-based information systems. An expert system (ES) uses its knowledge about a specific, complex application area to act as an expert consultant to end users. Expert systems provide answers to questions in a very specific problem area by making humanlike inferences about knowledge contained in a specialized knowledge base. They must also be explained their reasoning process and conclusions to a user. So expert systems can provide decision support to end users in the form of advice from an expert consultant in a specific problem area.

Components of Expert system

An expert system is typically composed of at least three primary components. These are the **inference engine**, the **knowledge base**, **working memory,** and the **user interface.**

1) Knowledge base

The knowledge base is a collection of rules or other information structures derived from the human expert. Rules are typically structured as If/Then statements of the form:

IF <antecedent> THEN <consequent>

The **antecedent** is the condition that must be satisfied. When the antecedent is satisfied, the rule is triggered and is said to "fire". The **consequent** is the action that is performed when the rule fires.

2) The inference engine

The inference engine is the main processing element of the expert system. The inference engine chooses rules from the agenda to fire. If there are no rules on the agenda, the inference engine must obtain information from the user in order to add more rules to the agenda. It makes use of knowledge base, in order to draw conclusions for situations. It is responsible for gathering the information from the user, by asking various questions and applying it wherever necessary.

3) Working Memory

Working memory contains the data that is received from the user during the expert system session. Values in working memory are used to evaluate antecedents in the knowledge base. Consequents from rules in the knowledge base may create new values in working memory, update old values, or remove existing values.

4) User interface

A user interface is the method by which the expert system interacts with a user. These can be through dialog boxes, command prompts, forms, or other input methods. Some expert systems interact with other computer applications, and do not interact directly with a human. In these cases, the expert system will have an interaction mechanism for transactions with the other application, and will not have a user interface.

Uses of Expert system

Expert system: Personality profiler. HR (Human Resources) want to assign only one of a large group of people to a new role. Each person answers a number of psychological questions that the expert system presents them with.

Expert system: Sales mix modelerA car company has a large number of options on a new model they are about launch. The car has a dozen paint colour options, three engine sizes, 24 optional accessories. The expert system has a complete record of what sold well in the past with previous models and some trends for the future.

Expert system: Medical diagnostics This contains a body of knowledge about thousands of diseases. It is used by the doctors at a hypothetical clinic to help diagnose patient illnesses based on their symptoms.
Expert system: A loan approval system The expert system has a body of knowledge about the results of past loans made by the credit company. It has knowledge about all the factors that point to a low risk or high risk loan.

A decision which cannot be made by using a rule or a model is the non-programmed decision. Such decisions are infrequent but the stakes are usually larger. Therefore, they cannot be delegated to the lower level. The MIS in the non-programmed-decision situation can help to some extent, in identifying the problem, giving the relevant information to handle the specific decision making situation. The MIS, in other words, can develop decision support systems in the non-programmed-decision-making situations.

A significant part of decision making skills is in knowing and practicing good decision making techniques. One of the most practical decision making techniques can be summarized in those simple decision making steps:

1. **Identify the purpose of your decision.** What is exactly the problem to be solved? Why it should be solved?
2. **Gather information.** What factors does the problem involve?
3. **Identify the principles to judge the alternatives.** What standards and judgment criteria should the solution meet?
4. **Brainstorm and list different possible choices.** Generate ideas for possible solutions.
5. **Evaluate each choice in terms of its consequences.** Use your standards and judgment criteria to determine the cons and pros of each alternative.
6. **Determine the best alternative.** This is much easier after you go through the above preparation steps.
7. **Put the decision into action.** Transform your decision into specific plan of action steps. Execute your plan.

8. **Evaluate the outcome of your decision and action steps.** What lessons can be learnt? This is an important step for further development of your decision making skills and judgment.

In everyday life we often have to make decisions fast, without enough time to systematically go through the above action and thinking steps. In such situations the most effective decision making strategy is to keep an eye on your goals and then let your intuition suggest you the right choice.

6.10 Information as an aid to decision making

How do we then ensure rationality? It is ensured, if the process of decision making is carried out systematically, whereby all the aspects of the decision making discussed above are taken care of. Herbert Simon said that a decision maker follows the process of decision making disregarding the decision or the type of decision and the motive behind the decision. This process is followed consciously or without knowing it. We can put this process in the Decision Making Model

6.11 Simon's Model

Simon (1977) describes the process of decision making as comprising four steps:

1. **Intelligence**
2. **Design**
3. **Choice**

Later stage has been added with a view of improving the decision i.e. Review.

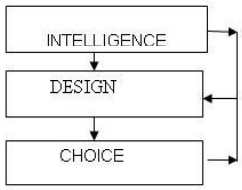

Figure 6.4 : Simon's 4 stage model

The **intelligence stage** encompasses collection, classification, processing, and presentation of data relating to the organization and its environment. This is necessary to identify situations calling for decision.

During **the decision stage**, the decision maker outlines alternative solutions, each of which involves a set of actions to be taken. The data gathered during the intelligence stage are now used by statistical and other models to forecast possible outcomes for each alternative. Each alternative can also be examined for technological, behavioral, and economic feasibility.

In the **choice stage**, the decision maker must select one of the alternatives that will best contribute to the goals of the organization.

In the **review stage**, past choices can be subjected to review during implementation and monitoring to enable the manager to learn from mistakes. Information plays an important role in all four stages of the decision process. Figure 1 indicates the information requirement at each stage, along with the functions performed at each stage and the feedback loops between stages.

An example of the Simon Model would illustrate further its use in the MIS. For example, a manager finds on collection and through the analysis of the data that the manufacturing plant is under-utilized and the products which are being sold are not contributing to the profits as desired. The problem identified, therefore, is to find a product mix for the plant, whereby the plant is fully utilized within the raw material and the market constraints, and the profit is maximized. The manager having identified this as the problem of optimization, now examines the use of Linear Programming (LP) Model. The model used to evolves various decision alternatives. However, selection is made first on the basis of feasibility, and then on the basis of maximum profit. The product mix so given is examined by the management committee. It is observed that the market constraints were not realistic in some cases, and the present plant capacity can be enhanced to improve the profit.

History

According to Keen (1978), the concept of decision support has evolved from two main areas of research: The theoretical studies of organizational decision making done at the Carnegie Institute of Technology during the late 1950s and early 1960s, and the technical work on interactive computer systems, mainly carried out at the Massachusetts Institute of Technology in the 1960s. It is considered that the concept of DSS became an area of research of its own in the middle of the 1970s, before gaining in intensity during the 1980s. In the middle and late 1980s, executive information systems (EIS), group decision support systems (GDSS), and organizational decision support systems (ODSS) evolved from the single user and model-oriented DSS.

Alter concluded from his research (1980) that decision support systems could be categorized in terms of the generic operations that can be performed by such systems. These generic operations extend along a single dimension, ranging from extremely data-oriented to extremely model-oriented. Alter conducted a field study of 56 DSS that he categorized into seven distinct types of DSS. His seven types include:

- **File drawer systems** that provide access to data items.
- **Data analysis systems** that support the manipulation of data by computerized tools tailored to a specific task and setting or by more general tools and operators.
- **Analysis information systems** that provide access to a series of decision-oriented databases and small models.
- **Accounting and financial models** that calculate the consequences of possible actions.
- **Representational models** that estimate the consequences of actions on the basis of simulation models.
- **Optimization models** that provide guidelines for action by generating an optimal solution consistent with a series of constraints.
- **Suggestion models** that perform the logical processing leading to a specific suggested decision for a fairly structured or well-understood task.

According to Sol (1987), the definition and scope of DSS has been migrating over the years. In the 1970s DSS was described as "a computer based system to aid decision making". Late 1970s the DSS movement started focusing on "interactive computer-based systems which help decision-makers utilize data bases and models to solve ill-structured problems". In the 1980s DSS should provide systems "using suitable and available technology to improve effectiveness of managerial and professional activities", and end 1980s DSS faced a new challenge towards the design of intelligent workstations.

In 1987 Texas Instruments completed development of the Gate Assignment Display System (GADS) for United Airlines. This decision support system is credited with significantly reducing travel delays by aiding the management of ground operations at various airports, beginning with O'Hare International Airport in Chicago and Stapleton Airport in Denver Colorado.

Beginning in about 1990, data warehousing and on-line analytical processing (OLAP) began broadening the realm of DSS. As the turn of the millennium approached, new Web-based analytical applications were introduced.

The advent of better and better reporting technologies has seen DSS start to emerge as a critical component of management design. Examples of this can be seen in the intense amount of discussion of DSS in the education environment.

6.12 Classification of DSS

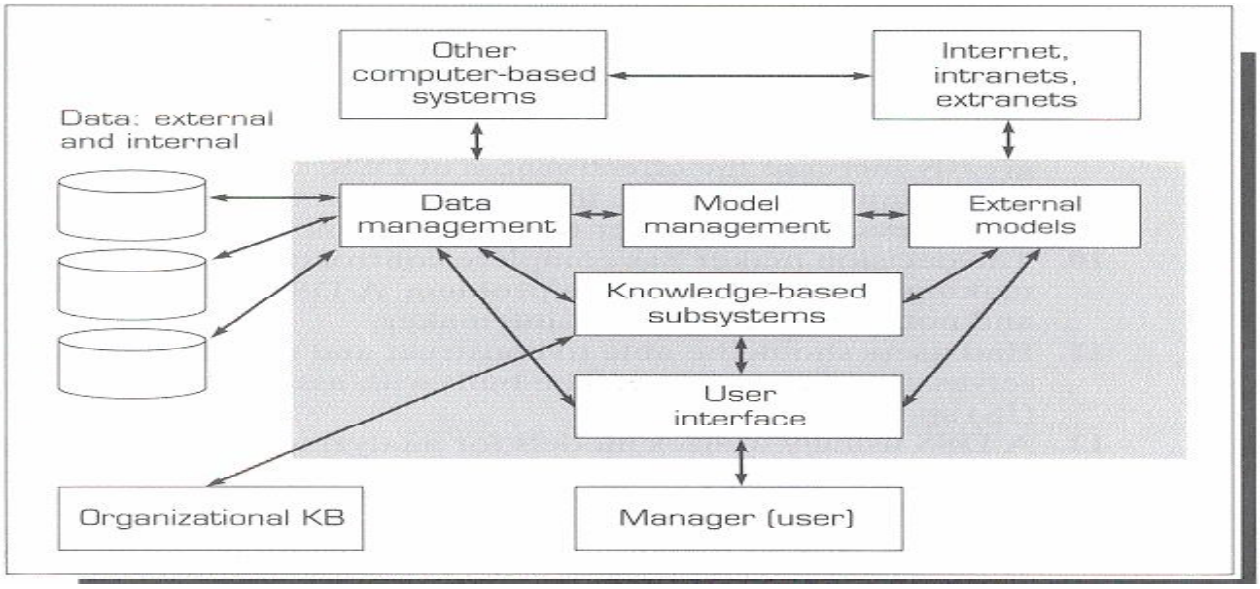

Figure 6.5 : A Schematic View of DSS

The decision making systems can be classified in a number of ways. There are two types of systems based on the manager's knowledge about the environment.

A. Closed decision making system:

If the manager operates in a known environment then it is a closed decision making system. The conditions of the closed decision making system are:

(a) The manager has a known set of decision alternatives and knows their outcomes fully in terms of value, if implemented.

(b) The manager has a model, a method or a rule whereby the decision alternatives can be generated, tested, and ranked.

(c) The manager can choose one of them, based on some goal or objective.

A few examples are a product mix problem, an examination system to declare pass or fail, or an acceptance of the fixed deposits.

B. Open decision making system

If the manager operates in an environment not known to him, then the decision making system is termed as an open decision making system. The conditions of this system are:

(a) The manager does not know all the decision alternatives.

(b) The outcome of the decision is also not known fully. The knowledge of the outcome may be a probabilistic one.

(c) No method, rule or model is available to study and finalize one decision among the set of decision alternatives.

(d) It is difficult to decide an objective or a goal and, therefore, the manager resorts to that decision, where his aspirations or desires are met best.

Deciding on the possible product diversification lines, the pricing of a new product, and the plant location, are some decision making situations which fall in the category of the open decision making systems.

The MIS tries to convert every open system to a closed decision making system by providing information support for the best decision. The MIS gives the information support, whereby the manager knows more and more about the environment and the outcomes, he is able to generate the decision alternatives, test them and select one of them. A good MIS achieves this.

Different authors propose different classifications. Using the relationship with the user as the criterion, Haettenschwiler differentiates passive, active, and cooperative DSS. A passive DSS is a system that aids the process of decision making, but that cannot bring out explicit decision suggestions or solutions. An active DSS can bring out such decision suggestions or solutions. A cooperative DSS allows the decision maker (or its advisor) to modify, complete, or refine the decision suggestions provided by the system, before sending them back to the system for validation. The system again improves, completes, and refines the suggestions of the decision maker and sends them back to him for validation. The whole process then starts again, until a consolidated solution is generated.

Taxonomy for DSS has been created by Daniel Power. Using the mode of assistance as the criterion, Power differentiates communication-driven DSS, data-driven DSS, document-driven DSS, knowledge-driven DSS, model-driven DSS and web-driven DSS.

- A **communication-driven DSS** supports more than one person working on a shared task; examples include integrated tools like Microsoft's NetMeeting or Groove
- A **data-driven DSS** or data-oriented DSS emphasizes access to and manipulation of a time series of internal company data and, sometimes, external data.
- A **document-driven DSS** manages, retrieves, and manipulates unstructured information in a variety of electronic formats.
- A **knowledge-driven DSS** provides specialized problem-solving expertise stored as facts, rules, procedures, or in similar structures.
- A **model-driven DSS** emphasizes access to and manipulation of a statistical, financial, optimization, or simulation model. Model-driven DSS use data and parameters provided by users to assist decision

makers in analyzing a situation; they are not necessarily data-intensive. Dicodess is an example of an open source model-driven DSS generator.

Using scope as the criterion, Power differentiates enterprise-wide DSS and desktop DSS. An enterprise-wide DSS is linked to large data warehouses and serves many managers in the company. A desktop, single-user DSS is a small system that runs on an individual manager's PC. Beginning in approximately 1995, the World-wide Web and global Internet provided a technology platform for further extending the capabilities and deployment of computerized decision support. The release of the HTML 2.0 specifications with form tags and tables was a turning point in the development of web-based DSS.

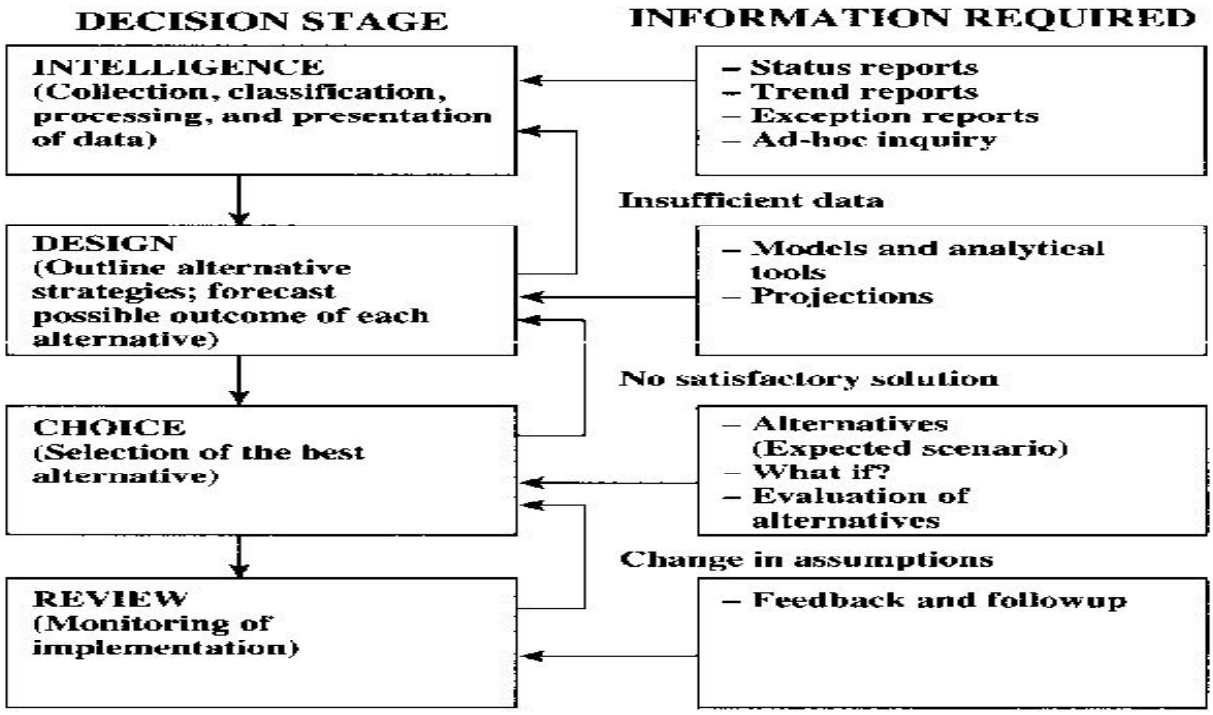

Figure 6.6 : Decision Making Model

6.13 Components of DSS

Three fundamental components of a DSS architecture are:

1. The database (or knowledge base),
2. The model (i.e., the decision context and user criteria), and
3. The user interface.

The users themselves are also important components of the architecture.

1) The Database or (knowledge base)

A **database** is an organized collection of data, today typically in digital form. The data are typically organized to model relevant aspects of reality (for example, the availability of rooms in hotels), in a way that supports processes requiring this information (for example, finding a hotel with vacancies).

The term database is correctly applied to the data and their supporting data structures, and not to the database management system (DBMS). The database data collection with DBMS is called a database system.

The term database system implies that the data is managed to some level of quality (measured in terms of accuracy, availability, usability, and resilience) and this in turn often implies the use of a general-purpose database management system (DBMS). A general-purpose DBMS is typically a complex software system that meets many usage requirements, and the databases that it maintains are often large and complex. The utilization of databases is now so widespread that virtually every technology and product relies on databases and DBMSs for its development and commercialization, or even may have such software embedded in it. Also, organizations and companies, from small to large, depend heavily on databases for their operations.

Well known DBMSs include Oracle, IBM DB2, Microsoft SQL Server, Microsoft Access, PostgreSQL, MySQL, and SQLite. A database is not generally portable across different DBMS, but different DBMSs can inter-operate to some degree by using standards like SQL and ODBC together to support a single application. A DBMS also needs to provide effective run-time execution to properly support (e.g., in terms of performance, availability, and security) as many end-users as needed.

A way to classify databases involves the type of their contents, for example: bibliographic, document-text, statistical, or multimedia objects. Another way is by their application area, for example: accounting, music compositions, movies, banking, manufacturing, or insurance.

The term database may be narrowed to specify particular aspects of organized collection of data and may refer to the logical database, to the physical database as data content in computer data storage or to many other database sub-definitions.

Database concept

The database concept has evolved since the 1960s to ease increasing difficulties in designing, building, and maintaining complex information systems (typically with many concurrent end-users, and with a large amount of diverse data). It has evolved together with database management systems which enable the effective handling of databases. Though the terms database and DBMS define different entities, they are inseparable: a database's properties are determined by its supporting DBMS and vice-versa. The Oxford English dictionary cites[citation needed] a 1962 technical report as the first to use the term "data-base." With the progress in technology in the areas of processors, computer memory, computer storage and computer networks, the sizes, capabilities, and performance of databases and their respective DBMSs have grown in orders of magnitudes. For decades it has been unlikely that a complex information system can be built effectively without a proper database supported by a DBMS. The utilization of databases is now spread to such a wide degree that virtually every technology and product relies on databases and DBMSs for its development and commercialization, or even may have such embedded in it. Also, organizations and companies, from small to large, heavily depend on databases for their operations.

No widely accepted exact definition exists for DBMS. However, a system needs to provide considerable functionality to qualify as a DBMS. Accordingly its supported data collection needs to meet respective usability requirements (broadly defined by the requirements below) to qualify as a database. Thus, a database and its supporting DBMS are defined here by a set of general requirements listed below. Virtually all existing mature DBMS products meet these requirements to a great extent, while less mature either meet them or converge to meet them.

In the earliest database systems, efficiency was perhaps the primary concern, but it was already recognized that there were other important objectives. One of the key aims was to make the data independent of the logic of application programs, so that the same data could be made available to different applications.

The first generation of database systems were navigational,[2] applications typically accessed data by following pointers from one record to another. The two main data models at this time were the hierarchical model, epitomized by IBM's IMS system, and the Codasyl model (Network model), implemented in a number of products such as IDMS.

The Relational model, first proposed in 1970 by Edgar F. Codd, departed from this tradition by insisting that applications should search for data by content, rather than by following links. This was considered necessary to allow the content of the database to evolve without constant rewriting of applications. Relational systems placed heavy demands on processing resources, and it was not until the mid 1980s that computing hardware became powerful enough to allow them to be widely deployed. By the early 1990s, however, relational systems were dominant for all large-scale data processing applications, and they remain dominant today (2012) except in niche areas. The dominant database language is the standard SQL for the Relational model, which has influenced database languages also for other data models.

Because the relational model emphasizes search rather than navigation, it does not make relationships between different entities explicit in the form of pointers, but represents them rather using primary keys and foreign keys. While this is a good basis for a query language, it is less well suited as a modeling language. For this reason a different model, the Entity-relationship model which emerged shortly later (1976), gained popularity for database design.

In the period since the 1970s database technology has kept pace with the increasing resources becoming available from the computing platform: notably the rapid increase in the capacity and speed (and reduction in price) of disk storage, and the increasing capacity of main memory. This has enabled ever larger databases and higher throughputs to be achieved.

The rigidity of the relational model, in which all data is held in tables with a fixed structure of rows and columns, has increasingly been seen as a limitation when handling information that is richer or more varied in structure than the traditional 'ledger-book' data of corporate information systems: for example, document databases, engineering databases, multimedia databases, or databases used in the molecular sciences. Various attempts have been made to address this problem, many of them gathering under banners such as post-relational or NoSQL. Two developments of note are the Object database and the XML database. The vendors of relational databases have fought off competition from these newer models by extending the capabilities of their own products to support a wider variety of data types.

2) Conceptual Model

In the most general sense, a model is anything used in any way to represent anything else. Some models are physical objects, for instance, a toy model which may be assembled, and may even be made to work like the object it represents. They are used to help us know and understand the subject matter they represent. The term conceptual model may be used to refer to models which are represented by concepts or related concepts which are formed after a conceptualization process in the mind. Conceptual models represent human intentions or semantics. Conceptualization from observation of physical existence and conceptual modeling are the necessary means human employ to think and solve problems. Concepts are used to convey semantics during various natural languages based communication. Since that a concept might map to multiple semantics by itself, an explicit formalization is usually required for identifying and locating the intended semantic from several candidates to avoid misunderstandings and confusions in conceptual models.

The term "conceptual model" is ambiguous. It could mean a model of concept or it could mean a model that is conceptual. A distinction can be made between what models are and what models are models of. With the exception of iconic models, such as a scale model of Winchester Cathedral, most models are concepts. But they are, mostly, intended to be models of real world states of affairs. The value of a model is usually directly proportional to how well it corresponds to a past, present, future, actual or potential state of affairs. A model of a concept is quite different because in order to be a good model it need not have this real world correspondence.[2]

Models of concepts are usually built by analysts who are not primarily concerned about the truth or falsity of the concepts being modeled. For example, in management problem structuring, Conceptual Models of human activity systems are used in Soft systems methodology to explore the viewpoints of stakeholders in the client organization. In artificial intelligence conceptual models and conceptual graphs are used for building expert systems and knowledge-based systems, here the analysts are concerned to represent expert opinion on what is true not their own ideas on what is true.

Type and Scope of Conceptual Models

Conceptual models (models that are conceptual) range in type from the more concrete, such as the mental image of a familiar physical object, to the formal generality and abstractness of mathematical models which do not appear to the mind as an image. Conceptual models also range in terms of the scope of the subject matter that they are taken to represent. A model may, for instance, represent a single thing (e.g. the Statue of Liberty), whole classes of things (e.g. the electron), and even very vast domains of subject matter such as the physical universe. The variety and scope of conceptual models is due to the variety of purposes had by the people using them.

Mental Model

A **mental model** is an explanation of someone's thought process about how something works in the real world. It is a representation of the surrounding world, the relationships between its various parts and a person's intuitive perception about his or her own acts and their consequences. Mental models can help shape behaviour and set an approach to solving problems (akin to a personal algorithm) and doing tasks. In cognitive psychology and philosophy of mind, a mental model is a representation of something in the mind, but a mental model may also refer to a nonphysical external model of the mind itself.

Metaphysical model

A metaphysical model is a type of conceptual model which is distinguished from other conceptual models by its proposed scope. A metaphysical model intends to represent reality in the broadest possible way. This is to say that it explains the answers to fundamental questions such as whether matter and mind are one or two substances; or whether or not humans have free will.

Logical Models

In logic, a model is a type of interpretation under which a particular statement is true. Logical models can be broadly divided into ones which only attempt to represent concepts, such as mathematical models; and ones which attempt to represent physical objects, and factual relationships, among which are scientific models.

Model theory is the study of (classes of) mathematical structures such as groups, fields, graphs, or even universes of set theory, using tools from mathematical logic. A structure that gives meaning to the sentences of a formal language is called a model for the language. If a model for a language moreover satisfies a

particular sentence or theory (set of sentences), it is called a model of the sentence or theory. Model theory has close ties to algebra and universal algebra.

Mathematical Models

Mathematical models can take many forms, including but not limited to dynamical systems, statistical models, differential equations, or game theoretic models. These and other types of models can overlap, with a given model involving a variety of abstract structures.

A more comprehensive type of mathematical model[5] uses a linguistic version of category theory to model a given situation. Akin to entity-relationship models, custom categories or sketches can be directly translated into database schemas. The difference is that logic is replaced by category theory, which brings powerful theorems to bear on the subject of modeling, especially useful for translating between disparate models (as functors between categories).

Scientific Models

A scientific model is a simplified abstract view of the complex reality. A scientific model represents empirical objects, phenomena, and physical processes in a logical way. Attempts to formalize the principles of the empirical sciences, use an interpretation to model reality, in the same way logicians axiomatize the principles of logic. The aim of these attempts is to construct a formal system for which reality is the only interpretation. The world is an interpretation (or model) of these sciences, only insofar as these sciences are true.

Statistical models

A statistical model is a probability distribution function proposed as generating data. In a parametric model, the probability distribution function has variable parameters, such as the mean and variance in a normal distribution, or the coefficients for the various exponents of the independent variable in linear regression. A nonparametric model has a distribution function without parameters, such as in bootstrapping, and is only loosely confined by assumptions. Model selection is a statistical method for selecting a distribution function within a class of them, e.g., in linear regression where the dependent variable is a polynomial of the independent variable with parametric coefficients, model selection is selecting the highest exponent, and may be done with nonparametric means, such as with cross validation.

In statistics there can be models of mental events as well as models of physical events. For example, a statistical model of customer behavior is a model that is conceptual, (because behavior is physical) but a statistical model of customer satisfaction is a model of a concept (because satisfaction is a mental not a physical event).

System Models

A system model is the conceptual model that describes and represents the structure, behavior, and more views of a system. A system model can represent multiple views of a system by using two different approaches. The first one is the non-architectural approach and the second one is the architectural approach. The non-architectural approach respectively picks a model for each view. The architectural approach, also known as system architecture, instead of picking many heterogeneous and unrelated models, will use only one integrated architectural model.

Logico-linguistic models

Logico-linguistic modeling is another variant of SSM that uses conceptual models. However, this method combines models of concepts with models of putative real world objects and events. It is a graphical

representation of modal logic in which modal operators are used to distinguish statement about concepts from statements about real world objects and events.

Entity Relationship Model

In software engineering, an entity-relationship model (ERM) is an abstract and conceptual representation of data. Entity-relationship modeling is a database modeling method, used to produce a type of conceptual schema or semantic data model of a system, often a relational database, and its requirements in a top-down fashion. Diagrams created by this process are called entity-relationship diagrams, ER diagrams, or ERDs.

Entity-relationship models have had wide application in the building of information systems intended to support activities involving objects and events in the real world. In these cases they are models that are conceptual. However, this modeling method can be used to build computer games or a family tree of the Greek Gods, in these cases it would be used to model concepts.

Domain Model

A domain model is a type of conceptual model used to depict the structural elements and their conceptual constraints within a domain of interest (sometimes called the problem domain). A domain model includes the various entities, their attributes and relationships, plus the constraints governing the conceptual integrity of the structural model elements comprising that problem domain. A domain model may also include a number of conceptual views, where each view is pertinent to a particular subject area of the domain or to a particular subset of the domain model which is of interest to a stakeholder of the domain model.

Like entity-relationship models, domain models can be used to model concepts or to model real world objects and events.

3) The user interface

A user interface is the system by which people (users) interact with a machine. The user interface includes hardware (physical) and software (logical) components. User interfaces exist for various systems, and provide a means of:

- Input, allowing the users to manipulate a system
- Output, allowing the system to indicate the effects of the users' manipulation

Generally, the goal of human-machine interaction engineering is to produce a user interface which makes it easy, efficient, and enjoyable to operate a machine in the way which produces the desired result. This generally means that the operator needs to provide minimal input to achieve the desired output, and also that the machine minimizes undesired outputs to the human.

Ever since the increased use of personal computers and the relative decline in societal awareness of heavy machinery, the term user interface has taken on overtones of the graphical user interface, while industrial control panel and machinery control design discussions more commonly refer to human-machine interfaces.

The design of a user interface affects the amount of effort the user must expend to provide input for the system and to interpret the output of the system, and how much effort it takes to learn how to do this. Usability is the degree to which the design of a particular user interface takes into account the human psychology and physiology of the users, and makes the process of using the system effective, efficient and satisfying.

Usability is mainly a characteristic of the user interface, but is also associated with the functionalities of the product and the process to design it. It describes how well a product can be used for its intended purpose by its target users with efficiency, effectiveness, and satisfaction, also taking into account the requirements from its context of use.

Types of User interface

Direct manipulation interface is the name of a general class of user interfaces that allow users to manipulate objects presented to them, using actions that correspond at least loosely to the physical world.

Currently (as of 2009) the following types of user interface are the most common:

- **Graphical user interfaces** (GUI) accept input via devices such as computer keyboard and mouse and provide articulated graphical output on the computer monitor. There are at least two different principles widely used in GUI design: Object-oriented user interfaces (OOUIs) and application oriented interface.
- **Web-based user interfaces** or **web user interfaces** (WUI) are a subclass of GUIs that accept input and provide output by generating web pages which are transmitted via the Internet and viewed by the user using a web browser program. Newer implementations utilize Java, AJAX, Adobe Flex, Microsoft .NET, or similar technologies to provide real-time control in a separate program, eliminating the need to refresh a traditional HTML based web browser. Administrative web interfaces for web-servers, servers and networked computers are often called control panels.
- **Touchscreens** are displays that accept input by touch of fingers or a stylus. Used in a growing amount of mobile devices and many types of point of sale, industrial processes and machines, self-service machines etc.

User interfaces that are common in various fields outside desktop computing:

- **Command line interfaces**, where the user provides the input by typing a command string with the computer keyboard and the system provides output by printing text on the computer monitor. Used by programmers and system administrators, in engineering and scientific environments, and by technically advanced personal computer users.
- **Touch user interface** are graphical user interfaces using a touchpad or touchscreen display as a combined input and output device. They supplement or replace other forms of output with haptic feedback methods. Used in computerized simulators etc.

Other types of user interfaces:

- **Attentive user interfaces** manage the user attention deciding when to interrupt the user, the kind of warnings, and the level of detail of the messages presented to the user.
- **Batch interfaces** are non-interactive user interfaces, where the user specifies all the details of the batch job in advance to batch processing, and receives the output when all the processing is done. The computer does not prompt for further input after the processing has started.
- **Conversational Interface Agents** attempt to personify the computer interface in the form of an animated person, robot, or other character (such as Microsoft's Clippy the paperclip), and present interactions in a conversational form.
- **Crossing-based interfaces** are graphical user interfaces in which the primary task consists in crossing boundaries instead of pointing.

- **Gesture interfaces** are graphical user interfaces which accept input in a form of hand gestures, or mouse gestures sketched with a computer mouse or a stylus.
- **Intelligent user interfaces** are human-machine interfaces that aim to improve the efficiency, effectiveness, and naturalness of human-machine interaction by representing, reasoning, and acting on models of the user, domain, task, discourse, and media (e.g., graphics, natural language, gesture).
- **Motion tracking interfaces** monitor the user's body motions and translate them into commands, currently being developed by Apple
- **Multi-screen interfaces**, employ multiple displays to provide a more flexible interaction. This is often employed in computer game interaction in both the commercial arcades and more recently the handheld markets.
- **Noncommand user interfaces**, which observe the user to infer his / her needs and intentions, without requiring that he / she formulate explicit commands.
- **Object-oriented user interfaces (OOUI)** are based on object-oriented programming metaphors, allowing users to manipulate simulated objects and their properties.
- **Reflexive user interfaces** where the users control and redefine the entire system via the user interface alone, for instance to change its command verbs. Typically this is only possible with very rich graphic user interfaces.
- **Tangible user interfaces**, which place a greater emphasis on touch and physical environment or its element.
- **Task-Focused Interfaces** are user interfaces which address the information overload problem of the desktop metaphor by making tasks, not files, the primary unit of interaction
- **Text user interfaces** are user interfaces which output text, but accept other form of input in addition to or in place of typed command strings.
- **Voice user interfaces**, which accept input and provide output by generating voice prompts. The user input is made by pressing keys or buttons, or responding verbally to the interface.
- **Natural-Language interfaces** - Used for search engines and on webpages. User types in a question and waits for a response.
- **Zero-Input interfaces** get inputs from a set of sensors instead of querying the user with input dialogs.
- **Zooming user interfaces** are graphical user interfaces in which information objects are represented at different levels of scale and detail, and where the user can change the scale of the viewed area in order to show more detail.

6.14 Development Frameworks

DSS systems are not entirely different from other systems and require a structured approach. Such a framework includes people, technology, and the development approach.

DSS technology levels (of hardware and software) may include:

1. The actual application that will be used by the user. This is the part of the application that allows the decision maker to make decisions in a particular problem area. The user can act upon that particular problem.

2. Generator contains Hardware/software environment that allows people to easily develop specific DSS applications. This level makes use of case tools or systems such as Crystal, AIMMS, and iThink.
3. Tools include lower level hardware/software. DSS generators including special languages, function libraries and linking modules.

An iterative developmental approach allows for the DSS to be changed and redesigned at various intervals. Once the system is designed, it will need to be tested and revised for the desired outcome.

6.15 Applications

As mentioned above, there are theoretical possibilities of building such systems in any knowledge domain.

One example is the clinical decision support system for medical diagnosis. Other examples include a bank loan officer verifying the credit of a loan applicant or an engineering firm that has bids on several projects and wants to know if they can be competitive with their costs.

DSS is extensively used in business and management. Executive dashboard and other business performance software allow faster decision making, identification of negative trends, and better allocation of business resources.

A growing area of DSS application, concepts, principles, and techniques is in agricultural production, marketing for sustainable development. For example, the DSSAT4 package developed through financial support of USAID during the 80's and 90's, has allowed rapid assessment of several agricultural production systems around the world to facilitate decision-making at the farm and policy levels. There are, however, many constraints to the successful adoption on DSS in agriculture.

DSS are also prevalent in forest management where the long planning time frame demands specific requirements. All aspects of Forest management, from log transportation, harvest scheduling to sustainability and ecosystem protection have been addressed by modern DSSs.

A specific example concerns the Canadian National Railway system, which tests its equipment on a regular basis using a decision support system. A problem faced by any railroad is worn-out or defective rails, which can result in hundreds of derailments per year. Under a DSS, CN managed to decrease the incidence of derailments at the same time other companies were experiencing an increase.

6.16 Benefits

1. Improves personal efficiency
2. Speed up the process of decision making
3. Increases organizational control
4. Encourages exploration and discovery on the part of the decision maker
5. Speeds up problem solving in an organization
6. Facilitates interpersonal communication
7. Promotes learning or training
8. Generates new evidence in support of a decision
9. Creates a competitive advantage over competition

10. Reveals new approaches to thinking about the problem space
11. Helps automate managerial processes

6.17 Difference between DSS and MIS

MIS functions to produce routine reports,DSS employ sophisticated data modelling & analysis tools for the purpose of resolving structured problems.

1. MIS is used by a limited group (staff managers & professionals), DSS are used by groups, individuals & managers at various levels.
2. DSS is characterized by an adaptability which contrasted with the semi-inflexible nature of MIS.
3. DSS data sources are much more varied comprising inventory, accounting & production sources & not just internal business ones & its analytical tools are more sophisticated (simulation, statistical analysis).

Thus, MIS & DSS are differentiated in terms of components, dynamics, analytical tools & general properties.

6.18 Summary

A Decision Support System is a collection of integrated software applications and hardware that form the backbone of an organization's decision making process. Companies across all industries rely on decision support tools, techniques, and models to help them assess and resolve everyday business questions. The decision support system is data-driven, as the entire process feeds off of the collection and availability of data to analyze. Business Intelligence reporting tools, processes, and methodologies are key components to any decision support system and provide end users with rich reporting, monitoring, and data analysis.

6.19 Key Words

- **Decision**- Settlement, a fixed intention bringing to a conclusive result or a judgment.
- **Rational Decision**- The one which effectively and efficiently ensures the achievement of the goal for which the decision is made.
- **DSS**- Systems and subsystems that help people make decisions based on data that is culled from a wide range of sources.
- **Open Decision Making**- If the manager operates in an environment not known to him, then the decision making system is termed as an open decision making system.
- **Closed decision making system:** If the manager operates in a known environment then it is a closed decision making system.

6.20 Self Assessment Test

1 What do you understand by DSS? Explain the benefits of using DSS?

2 Discuss Simon's model of decision making?

3 Explain classification of DSS?

4 Briefly differentiate Decision support systems with Management Information Systems.

5 Write a short note on applications of DSS?

6.21 References

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Unit - 7 : Information Systems Planning & System Acquisition

Unit Structure:

7.0 Objectives

After studying this unit, you should be able to understand

- The concept of Information Systems and Planning.
- How MIS uses information.
- Nolan's stage model for Planning.
- Information Resource Management
- IRM Maturity Model
- The concept of System Acquisition
- Its need and strategies
- Hardware Acquisition
- Software Acquisition

7.1 Introduction

Information is a resource in the operation and management of organizations. Timely availability of relevant information is vital for effective performance of managerial functions such as planning, organizing, leading, and control. An information system in an organization is like the nervous system in the human body: it is the link that connects all the organization's components together and provides for better operation and survival in a competitive environment. Indeed, today's organizations run on information. The information systems are to be planned and designed for the best and optimal utilization of information.

In the early years of computing, the development of large mainframe computers and telecommunications networks and terminals caused a centralization of computer hardware and software, databases, and information specialists at the corporate level of organizations. Next, the development of minicomputers and microcomputers accelerated a downsizing trend, which prompted a move back toward decentralization by many business firms. Distributed client/server networks at the corporate, department, workgroup, and team levels came into being, which promoted a shift of databases and information specialists to some departments and the creation of *information centers* to support end-user and workgroup computing. Lately, the trend is to establish more centralized control over the management of the IT resources of a company while still serving the strategic needs of its business units, especially their e-business and e-commerce initiatives. This trend has resulted in the development of hybrid structures with both centralized and decentralized components.

Some companies spin off their information systems function into Information Systems (IS) *subsidiaries* that offer IS services to external organizations, as well as to their parent company. Other companies create or spin off their e-commerce and Internet-related business units or IT groups into separate companies or business units. Corporations also outsource**,** that is, turn over all or parts of their IS operations to outside contractors known as *systems integrators.* In addition, some companies are outsourcing software procurement and support to *application service providers* (ASPs), which provide and support business application and other software via the Internet and intranets to all of a company's employee workstations. We will discuss outsourcing in greater detail later in this section. In the meantime, let's take a few minutes to review, and expand on, what we know about managing the various functions and activities in IS. IS operations management is concerned with the use of hardware, software, network, and personnel resources in the corporate or business unit data centers (computer centers) of an organization. Operational activities that must be managed include computer system operations, network management, production control, and production support.

Most operations management activities are being automated by the use of software packages for computer system performance management. These system performance monitors look after the processing of computer jobs, help develop a planned schedule of computer operations that can optimize computer system performance, and produce detailed statistics that are invaluable for effective planning and control of computing capacity. Such information evaluates computer system utilization, costs, and performance. This evaluation provides information for capacity planning, production planning and control, and hardware/software acquisition planning. It is also used in quality assurance. In addition to these measures, most organizations still establish and enforce policies for the acquisition of hardware and software by end users and business units. This process ensures their compatibility with company standards for hardware, software, and network connectivity. Also important is the development of applications with proper security and quality controls to promote correct performance and safeguard the integrity of corporate and departmental networks and databases.

7.2 Information Systems Planning

Information Systems Planning has been a topic of considerable importance and interest to IS professionals in both the business and academic communities since the 1970's. Planning is recognized as a critical competitiveness issue. Today, because information systems serve as the driver of many organizational transformations, there is increased pressure on organizations to leverage their investments in technology and information systems. Success usually occurs when an organization is able to achieve congruence between IS and organizational planning, and this is achieved when the technical and general managers of an organization work collaboratively. The strategic information systems planning process is intended to ensure that technology activities are properly aligned with the evolving needs and strategies of the organization**.** A framework that

helps to clarify the importance of information systems in today's organizations is the Information Systems Strategy Triangle. The message conveyed by the triangle is that it is - important for the three elements of the triangle, namely Business, Organizational and Information Systems strategies to align with and complement each other. It is important to note that Business Strategy resides at the top of the triangle. The triangle is depicted as follows:

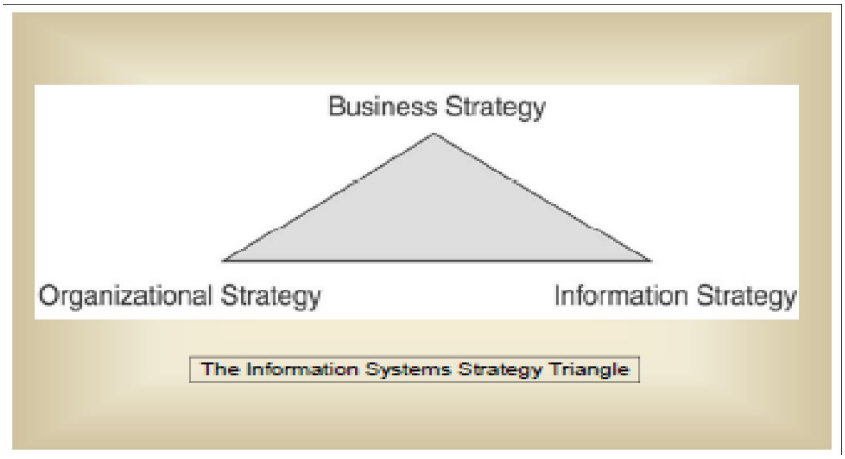

Figure 7.1

The three elements of the triangle are as follows:

1. Business strategy starts with a mission and is a coordinated set of actions to fulfill objectives, purpose and goals and serves to set limits on what business will seek to accomplish.
2. Organizational strategy deals with the people, work processes, structure, hiring practices and plan that allows for achievement of business goals.
3. Information systems strategy is the plan an organization uses in providing information services.

7.3 The Planning Process

There are no shortcuts to the strategic planning process. Preparatory steps that ensure that business, organizational and information strategies are aligned in a complementary fashion, are extremely important. Internal and external assessments need to be addressed, and the overall role of technology and information systems within the organization must be determined. A sense of how much should be spent on technology initiatives is also mandated. The most important point to remember is that the planning process for technology must be part of the overall business plan.

Strategy states the direction we want to go and how we intend to get there, and a plan depicts a view of the future that guides current day decision making. Organizations need to develop a strategic plan in order to provide a context for decision making. Deciding on the type of tools to use in the planning process is neither straightforward nor simple.

The planning process is complex, there is not a single best approach, and arriving at a single best methodology for a specific organization is nearly impossible. As a result, many organizations utilize a combination of approaches.

The planning process can become a lengthy and rigorous ordeal. In analyzing the process, some feel that it unfolds in five phases. The overall five phase breakdown is as follows:

1. Strategic Business Planning – Prerequisite to systems planning and consists of mission, future direction, targets and strategy.
2. Information Systems Assessment – Evaluation of current IS resources and how well they are serving the organization.
3. Information Systems Vision – Ideal role that should be pursued for use of IS resources.
4. Information Systems Guidelines – Set of statements that articulate use of organization's technical and IS resources.
5. Strategic Initiatives – Three to five year long-term proposals that stipulate new initiatives for IS organization.

Strategic information systems planning was previously the work of technology and systems professionals. It has now changed to be a collaborative planning challenge of parties including top managers, business unit managers, technology and systems professionals, and sometimes external stakeholders such as customers and alliance partners.

Thus, planning becomes a partnership among those with technical skills, the information systems group, and the general and functional managers of the organization. The planning process requires discussion, clarification, negotiation and the achievement of a mutual understanding. With today's rapidly evolving technology advances, along with the somewhat unpredictable emergence of new competitors brought about by the Internet, organizations do not have a year to develop a plan, several years to implement the plan, and a three to five year useful life for the plan. Everything that is technology-related moves at a rapid pace and change is inherent in the adoption of new technology and ISs. Due to the rapidly changing technology environment, many

feel that a "sense and respond" approach to planning is appropriate. When apparent opportunities appear, organizations need to respond quickly in order to take advantage. Some rapid responses may be viewed later as failed experiments, but that may prove to be better than a lost opportunity.

As mentioned earlier, many organizations have adopted a combination of planning techniques as they undertake their planning process. Eight popular planning techniques that have emerged include the following:

1. Stages of Growth – Include early successes, contagion, control and integration stages and is helpful in determining where an organization resides on learning and development curve.

2. Critical Success Factors – Key areas, usually less than 10 for an organization, where things must go right for the organization to flourish.

3. Competitive Forces Model – Michael Porter's model advocates that we must contend with five competitive forces in the strategic use of IS. Forces include threat of new - entrants, bargaining power of buyers and suppliers, threat of substitute products or services and rivalry among competitors.

4. Three Emerging Forces – Larry Downes emphasizes the critical role of IS and suggests consideration of three factors, namely increasing growth of digitalization, globalization of commerce, and deregulation of trade.

5. Value Chain Analysis – Porter's Value Chain model suggests five primary activities that must be given attention in creating a product or service, getting it to buyers and servicing. Included are inbound logistics, operations, outbound logistics, marketing and sales and service.

6 E-Business Value Matrix – A portfolio management approach that creates four categories of projects, namely new fundamentals, operational excellence, rational experimentation and breakthrough strategy.

7. Linkage Analysis Planning – Examination of inter-organizational electronic links and identification of power relationships within suppliers, buyers and strategic partners.

8. Scenario Planning – Plan whereby there is speculation of what the future might be like and what actions must be taken as different futures begin to materialize.

In the preliminary planning preparation, those responsible for the planning process must decide which combination, if any, of the above planning techniques to employ as the process is designed. Generally as methodologies are developed, four elements for consideration emerge. They include an opinion of what needs to be solved, defined techniques on what has to be done

and when to do it, advice on how to manage the quality of deliverables, and a tool kit to facilitate the process .

7.4 Technology Based Approach to Planning

In recent years, online electronic tools have emerged to assist with the planning process. The online approach is particularly attractive, as participants can connect to a host website from their own facility and enjoy the same benefits as face-to-face sessions. The keys to success with the process are the quality of the front-end preparation and the quality of the skilled facilitators. Opened-ended questions and ranking of elements on matters such as organizational mission, values, current state of the organization, external environment, overall organizational alignment and future direction must be addressed. Normally, this is done through a series of appropriately stated questions and related items that request input by rank order. Facilitators become familiar with the organization and its issues prior to conducting the sessions.

The following group of collaboration activities is made possible through the software provided.

1. Open anonymous electronic brainstorming (all participants' ideas are seen by all).
2. Ability to rapidly categorize key ideas and themes.
3. Ability to electronically prioritize the key ideas and themes.
4. Electronic survey capability for perception surveys and concept testing.
5. Topic commentary to solicit open comments on a series of key issues and themes.
6. Project outlining capability to develop high level action plan and implementation.

There are several significant advantages to be gained by this online process. All participants can immediately, but anonymously, see ideas generated by other participants. There is no longer a need for boards filled with post-it notes. As responses are received, the facilitator can immediately identify and list emerging common themes which can then be discussed. Since facilitators are very skillful, discussion can prove to be very valuable and enhancing. Finally, there is a time-saving feature to the process. A two to three hour session might be equated to a full day planning session conducted using traditional manual processes.

7.5 Nolan's Stage Model

Richard L. Nolan developed the theoretical Stages of growth model (SGM) during the 1970s. This is a general model, which describes the role of information technology (IT), and how it grows within an organisation. A first draft of the model was made in 1973, consisting of only four stages. Two stages were

added in 1979 to make it a six-stage model. There were two articles describing the stages, which were first published in the Harvard Business Review.

The structure of the final, six-stage model is depicted in the diagram below:

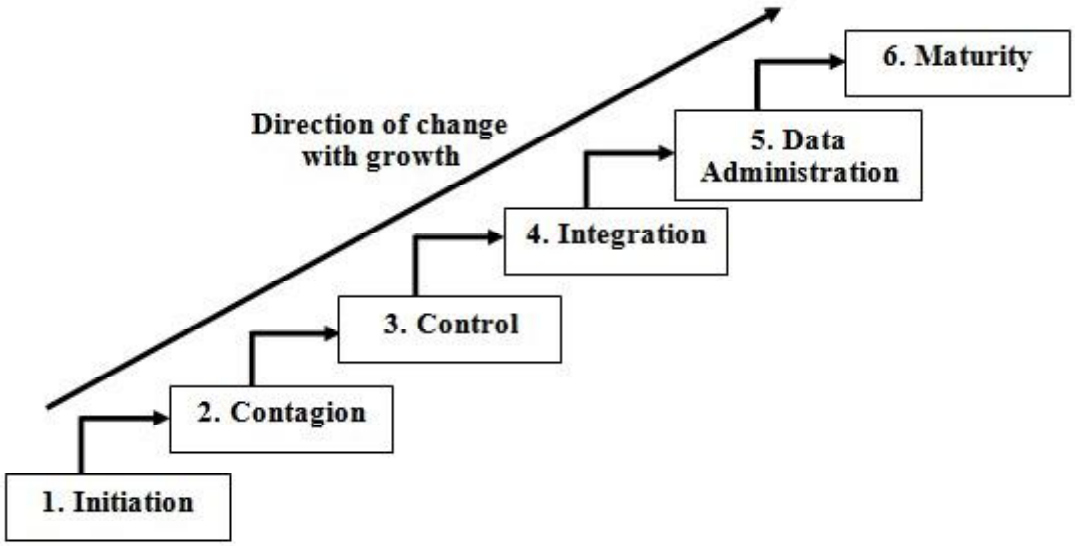

Figure 7.2 : Stages of growth model

The diagram above shows six stages, and the model suggests that:

- Stage 1: Evolution of IT in organizations begins in an initiation stage.
- Stage 2: This is followed by expeditious spreading of IT in a contagion stage.
- Stage 3: After that, a need for control arises.
- Stage 4: Next, integration of diverse technological solutions evolves.
- Stage 5: Administration/management of data is necessitated, to allow development without chaotic and increasing IT expenditures.
- Stage 6: Finally, in the maturity stage, constant growth will occur.

Structure of the Model

Stage 1 – Initiation

In this stage, Information Technology is first introduced into the organization. According to Nolan's article in 1973, computers were introduced into companies for two reasons:

(a) The first reason deals with the company reaching a size where the administrative processes cannot be accomplished without computers. Also, the success of the business justifies large investment in specialized equipment.

(b) The second reason deals with computational needs. Nolan defined the critical size of the company as the most prevalent reason for computer acquisition. Due to the unfamiliarity of personnel with the technology, users tend to take a "Hands Off" approach to new technology.

This introductory technology is simple to use and cheap to implement, which provides substantial monetary savings to the company. During this stage, the IT department receives little attention from management, and works in a "carefree" atmosphere.

Stage 2 – Contagion

Even though computer systems are recognised as process change enablers in Stage 1, Nolan acknowledged that many users become alienated by computing. Because of this, Stage 2 is characterised by a managerial need to explain the potential of computer applications to alienated users. This leads to the adoption of computers in a range of different areas.

Stage 2 presents some difficulties:

- Project and budgetary controls are not developed, leading to unavoidable a saturation of existing computer capacity and more sophisticated computer systems being obtained.
- System sophistication requires employing specialised professionals, and, due to the shortage of qualified individuals, employing these people results in higher salaries.
- The budget for the computer organisation rises significantly, and causes management concern.
- Although the price of Stage 2 is high, it becomes increasingly evident that planning and control for the growth of computer systems is necessary.

Stage 3 – Control

Stage 3 is a reaction against excessive and uncontrolled expenditures of time and money spent on computer systems, and the major problem for management is the organization of tasks for control of computer operating costs. In this stage, project management and management report systems are organised, which leads to development of programming, documentation, and operation standards. During Stage 3, a shift occurs from management of computers to management of data resources. This shift is an outcome of the analysis of how to increase management planning, control and expenditure for data processing operations.

It provides flexibility in data processing that is needed to meet management's new controls.

The major characteristic of Stage 3 is the reconstruction of data processing operations.

Stage 4 – Integration

Stage 4 features the adoption of new technology to integrate systems that were previously separate/ disparate entities. This creates further data processing (IT) expenditure at rates similar to that of Stage 2. In the latter half of Stage 4, exclusive reliance on computer controls leads to inefficiencies. The inefficiencies associated with rapid growth may simultaneously create another wave of problems. This is the last stage that Nolan acknowledged in his initial (1973) draft of the stages of growth.

Stage 5 – Data Administration

Nolan determined that four stages were not enough to describe the proliferation of IT in an organization and so added Stage 5 in 1979. Stage 5 features a new emphasis on managing corporate data rather than IT. Like the proceeding Stage 4, it is marked by the development and maturity of the new concept of data administration.

Stage 6 – Maturity

In Stage 6, the application portfolios - tasks like order entry, general ledger, and material requirements planning - are completed according to a structure that mirrors the organisation and its information flows. During this stage, tracking sales growth becomes an important aspect. Typically:

- 10% of the work relates to batch and remote job entry.
- 60% of the work relates to dedicated database and data communications processing.
- 5% of the work relates to personal computing.
- 25% of the work relates to minicomputer processing.

Management control systems are estimated as being 40% of Stage 6. There are three aspects of management control; manufacturing, marketing and financial:

- Manufacturing control requires forecasting future needs.
- Marketing control strictly deals with research.
- Financial control requires forecasting future cash flow requirements.

Stage 6 exercises a high degree of control, by compiling all of the information from Stages 1 through to 5, inclusive. This allows the organization to function at relatively high levels of efficiency and effectiveness.

Though Nolan's Stages of Growth Model was ahead of its time when it was first published in the 1970s - providing the first such theoretical model to describe the growth of IT within an organization - it would probably now be perceived to have several shortcomings and to be old-fashioned or out-of-date. The model had as a main focus the change in IT budget, but critics questioned whether it was "reasonable to assume that a single variable serves as a suitable surrogate for so much." Though it would seem reasonable that this single variable could be an indicator of other variables such as the organizational environment or the organization's learning curve, it would not necessarily be the sole driving force for the entire model. Nolan showed little connection that would make that main focus a valid one.

Criticism

In his model, Richard Nolan states that the force behind the growth of computing through the stages is technological change. King and Kramer find this to be far too general as they say, "there are additional factors that should be considered. Most important are the "demand-side" factors that create a ripe environment for technological changes to be considered and adopted. As proposed, technological change has a multitude of facets that determine its necessity. Change cannot be brought forth unless it is needed under certain circumstances. Unwarranted change would result in excess costs and potential failure of the process.

Last, the stages of growth model assume straightforward organizational goals that are to be determined through the technological change. This can be viewed as very naïve from the user perspective. King and Kraemer state, "the question of whether organizational goals are uniform and consistent guides for the behavior of organizational actors, as opposed to dynamic and changing targets that result from competition and conflict among organizational actors, has received considerable attention in the literature on computing." Clearly, organizational goals are ever changing and sometimes rigid indicators of direction. They cannot be "uniform" objectives that are not subject to change.

7.6 Information Resource Management

Information Resource Management (IRM) is the management (planning, organization, operations and control) of the resources (human and physical) concerned with the systems support (development, enhancement and maintenance) and the servicing (processing, transformation, distribution, storage and retrieval) of information (data, text, voice, image) for an enterprise. As IRM by treating information as a corporate asset can improve the competitive advantage of the organization, it could be a strategic decision to have an improvement plan for the IRM itself. The concept of information resource management reflects a notion of information as a distinct corporate resource-in addition to capital, materials, organization and staff. Information management becomes more important every day: we need to ensure that people within our organization get the information they need to do their jobs effectively, and, if we are to achieve real success, we need to ensure that people do not get information that is not relevant to their activity. The competitive advantage of organizations is very much governed by the effectiveness with which they manage their information resources. On the other hand you can only improve an area that you have already measured it.

IRM/MRP ANALOGY

The concept of Information Resource Management is actually no different in intent than "Materials Resource Planning" (MRP) as used in manufacturing. Both are concerned with the efficient and cost effective use of resources. The classification and control of resources are the main objectives. Resources are classified to prove their uniqueness so that redundancy is not introduced and to promote sharing. Control is required to collect, inventory and retrieve resources as required by the business. Whereas MRP is concerned with managing products and the parts required to produce them, IRM is concerned with managing information and the resources required to produce it.

One of the important by-products of cataloging and cross-referencing information resources is a model of the enterprise, including how it is organized and how it operates. Other benefits include:

- All information resources are controllable, permitting the ability to design integrated systems and perform an "impact analysis" of a proposed resource change.
- Simplified search of information resources for reuse. Redundancy of resource definition is eliminated.
- Complete and current documentation of all information resources, in an organized and meaningful way.
- Communications within the organization is improved since developers and users would use standard and common definitions for information resources, all of which would be in standard business terminology.

IRM is a comprehensive approach to planning, organizing, budgeting, directing, monitoring and controlling the people, funding, technologies and activities associated with acquiring, storing, processing and distributing data to meet a business need for the benefit of the entire enterprise. They developed a measurement instrument for operationalizing the IRM. The instrument serves two functions:

1) To create a coherent, theoretical foundation for further research on IRM construct.

2) To provide reference norms for practicing managers to use to assess the extent of IRM implementation in their organizations.

A "maturity model" is a conceptual framework, with constituent parts, that defines maturity in the area of interest. If we substitute information resource management as our area of interest in maturity model definition

provided by Project Management Institute (PMI), we can come to a definition for IRM Maturity Model (IRM3) as a conceptual framework that defines maturity in information resource management. Maturity model let us know where we are in IRM and it could contribute to manage organizational information in a better way. Best practices are those actions and activities undertaken by

the company or individuals that lead to sustained competitive advantage. The key term in this definition is sustained competitive advantage. In the other words, best practices are what differentiate you from the competitors. Generally, there are two ways to identify best practices for organizations: 1) internal environment, and 2) external environment. Critical Success Factors (CSFs) of the organization can be considered as an internal source to find out best practices. External environment for identifying best practices includes benchmarking, seminars, publication, and participating in professional societies.

7.7 IRM3

Best Practices

A research which has been conducted by Ward and Mitchell shows that there are no statistically significant differences between Information Resource Management Critical Success Factors (CSFs) of private and public sector. By reviewing, combining, and removing duplication of the result of various researches a list of best practices required for IRM maturity model is as follows:

Integrating IRM decision making in a strategic management process.

Setting an IRM performance baseline by benchmarking against leading organization and set appropriate target.

Linking mission goals and IRM outcomes through performance management.

Aligning IT and organizational mission goals to improve service to customers/stakeholder.

Guiding IRM project strategy and follow-up through an investment philosophy.

Directing IRM changes by senior managers.

Building effective relationships with senior executives.

Using business process innovation to drive IRM strategies and maximize benefits of technology.

Hiring and retaining skilled professionals.

Steps

The IRM maturity model consists of three interlocking phases: knowledge, assessment and improvement. Best practices, methodology, and concept of IRM will be described in the knowledge phase. Information resource management is compared to the best practices in the assessment phase in order to find its maturity level on a continuum basis. By utilizing the assessment result, in improvement phase, organization makes decision on how to improve IRM maturity. Following steps could help organizations to implement IRM3:

Step 1: Prepare for assessment. In this step we should have a clear status of our current IRM, information resource management best practices, and a plan that could be an approach of how the organization wants to initiate IRM3, by whom and when. Information gathering tool such as questionnaire survey, interview, or workshop in addition to sample population should be defined in this step. Obviously having a clear image of IRM3 in addition to understanding the concept of the model could lead the organization to a better measurement for their IRM maturity.

Step 2: Perform assessment. The next step is to assess the organization's degree of maturity in information resource management. To do this step, an organization must be able to compare the characteristics of its current maturity status with those criteria (dimensions) described in the model. This step includes a complete review of the best practices in four dimensions: plan, deploy, check, and improve. At the end of

this step, a general status of organization's IRM maturity will be revealed.

Step 3: Plan for improvements. Most organizations will likely be unable to achieve all of the desired best practices at once. For those organizations choosing to pursue improvements in order to increase maturity, the results of the previous step will form a basis for the improvement plan.

Step 4: Implement improvements. This step is where the organizational change will take place. Once the improvement plan has been established, the organization only needs to follow the plan. Knowing where you are in IRM is not enough; you require implementing the improvement plan to reach the higher maturity level in IRM.

Step 5: Repeat the process. Having completed some improvement activities, the organization will be either return to the assessment step to reassess where it is currently on the continuum of IRM maturity or return to step three to begin addressing other best practices identified earlier assessment.

These steps should be repeated periodically. The intervals for the organizations of higher level of maturity in IRM may be longer than those being in preliminary stages. In addition radical changes in the external environment of the organization by changing key process and key data accordingly, are able to act as a motive to an unplanned assessment.

Assessment

In assessment phase, we measure maturity level of each best practice. With a little difference, we applied PDCI here which stands for plan, deploy, check, and improve. In plan, the best practice should be investigated to see if there is an approach.

This approach should be integrated with other approaches and must be sound. In deploy, any document related to the said best practice should be deployed in accordance with the plan completely. Each process of the best practice should be checked as per the specific measures in check section. Based on the result of last part, there should be some corrective actions in improve section. Basic theme of the scoring method

has been taken from European Foundation for Quality Management (EFQM).

7.8 Hardware Acquisition

Planning of the hardware requires the identification of hardware options & selection of the hardware for most suitable applications. Adaptive changes are required as business environment keeps on changing as per the hardware technology needs. The procurement should be based without long range planning as the risk of obsolescence is very high in computer hardware.

HARDWARE FRAMING REQUIREMENTS

After decision making for the computerized system hardware requirements are required as per the applications are decided to be used. Basic requirements may be Essential or Preferred. Some examples may be grouped as:

- Capability of the main & backing storage.
- Delivery, installation, maintenance costs & availability of spares.

- Compatibility with existing or projected systems.
- Physical space requirements.
- Software support & system interfacing applications.
- Training availability & costing.
- Response time against processing transactions.

It is difficult to state the correct requirement of hardware practically at any situation as manufacturers offers perplexing range of choices. Donald Sanders points out the checklist to make a selection as:

1. Define the necessities to improve personal productivity.
2. Identify the primary applications with hardware requirements for significant primary & secondary storage .
3. Compatibility issues considerations with respect to Input-output equipments.
4. System & user-friendly catalogues or manuals which are easy to understand.
5. Future expansion such as storage upgrades, to raise computing power with other system advancements.
6. Satisfactory supplier's offers –Service arrangements & management contracts.

7.9 Configuration Planning of Computer Hardware

Configuration planning for the hardware usage is required for efficient & successful objective fulfillment. This process is based on issues such as service requirement, technology & needs forecasts, capacity calculations & utilization factor.

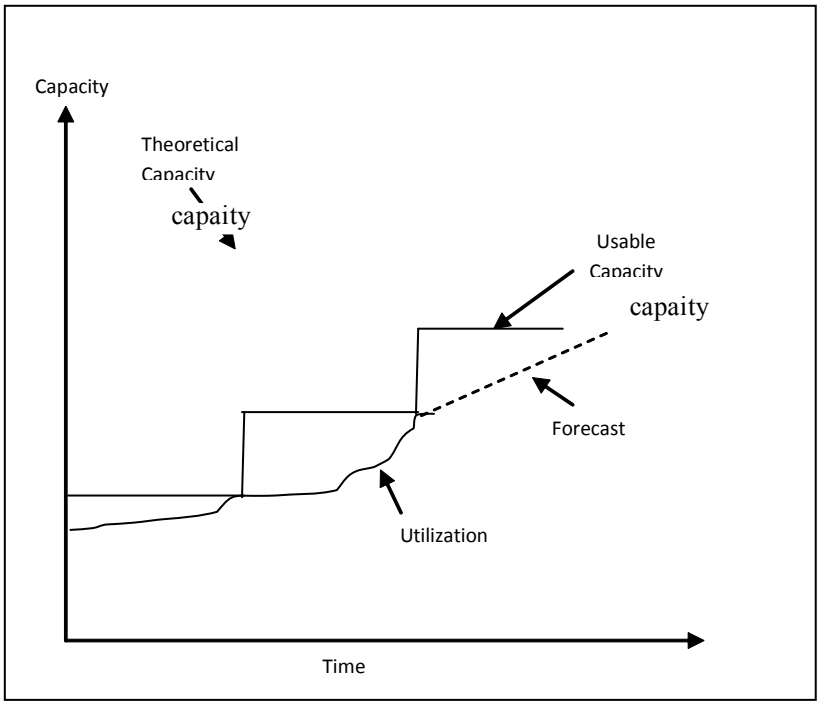

Figure 7. 3 : Capacities & utilization over time

There is a gap between the claimed capacity & the usable capacity of the hardware which can be achieved only under controlled situations. The actual usage shall depend upon factors such as applications running currently, level of business activities in progress etc. While planning the configuration of the system capacities can be added to reduce the downtime for the users & to maintain the availability of the computer system. Including manpower can also add to the capacity without actually buying new equipments for longer periods in a week.

7.10 Contractual Aspects of Hardware Purchasing

As per the organization size, system requirement & personal aspects user can acquire the system in different ways -

- **Rental-**

1. It is a short term commitment practice with low maintenance responsibility & money obstruction. Some decisions have to take place before system implementation such as either to purchase new generation equipments or to continue with the rental system till the user get habitual to it & if purchase may be delayed till adequate financing.
2. A computer system can be rented for short-term basis in which certain amount has to be paid for the utilization of the equipment which may be somewhat costlier.
3. An agreement is written in such a way that the renter is assured of having a smooth running & well maintained system. Deed can be cancelled with prior information of 1-2 months & this agreement can be extended according to user needs & availability of the system with sufficient security sustain.
4. Risk of obsolescence is not present in this method as the user can go for improved & advanced technology as soon as the rental period gets over or even cancel the agreement if both parties agreed on the same.
5. Continuous availability of the system after the agreement get over is not at all assured.
6. The organisation does not get any tax and ownership benefits other than deductions of monthly expenses.

- **Lease-**

1. It is a commitment to make use of a system till specific time duration of 3-7 years (approx.) where payments (including equipment, service & maintenance costs) are predetermined that may be paid either monthly, quarterly, semi-annually or annually & will not be changed throughout the lease time period.
2. Leasing is comparatively less expensive where supplier makes availability of better services as contracted for longer commitment.
3. Lessor cannot be the owner of the equipment at the end of the lease period instead may be equipped as per lease contract made. If system is running smoothly & lessor don't want to switch to new equipments or system than lessor need to convince the lessee to extend the lease period or to own the equipment by making some fix price.
4. Leasing protects from technical obsolescence as lessor can improve the system at the end of the short lease time period else supplier can also upgrade it before the lease expires.

5. Does not require capital investments.
6. Leasing offers explicit tax benefits. In addition to deducting the cost of the lease as business expenses, tax credits are available for the investment, which directly lowers the income tax as business pays.

- **Purchase-**

1. Purchase requires capital investments as the organisation can enjoy full control over the system by stepping forward for absolute purchase by borrowing money from funds.
2. Due to the risk of obsolescence, an organisation cannot easily switch over to another system. To accomplish the same, either an organisation needs to sell the system or to enhance system capability to attain better outputs.
3. Maintenance must be acquired on system parts and the labour, for which monthly charges may vary. If the hardware is financed, then instalments must be made at regular intervals. This purchase and surplus costing may go for Annual Maintenance Contract (AMC).
4. Tax benefits can be attained in purchasing the system such as –

- Monthly maintenance charges, interest on loan to finance the purchases are deductible as business expenses.
- Local and sales taxes paid on the purchase, hardware cost which is depreciated over time and reduces taxable income may be deductible from income tax. These depreciations trim down the cost of computers which cannot be provided by lease or rental agreements.

7.11 Hardware Maintenance

After the delivery and installation of a system the vendor is responsible for its upholding under the specific warranty time period. Maintenance support is useful only when needed. It can be **Corrective** for repairing the system hardware components such as printer, monitor etc. Secondly, **Adaptive** maintenance modifies the system configuration as per updated requirements. Thirdly, system can be kept in running state using **Preventive** maintenance either through reorganization or cleaning the equipments.

Maintenance can be accomplished by specialized companies known to be as "Third Party Maintenance" who make it either by having the contract with the supplier or by having the knowledge of the system.

Hardware maintenance contract can be negotiated based on certain issues such as-

1. Terms- Terms of the agreement may cover both labour and parts, labour and allowance, or labour only with parts vary as on needed. The type of deal may depend upon expenditures willingly to be done by the organisation.
2. Service and response- Maintenance concerns with the moment of time when the service is requested and when the service support rendered. The response time can be improved with in-house repairs as compared to the response of third party concerns. So, the user needs to decide upon the maintenance contract to be agreed with. Repair services are often provided during normal working hours else cost may be added with extra charges.
3. Vendor support- Prior to hardware purchase from the vendor it is beneficial to evaluate the services provided with respect to the fees to be payable, excluded services, provisions for emergency support & if the vendor supports for training and installations which may be complementary or for a fee.

7.12 Software Acquisition

Before the task of purchasing commercially available software, contracting a supplier to create a custom software package, or developing a "homegrown" software application can commence, adequate planning must take place. Having a defined software acquisition and supplier management process helps insure that important steps in the acquisition process are not forgotten. Predefined goals and objectives align the business needs with the mission of the acquisition. The software industry is now several decades old, however problems including schedule slippage, budget overruns, missing functionality and poor quality and reliability are still prevalent. These continuing issues make the need for good software acquisition and supplier management practices essential to the success of our organizations.

The reason we keep making the same mistakes over and over is that we are not learning from our own past. We either fail to examine the past because we are afraid of what we will find, we make an assumption that the past is not relevant because "this project is different", or we don't have the mechanisms in place to capture the data and information we need to adequately analyze our past efforts. However, as software becomes an integral part of our businesses and our lives, we can no longer afford not to learn from our past mistakes. Having a defined software acquisition and supplier management process facilitates the propagation of lessons learned from one acquisition project to the next so we can repeat our successes and stop repeating actions that lead to problems.

Today's software intensive products and business practices require companies to approach software purchases with a well- informed and strategic method. The first seven steps in the Software Acquisition and Supplier Management Model include:

Step 1: Planning the acquisition

Step 2: Defining the soft ware product's requirements

Step 3: Determining the acquisition approach

Step 4: Identifying and evaluating potential suppliers (and their software products)

Step 5: Defining the contract requirements

Step 6: Selecting a supplier

Step 7: Negotiating and awarding the contract

Step 1: Planning the acquisition

Planning for the software acquisition begins when the idea or need is established for acquiring a software product. In this first step of the acquisition process:

1 Key acquisition roles are assigned.

2 The business need for the software is described in terms of technical and functional needs, quality attributes, project constraints, and acceptance and completion criteria.

3 The acquisition plan is documented.

Assigning Key Roles: Responsibilities for key acquisition roles must be assigned. This includes the acquisition sponsor, acquisition manager and members of the acquisition team. It also includes representatives from the customer and/or user community and other key stakeholders that will work with the acquisition team to define the business needs and software requirements. The role of the acquisition sponsor is to provide organizational influence to help justify and sell the acquisition within the acquirer's organization. The sponsor is responsible for:

- Communicating the vision of the proposed product to executive management
- Establishing credibility to the acquisition effort
- Obtaining approval to proceed
- Supplying a solid business case and strong support for the acquisition
- Championing the cause of the acquisition
- Ensuring ongoing funding, staffing and resources for the acquisition project

The role of the acquisition manager is to:

- Lead and manage the acquisition team.
- Direct ongoing acquisition project activities.
- Control cost and schedule.
- Track and control the acquisition project against the plan.
- Report acquisition status to the sponsor and other management.

The role of each individual Acquisition Team member is to adequately represent their stakeholder organization and to perform assigned tasks.

Describe the Business Need: The increasingly high rate of change in new technology makes it difficult for companies to keep up with current trends and remain competitive. The current state of the company has to be continually examined to determine any need for change or update. A business need could be a problem that needs to be addressed or it could be an opportunity for the business to improve in some area. It is important to precisely specify the business need so that people will clearly understand what action is to be taken and avoid addressing the wrong need. Quantitative measures consisting of data related to the stated business need should be used to support the facts upon which the need is based. For example, the need to obtain a software configuration management tool could be supported with quantitative measures including the number of source modules, lines of code, fielded and in -process versions of the software that must be maintained. The business need also includes the description of any assumptions upon which the project is based or any constraints on the project factors such as schedule, budget, resources, software to be reused, acquired software to be incorporated, technology to be employed, and product interfaces to other products. For example, any estimates, expectations, statements or proposed solutions that lack supporting data should be considered as assumptions.

Business sponsors and stakeholders indicate their buy-in and support of the business need through the approval of the business need description.

The identity of the stakeholders is not always obvious. Different stakeholders can also give conflicting direction. This is especially difficult if one organization is paying for the software and another is going to actually use it and they disagree about the basic business need. Despite all of these difficulties, agreement needs to be reached about what the software will do. The Acquisition Team must understand the individual stakeholder motives. How might the stakeholders benefit from the acquisition and how might the acquisition be a threat to them? A recommended method for accomplishing this is to meet with each stakeholder individually to encourage open communication and sharing of both positive and negative perspectives of the acquisition as it relates to them.

Stakeholders typically have commonly acknowledged business needs that the Acquisition Team can easily identify. However, stakeholders may also have unacknowledged motives (hidden agendas) that might drive the direction of their influence on the acquisition effort. The Acquisition Team needs to uncover and understand both the acknowledged business needs and these less obvious motives to effectively plan the acquisition. Table 1 includes an example of business needs/motives for the acquisition of a payroll software package:

Table 1 – Example of Business Needs/Motives for a Payroll Software Package Acquisition

Key Stakeholder	Business Needs/Motives
Accounting	Convenient mechanisms for capturing time worked, vacations, etc for each employee Track, reconcile, manage and report payroll Eliminate the need to "chase" employees and supervisors for
HR	Automate and track employee elected deductions, contributions, savings, etc. Eliminate the tedious tasks of dealing with paper forms from their workload
Employees	Convenient mechanisms for reporting time worked, vacations, etc. Detailed statement of earnings, deductions, contributions, savings, etc.
IRS, Social Security and State Tax Offices	Ability to automate wage garnishment, reporting and fun transfers for taxes owed Ability to collect taxes owed on or before due date Eliminate labor intensive paperwork
Insurance Companies	Ability to automate premium payments through payroll deduction Ability to sell more policies and options to employees
Charities	Ability to establish and automate long term contributions throug payroll deduction
Employee's Bank	Automated transfer of payroll into employee bank accounts Get entire payroll check into employee bank account sooner
Company's Bank	Automated transfer of payroll into employee bank accounts Automated transfer of withheld taxe s from company account Keep

Document the Acquisition Plan: An Acquisition Plan is established to detail the methods to be employed throughout the acquisition project's life cycle. The time spent defining the acquisition strategy early on will go a long way in assuring stability throughout the acquisition process and the life of the software. The acquisition planning process should link acquisition objectives and tasks to resources (time, people, funds, and technology). It must organize these resources and define a process for achieving the approval of all stakeholders to guarantee the adoption of the acquisition plan. It should then guide the acquisition activities and provide for the integration of the effort. Software acquisition activities are sensitive to the same risks that occur in any project and require the same level of project and risk planning and management concerning decisions, budget, schedule, quality, etc.

Step 2: Defining the soft ware product's requirements

In the Define the Software Product step of the acquisition process, the software requirements are elicited, analyzed, specified and validated. This step drives t he direction of the acquisition. The desired product must be adequately analyzed and its individual features and quality attributes decided on and documented. The Acquisition Team should prioritize the requirements and separate needs from wants. Successful acquisition projects are dependent on clearly defined requirements. We cannot stress enough the importance of good requirements documentation. As identified in a Standish Group survey, IT executive managers believe that the three major reasons that a project will succeed are user involvement, executive management support, and a clear statement of requirements. Opinions about why projects are impaired and ultimately canceled ranked incomplete requirements and lack of user involvement at the top of the list.

In order to write good requirements documentation we need to understand the basic categories of requirements. Requirements are classically referred to in two categories: "Functional" and "Non-Functional" requirements and design constraints. The functional category specifically addresses tangible features, capabilities or functions of the desired software. This includes requirements for the various modes of operation, operational scenarios, data input/generation, data transformations and data outputs/storage. The non-functional category addresses requirements that must be inherent throughout the design and are not tied directly to any single feature or function. Non-functional requirements include requirements for usability, reliability, performance, supportability, safety, security and other product attributes. Design constraints include any predefined limitations on how the system can be designed and implemented. Constraints should include:

Any required standards or policies that must be used

Any external interfaces, communication protocols or operational limitations

Any existing budget or schedule limitations
Any platform limitations (e.g., hardware, operating system, language, tools)

The software requirements should be verified to ensure that they are:

Unambiguous: Every requirements statement should have one and only one interpretation.

Complete: Includes all the functions and functional attributes of the software and all constraints that must be satisfied.

Testable: There exists a reasonably cost-effective way to determine that the software satisfies the requirements.

Traceable: Each requirement should be traceable back to its source (e.g., system level requirements, standard, and enhancement request). It should also be specified in a manner that allows traceability forward into the design, implementation and tests.

Consistent: Internal conflicts do not exist between requirements.

Modifiable: Each requirement should be specified in a coherent, easy-to-understand manner. The requirements should be non-redundant (i.e., each requirement is stated in only one place). Each requirement should be specified in a manner that allows it to be changed without excessive impact on other requirements.

Reasonable: The requirements can be implemented using available technologies, techniques, tools, resources and personnel within the specified cost and schedule constraints.

Step 3: Determining the acquisition approach

Once we understand the product requirements, we must determine the mechanism for acquiring the software. Our options include:

COTS Software: Things to consider if we purchase COTS or supplier developed software include: How fast do we need it delivered?

How many users will there be (licenses needed)? What is the expected growth rate? Is there commercially available software and what is its cost?

What is our projected budget for purchase and for ownership? What licensing restrictions can we live with?

What are our integration needs with our existing systems? With our business processes?

What is our risk tolerance? What are the rollout costs?

What is the state of the technology (sunrise or sunset)? What are our competitors doing?

Internally Developed Software: We may have the need for software that is not in mainstream usage. This may necessitate the development of a customized software product to meet our unique needs. One way of accomplishing this is to create a "home grown" software product through developing it internally. Things to consider if we develop the software internally include:

How fast do we need to complete it? What are our core competencies?

Do we have the needed infrastructure (tools, equipment, methodologies)?

What are our development costs? What are the rollout costs? What is our risk tolerance?

What is the state of the technology (sunrise or sunset)? What are our competitors doing?

Can we market it? Can we maintain it?

Software Developed Through Contract/Subcontract: If a customized package is needed but the organization lacks the internal capabilities or resources to produce homegrown software, another option is to contract or subcontract the development to another company.

Combination: Finally, the organization may select to combine two or more of the above options. The acquirer may develop most of the software in -house but subcontract one or more functions to suppliers with specialized skills. For example, they might subcontract the GUI interface or security functions to a supplier with specific expertise in those areas. Another option would be to integrate COTS software that performs a specific function into a customized software product. For example a COTS database manager could be integrated into an inventory tracking software that is being internally developed.

For each viable option, a cost/benefit analysis should be performed that explores:

Costs:

- o Acquisition and supplier management
- o Development
- o Purchase/licensing of new equipment
- o Acceptance and roll-out
- o Operating and support costs

- o Maintenance costs including enhancements, corrections, and adaptation

Benefits:

- o Increased efficiency/ effectiveness
- o increased profits/revenues
- o Marketplace advantages
- o Taking advantage of innovation and response to competition
- o Adaptation to change (e.g., environment, technology, business rules, regulations)
- o Increased customer/ employee satisfaction

Step 4: Identifying and evaluating potential suppliers (and their software products)

In the Identify and Evaluate Potential Suppliers step a market search is performed to make sure that we are considering the available candidate suppliers and their software products. Sufficient preliminary research should be performed to narrow the list to the few potential suppliers that best match our business needs in order to target our evaluation and keep evaluation costs to a minimum. The data collected during the market search can be used as feedback to reassess our original requirements and to determine whether modification to those requirements will result in greater overall value in terms of cost, performance, availability, reliability, etc. The market analysis should also cover maintenance and support data, test results, and user satisfaction analyses.

In this step we evaluate selected potential suppliers by performing an in -depth examination of their capabilities, quality systems and products. Care should be taken to obtain enough information to compare the qualifications of each supplier in order to make an informed decision. Methods for doing this include:

Formal Request-For-Proposal (RFP)

Supplier Demos and Conferences Prototypes

Evaluation Copies Supplier Evaluations,

References and Past Performance

Formal Request-For-Proposal (RFP): Advertising of an upcoming Request for Proposal (RFP) may not only identify unknown suppliers but it may also encourage suppliers to offer technological input and business advice. They may be able to suggest new technologies and capabilities not previously known about or considered by the acquirer as possible alternatives. The Request-For-Proposal (RFP) process is typically used only for customized software to be developed by the supplier. It is a very formal process where specific proposal requirements and questions are outlined b y the acquirer in the RFP and responded to by the supplier in a proposal.

Since supplier's funds for bids and proposals are often limited it is important that the acquirer realize that they are competing for the attention of qualified suppliers. The time before formal RFP release is important for both the acquirer and the potential suppliers to examine potential alternatives and solutions.

Supplier Demos and Conferences: Holding a supplier demonstration provides an excellent opportunity to see the product first hand and ask questions. Demos provide a mechanism for the Acquisition Team to evaluate the product and hear other team member's questions and comments in context with the demonstrations. Actually seeing the features of different software in a live demonstration provides a context for comparison. Perhaps the basic functionality is comparable but one tool has a more intuitive user interface. We may like the user-interface of one tool but are convinced of the structural integrity of another. Supplier conferences are back-to-back meetings, which are held with all of the suppliers demonstrating their products in succession. Conferences can foster competition and they can make it easier to make comparison.

The level of product knowledge and confidence of the supplier representative and their willingness to answer tough questions can be an indicator of our future relationship with them. Another indicator of future support is whether the supplier presents a "canned" demo or has spent the time to customize their demo to specifically address our business needs and requirements.

Prototypes and Evaluation Copies: A prototype can be used to determine the supplier understands of the requirement. However, do not mistake a prototype for more than what it is — a shortcut for demonstrating proof-of-concept. Prototypes are typically not developed with supportability, readability, and usability in mind, and bypass normal configuration management, interface controls, technical documentation, and supportability requirements. For many COTS products, evaluation copies are available as mechanisms for demonstrating the software functions/capabilities and for eliciting user buy-in. Check sheets, like the following example for a software configuration management tool, can be created for use by the acquisition team when evaluating the software product.

Past Performance, Supplier Evaluations and References: A supplier who has had a consistent history of successfully providing software is more likely to perform effectively in the future. Past performance is a strong indicator of whether the supplier has the capability and ability to successfully complete delivery within schedule, on budget, and with the required level of functionality and quality. Like past performance, previous experience is a credible indicator of the likelihood that a supplier can successfully perform in the future. For instance, if a Software Engineering Institute (SEI) Capability Maturity Model (CMM) Level 1 supplier struggled to complete previous software project for us, that supplier still might be preferable to other Level 1 suppliers for a comparable project merely because the supplier probably learned many lessons that will benefit it on a subsequent project. Ideally, the supplier has both previous experience and an excellent record of past performance.

Evaluation criteria lists can be utilized when evaluating multiple suppliers to ensure complete coverage of all the important factors and promote consistency in the evaluation process. Evaluation criteria lists are made up of questions that help organize and structure the evaluation. These lists can be comprehensive and include all of the criteria being considered or they can be directed to a specific part of the evaluation (e.g., product specific criteria for a set of features or process specific like a software quality evaluation criteria). Standardized evaluation criteria lists can be created for use across multiple acquisition projects to promote efficiency and the sharing of lessons learned. However, these standardized lists should be tailored to the specific needs of each individual project.

Completed evaluation criteria list provide documented input into the supplier selection process. They also provide historical information and evidence that a comprehensive evaluation was performed in case there are any questions about the evaluation in the future.

Step 5: Defining the contract requirements

In the Define Contract Requirements step of the acquisition process the contract or agreement type is selected and the contents of the contract or agreement are defined. A well-written contract minimizes the probability of misunderstandings and is a major contributor to a congenial relationship between the acquirer and the supplier. Experience has shown that when the contra ct is unambiguous and clearly defines the duties and responsibilities of the parties, the animosity that arises from quibbling over performance obligations usually can be avoided. The contract should be customized to consider the supplier's strengths and weaknesses. For example, if the supplier has achieved a high level of maturity, we may decide that online access to the supplier's development environment and management status reports (e.g., cost, schedule, risk management and metrics data) is an effective alternative to the traditional oversight mechanisms of formal reviews and submission/approval of data items. Alternatively, if a supplier's process for coordinating the efforts of different engineering disciplines and stake holders is relatively weak, we may add a requirement for an on-site liaison to support coordination with users and the suppliers developing interfacing systems. Acquirers should select contract types that are most likely to minimize risks for both parties and motivate suppliers to perform optimally.

Types of contracts or agreements include:

Fixed-Price Contracts: Fixed-price type contracts are appropriate for software that can be objectively defined in the requirements specification and for which the risks of performance are manageable. For such acquisitions, performance-based statements of work, measurable performance standards and surveillance plans are ideally suited. The supplier is motivated to find improved methods of performance and cost control since this contract type places all costs and resulting profit or loss directly on them.

Table 2

Advantag	Disadvanta
Provides firm assurance of ultimate cost Insures prompt notification to acquirer of delays and extra costs resulting from changes Provides maximum incentive for quickest completion at lowest cost Involves minimal auditing by acquirer	Requires exact knowledge of what is wanted before contract award Supplier views all requirement changes as out -of- scope Requires substantial time and cost tc develop inquiry specs, solicit, and evaluate bids. High biding costs and risks may turn

Cost-reimbursement contracts: Cost-reimbursement type contracts are used only when costs cannot be estimated with sufficient accuracy to use any of the fixed-price type contracts. They establish an estimate of total cost for the purpose of obligating funds and establishing a ceiling that the supplier may not exceed without the approval of the acquirer. They are appropriate for software that can only be defined in general terms or for which the risks of performance are uncertain. Where possible, they should include specific incentive provisions in addition to the award fee to insure that suppliers are rewarded for good performance.

Advantag	Disadvanta
Does not require exact knowledge of what is wanted before contract award Requires acquirer approval for costs beyond established ceiling	No assurance of actual final cost No financial incentive to minimize time and cost Permits excessive design changes by acquirer increasing time and

Incentive Contracts: Incentive type contracts relate the amount of profit or the fee to the supplier's performance. Incentive increases or decreases are applied to performance targets rather than minimum performance requirements.

Advantag	Disadvanta
Motivates the supplier to effectively manage costs	In attempts to increase efficiency shortcuts may be taken that compromise

Indefinite-Delivery Contracts: Indefinite-delivery type contracts do not specify a firm quantity of supplies or services (other than a minimum or maximum quantity). Instead, they provide for the issuance of orders for the delivery of supplies or the performance of tasks during the period of the contract.

Advantag	Dis
Allows the contract to be issued without knowledge of exact times/quantities of future deliveries	By the time an order on the contract is issued, the supplier may need to be re-qualified

Time-and -Materials, Labor-Hour and Letter Contracts: Time-and-materials, labor-hour, and letter type contracts provide for acquiring supplies or services on the basis of direct labor hours at specified fixed hourly rates that include wages, overhead, general and administrative expenses, and profit. When the use of time -and-material, labor-hour, and letter contracts is appropriate, acquirers should employ performance-based methods to the maximum extent feasible.

Advantag	Disadvanta
Provides for acquiring products or services on the basis of direct labor hours and materials at cost Allows the contract to be issued when it is	No assurance of actual final cost No financial incentive to minimize time and cost Surveillance of supplier's performance is

Agreements – Basic and Basic Ordering: A basic agreement is not a contract. It is a written instrument of understanding, negotiated between the acquirer and supplier that contain contract clauses that might apply to future contracts between the parties during its term. It is normally used when a substantial number of separate contracts may be awarded to a supplier during a specified period and the acquirer has experienced previous problems with that supplier. Basic agreements are included into the appropriate contract by specific reference. A basic ordering agreement is also not a contract. It is a written instrument of understanding, negotiated between the acquirer and supplier that contains contract clauses that might apply to future contracts between the parties during its term. It is normally used to expedite contracting for uncertain requirements for supplies or services when specific items, quantities, and prices are not known at the time of the agreement.

The goal is to reduce administrative lead-time, inventory investment, and inventory aging due to design changes. They are included in the appropriate contract by specific reference.

Advantag	Disadvanta
Allows for pre-documentation of understanding and contract clauses that can be referenced by the contract Expedites the contracting activity Reduces administrative lead-time Reduces inventory	Is not a contract A contract is still required to execute the agreement

Step 6: Selecting a supplier

In the Select a Supplier step of the acquisition process the results of the supplier evaluation are judged against established selection criteria, risk associated with each supplier are identified and analyzed, and a cost/benefit analysis is conducted. Based on this information, the final supplier selection is made.

Cost/Benefit Analysis: Cost/benefit analysis now needs to be revisited. This time however, we are looking at the costs and the benefits associated with each individual supplier. In this cost/benefit analysis we will also factor in the costs of risk management activities for each supplier. These costs include the cost of implementing the containment plans, tracking risks and the expected costs if the risks turn into problems. For example:

Costs	Benefits
Acquisition cost - Acquisition and supplier management - ***Risk management*** - Development - Purchase/licensing - New equipment - Acceptance - Roll-out Operating and support costs Maintenance costs - Enhancements - Corrections - Adaptation	Increased efficiency/ effectiveness Increased profits/revenues Marketplace advantages Take advantage of innovation Response to competition Adaptation to change (e.g., environment, technology, business rules, regulations) Increased customer/employee satisfaction

Supplier Scoring: A final scoring matrix can be created to summarize all of the evaluation criteria information and lower level scores for individual cost, schedule, product and process attributes.

Care should be taken that all information is gathered and the suppliers are scored at the same time in each of the respective criteria to eliminate variances in the scoring. This is best performed in a group-scoring meeting where participants have all of the gathered information available to assist in their scoring decisions and the scoring activity can maintain momentum and consistency.

Supplier Qualification Audits: Once the primary supplier candidate has been selected; a supplier qualification audit may be used as a final in -depth evaluation of that supplier's quality system and capability to produce the required software prior to final selection. An audit is a planned, independent and documented assessment to determine whether agreed-upon requirements are being met. A quality system audit evaluates an organization's existing quality program's adequacy and conformance to company policies, contractual commitments, industry standards and/or regulatory requirements.

The Acquisition Team selects an auditing organization (e.g., in -house audit team or external audit team) and defines the scope and objectives of the audit. The supplier provides the audit organization with the requested audit inputs (e.g., process and product documentation, plans, quality records). The lead auditor prepares the audit plan. Auditors prepare for the audit by studying the relevant documentation prior to the on-site visit. This allows the auditor to determine if the quality system is properly designed and/or documented. The auditors should evaluate the documentation to ensure that it is appropriate, adequate and current. The execution step of the audit is the actual on-site visit where data and information are gathered. The job of the auditors is to collect factual information, analyze and evaluate it in terms of the specified requirements, draw conclusions from this comparison and report results to management. After the completion of the on-site visit, the lead auditor prepares an audit report detailing the findings of the audit. If a decision is made to actually select the supplier, any non-conformances or noncompliance found during the audit should be followed up by the auditee's management with corrective action plans. The audit team is then responsible for validating that the corrective actions were appropriately implemented and that they were effective in resolving the non-conformances or noncompliance. This step may impact the final negotiations and contract award step of the acquisition process.

Step 7 - Negotiate and Award Contract

Once the supplier has been selected the contract or agreement terms are negotiated and the contract is awarded. Now is the time to do the final negotiation with the preferred supplier. In this step, the final terms of the contract are negotiated and the contract is awarded.

Leverage: The information we have acquired through researching supplier candidates can now be used to our advantage in negotiating the final terms.

We should also consider areas where we have leverage including, potential future sales including support agreements and additional software.

Information we have gained about the strengths of the supplier's competitors and the supplier's own weaknesses.

Use of our corporate identify as reference (future marketing).

We should also consider the leverage that the supplier has, including:

Market place share, reputation, business stability and product recognition.

Superior process capability.

Domain knowledge and experience.

Superior product capabilities including functions or features that no other supplier can provide.

Risk Sharing: The contract should equitably allocate the risks of the acquisition project between the supplier and the acquirer. This allocation should be based on which party is best able to manage the risk. Risks essentially fall within three categories: cost, schedule and performance. Each of these three categories of risk deserves a separate discussion in the contract.

7.13 Summary

Technology and information systems play an ever-increasing role in today's organizational environment. Because of the rapidly changing nature of technology developments, it is sometimes difficult to employ standard planning processes. The primary guideline for information systems planning is that the planning process must be designed and conducted in alignment with organizational and business plans. Most organizations now agree that IS is an important strategic organizational resource that can provide strategic advantage and boost business performance . As part of their plan, many organizations have adopted a sense and respond position with regard to opportunities that may present themselves. Often, a scenario development approach that looks to possible future developments is essential to help combat the rapid rate of technology change. There are multiple planning tools available for the strategic information systems planning process. Choosing the tools that meet the needs of the organization and lend focus to the desired areas of emphasis is critical. Finally, organizations should consider the introduction of technology-driven approaches to planning to help with speed, efficiency, flexibility and communications.

Distributed client/server networks at the corporate, department, workgroup, and team levels came into being, which promoted a shift of databases and information specialists to some departments and the creation of information centers to support end-user and workgroup computing. Lately, the trend is to establish more centralized control over the management of the IT resources of a company while still serving the strategic needs of its business units, especially their e-business and e-commerce initiatives. This trend has resulted in the development of hybrid structures with both centralized and decentralized components. Most organizations still establish and enforce policies for the acquisition of hardware and software by end users and business units. This process ensures their compatibility with company standards for hardware, software, and network connectivity. Also important is the development of applications with proper security and quality controls to promote correct performance and safeguard the integrity of corporate and departmental networks and databases. Having a defined software acquisition and supplier management process facilitates the propagation of lessons learned from one acquisition project to the next so we can repeat our successes and stop repeating actions that lead to problems.

7.14 Key Words

- **Information System:** The term information system usually refers to a computer-based system, one that is designed to support the operations, management, and decision functions of an organization.
- **System**: A system is a set of components that operate together to achieve a common purpose.
- **Planning** : It refers to the preparatory steps that ensure that business, organizational and information strategies aligned in a complementary fashion.
- **Information Resource Management :** It is the management of the resources concerned with the systems support and the servicing of information for an enterprise.
- **Hardware acquisition:** Planning of the hardware requires the identification of hardware options & selection of the hardware for most suitable applications.
- **Maintenance**: After the delivery and installation of a system the vendor is responsible for its upholding under the specific warranty time period.
- **COTS:** Commercial off the Shelf Software

7.15 Self Assessment Test

1 What do you mean by information system planning? Explain planning process in detail.

2. Explain Nolan's stage model.

3. What is information resource management? Explain IRM3.

4. What do you understand by System Acquisition?

5 Discuss various aspects involved in acquisition of hardware?

6 Explain various steps for software acquisition?

7 What is in-house development of the Software?

7.16 References

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such as political system, economic system, educational system and so forth. The objective of the system demands that some output is produced as a result of processing the suitable inputs.

Our definition of a system suggests some characteristic that are present in all systems: organization (order), interaction, interdependence, integration, and a central objective.

Organization

Organization implies structure and order. It is the arrangement of components that helps to achieve objectives.

Interaction

Interaction refers to the manner in which each component functions interact with other components of the system. In computer system, the central processing unit must interact with the input device to solve a problem.

Interdependence

Interdependence means that parts of the organization or computer system depend on one another. They are co-ordinate and linked together according to a plan. One subsystem depends on the input of another subsystem for proper functioning: that is the output of one subsystem is required input for another subsystem. The interdependence is crucial in system work.

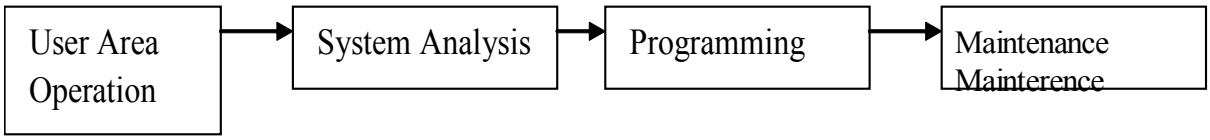


Figure 8.1 : Task interdependence in a computer based subsystem

Integration

Integration refers to the holism of system. Synthesis follows analysis to achieve the central objective of the organization. Integration is concerned with how a system is tied together. It is more than sharing a physical part or location. It means that partners of the system work together within in a system even though each part performs a unique function. Successful integration will typically produce a synergistic effect and greater total impact than if each component works separately.

Central Objective

The objectives may be real or stated. Although a stated objective may be real objective, it is not uncommon for an organization to state one objective and operates to achieve another. The most important point is that users must know the central objective of a computer application early in the analysis for a successful design and conversion.

8.2 System Development Life Cycle

The SDLC is a common methodology for systems development in much organization, it features several phases that mark the progress of the systems analysis and design effort. At first glance, the life cycle appears to be a sequentially ordered set of phases, but it is not. The specific steps and their sequence are meant to be adapted as required for a project, consistent with management approaches.

(c) System Analysis

The next phase is system analysis. Analysis involved a detailed study of the existing system in use, leading to specifications of a new system. Analysis is a detailed study of various operations performed by a system and their relationships within and outside the system. During analysis, data are collected on the available files, decision points and transactions handled by the present system. Interviews, on-site observation and questionnaire are the tools used for system analysis. Using the following steps it becomes easy to draw the exact boundary of the new system under consideration:

- Keeping in view the problems and new requirements
- Workout the pros and cons including new areas of the system

All procedures, requirements must be analysed and documented in the form of detailed data flow diagrams (DFDs), data dictionary, logical data structures and miniature specifications. System Analysis also includes sub-dividing of complex process involving the entire system, identification of data store and manual processes.

The main points to be discussed in system analysis are:

- Specification of what the new system is to accomplish based on the user requirements.
- Functional hierarchy showing the functions to be performed by the new system and their relationship with each other.
- Function network which are similar to function hierarchy but they highlight the those functions which are common to more than one procedure.
- List of attributes of the entities - these are the data items which need to be held about each entity (record)

(d) System Design

Based on the user requirements and the detailed analysis of a new system, the new system must be designed. This is the phase of **system designing**. It is a most crucial phase in the development of a system. Normally, the design proceeds in two stages:

Preliminary or general design: In the preliminary or general design, the features of the new system are specified. The costs of implementing these features and the benefits to be derived are estimated. If the project is still considered to be feasible, we move to the detailed design stage.

Structure or Detailed design: In the detailed design stage, computer oriented work begins in earnest. At this stage, the design of the system becomes more structured. Structure design is a blue print of a computer system solution to a given problem having the same components and inter-relationship among the same components as the original problem. Input, output and processing specifications are drawn up in detail. In the design stage, the programming language and the platform in which the new system will run are also decided.

There are several tools and techniques used for designing. These tools and techniques are:

- Flowchart
- Data flow diagram (DFDs)
- Data dictionary
- Structured English
- Decision table
- Decision tree

- Manual results can be compared with the results of the computerised system.
- Failure of the computerised system at the early stage, does not affect the working of the organisation, because the manual system continues to work, as it used to do.

i. **Pilot run:** In this type of run, the new system is installed in parts. Some part of the new system is installed first and executed successfully for considerable time period. When the results are found satisfactory then only other parts are implemented. This strategy builds the confidence and the errors are traced easily.

(h) Maintenance

Maintenance is necessary to eliminate errors in the system during its working life and to tune the system to any variations in its working environment. It has been seen that there are always some errors found in the system that must be noted and corrected. It also means the review of the system from time to time. The review of the system is done for:

- knowing the full capabilities of the system
- knowing the required changes or the additional requirements
- studying the performance

If a major change to a system is needed, a new project may have to be set up to carry out the change. The new project will then proceed through all the above life cycle phases.

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

8.3 System Development Models

8.3.1 Waterfall Model

The Waterfall model is a sequential development approach, in which development is seen as flowing steadily downwards (like a waterfall) through the phases of requirements analysis, design, implementation, testing (validation), integration, and maintenance. The first formal description of the method is often cited as an article published by Winston W. Royce in 1970 although Royce did not use the term "waterfall" in this article. The basic principles are:

- Project is divided into sequential phases, with some overlap and splash back acceptable between phases.
- Emphasis is on planning, time schedules, target dates, budgets and implementation of an entire system at one time.
- Tight control is maintained over the life of the project via extensive written documentation, formal reviews, and approval/signoff by the user and information technology management occurring at the end of most phases before beginning the next phase.

The Waterfall model is a traditional engineering approach applied to software engineering. It has been widely blamed for several large-scale government projects running over budget, over time and sometimes failing to deliver on requirements due to the Big Design Up Front approach. Except when contractually

The basic principles are:

- Focus is on risk assessment and on minimizing project risk by breaking a project into smaller segments and providing more ease-of-change during the development process, as well as providing the opportunity to evaluate risks and weigh consideration of project continuation throughout the life cycle.
- "Each cycle involves a progression through the same sequence of steps, for each part of the product and for each of its levels of elaboration, from an overall concept-of-operation document down to the coding of each individual program."
- Each trip around the spiral traverses four basic quadrants: (1) determine objectives, alternatives, and constraints of the iteration; (2) evaluate alternatives; Identify and resolve risks; (3) develop and verify deliverables from the iteration; and (4) plan the next iteration.
- Begin each cycle with an identification of stakeholders and their win conditions, and end each cycle with review and commitment.

8.3.4 Rapid Application Development

Rapid application development (RAD) is a software development methodology, which involves iterative development and the construction of prototypes. Rapid application development is a term originally used to describe a software development process introduced by James Martin in 1991. The basic principles are:

- Key objective is for fast development and delivery of a high quality system at a relatively low investment cost.
- Attempts to reduce inherent project risk by breaking a project into smaller segments and providing more ease-of-change during the development process.
- Aims to produce high quality systems quickly, primarily via iterative Prototyping (at any stage of development), active user involvement, and computerized development tools. These tools may include Graphical User Interface (GUI) builders, Computer Aided Software Engineering (CASE) tools, Database Management Systems (DBMS), fourth-generation programming languages, code generators, and object-oriented techniques.
- Key emphasis is on fulfilling the business need, while technological or engineering excellence is of lesser importance.
- Project control involves prioritizing development and defining delivery deadlines or "timeboxes". If the project starts to slip, emphasis is on reducing requirements to fit the timebox, not in increasing the deadline.
- Generally includes joint application design (JAD), where users are intensely involved in system design, via consensus building in either structured workshops, or electronically facilitated interaction.
- Active user involvement is imperative.
- Iteratively produces production software, as opposed to a throwaway prototype.
- Produces documentation necessary to facilitate future development and maintenance.

The user request identifies the need for change and authorizes the initial investigation. It may undergo several modifications before it becomes a written commitment. Once the request is approved the following activities are carried out background investigation, fact-finding and analysis and presentation of results called project proposal.

Needs identification

User need identification and analysis are concerned with what the user needs rather than what he/she wants not until the problem has been identified, defined and evaluated should the analyst think about solution and whether the problem is worth solving. This step is extended to help the user and the analyst understand the real problem rather than its symptoms.

Determining the user's information requirements

Shared, complete and accurate information requirement are essential in building computer based information system. The information analyst determines the need of the user and the information flow that will satisfy those needs.

There are several reasons why it is difficult to determine the user requirements:-

1. System requirements change and user requirements must be modified to account for these changes.
2. The articulation of requirement is difficult, except for experienced users. Function and processes are not easily described.
3. Heavy user involvement and motivation are difficult Reinforcement for their work is usually not realized until the implementation phase too long to wait.
4. The pattern of interaction between users and analysts in designing information requirements are complex.

8.4.1 Strategies for requirement determination

There are three key strategies or general approaches for eliciting information regarding the user'srequirements:-

This strategy obtains information from users by simply asking them about the requirements. It assumes a stable system where the users are well informed and can overcome basis in defining their problems. There are three key asking methods:

i) Questions may be open-minded or closed.

ii) Brainstorming

iii) Group consensus

Getting information from the existing information

It simply asks the user what information is currently received and what other information is required. This is called the data analysis. The data analysis method is ideal for making structured decision, although it requires that users articulate their information requirements. A major drawback is a lack of established rules for obtaining and validating information needs that are not linked to organization objectives.

Prototyping

The third strategy for determining user information requirement is used when the user cannot establish information needs accurately before the information system is built. The iterative discovery approach captures

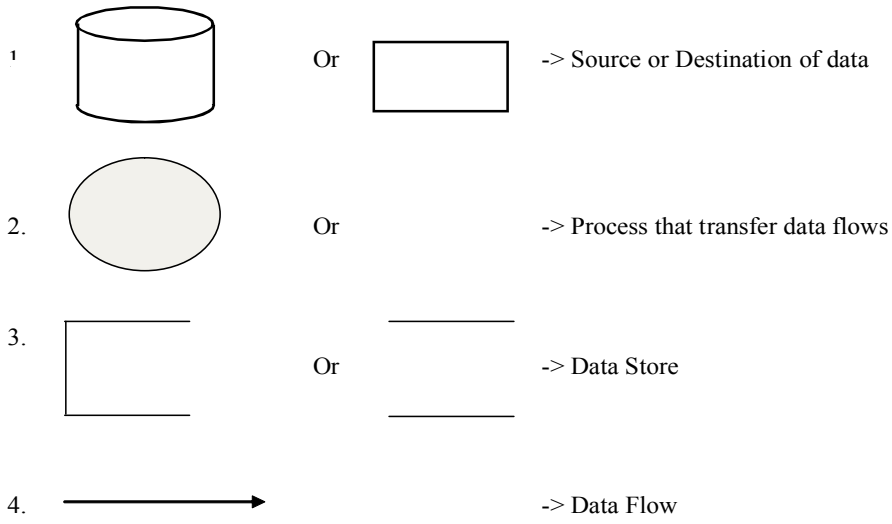
capture, manipulate, store and distribute data between a system and its environment and between components within a system. The final deliverables and outcomes for DFD are:

- Context data flow diagram, which defines the boundary of the system.
- DFDs of current physical system determine how to convert the current system into its replacement.
- DFDs of current logical system.
- DFDs of new logical system.

In a DFD, there are only four symbols that represent the same things: data flows, data stores, processes, and source/sinks (or external entities).

1. An **arrow** indentifies **data flow** as data in motion, moving from one place in a system to another.
2. An **open rectangle** defines **data store**; data as rest, which may take the form of many different physical representations.
3. A **circle or a bubble** defines a **process** is the work or actions performed on data so that they are transformed, stored, or distributed.
4. A **square** defines a **Source/sink** is the origin or destination of data, sometimes referred to as external entities.

Basic Symbols:



Data flow diagrams should be mechanically correct, but they should also accurately reflect the information system being modeled. To that end, analyst should check DFDs for completeness and consistency and draw them as if the system being modeled were timeless. Complete sets of DFDs should extend to the primitive level where every component reflects certain irreducible properties. Following above guidelines, DFDs can aid the analysis process by analyzing the gaps between existing procedures and desired procedures and between current and new systems.

It is common practice for a database designer to begin the process by drawing a context-level DFD, which shows the interaction between the system and outside entities. This context-level DFD is then "exploded" to show more detail of the system that is being modeled. It is the starting point in the system design that decomposes requirements to the lowest level of detail. It identifies major transformations that eventually become programs in system design. It consists of a series of bubbles joined by lines. Bubbles represent transformations and the lines represent the data flows in the system.

- Display (0 or 2 decimal places).
- Examples and often statements about where each data element appears within the data modeling diagrams (e.g. which processes, data stores, data flows).

Logic Modeling involves representing the internal structure and functionality of the processes represented on data flow diagrams. In the analysis phase, logic modeling will be complete and reasonably detailed, but it will also be generic in that it will not reflect the structure or syntax of a particular programming language. There are three traditional tools for logic modeling: structure English, decision tables and decision trees.

8.5.3 Structured English: It is modified form of the English language used to specify the logic of information system processes. Although there is no single standard, structured English typically relies on action verbs and noun phrases and contains no adjectives or adverbs. When the process logic involves formulas or iteration or when structured decisions are not complex, an appropriate technique for analyzing the decision process is the use of Structure English. As the name implies, Structure English based on flowing elements:

1. Operation statements written as English phrases executed from the top down.
2. Conditional blocks indicated by keywords such as IF, THEN & ELSE.
3. Repetition blocks indicated by keywords such as DO, WHILE & UNTIL.

Example: Structure English

Compute-Discount

Add up the number of copies per book title

IF order is from bookstore

and-IF order is for 6 copies or more per book title

THEN: discount is 25%

Else (order is for fewer than 6 copies per book title)

SO: no discount is not allowed

ELSE (order is from libraries or individual customers)

so-IF: order is for 50 copies or more per book title

discount is 15%

ELSE IF order is for 20 to 49 copies per book tilte

discount is 10%

ELSE IF order is for 6 to 19 copies per book title

discount is 5%

ELSE (order is for less than 6 copies per book title)

SO: no discount is allowed

Criteria	Structured English	Decision Table	Decision Tree
Determining conditions & actions	Second Best	Third Best	Best
Transforming conditions & actions into sequence	Best	Third Best	Best
Checking consistency & completeness	Third Best	Best	Best

The comparison between decision table and decision trees is shown in table 3.

Table 3

Criteria	Decision Tables	Decision Trees
Portraying complex logic	Best	Worst
Portraying simple problems	Worst	Best
Making decisions	Worst	Best
More compact	Best	Worst
Easier to manipulate	Best	Worst

Third, data modeling develops the definition, structure, and relationships within the data. Many analysts believe that a data model is the most important part of the statement of information system requirements. This belief is based on following reasons:

- The characteristics of data captured during data modeling are crucial in the design of databases, programs, computer screens, and print reports
- Data rather than processes are the most complex aspects of many modern information systems and hence require a central role in structuring system requirements.
- The characteristics about data (such as length, format, and relationship with other data) are reasonable permanent.

8.5.5 E-R Diagram: The most common format used for data modeling is **entity-relationship (E-R)** diagramming. E-R data model is a detailed, logical representation of the data for organization or for a business area. There are three main constructs in E-R diagram: data entities, relationships, and their associated attributes. An entity is a person, place, object event, or concept in the user environment about which the organization wishes to maintain data. Each entity type has a set of attributes associated with it. An attribute is a property or characteristic of an entity that is of interest to the organization. Relationships are the glue that holds together the various components of an E-R model. A relationship is an association between the instances of one or more entity types that is of interest to the organization. A graphical representation of the data layout of a system at a high level of abstraction defines data elements and their inter-relationships in the system.

Entity Relationship Diagram – Notation

- Ready availability of high-powered computer-based tools to support systems development and easy maintenance.

Comparing with seven phases standard SDLC, RAD SDLC has only four phases. They are planning, design, development, and cutover. RAD pushes analysis and part of design jobs of standard SDLC into one design step. Actually, RAD is not a single methodology but is instead a general strategy of developing information systems, which takes account human factors and corporate culture as well as technology. To succeed, RAD relies on bringing together several system development components, such as JAD, prototyping, and all kinds of traditional requirements structuring methods. It is impossible to do so without using the high-powered computer-based tools such as visual tools and integrated CASE tools, which include code generators for creating code from the designs end users and analysts create during prototyping. According to Martin, there are four necessary pillars for RAD approach: tools, people, methodology, and management.

Advantages of RAD:

- Time saving, money saving, human effort saving
- Tighter fit between user requirements and system specifications
- Best fit for quickly changed business environment
- Concentrates on essential system elements from user viewpoint.

Disadvantages of RAD:

- High costs of commitment on the part of key user personnel
- Easy to ignore some issues, such as missing information on underlying business processes, inconsistent internal designs with and across systems, lack of scalability, lack of attention to later systems administration built into the system, etc

In one sentence, RAD heavily depends on JAD and Prototyping, so it inherits the advantages of these two approaches while it has to tolerate the disadvantages of the two. Last but not the least, the RAD approach is not appropriate to all projects Project scope, size and circumstances all determine the success of a RAD approach.

Object-oriented system analysis abstracts concepts from the application domain and describes what the intended system must do, rather than how it will be done. Instead of using functional decomposition of the system, the OOA approach focuses on identifying objects and their activities. Using the Object-oriented approach, system analysts model information systems by identifying a set of objects, along with their attributes and operations that manipulate the object data. Objects are grouped into classes that have common properties. Classes are organized into hierarchies, in which the subclasses inherit the properties, including the data definitions and operations. The model specifies the functional behavior of the system, independent of concerns relating to the environment in which it is to be finally implemented.

The OO analysts need to devote sufficient time to clearly understand the requirements of the problem and the analysis model should capture those requirements completely and accurately. The core of OO is reusability. The whole OO system is built on inheritance, so a subtle misunderstanding of the basic requirements of the problem may cause the whole system seems ridiculous. OOA is inspired by nowadays very popular object-orient programming (OOP). The traditional system analysis methods cannot adapt to OOP to make the whole development process smoother and seamless, so OOA comes up and tries to solve such problem. [7] The outcomes of OOA usually are considered reusable for further OO system development

- Defines the boundary and interaction between the system and the outside world
- Composed of: Statement of Purpose, Context diagram, and Event List

(C) Behavioral Model

- Model of the internal behavior and data entities of the system
- Models the functional requirements
- Composed of Data Dictionary, Data Flow Diagram, Entity Relationship Diagram, Process Specification, and State Transition Diagram

(D) Implementation Model

- Maps the functional requirements to the hardware and software. Minimizes the cost of development and maintenance
- Determines which functions should be manual vs. automated. Can be used to discuss the cost-benefits of functionality with the users/stakeholders
- Defines the Human-Computer interface
- Defines non-functional requirements
- Tools: Structure Charts

In the design stage, the programming language and the hardware and software platform in which the new system will run are also decided.

The system design involves:

i. Defining precisely the required system output

ii. Determining the data requirement for producing the output

iii. Determining the medium and format of files and databases

iv. Devising processing methods and use of software to produce output

v. Determine the methods of data capture and data input

vi. Designing Input forms

vii. Designing Codification Schemes

viii. Detailed manual procedures

ix. Documenting the Design

Requirements structuring is the process to use some kind of systematical and standard, well-structured methods to model the real world. Traditionally, we use data flow diagram for process modeling, decision table or decision tree for logic modeling, and Entity-relationship diagram for data modeling. These modeling tools usually separately model only one face of the real world. So, when we try to show the integral picture of a system, we usually choose more than one of the above requirements structuring methods.

5. Explain Spiral model of development with diagram.

6. The analysis and design of information systems is driven from an organizational perspective and not from technology perspective. Do you agree? Justify your stand.

7. Justify the statement "System analysis and design is an agent of change and innovation in an organization."

8.11 References

- System Analysis and Design – Awad, E,2000
- Modern Syatem Analysis and Design- Hoffer J., George J., Valacich J., Panigrahi P., Pearson Education,2008.
- . Practical System Design – Daniels, Galgotia Publication Pvt. Ltd.

Every system works as a part of a larger system and contributes to it. The implementation process finds a place in the later part of the different phases of software development life cycle. The approach adopted to develop a system should take into consideration the environment and peripherals with which this system will interface and the path chosen for the development should give equal amount of consideration to the economic, technical and operational feasibility.

The development and building of a new information system results in an organizational change. A major challenge being faced by organizations is to manage this change effectively. Change may be forced on an organization, or an organization may change in response to the external environment or an internal need. The implementation of a new system implies organizational change. When change occurs in any part of the organization then it has effects on the whole management system and balancing this change becomes a demanding task.

9.2 System Implementation

After the maintenance, the implementation phase of the systems development life cycle is the most expensive and time consuming phase. The design of an information system for any organization is always followed by a number of tasks that need to be completed so as to achieve the installation and operation of the new system. This process is called systems implementation. The implementation of a system is an extensive intricate journey by which organizations move from an old technology to a newer one.

Implementing a new information system into an organizational context is not a mechanical process. The organizational context has been shaped and reshaped by the people who work in the organization. The work habits, beliefs, inter-relationships, and personal goals of these members all effect the implementation process. In spite of identifying the factors influencing the successful implementation of a system , there are no sure recipes that can be followed to evade any resistance. To implement a system successfully, a large number of inter-related tasks need to be carried out in an appropriate sequence.

Utilizing a well-proven implementation methodology and enlisting professional advice can help, but often the number of tasks, poor planning and inadequate resources may cause problems with an implementation project. Following tasks are accomplished during system implementation:

(1) ***Acquisition of hardware:*** In case there is a process of replacing a manual system by a computer based system this process of acquisition of hardware becomes an important activity. The type of hardware required for implementation is specified in system analysis and design document.

Process of acquiring hardware: Following steps may be followed while acquiring hardware:

i. ***Determine the requirement:*** In the first step, hardware requirement must be obtained from the designed document. Accordingly, mainframe, mini or micro computer may be required.

ii. ***Proposal:*** In this the RPF i.e., request for proposal is prepared, which is in the form of an order and is sent to different computer vendors. RPF should specify the type of hardware that the organization wants to purchase or get on lease.

iii. ***Evaluation:*** If more than one proposal comes, there is need to evaluate these in two stages – primary stage and the final stage. In the primary stage those proposal are set aside which do not fulfill the initial selection criteria of either cost, technology, etc.

iv. ***Finalization of vendor****:* On the basis of above the vendor is finalized at the committee level and is sent for approval from the financing authority.

v. ***Actual Acquisition:*** On the basis of approval from the financing authority, the authorized person may place the order to the chosen vendor showing him the details of item required, the place where the delivery of the goods is to be made, the mode of transportation and the mode of payment etc. The date of acquisition is finalized and accordingly payments are made.

(4) ***Conversion:*** It is the process of changing over from the existing system to the new system. It may be from manual to computerized system or from one computerized system to a new computerized system. The former is more extensive than the later.

(5) ***User Training:*** As the term itself clarifies, this activity involves training the user to use the system in an optimum way. For example, training a cash- teller to use the ATM. The training period may range from one day to one month or even more depending upon the complexity of task.

(6) ***Post-Implementation Evaluation:*** This involves determining how well the system meets, the performance requirements. Here emphasis is laid on evaluating the development process, hardware, operation and output, unlike system testing, which determines where the system fails so that necessary adjustments can be made, post implementation evaluation includes hardware performance evaluation, operation evaluation and output evaluation.

9.3 Purpose of System Implementation

The purpose of System Implementation can be summarized as making the new system available to a prepared set of users (the deployment), and positioning on-going support and maintenance of the system within the Performing Organization (the transition). At a finer level of detail, deploying the system consists of executing all steps necessary to educate the Consumers on the use of the new system, placing the newly developed system into production, confirming that all data required at the start of operations is available and accurate, and validating that the business functions that interact with the system are functioning properly. Transitioning the system support responsibilities involves changing from a system development to a system support and maintenance mode of operation, with ownership of the new system moving from the Project Team to the Performing Organization.

System implementation involves coding, testing, installation, documentation, training, and support. These listed activities are aimed at the following:

1. Converting the final physical system specifications into operational and reliable software and hardware.
2. Maintaining proper documentation of the work done.
3. Providing help for the current and future users and care takers of the system.

It is not essential that only system development experts are entrusted with these activities. They may be performed by other team members Individuals involved in system implementation should ensure that all of these various activities are properly planned and executed.

A key difference between System Implementation and all other phases of the development life cycle is that all project activities up to this point have been performed in safe, protected, and secure environments, where project issues that arise have little or no impact on day-to-day business operations. Once the system goes live, however, this is no longer the case. Any miscues at this point will almost certainly translate into direct operational and/or financial impacts on the Performing Organization. It is through the careful planning, execution, and management of System Implementation activities that the Project Team can minimize the likelihood of these occurrences, and determine appropriate contingency plans in the event of a problem.

9.4 Process of System Implementation

System implementation is made up of many activities. A broader and appropriate clustering of these activities can include coding, testing, installation, documentation, training, and support. These activities are aimed at

culmination of all prior efforts – where all of the meetings, planning sessions, deliverable reviews, prototypes, development, and testing pay off in the delivery of the final system. It is also the point in the project that often requires the most coordina-tion, due to the breadth and variety of activities that must be performed. Depending upon the com-plexity of the system being implemented, it may impact technical, operational, and cultural aspects of the organization. A representative sample of high-level activities might include the installation of new hardware, increased network capabilities, deployment and configuration of the new system software, a training and awareness campaign, acti-vation of new job titles and responsibilities, and a completely new operational support structure aimed at providing Consumer-oriented assistance during the hours that the new system is available for use (to name a few). Whatever the realm of activities related to the new system, their impacts should be addressed in the Organizational Change Management Plan, while specific deployment activ-ities should all be encompassed in the Project Implementation and Transition Plan, (both created during the Project Planning phase of the Project Management Lifecycle.)

- ***Transition to Performing Organization:*** The purpose of the Transition to performing organization process is to successfully prepare the performing organization to assume responsibility for maintaining and supporting the new application.

In many organizations, the team of individuals responsible for the long-term support and maintenance of a system is different from the team initially responsible for designing and developing the application. Often, the two teams include a comparable set of technical skills. The responsibilities associated with supporting an operational system, however, are different from those associat-ed with new development. In order to effect this shift of responsibilities, the Project Team must provide those responsible for system support in the Performing Organization with a combination of technical documentation, training, and hands-on assistance to enable them to provide an acceptable level of operational support to the Consumers. This system transition is one element (albeit a major one) of the overall Project Implementation and Transition Plan, developed as part of the PM Lifecycle. The Project Manager should review the transition plan to confirm that all defined actions have been successfully completed.

The following figure illustrates all of the processes of system Implementation.

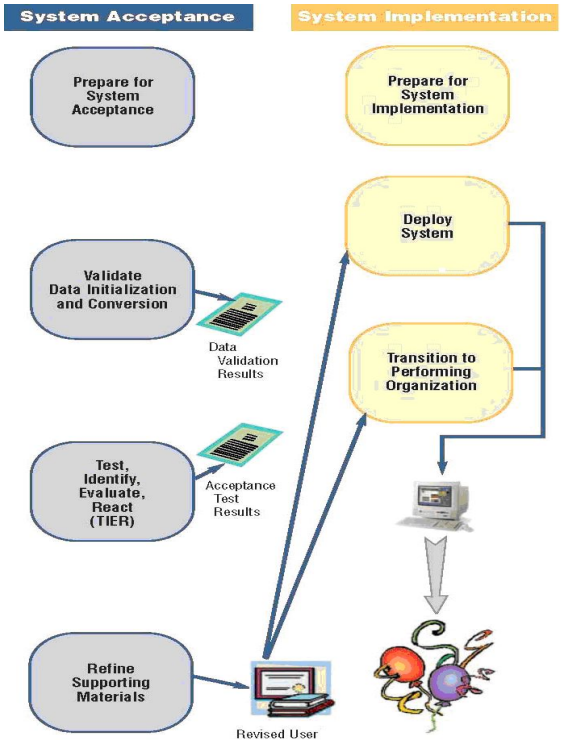


Figure 9.2

of organizational change and go through multiple refinements before they are complete. These refinements involve redefinition, restructuring, reformulations, prototyping and thereby create intermediate completed versions of the system. These imply that any new system will not be implemented successfully without explicit change procedures.

All organizations exist in a changing environment and they themselves are constantly changing. When an organization fails to change, the cost of that failure may be quite high. Organizational change can be difficult to achieve, but adaptive and flexible organizations have a competitive advantage over the rigid and static ones.

It is important to distinguish between change that inevitably happens to all organizations and change that is planned by the organization. Planned organizational change is a conscious attempt to improve the way in which groups, departments or the whole organization function.

There are essentially two underlying objectives of such a change:

1) To improve the ability of the organization to adapt to changes in its environments;

2) To change patterns of employee behaviors.

9.5.1 Importance of Change

Change occurring in any organization is likely to be incremental. This means that change is a process that happens to and proceeds in parallel to a system in operation Change also is not simply the process of demonstrating that the new concept is better for an organization . Change that is viewed as desirable by one group may seem to be a bad idea by others. The most commonly used model for system change is the three-stage model proposed by Kurt Lewin:

1. **Unfreezing** – Create a climate for change and get contracts with users.

2. **Change-** Analysis, Design, Development, and installation.

3. **Refreeze-** Institutionalize the new system.

This model emphasizes the fact that organizational systems which aim at stable environments should take into consideration the views and expectations of their key players and stakeholders. This is an activity to ensure the transition to the new system without hurdles and drastic failures. The effects of organizational change are particularly important for information systems.

The KOLB/FROHMAN model of organizational change elaborates the Lewin model further. According to this model an organizational consultant is responsible for establishing the relationship with the client. The consultant is a person who is not generally an integral part of the system, but an entity from the environment of the system where the change has to take place. This consultant acts as a catalyst for the change process and is often referred to as a change agent.

System designers are generally external **change agents** who may not be well versed with the environment of the organization and also the behavioral patterns of the employees. An active change agent can assure better communication with the user and thus minimize the possibility of misunderstandings. The change agent can be involved through all the stages of the change process so as to assure that refreezing takes place. So implementing this change can sometimes become an up hill task.

Information technology can result in and bring about various degrees of organizational change, which might be incremental to far-reaching . The following kinds of structural organizational change are enabled by information technology:

example, going from a highly reactive, entrepreneurial organization to one that has a more stable and planned development. Experts assert that successful organizational change requires a change in culture – cultural change is another example of organization-wide change. Examples of a change in a subsystem might include addition or removal of a product or service, reorganization of a certain department, or implementation of a new process to deliver products or services.

- **Transformational Versus Incremental Change :**

An example of transformational (or radical, fundamental) change might be changing an organization's structure and culture from the traditional top-down, hierarchical structure to a large amount of self-directing teams. Another example might be Business Process Re-engineering, which tries to take apart the major parts and processes of the organization and then put them back together in a more best possible fashion. Transformational change is sometimes referred to as quantum change. Examples of incremental change might include continuous improvement as a quality management process or implementation of new computer system to increase efficiencies. Many times, organizations experience incremental change and its leaders do not recognize the change as such.

- **Remedial Versus Developmental Change :**

Change can be intended to remedy current situations, for example, to improve the poor performance of a product or the entire organization, reduce burnout in the workplace, help the organization to become much more proactive and less reactive, or address large budget deficits. Remedial projects often seem more focused and urgent because they are addressing a current, major problem. It is often easier to determine the success of these projects because the problem is solved or not.

Change can also be developmental – to make a successful situation even more successful, for example, expand the amount of customers served, or duplicate successful products or services. Developmental projects can seem more general and vague than remedial, depending on how specific goals are and how important it is for members of the organization to achieve those goals. Some people might have different perceptions of what is a remedial change versus a developmental change. They might see that if developmental changes are not made soon, there will be need for remedial changes.

- **Unplanned Versus Planned Change :**

Unplanned change is imposed on the organization and is often unforeseen. changes in government regulations and changes in the economy, for example, are often unplanned. Responsiveness to unplanned change requires tremendous flexibility and adaptability on the part of the organizations. Managers must be prepared to handle both planned and unplanned forms of change in organizations.

Planned change is change resulting from a premeditated decision to alter the organization. companies that wish to move from a traditional hierarchical structure to one that facilitates self-managed teams must use a proactive, carefully orchestrated approach. Essentially there are two goals of organizational change. First, it seeks to improve the ability of the organization to adapt to the changes in its environment and second, it seeks to change the employee behaviour.

If an organization is to survive, it must respond to change in its environment. When competitors introduce new products or services, government agencies enact new laws, important sources of supply go out of business, or similar environmental changes take place, the organization needs to adapt efforts to stimulate innovation, empower employees, and introduce work teams are examples of planned change activities directed at responding to changes in the environment. An organization's success or failure is essentially due

9.6 Summary

A system is a collection of components that work together to realize some objective. Basically there are three major components in every system, namely input, processing and output.

Implementation is the process of installing a newly developed system at the users' premises and continuously getting meaningful output from it. In other words, implementation means putting the developed system into operation. Implementation procedure is a step – by- step method for implementing the newly developed information system. The various steps are:

Purpose of implantation, deployment system and transition to perform organization along with this there is also need to accomplish some task such as acquisition of hardware, acquisition of software, users training, installation, and post implementation evaluation.

Change is inevitable and is a continuing process. Even minor changes may have major repercussions, and what appears to be a minor change to a manager may seem major to those affected by it.

When change occurs in any part of organization, it disturbs the old equilibrium necessitating the development of new equilibrium which takes some time. Organizational changes are mainly classified into five categories – organizational wide versus subsystem change, transformational versus incremental change, remedial versus development change and unplanned versus planned change. Pressure on organization to change is ever never ending therefore, it is requires from managers and employees to identify and overcome resistance to change and to become more effective change agents.

9.7 Keywords

- **Change**: Means to become different from the way something was in the beginning of it.
- **Feasibility Study**: Analysis the viability of proposed project.
- **Implementation**: The last phase of building or acquiring systems: the process of making
- **Phase**: a system operational in the organization.
- **Post Implementation**: Assessing the system after it has been implemented to learn from thesystem development process.
- **Resistance to change** Resistance to change is the action taken by individuals and groups whenthey perceive that a change that is occurring as a threat to them.
- **System**: Set of interacting components that operates together to accomplish acommon purpose.
- **Change Agent**: System designers are generally external **change agents.**
- **Forecasting**: Predicting the future events to avoid problems.

9.8 Self Assessment Test

1 What is meant by system implementation? Discuss various activities involved in it.

2 Explain the different phases of system development life cycle.

3 Explain the purpose and process of system implementation.

4 Why is system maintenance necessary?

Unit -10 : Evaluation & Maintenance of Information System

Unit Structure:

10.0 Objectives

After reading this unit you will be able to understand :-

- Concept of MIS.
- Evolution and evolution approaches.
- Evolution classes.
- System maintenance.

10.1 Introduction

A **management information system** (**MIS**) provides information that is needed to manage organizations efficiently and effectively. Management information systems involve three primary resources: people, technology, and information or decision making. Management information systems are distinct from other information systems in that they are used to analyze operational activities in the organization. Academically, the term is commonly used to refer to the group of information management methods tied to the automation or support of human decision making, e.g. decision support systems, expert systems, and executive information systems.

The successful MIS supports a business' long range plans, providing reports based upon performance analysis in areas critical to those plans, with feedback loops that allow for titivation of every aspect of the enterprise, including recruitment and training regimens. MIS not only indicate how things are going, but also why and where performance is failing to meet the plan. These reports include near-real-time performance of cost centers and projects with detail sufficient for individual accountability. This unit covers the concept of MIS, Evolution and evolution approaches , evolution classes and system maintenance.

Evaluation of MIS is an integral part of the management control process, in which the organizations determine or appraise the quality or worth of their information systems. In other words, evaluation of MIS is a process of measuring performance of organizational information systems. The feedback so obtained helps determine the necessary adjustments to be made in their information systems.

10.2 Evaluation Approaches

There are different approaches to evaluate MIS in an organization. The MIS evaluation approaches provide different means to measure accomplishments of system objectives. Hamilton's survey (1980) indicates that

provided, an analysis of the actual use process, and cost/benefit analysis of the system and its effects on the user performance.

10.3 Evaluation Classes

Evaluation of performance measurement consist of two major classes (Davis and Olson, 1985), as given below:

Effectiveness

This refers to the quality of the outputs from the system. Effectiveness means doing the 'right' thing in the right manner so that desired result may be achieved. Information System is said to be effective if its product (i.e. output) is of quality, and the process of producing output is right (effective).

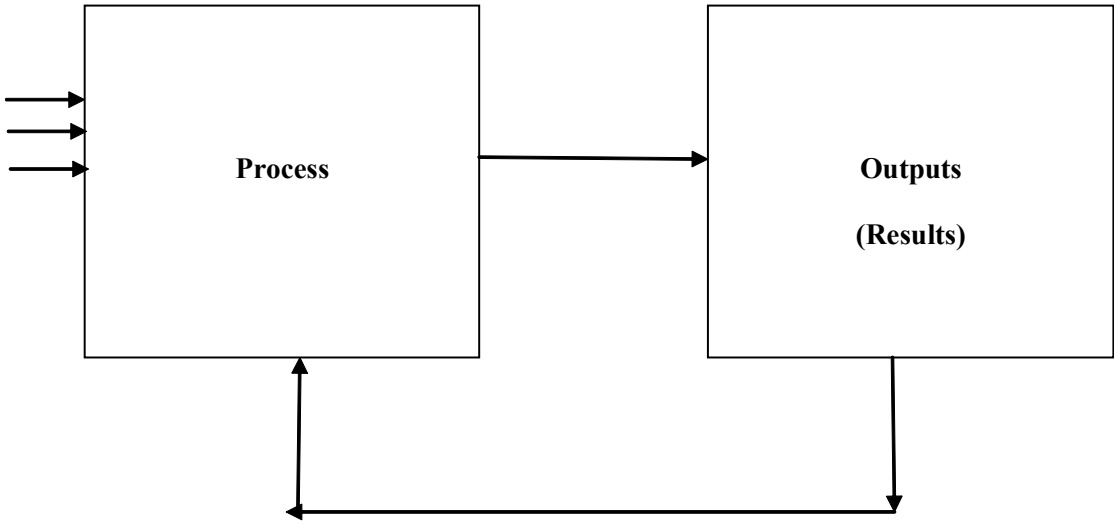


Figure 10.1 : Relation between Efficiency and Effectiveness

Efficiency

It is a measure of the amount of resources required to achieve the output, i.e. the use of system resources to get results. Being efficient implies the system is operating the 'right' way.

The relationship between effectiveness and efficiency is that effectiveness is a measure of 'goodness' of output, while efficiency is a measure of the resources required to achieve the output. This relationship has also in above diagram.There are various dimensions of information systems that should be evaluated. These may include the development process, which, concerns whether the system was developed following set standards; information being provided and the information system performance. Depending upon the dimensions of the information system to be evaluated, an appropriate evaluation approach may be adopted. To understand the concept of MIS evaluation, two types of evaluation have been discussed in this section. These are product-based evaluation and economic evaluation; where one type of evaluation (economic) focuses on the costs/benefits of MIS, the other type focuses on the product, i.e. information support from the MIS.

Product-Based MIS Evaluation

Since the focus of the product-based evaluation is on the product (information support) or the output from the system, the evaluation may be termed as effectiveness evaluation. For assessing the effectiveness of output from MIS, the following model may be used.

serves as a standard or effectiveness norm. against which the organization may compare the effectiveness of the existing MIS to determine deviations, if any. It is on the basis of this comparison that an MIS may be termed as either effective or otherwise. The tolerance limit for defective reports may be decided by the organizations concerned; it may vary from 5 to 20% and accordingly, the standards for an effective MIS may be computed in terms of its as follows.

On the five-point scale, the total scale is divided into four parts. Taking the total scale equal to 100, each part on the scale is equal to the value of 25. Thus on this scale, 100%, 75%, 50%, 25% and 0% of the reports are represented by a score of 4,3,2,1 and 0, respectively. According to this conversion rule, 1% of the reports would be represented by $1/25^{th}$ (0.04) part on the scale. For 90% of the reports, the score may be calculated as below.

If 1% of the outputs are represented by a score of 0.04 part on the scale.

90% of the outputs are represented by a score of on the scale.

Therefore, 90% of the outputs will be represented on the scale by an effectiveness score of 3.6. from the above, it may be said that for 5%, 10% and 15% defective reports should be equal to 3.8, 3.6 and 3.4, respectively.

Cost/Benefit-Based Evaluation

In cost/benefit evaluation, a thorough study of various expected costs, the benefits to be expected from the system and expected savings, if any, is done. It is an economic evaluation of the system, in which costs to be incurred for developing, implementing and operating a system are to be justified against the expected benefits from the system. In other words, costs/benefit analysis determines the cost-effectiveness of the system.

For undertaking cost/benefit evaluation, various estimates of costs as well as benefits expected from the system are to be made. In developing cost estimates for a system, several cost elements are considered. Among them are initial development costs, capital costs, operating costs, etc. Similarly expected benefits from the system are performance/decisions, etc. The various categories of costs and benefits are measured and included in cost/benefit analysis. A brief description of all these cost elements and benefits is given below.

Initial Development Cost

Initial development cost is the cost incurred in developing an information system. Various elements of development cost include project planning cost, feasibility study cost, design cost, conversion cost, implementation cost (including user training cost, testing costs, etc.) in other words, total development cost is considered one-time cost and is termed as initial development cost.

Capital Cost

Capital cost is also one-time cost. It is the cost incurred in facilities and in procuring various equipment, including hardware, etc., required for the operation of the system. Facility costs are expenses incurred in the preparation of the physical site where the system will be implemented. It includes wiring, flooring, lighting, acoustics, and air-conditioning cost. The cost on space required for office, storage and computer room, if not hired, is also included in the facility cost. Hardware and equipment cost relates to the actual purchase or lease of the computer and peripherals.

Annual Operating Cost

Annual operating cost is the cost incurred in operating the system. It includes computer and equipment maintenance cost, personnel cost, overheads and supplies cost. Computer and equipment are to be maintained and thus some cost is incurred, known as Annual Maintenance Cost (AMC). Similarly, personnel are

Fixed costs are constant costs and do not change, regardless of how well a system is used. They are only one-time cost like development cost, capital and insurance cost, etc., whereas variable costs are incurred on a regular basis. They are usually proportional to work volume and continue as long as the system is in operation. For example, the cost of supplies depends upon the size and volume of reports/processing work. Fixed benefits are also constant and do not change. For example, 10 percent reduction in staff as a result of the new system is a fixed benefit. Variable benefits, on the other hand, are realized on a regular basis. For example, the amount of daily time saved of a manager varies with the number and types of decisions taken.

Once the variable of interest and their respective figures are identified, a table, known as MIS evaluation table may be prepared, as shown in Table given below.

The MIS evaluation table summarizes the benefits to be expected from the system, the expected costs and expected savings, if any, for the MIS user. The annual savings and rate of return are computed by using any or a combination of evaluation methods which have been mentioned below. Equipment life has tended to be relatively short because of technological obsolescence; for medium-to-large scale equipment, it is estimated to be five years; for microcomputers, owing to faster obsolescence, it is considered to be three years.

Table : MIS Evaluation Form

Name of the organization _____ Address_____ _____	Date _____ Ref. No. _____
(A) Estimated Initial Development Cost	
1. Project Planning	Rs. _____
2. Feasibility Study	Rs. _____
3. Design	Rs. _____
4. Conversion	Rs. _____
5. Implementation	Rs. _____
6. Miscellaneous	Rs. _____
Total (A)	
(B) Estimated Capital Cost	
1. Computer Room Equipment and H/W	Rs. _____
2. Facilities	Rs. _____
Total (B)	Rs. _____
(C) Estimated Capital Cost	
1. Personnel	Rs. _____
2. Computer/Equipment Rent	Rs. _____
3. Overhead and Supplies	Rs. _____
Total (C)	Rs. _____
(D) Estimated Operatin Cost	
1. Reduced Salary and Labour Cost	Rs. _____
2. Reduced Inventory Cost	Rs. _____
3. Better Decisions	Rs. _____
4. Any Other Intangible Benefit	Rs. _____
Total (D)	Rs. _____
(E) Annual Savings D - C	
(F) Rate of Return (rate at which present value of savings Savings equals present value of one-time costs) (Pv of E = Pv of A+B)	-%

10.4.2 Types of Maintenance

For the purpose of convenience, maintenance may be categorized into three classes, namely;

Corrective Maintenance

This type of maintenance implies removing errors in a program which might have crept in the system due to faulty design or wrong assumptions. Thus, in corrective maintenance, processing or performance failures are repaired.

Adaptive Maintenance

In adaptive maintenance, program functions are changed to enable the information system to satisfy the information needs of the users. This type of maintenance may become necessary because of organizational changes which may include:

(i) Change in the organizational procedures,
(ii) Change in organizational objectives, goals, policies, etc.,
(iii) Change in forms,
(iv) Change in information needs of managers,
(v) Change in system controls and security needs, etc.

Perfective Maintenance

Perfective maintenance means adding new programs or modifying the existing programs to enhance the performance of the information system. This type of maintenance is undertaken to respond to the user's additional needs which may be due to the changes within or outside of the organization. Outside changes are primarily environmental changes, which may in the absence of system maintenance, render the information system ineffective and inefficient. These environmental changes include:

(i) Change in governmental policies, laws, etc.,
(ii) Economic and competitive conditions, and
(iii) New technology.

No doubt, maintenance is regarded as a necessary evil but it should not be delegated to junior programmers; nor should it be performed on a haphazard or informal basis; rather maintenance must be given its due status in the organization and should be, as far as possible, properly planned and the maintenance responsibility should be entrusted to a qualified supervisor and team of MIS experts.

Classification of Maintenance

System Maintenance can be understood under four categories depending upon change in the systems.

Slipstream Upgrade

A minor upgrade typically a code adjustment or minor bug fix which may not be announced.

Many companies don't announce to users that a slipstream upgrade has been made. A slipstream usually requires recompiling all the code, so it can create entirely new bugs.

Patch

A minor change to correct problem or make small enhancement. It usually addition to an existing program. That is the programming code representing the system enhancement is usually "patched into " or added to, the existing code. Although slipstream upgrades and patches are minor changes, they can cause users and support personnel big problems, if the programs do not run as before. Many patches come from off-the-shelf software vendors.

Unit - 11 : Information System Security and Control

Unit Structure:

11.0 Objectives

After going through this unit, you should be able to:

- Understanding the concept of Information System security and control
- To Study the various types of Security Threats
- To study the System Security Control
- To study the Technology for Information System Control
- Evaluate elements of an organizational and managerial framework for security and control
- Assess the business value of security and control
- Identify the challenges posed by information systems security and control and management solutions
- Evaluate the most important tools and technologies for safeguarding information resources
- Outline the principles of developing a recovery plan.

11.1 Introduction

This unit deals with the security issue of information system used in the organization. This security issue become more important in the technological environment where organization have various geographical presences and has to used networks and internet to communicate between these locations. The security issue covers computer hardware security, software security, data security, information system security etc. these days data security became very serious as internet and network computers full of hackers and crackers. The hackers and crackers keeps on doing unlawful activity called computer crime or cyber crime. Computer crime is an act which results from deliberate, distortion, tampering, misrepresentation of the data, unauthorized access to data etc.

11.2 Security

Security is concern for all the business organization they need safeguard which protect their hardware, software data and other useful information from unauthorized access. Security has got many dimensions:

1. **Integrity:** Integrity refers to information and data given by the system has not altered by unauthorized party.
2. **Authenticity:** Authenticity refers to identify the identity of the individual who is handling the information system.
3. **Confidentiality:** is the information provided by information system is made available to only authorized individual to keep up confidentiality with the other user.
4. **Privacy:** The information and data received from the customer should be keep private. ie the information is used for the purpose for which it has been gathered and individuality of the individual is kept secret.

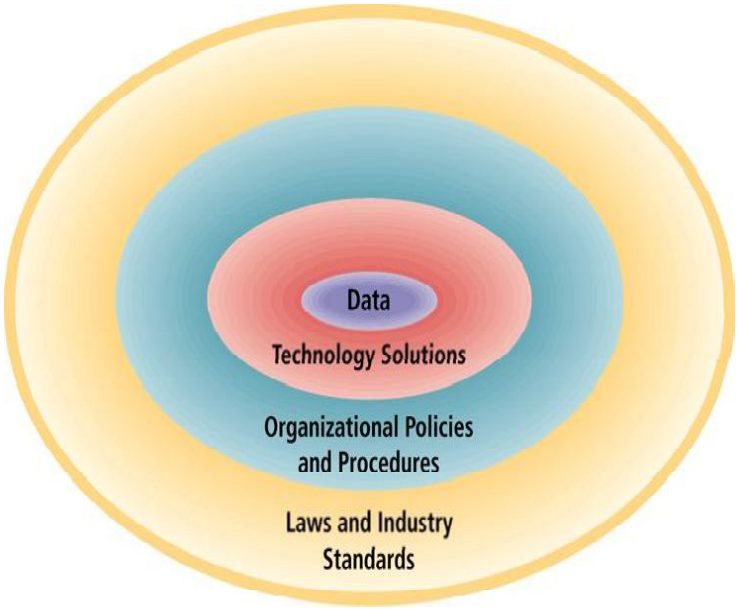


Figure 11.1

Information system security includes policy, procedure, tools, techniques, law etc. to protect hardware and software from intentional, accidental and natural disaster. It also includes mal functioning or manipulation of input and output, data transmission and databases.

11.2.1 Security Threats

Breach by Internal Employee: Employees have to access to privilege information and loosely define internal security procedure they are often able to move throughout the information system and databases. The basic threats come from the employees working in the organization. Many a time employee carelessly or deliberately forgets to follow security standards and guideline resulting leakage of useful dataand information to the outside world. They also share password with the outside people of fellow colleague who access the company databases and other useful information. The employee end user and technical are major source of errors into an information system. Employee can introduce error by entering faulty data not following proper instruction for data processing and use of computer hardware. The technical person may introduce error in define the problem maintaining the software etc., The best way to reduce breach of security within the employees by educating them about the security policy, possible harm to the organization and possible threat of prosecution under cyber law.

11.2.2 Software Threats

Software errors are one of the primary threats to information system causing unseen situations and loss of productivity. A major problem of information system is presence of bug or program defects, malicious code, virus, hacking, cyber vandalism, denial of service, sniffing etc. virus is a computer program that has ability to replicate or make copies of itself and spread to other files. Viruses can perform variety of activity like display of messages or picture or it may be high distractive destroying file, databases, formatting hard disk or cause permanent damage to hard disk.

11.2.3 Hardware Failure

Hardware failure is also one of the major threats to information system that causes physical damage to computers, peripheral equipment, and communications media. The major causes of such damage are natural disasters, blackouts and brownouts, and vandalism.

11.2.4 Sniffing

A sniffer is the type of eaves dropping program that monitor the information troubling of the network. The sniffer can be used to damage the information and very difficult to detect. When use legitimately sniffer identify potential trouble points in the networks. Sniffer allows a hackers to steal information from anywhere in the network that is from servers, messages etc..

11.2.5 Natural Disasters

Natural disasters that pose a risk to Information systems includes fires, floods, earthquakes, hurricanes, tornadoes, and lightening, which can destroy hardware, software or both, causing total or partial paralysis of systems or communications lines. Floodwater can ruin storage media and cause short circuits that can burn delicate components such as microchips. Lightening and voltage surges cause tiny wires melt and destroy circuitry.

11.2.6 Blackouts and Brownouts

Computers run on electricity. If power is disrupted, the computer and its peripheral devices cannot function, and the change in power supply can be very damaging to computer processes and storage. Blackouts are total losses of electrical power. In Brownouts, the voltage of the power decreases, or there are very short interruptions in the flow of power. Power failure might not only disrupt operations, but it can also cause irreparable damage to hardware. Occasional surges in voltage are equally harmful, because their impact on equipment is similar to that of lightening.

The popular way of handling brownouts is to connect a voltage regulator between computers and the electric network. A voltage regulator boosts or decreases voltage to smooth out drops or surges and maintains voltage within an acceptable tolerance. To ensure against interruptions in power supply, organizations use uninterruptible power supply (UPS) systems, which provide an alternative power supply for a short time, as soon as a power network fails.

11.2.7 Vandalism

Vandalism occurs when human beings deliberately destroy computer systems. Bitter customers might damage ATMs, or disgruntled employees might destroy computer equipment out of fear that it will eliminate their

jobs or simply to get even with their superiors. It is difficult to defend computers against vandalism. ATMs and other equipment that are accessible to the public are often encased in metal boxes, but someone with persistence can still cause severe damage. In the workplace, the best measure against vandalism is to allow access only to those who have a real need for the system. Sensitive equipment, such as servers, should be locked in a special room. Such rooms usually are well equipped with fire suppression systems and are air-conditioned, and thus protect also against environmental risks.

11.2.7 Risks to Data and Applications

The primary concern of any organization should be its data, because it is often a unique resource. Data collected over time can almost never be recollected the same way, and even when it can, the process would be too expensive and too time consuming to recover the business from its loss. The concern for applications especially if the applications are not tailor-made, should come second. All data and applications are susceptible to disruption, damage, and theft. While the culprit in the destruction of hardware is often a natural disaster or power spike, the culprit in damage to software is almost always human.

11.2.8 Theft of Information and Identity

Sometimes the negligence of corporations and the careless use of technology, especially on public links to the Internet, create security "holes" or vulnerabilities. In some cases it is employees who unwittingly give away important information such as access codes. Con artists use tricks known as social engineering. They telephone an employee who has a password to access an application or a database, introduce themselves as service people from a telephone company, or the organization's own IT unit, and say they must have the employee's password to fix a problem. Employees are often tempted to provide their password. The social engineers then steal valuable information.

Once criminals have a person's social security number drivers license number, or credit-card number, they can pretend to be this person. This crime is called identity theft. The imposter can easily withdraw money from the victim's bank accounts, put charges on the victim's credit cards. Since an increasing number of applications for such instruments as well as financial transactions are executed online, identity theft has become a serious problem. According to Gartner Group, 9.4 million U.S. adults were identity theft victims between may 2003 and april 2004, and their financial losses were $ 11.7 billion.

Both social engineering and breaking access codes to steal data from online databases have caused huge damage to corporations. Connecting databases to the Internet is necessary for proper operation of multisite organizations and organizations that must share data remotely with business partners. The only way to minimizing hacking into such systems is to improve security measures.

In recent years identity theft has been more prevalent as part of phishing, a crime. Crooks spam millions of recipients with bogus messages, supposedly from legitimate companies, directing them to a site where they are requested to "update' their personal data including passwords. The sites are ones constructed by the criminals who steal the personal data and use it to charge the victim's credit account, apply for new credit cards, or-in the worst situations – also apply for other documents such as driver's liecense and apply for loans online.

11.2.9 System Vulnerability and Abuse

Before computer automation, data about individuals or organizations were maintained and secured as paper records dispersed in separate business or organizational units. Information systems concentrate data in computer files that potentially can be accessed more easily by large numbers of people and groups outside the organization. Consequently, automated data are more susceptible to destruction, fraud, error and music.

When computer systems fail to run or work as required, firms that depend heavily on computers experience a series loss of business function. The longer **computer** systems are down, the more serious the consequences for the firm.

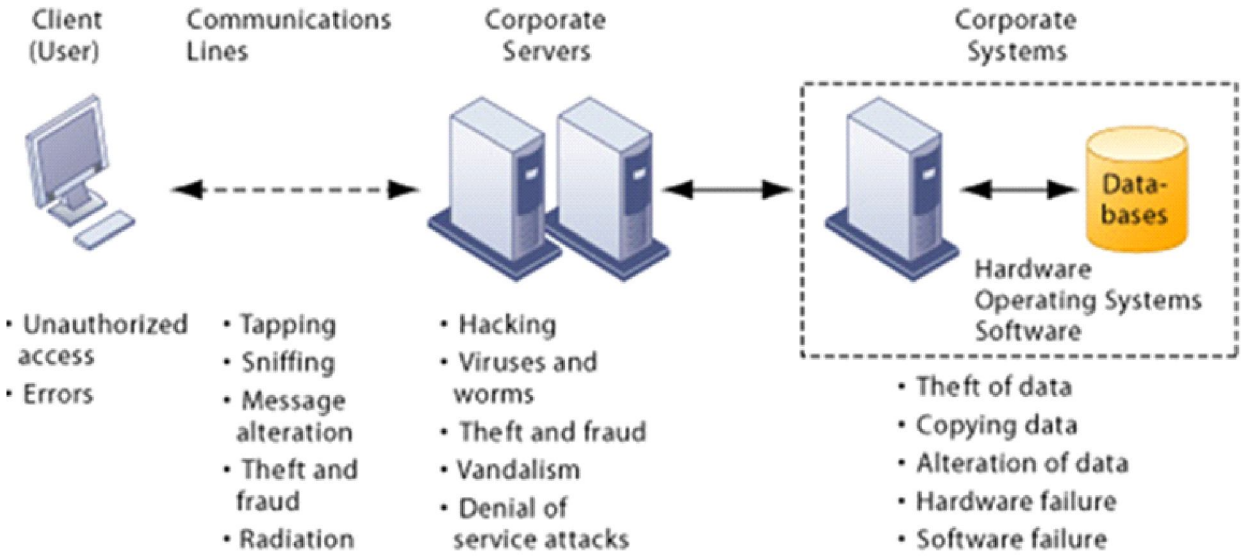


Figure 11.2

In E-enterprise there is a heavy use of technology that includes Information Technology, Networks, Internet and Web, supported by allied technologies such as RFID, Bar Coding, Smart Card, Data Base Management, Telecommunication and so on. The storage of data, information, programme, packages, reports and information products is electronic and is either on hard disks on servers or on compact disks (CD's). Electronic medium, whether online or offline is vulnerable to many threats. The vulnerability of the systems to security threats can be met effectively only with Security Management Systems (SMS) with specific following objectives :

- Minimise the loss of physical and information assests.
- Minimise the loss of business or business opportunities.
- Ensure system integrity and reliability of data.
- Keep quality of information systems highest.
- Recover fast from any disaster

Threats to information systems are caused from several sources and reasons. All the reasons can be put in three classes namely failure of system, human actions, and damage due to natural calamities.

Failure of system : Hardware, Software, Network, and Telecommunication functioning.

Human actions : Illegal access, Theft, User Errors, Programme changes.

Natural calamities :Fire, Earthquake, Floods.

Today's information system spread is global at different locations. They function in networked environment using network technology, Internet, wireless networks. Such complex network with different technologies makes information systems more vulnerable to various threats. We now go more into the details of threats and vulnerability to get better insight into the security problems in the organisation.

11.2.10 Human Actions

Information systems are more vulnerable to human actions. Information systems are used by internal personnel of the organisation as well as outside personnel who have been given access to it for limited purpose. These actions could be wrong accidently and unintentionally, or purposely with intention of theft, copying, damaging and corrupting the information and system. The result of such human actions is non-availability of the system, some data and information for usage. The loss of data to competition affecting the business is also a possibility.

Improper erroneous use of system could be from personnel, if they are not trained properly and have poor understanding of the information system. Human action could be wrong if unauthorized personnel from within or outside the organisation access the system. Unauthorized access also gives opportunity to insert computer viruses in the system.

If a software package and programmes are delivered with bugs, a programme code error or defect, it can harm the system resulting into non-availability or erroneous process. Zero defects, and complete fool proof testing of the information system is not possible. Next culprit of failure is computer viruses. Computer viruses are the programmes inserted to spread rapidly through computer system networks for destroying data, corrupting the data, disrupting the process, denying the service, and crashing the network.

Another source of failure is information system quality problems due to developers actions. In the process of software development, if sufficient care is not taken in design and architecture, development and quality assurance; software would fail frequently while in use.

11.2.11 Natural Calamities

Information systems are also insecure in the event of destruction due to natural calamities like fire, earthquake, floods and so on. In such events, impact on the system could be very large. It may result in total loss of the system: both hardware and software, data files, and reports. The effect of such impact is not easily manageable for the system to make up and run for the users. The impact of natural calamities is most of the time disastrous, calling for high level protective security measures. The problems with these calamities are that they are not predicable to know when they would occur.

11.2.12 Hackers

The explosive growth of Internet use by business and individuals has been accompanied by rising reports of Internet security breaches. The main concern comes from unwanted intruders, or hackers, who use the latest technology and their skills to break into supposedly secure computers or to disable them. A hacker is a person who gains unauthorized access to a computer network for profit, criminal mischief, or personal pleasure. There are many ways that hacker break-ins can harm businesses.

11.2.13 Computer Viruses, Worms, Trojan Horses and Logic Bombs

Computer viruses are so named because they act on programs and data in a fashion similar to the way viruses act on living tissue : computer viruses easily spread from computer to computer. Because so many computers are now connected to one another and many people share files, people unknowingly transmit to other computers viruses that have infected their own files. Once a virus reaches a computer, it damages applications and data files. In addition to destroying legitimate applications and data files, viruses might disrupt data communications: the presence of viruses causes data communications applications to process huge numbers of messages and files for no useful purpose, which detracts from the efficiency of transmitting and receiving legitimate messages and files. The only difference between computer virus and worm is that a

worm spreads in a network without human intervention. A worm attacks computers without the need to send e-mail or open any received files.

Some viruses do not affect any files, but the speed at which they spread and their repeated attacks slow down network traffic to an intolerable crawl. According to researchers at the University of California and other institutions, in January 2003 the Slammer worm struck more than 75,000 computers in just 10 minutes. The number of infected computers doubled every 8.5 seconds.

Some viruses are called Trojan horses, analogous to the destructive gift given to the ancient Trojans. In their war against troy, the Greeks pretended they were abandoning the city outskirts and left behind a big wooden horse as a present. The Trojans pulled the horse into the city. When night fell, Greek soldiers hidden within the horse jumped out and opened the gates for thousands of their comrades, who conquered the city. In computer terms, a Trojan horse is any virus disguised as legitimate software or useful software that contains a virus. Many people also refer to spyware that comes with useful software as Trojan horse software.

Some rogue computer programs do not spread immediately like a virus but are often significantly more damaging to the individual organization that is victimized. A logic bomb is a software that is programmed to cause damage at a specified time to specific applications and data files. It lies dormant until a certain event takes place in the computer or until the computer's inner clock reaches specific time; the event or time triggers the virus to start causing damage. Logic bombs are usually planted by insiders, that is, employees of the victimized organization.

11.3 Controlling Security Threat and Vulnerability

The objective of such system is to reduce significantly the incidence of failures, erroneous human actions, and predict and prepare for contingencies to minimize the damaging impact of natural calamities. SMS is a configuration of manual and automated measures that protect information systems and assure the performance as desired. Manual measures include Security Policies, Procedures, Rules and operations discipline, which create awareness about security and enforces administrative discipline in work process across the organisation. Automated measures such as smart cards, ID's, view monitors and such other devices are built in security mechanisms of physical infrastructure for personnel access. Automated measures also need to be implemented in Information Technology and Information System infrastructure. These measures are software programmes designed to search, identify, declare, and stop the processing if anything is defective, erroneous, inconsistent, and not as per specification is observed in the operation.

11.4 Types of Information System Security Control

Technology provides a foundation for information system security and control but it has to be supported with intelligent management security policies. Protection of information resources requires security policy and set of control as described in ISO 17799 a international set of standards for security and control. It specifies bet practices in information system and control by defining security policy, business continuity planning, physical security, access control and compliances in an organization.

11.4.1General Controls

General controls means control of general operation and interaction with information system. It deals with basic operation of the information system. It includes software controls, hardware controls, computer operations controls, data security controls, controls over the systems implementation process, and administrative controls.

Software Control: It Monitor the use of system software and prevent unauthorized access of software programs, system software, computer programs, databases. System software is an important control area because it performs overall control functions for the programs that directly process data and data files. For example at the time of booting a user has to log in his login password without which he can not boot the system. Similarly if the employee is working on the system and leave system running after the predefine time the screen locked itself which can be open only by entering the password.

Hardware Controls: It ensure the hardware is physically secure and check for the equipment malfunction. Computers are kept in the control environment so that their functioning does not get affected by temperature and moisture. Many a times during rainy season electronic devices & computer stop working because of moisture. All the hardware equipment should be protected against fires and extremes of temperature and humidity. Organizations that are dependent on their computers also must make provisions for backup or continued operation to maintain constant service. The computers should also backup by constant power supply to protect data, software programs and operating systems from damages due sudden power failure.

Computer Operations Controls: This control deals to ensure proper implementation and execution of program procedure design for the processing and storage of data. Here the work of the computer department to ensure that programmed procedures is consistently and correctly applied to the storage and processing of data as described at the time of information system development. They include controls over the setup of computer processing jobs and computer operations and backup and recovery procedures for processing that ends abnormally. For example manual of the data processing department which described all the do and dont's of the process.

Data Security Control: It ensure that valuable business data files on either disk, tape and hard disk are not subject to unauthorized access, change, or destruction while they are in use or in storage. It also include security and control of data while transmission from one location to another. It can be done using encryption methods (Discusses later) in which data is transformed in the coded form while storing or transmitting. At the time of use or at the receiving end data is decoded using suitable method. For example when you log on to any email service provider when you enter your password you get asterisk (*).

Implementation Control: It includes two types of control one control at the time of development of information system and second control at the time of operation of the information system. At the time of development it audits the systems development process at various points to ensure that the process is properly controlled and managed. The systems development audit looks for the presence of formal reviews by users and management at various stages of development; the level of user involvement at each stage of implementation; and the use of a formal cost-benefit methodology in establishing system feasibility. The audit should look for the use of controls and quality assurance techniques for program development, conversion, and testing and for complete and thorough system, user, and operations documentation. At operational level control it allow us to accept desired data in predefine manner. For example if the data is define as numeric it will not accept alphanumeric character. The date field which will use for our day to day activity will accept date in the predefine manner.

Administrative Controls: It control over all working of the information systems and its user. Creation of user, checking of the activity of the user, authority of the user etc are the main function in this category. It also formalize standards, rules, procedures and control disciplines to ensure that the organization's general and application controls are properly executed and maintained.

11.4.2 Application Controls

Application controls ensure that only authorized and pre define authorized data are accurately and completely process by information system. Application control include both computer and manual procedures. Application controls consist of input controls, processing controls, and output controls. Input controls check data for accuracy, correctness and completeness when data is entered in the information system. There are specific input controls for input authorization, data conversion, data editing, and error handling. Processing controls establish that data are complete, accurate, consistent during updating. Run control totals, computer matching, repeated processing and programmed edit checks are used as processing controls. Output controls ensure that the results of computer processing are accurate, complete, and properly presented and distributed and stored for future use.

Control Totals: it is an input and processing control type which established advance provision for input and processing transactions. These totals can range from a simple document count to totals for quantity fields, such as total sales amount (for a batch of transactions). Computer programs count the totals from transactions input or processed.

Edit Checks: It is input application type in which programmed routines can be performed to edit input data for errors before they are processed. Transactions that do not meet edit criteria are rejected. For example, data might be checked to make sure they are in the right format (for instance, a nine- digit social security number should not contain any alphabetic characters). In batch processing prior to submit data to a batch for processing the whole batch is checked for consistency of data format.

Computer Matching: it is an input and processing control type where input data with information held on master or suspense files and notes unmatched items for investigation. For example, a matching program might match employee time cards with a payroll master file and report missing or duplicate time cards.

Run Control Totals: It is a processing and output control type which balance the total of transactions processed with total number of transactions of input or output. It is very important for processing of data which is responsible of keeping record of all the input data.

Report Distribution Logs: It is output control type which define the documentation specifying the authorized recipients who received their reports, checks, or other critical documents. Here we try to control and check the various end users with respect to nature of information / reports required by them.

11.4.3 Procedural Control

Procedural controls are methods that specify how the information services organization should be operated for maximum security. They help an organization maintain the accuracy and integrity of operations and systems development activities. It include various do's and don'ts of the activities perform in the processing of data. Decomposition of complex activity into simple task and event comes into procedural control. Separation of duties is a basic principle of procedural control. Computer operations and control of data and program files be assigned to separate groups. For example systems analysts and computer programmers may not be allowed to operate a mainframe computer system or make changes to data or programs being processed. In addition the responsibility for maintaining a library of data files and program files is assigned to a librarian or database administrator. Finally a production control section may monitor the progress of information processing jobs data entry activities and the quality of input/output data. This is an important quality assurance function.

Standard procedures are typically developed and maintained in manuals as well as computerized system. By following standard procedures we promote uniformity and minimizes the chances of errors and fraud. It helps employees know what is expected from them in operating procedures and output quality. It is important that procedures be developed for both normal and unusual operating conditions. For example procedures should tell employees what to do differently when their computers are not working. Systems and operations documentation must be developed and kept up-to-date to ensure the correct processing of each application. Documentation is also invaluable in the maintenance of a system as needed improvements are made.

11.5 Technology for Information System Control

Information technology has provided various tools and techniques to control the security of information system. The security is only time depended one method may be suitable and performing well at one moment of time. The same method becomes absolute on another frame of time where the hackers and crackers are more skill full to find out the flaws in the information system and break the security of the system.

11.5.1 Access Control

Access control consists of all the policies and procedures a company uses to prevent improper access to systems by unauthorized insiders and outsiders. To gain access a user must be authorized and authenticated. Authentication refers to the ability to know that a person is who he or she claims to be. Access control software is designed to allow only authorized persons to use systems or to access data using some method for authentication. Authentication is often established by using passwords known only to authorized users. An end user uses a password to log on to a computer system and may also use passwords for accessing specific systems and files. However, users often forget passwords, share them, or choose poor passwords that are easy to guess, which compromises security. Passwords can also be "sniffed" if transmitted over a network or stolen through social engineering.

The security of password can be better control with the biometric characterstic of the employee where login and password are based on biometric of the employee which is unique in itself. Biometric authentication represents a promising new technology that can overcome

some of the limitations of passwords for authenticating system users. Biometric authentication is based on the measurement of a physical or behavioral trait that makes each individual unique. It compares a person's unique characteristics, such as fingerprints, face, or retinal image, against a stored set profile of these characteristics to determine whether there are any differences between these characteristics and the stored profile. If the two profiles match, access is granted. The technology is expensive, and fingerprint and facial recognition technologies are just beginning to be used for security applications.

11.5.2 Firewall

The use of firewalls to prevent unauthorized users from accessing private networks and servers. As growing numbers of businesses expose their networks to Internet traffic, firewalls are becoming a necessity. A firewall is a combination of hardware and software that controls the flow of incoming and outgoing network traffic. It is generally placed between the organization's private internal networks and untrusted external networks such as the Internet, although firewalls can also be used to protect one part of a company's network from the rest of the network (see Figure).

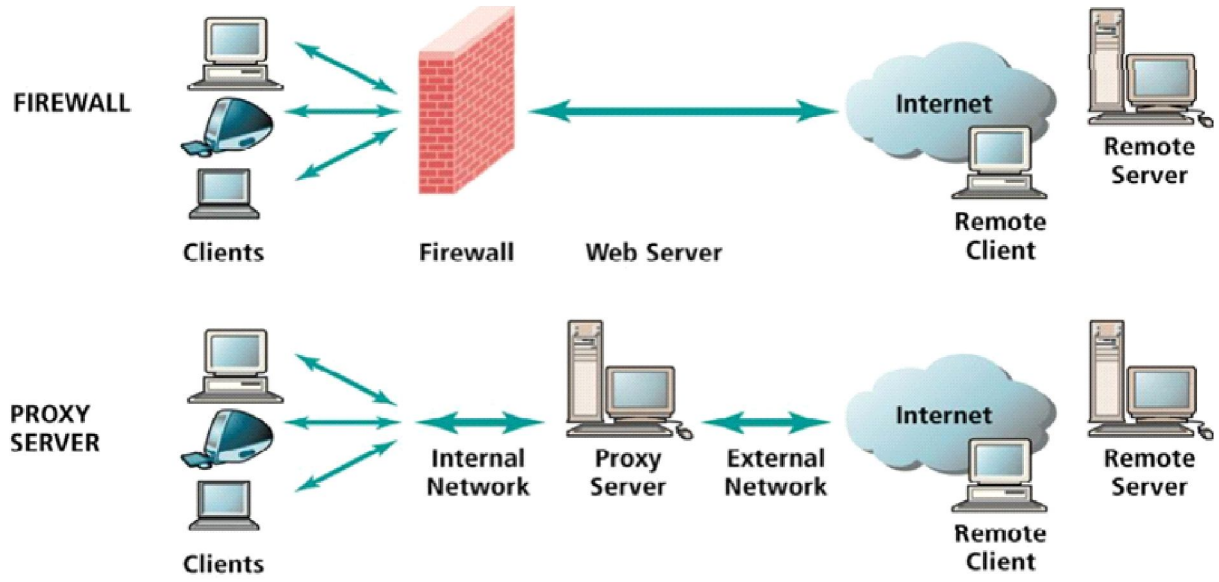


Figure 11.3

The firewall acts like a gatekeeper that examines each user's credentials before access is granted to a network. The firewall identifies names, Internet Protocol (IP) addresses, applications, and other characteristics of incoming traffic. It checks this information against ,the access rules that have been programmed into the system by the network administrator. The firewall prevents unauthorized communication into and out of the network, allowing the organization to enforce a security policy on traffic flowing between its network and other untrusted networks, including the Internet.

In many organizations, the firewall often resides on a specially designated computer separate from the rest of the network so no incoming request can directly access private-network resources. There are a number of firewall screening technologies, including static packet filtering, stateful inspection, Network Address Translation, and application proxy filtering.

11.5.3 Encryption

Many organizations rely on encryption to protect sensitive information transmitted over the Internet and other networks. Encryption is the coding and scrambling of messages to prevent unauthorized access to or understanding of the data being transmitted. A message can be encrypted by applying a secret numerical code, called an encryption key, so that the data are transmitted as a scrambled set of characters. (The key consists of a large group of letters, numbers, and symbols.) To be read, the message must be decrypted (unscrambled) with a matching key.

There are several alternative methods of encryption, but public key encryption is becoming popular. Public key encryption as shown in Figure which uses two different keys, one private and one public. The keys are mathematically related so that data encrypted with one key can be decrypted using only the other key. To send and receive messages, communicators first create separate pairs of private and public keys. The public key is kept in a directory and the private key must be kept secret. The sender encrypts a message with the recipient's public key. On receiving the message, the recipient uses his or her private key to decrypt it.

Encryption is especially useful to shield messages on the Internet and other public networks because they are less secure than private networks. Encryption helps protect transmission of payment data, such as credit card information, and addresses the problems of message integrity and authentication. Message integrity is the ability to be certain that the message being sent arrives at the proper destination without being copied or changed.

Digital signatures and digital certificates help with authentication. The Electronic Signatures in Global and National Commerce Act of 2000 has given digital signatures the same legal status as those written with ink on paper. A digital signature is a digital code attached to an electronically transmitted message that is used to verify the origin and contents of a message. It provides a way to associate a message with a sender, performing a function similar to a written signature. For an electronic signature to be legally binding in court, someone must be able to verify that the signature actually belongs to whoever sent the data and that the data were not altered after being digitally signed.

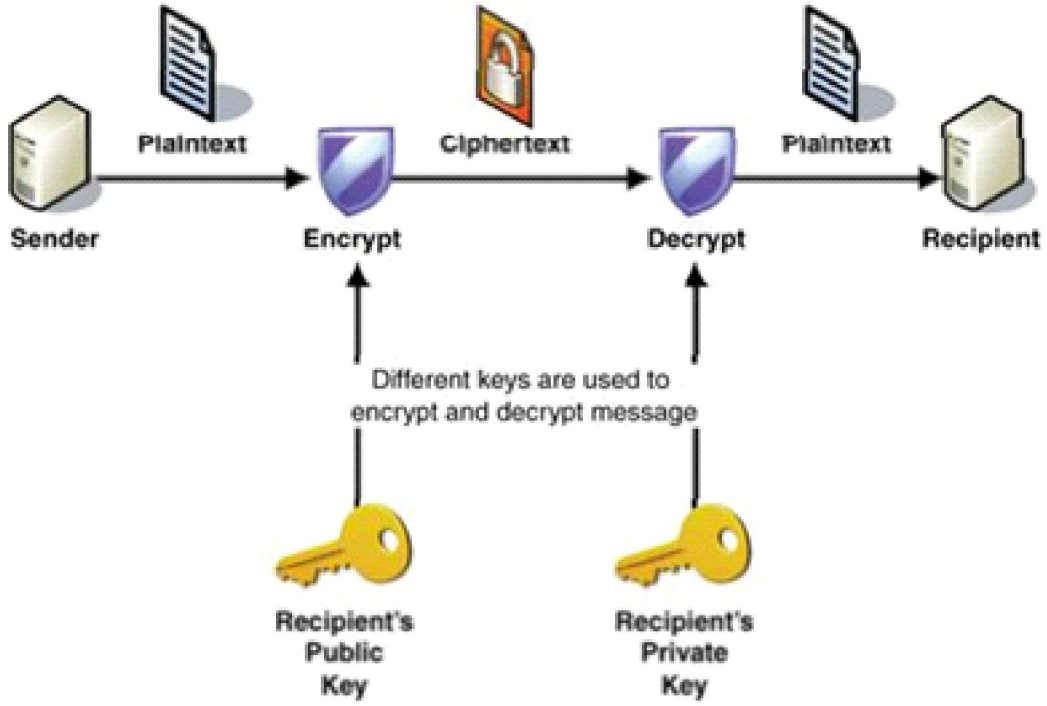


Figure 11.4

Digital certificates are data files used to establish the identity of users and electronic assets for protection of online transactions. A digital certificate system uses a trusted third party known a certificate authority (CA) to validate a user's identity. The CA system can be run as a function inside an organization or by an outside company such as VeriSign. The CA verifies a digital certificate user's identity offline. This information is put into a CA server, which generates an encrypted digital certificate containing owner identification information and a copy of the owner's public key. The certificate authenticates that the public key belongs to the designated owner. The CA makes its own public key available publicly either in print or perhaps on the Internet. The recipient of an encrypted message uses the CNs public key to decode the digital certificate attached to the message, verifies it was issued by the CA, and then obtains the sender's public key and identification information contained in the certificate. Using this information, the recipient can send an encrypted reply. The digital certificate system would enable, for example, a credit card user and a merchant to validate that their digital certificates were issued by an authorized and trusted third party before they exchange data.

Public key infrastructure (PKI), the use of public key cryptography working with a certificate authority, is becoming the principal technology for providing secure authentication of identity online.

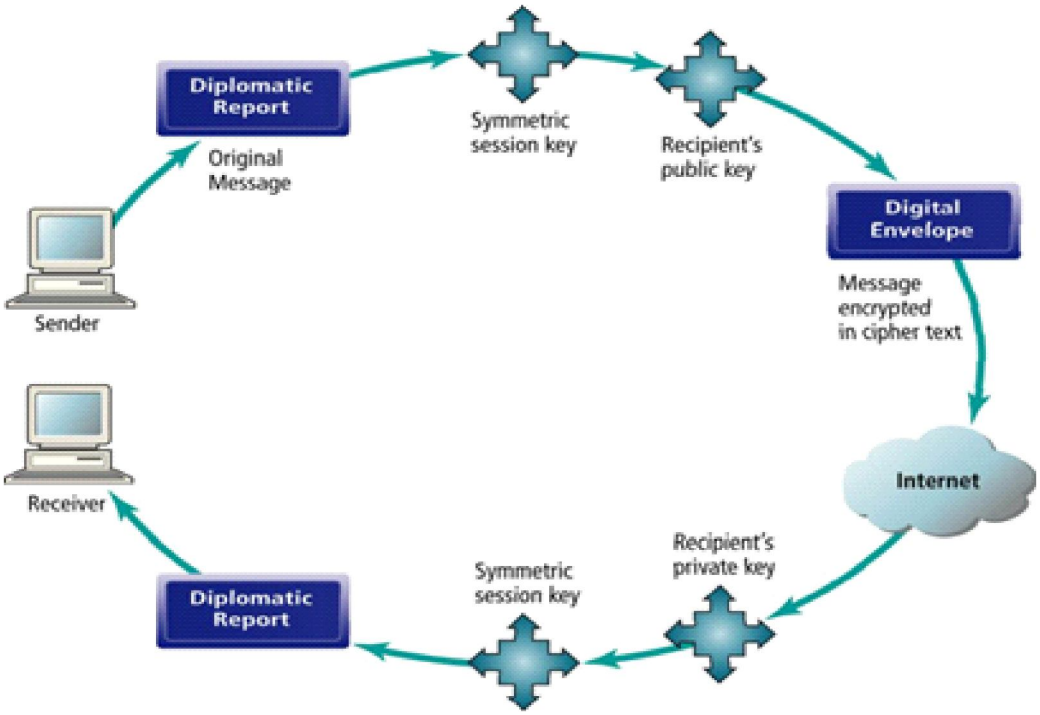


Figure 11.5

11.6 Disaster Management

Inspite of all care taken to secure information technology infrastructure, there is an element of risk due to certain unforeseen circumstance, or unpredictable and uncontrollable cause damaging information assests of the organisation. To counter this threat, management resorts to disaster management plan (DMP). DMP is a plan of action to recover from the impact on the information systems. They are either collapsed or dysfunctional. You need a recovery process to start them all over again. Organisations like bank, railways, process automated manufacturing companies, and hospitals have many critical applications, which are their lifeline. In all such cases, a disaster recovery plan is a prime necessity. The objective of DMP is not only to start the system again but start properly from a stage when it is stopped and with all data integrity maintained after recovery to ensure that quality of output is not defective due to loss of data, incomplete data, or incorrect data.

DMP specifies the proceedure of recovery action when disaster occurs. It fixes roles and responsibiities on individuals to deal with the crisis situation. DMP also provides guidance on how to keep organisation running while DMP is being acted upon. DMP plan includes measures such as following:

- Alternative processing arrangements.
- Duplicate and offsite storage of data, hardware and software.
- Choice of systems and Applications, which should run, in any case.

A systematic approach to prepare DMP is to evaluate the security threat and vulnerability of the systems. The broad guidelines are as under:

DMP Preparation Plan

1. Identify critical business processes.
2. Access the business risk : Probability of risk occurrence, and risk exposure with respect to time of exposure.

3. Enlist the impact target of the damage for attention to manage and recover.
4. Identify the life saving sensitive data, files, software, applications, packages, hardware, servers and databases linked to these processes.
5. Segregate the need in two classes where an organisation can resort to following actions :

- Switch to manual process.
- Work at offsite with data backup created at offsite location.

6. Prepare a plan of bridging pre and post disaster scenario so that continuity of data and information is maintained.
7. Ensure all risks are suitably covered by appropriate insurance policies.
8. Authority, rights for decisions and actions in the event of disaster should be clear in DMP.
9. Test the DMP plan once a year in simulated live model event.

Threats to Facilities and Structure

- Earthquakes, Fire, Explosions, Floods, and such other events.
- Power failure and Power related problems.
- Theft.
- Damage by disgrunted employees.
- Unauthorized use of IT structure.

Controls

- Place critical hardware on higher floors.
- Design buildings for the natural threats.
- Store sensitive data, applications, offsite in a different building.
- Provide Security training to employees.
- Install close circuit cameras.
- Provide dedicated power lines with UPS.
- Screen employees and usual visitors and get the appropriate secrecy bonds signed from them.
- Use biometric access controls and ID's.

Threats to Communication Systems

- Incorrect input due to communication break down.
- Intrusion by unauthorized persons and damage to communication system.
- Insertion of viruses.
- Defective network operations.

Controls

- Firewalls.
- Error detection and correction methods.
- Redundant lines.

- User IDs, Passwords and PINs.
- Access logs.
- Encryption, Decryption of Key inputs/outputs.
- Log of system failures.

Threats to database and DBMS

- Corruption of data
- Theft of Data
- Unauthorised access
- Data inconsistency

Controls

- Use of Antivirus software.
- Restart and recovery procedure.
- Backup copies.
- Concurrency protection
- Restricted authority to update, d4elete.
- Limited, authorised access to Database.
- Dedicated DB administrator.

11.7 Information System Management : Opportunities and Challenges

Information system security needs organizational management and technological resources. The success depends on the framework required for security and control with skill full risk reward function and organizational goals.

Today a organization have opportunity to secure all the transaction, functions, databases, servers etc to facilitate smooth functioning of the organization in achieving its goals. The use of state of art technology and continuous monitoring and improvement in the security and control allows organization in attending their objectives. Establishing the good framework of security and control require trade off risk and reward. Designing a system neither over control nor under control and implementing and effective security policy are measure management challenges.

11.8 Key Words

- **MIS:** A management information system (MIS) provides information which is needed to manage organizations efficiently and effectively.
- **Information:** Information is closely related to notions of communication, data, instruction etc.
- **Information System:** information systems inter-relate with data systems on the one hand and activity systems on the other.
- **Integrity:** Integrity refers to information and data given by the system has not altered by unauthorized party.
- **Authenticity:** Authenticity refers to identify the identity of the individual who is handling the information system.

- **Hackers:** Hacker gain unauthorized access by finding weakness of security procedure.
- **Software Control:** System software and prevent the unauthorized access of **Software Programs**. System: Systems may have some functions or groups of functions.
- **Encryption:** Encryption is the coding and scrambling of messages to prevent unauthorized access to or understanding of the data being transmitted
- **Firewall:** Firewall to prevent the accessing private networks and servers

11.9 Self Assessment Test

1. What do you understand by system security? Briefly discuss it threats.
2. Discuss the information system control.
3. Define information system control and it types.
4. What are hacker. Briefly describe the type of hackers.

11.10 References

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Unit - 12 : MIS in Functional Areas of Management

Unit Structure:

12.0 Objectives

After reading this unit, you will be able to understand

- Meaning of information system.
- Role of management information system in business.
- Functional areas of business management.
- Finance and accounting management.
- Marketing management.
- Human resource management.
- Production management.
- Research & Development.
- Application of MIS in functional areas.

12.1 Introduction

The role of information systems in organisational productivity has been extremely challenging. This is partially because the benefits of information systems are often intangible, manifesting themselves in areas such as improved customer service and greater organisational responsiveness. Hence, organizations are developing new measures, such as 'reduce cycle times' and 'delighting the customer', to better measure the impact of information systems on organisational productivity. The various functional areas in business including manufacturing, marketing, finance and accounting, quality control, and human resources, have all been influenced by the information systems. Earlier the emphasis was on developing standalone functional systems and to create customer-oriented systems. These functional areas using information systems, are capturing new markets, achieve a competitive edge in existing markets, and providing an effective customer service. Today, most organizations are planning to develop cross-functional systems. There are many different types of information systems : transaction processing systems, MIS, and intelligent support systems consisting of decision support systems, expert system, executive information system, and office automation systems. All

of these play a supportive role in a business function, and functional information systems often consist of one or more of the aforementioned systems.

12.2 Functional Areas of Management

Every business organisation consists of several well defined functions. These are often organised into areas or departments. These are known as the functional areas of business. In each functional area, a set of business functions is performed. There are mainly five functional areas such as Accounting, Finance, Human resource, production and Research and development. As we all know, there are so many users of MIS in any business organization. Each user has his own set of queries which he wants to solve from the information system. Every level of management has its specific information needs and to run a business successfully they retrieve this information from the information system. So, it is the basic requirement of each manager that he can understand what role information system plays in their decision making with regard to different functional areas. The MIS of a business organization is an integration of various sub-functional information systems in each business organisation as shown in the figure

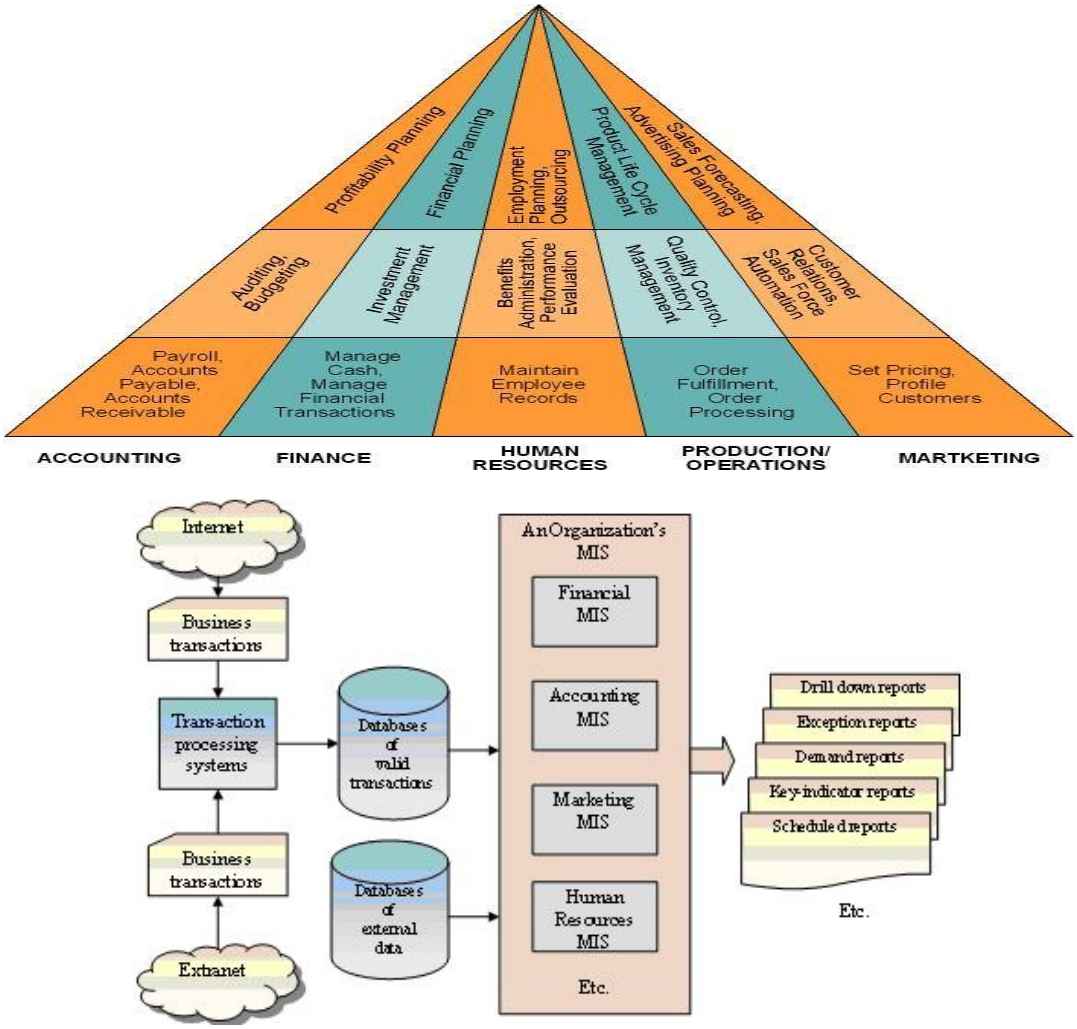

Figure 12.1

Truly successful systems that have a lasting impact on the organisations are those that are cross-functional, i.e., systems that are not narrowly defined by functional boundaries, but instead address the broad information needs of managers, regardless of their functional specifications. In each of the functional area, a data flow model portrays the local decision making environment. The data flow diagram in basic functional areas consists of the following components : External environment, Data bank, Decision making, Other areas of the firm and Feedback mechanism.

External environment: It contains two components: the operating environment, which consistes of consumers, suppliers, competitors, distributors and the labour supply; and the remote environment, which consists of economic , social, political, technological, and industry concerns. These environmental sources generate key external information that flows into the firm, at times informally.

Data bank: The term 'data bank' is used generaly to describe the general storage of data. A data bank can include data existing in files and in computer databases. An organisation's data bank consists of internal data, such as those generated from the firm's transaction processing system or from internal forecasts, and external data, which are collected from monitoring the external environment.

Decision making: It is the key of each functional data flow model. This process consists of selecting those data that is needed to make a decision.

Other areas of the firm: Information produced by decision making in one functional area is often used in another. For e.g., sales forecast prepared by the marketing department is used as data by the finance department to produce the overall finacial plan for the firm.

Feedback mechanism: Feedback mechanism means that decisions made by the firm ultimately affect its performance in the market place. The firm's performance is often important to the competitor's, consumers and suppliers in its operating environment, whereas the remote environment is generally not affected.

12.3 Finance Information System

Traditionally, financial function or financial decision making deals with procurement of funds only. But now in modern times, the financial decision making relates not only with procurement or raising of funds from various resources but also their allocation to other activities so that maximum results be obtained by using the available resources. In other words, we can say that financial management deals with reducing the cost of capital and maximizing the profits.

Procurement of funds is not a simple decision because there are so many resources from where a manager can raise the funds. There are mainly two categories – one is long term sources like debentures, equity and bonds, etc. and the other, is short term sources like bank borrowings, etc. Each source has its own merits and demerits regarding cost, control and risk. Utilisation or allocation of resources is another crucial decision of financial management. Allocation can be made in two ways, one in long-term assets and the other is in short-term assets. Proper utilization leads to maximum profit and if funds are not utilized properly, they will not generate maximum income and cost will also increase and hence defeat the purpose of the procurement of funds. So proper procurement of funds or financing of a business and allocation of financial resources within a business, the financial manager has to perform various activities such as cash and investment management, capital budgeting and financial planning, also known as its subsystems.

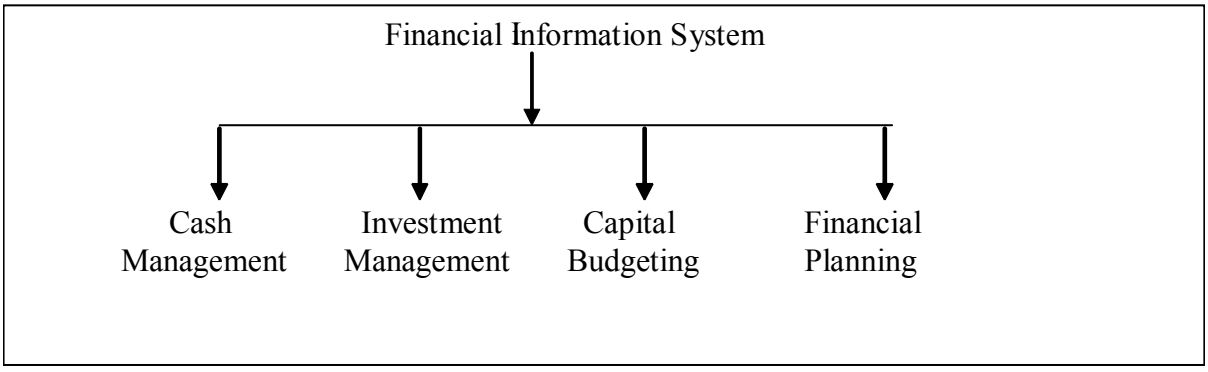

Figure 12.2

Cash Management

Cash management is an important task of the finance manager. He has to forecast the various cash requirements at different stages and then arrange or procure cash to meet these requirements. Cash management should be such that neither there is shortage of cash nor it left idle in the organisation. Any shortage of cash will damage the credit worthiness of the enterprise. The idle cash will mean it is not properly utilized.

Cash management systems collect information on all cash receipts and payments. It collects this information on a periodical basis or collect on line information. Because of the fast retrieval of this information, the manager is able to deposit this cash into a bank or in the other financial institution or in a short-term project. This income will enhance the financial position of the organisation. These systems also produce daily, weekly and monthly forecast reports of cash receipt and payments which help the manager to identify future requirements. For this purpose, cash management system uses mathematical models.

Investment Management

Investment management deals with kind and proportion of different securities to be maintained with in business organisation. Many business organizations invest their excess cash in short term and low risk marketable securities such as commercial paper, etc, or in higher return-high risk securities, so that investment income may be earned till the business require more funds. The portfolio of such securities can be managed with the help of portfolio management software. Information regarding securities in which investment can be made is also available on Internet and other networks. These online services help a financial manager to make buying, selling or holding decision for each security, so that an optimum portfolio of securities is developed which minimises the risk and maximizes income for the business organisation.

Capital Budgeting

Capital budgeting is the process of making investment decisions in capital expenditure. Capital budgeting decisions have a long term perspective, means that its results move come in a long period of time generally exceeding one year. The financial manager has to access the profitability of various projects before committing the funds by using a variety of techniques, may be IRR method or NPV method or so on. Computerised capital Budgeting System makes heavy use of spreadsheet model that incorporates the present value analysis of expected cash flows and probability analysis of risks to determine the optimum mix of capital projects for a business.

Financial Planning

The financial planning is not only concerned with the best overall mix of financing for the business. Financial analysts typically use electronic spreadsheets and other financial planning software to evaluate the present and projected financial performance of a business. Financial analysts use financial forecasts concerning the economic situation, interest rates, type of financing available, cost of financing , etc. to construct an optimum financing plan for business. Electronic spreadsheet packages, DSS software and web based software can be used to manipulate financial models.

12.4 Accounting Information System

Accounting system is the art of recording, classifying, summarizing transaction and events in a significant manner and in terms of money and interpret the results thereof. Accounting systems are based on double entry, book keeping principles. The main branches of accounting system are financial accounting, management accounting and costing. Accounting system records and reports the flow of funds with in the organisation on a historical basis and produces financial statements such as balance sheet, profit and loss accounts, etc.

They also produce forecast of future conditions such as projected financial statements and financial budgets. The actual performance is matched with the projected one by other analytical accounting reports.

Computerised Accounting Information System being the oldest and most widely used information systems in business, comprises the transaction processing system such as order processing , inventory control, accounts receivable, accounts payable, payroll and general ledgers system. A summary of each sub system of accounting information system is given in the table 16.1. Management Accounting system focuses on the planning and control of business operation. Costing is the process of ascertaining costs.

Accounting information systems are also affected by internet, intranet, extranets and other local networks. Because of the online interactive nature of these, network calls for new forms of transaction documents, procedures and control.

Table 12.1 : A Summary of Sub-systems of Accounting Information System

Subsystem	Activities of each Sub System
Order processing	Captures and processes customer orders and produces data for inventory control and accounts receivable.
Account receivable	Records amount owed by debtors and produces customer invoices, monthly customer statements and credit management reports.
Accounts Payable	Records purchase from, amounts owed to and payments to creditors, and produce cash management reports.
Pay roll	Records employee work and compensation data and produce pay checks and other pay roll documents and reports.
Inventory control	Process data reflecting changes in inventory and provides shipping and reorder information.
General ledger	Consolidates data from other accounting systems and reports of the business.

12.5 Finance and Accounting Information System

Finance and accounting as such are separate functions but are sufficiently related to each other also. Accounting covers the classification of financial transactions and summarization into the standard financial statement such as balance sheet, profits & loss a/c, etc. The finance system ensures an adequate organizational financing at a low cost so as to maximize to share holders. It compromises of major functions such as granting of credit to customers, collection process, cash management, investment management and so on.

Components and activities of Finance and Accounting information system are discussed in subsequent paragraphs.

Data Resources

In finance and accounting information system data compromises: The cash receipts, Cash payment, Opening stock, Amount owed by debtors, Amount owed to creditors, Customer order, Compensation data, Employee work, Closing stock, Work-in-progress stock

People Resources

To operate finance and accounting information system, one of the important resources is people which are of two types : End users and Information system specialists.

End users

These are Owners, Clerks, Accountants, Financial manager, Auditors, Financial analyst and so on.

Information system specialist

Information system specialists are the persons who are involved in the designing and development of finance and accounting information system. These are: System designer, System builder, Programmer, System analyst, Financial specialist

Software resources

Software resources compromise main resources of the computerized finance and accounting information system. Examples are :

System software

Consists of operating system program which controls and supports the operation of computer system. Examples are : Windows, Unix, Linux and Dos

Application software

Readymade accounting packages in the market are : Tally, Ex Munimji, Portfolio management software packages for investment management, Organizations develop their own application softwares.

Utilities

These are MS office, MS Excel, MS Powerpoint

Procedures

These are operating instructions for the end users of the system. Examples are:

- Manuals of accounting packages and
- Instructions to fillout a paper form

Hardware Resources

All the physical and tangible devices. Examples are: Computer, Printer, Scanner, Floppy, Mouse, Bar code, Paper for hard copy, CD's and Disk, etc.

Network Resources

This involves the usage of Communication Media, Network cards, Switches, Modem, Communication satellite system, Fiber-optic cable, interface card bridges etc.

Network Support

This involves the usage of Internet, Intranet of the organization and Extranet and software that supports these networks, Local area network, etc.

Input

In finance and accounting system we have input of: Cash payments, Cash receipts, Customer order, Amount due to debtor, Amount paid to creditors, Employee work and compensation data, Employee personal details, Knowledge base of accounting principles, concepts and conventions.

Processing

After getting the data, the system starts recording, classifying and summarizing the data in a respective ledger.

- Calculate the balance of each amount.
- Ratio analysis
- Capital budgetary technique
- Perform break even analysis
- With the help of EOQ modal (Economic Order Quantity), calculate reorder quantity, etc.

Output

Processed data of finance and accounting system is converted into useful information for different stakeholders of the organisation. Examples are:

- All financial statements including balance sheet, trading, profit and loss account, income and expenditure statement, funds flow statement, etc.
- Exception report showing any deviation from the expected targets, poor usage of fixed assets, etc.
- Prepare reports on fund requirement, cash management report, comparative report on capital budgeting decisions, credit management reports, sales performances report, statutory report for government offices such as auditor general, income tax, etc.

Control and feedback

Control in finance and Accounting Information system manages:

- Revision of plans.
- Revision of schedule.
- Alternative source of financing.
- Generating audible signal to indicate proper entry of sale data, purchase data, etc.

Storage of Data Resources

Maintaining records on customers, debtors, creditors, employees, products and services with the help of database of MS office(access), foxpro and so on. Various data warehouses are available for accounting purposes. SQL server and any other RDBMS support financial and accounting data, financial websites are also available on the internet.

12.6 Marketing Information System

The marketing management function deals with satisfying the consumer. The scope of function starts from identifying the needs of the consumer, evolving product concept, designing the product, positioning the product in the market and selling at appropriate price. In the process of performing the marketing function, activities such as market research, consumer survey, advertising, sales promotion compaign, stocking of products, developing dealer distributor network from the major tasks.

The function has a strong interface with the production and finance department. It relies heavily on production for uninterrupted supply of goods, appropriate stock replenishments and inventory at various locations. The major source of finance in the organisation is the sales, and marketing has a responsibility to obtain the orders from customers and fulfill them.

The control of sales from the point of view of sales income is a major task of marketing management. Forecasting of sales, evolving marketing strategies, pricing, product designing and launching are some of the key responsibilities of marketing management. Retaining market share, penet rating into new markets, assessing consumer responses to a new market launch are the challenging tasks of the marketing management. In a competitive environment, the function assumes key role in the organisation. The major responsibility of the function then remains to evolve competitive stratergies in all the branches of marketing management.

Marketing Information System is also a collection of various subsystems such as sales force management, advertising and promotion, sales management, market research, interactive marketing, customer service support, product management and market intelligence system. Figure shows integrated market information system.

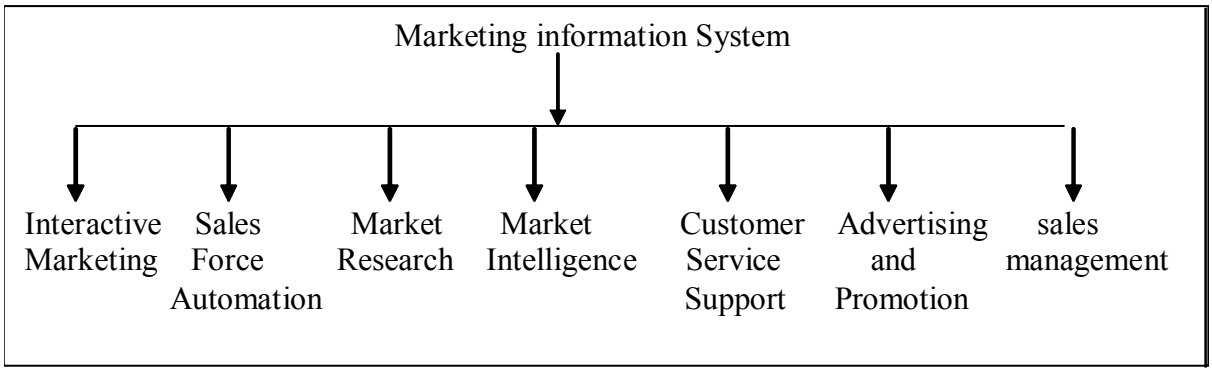

Figure 12.3

Interactive marketing is based on using internet, intranets and extranets to establish two way communication between a customer and business organisation. The objective of interactive marketing is to enable a business organisation to profitability use these networks to attract and keep customers who will become partners with the business in creating, purchasing and improving products and services. The outcomes of interactive marketing are rich mixture of vital marketing data, new product ideas, volume sales and strong customer relationship.

Sales Force Automation

In many companies, sales force is armed with laptop computers, web browsers, and sales contact management softwares like sales CTRL, a sale force automation package and so on. Sales representatives can access information about prospects and customers and provide immediate feedback and sales reports with the help of above mentioned tools. The sales representatives connect themselves to marketing websites on the internet, extranets and organisation intranets.

Advertising and Promotion

Every marketing manager aims at maximizing the sales at the lowest possible cost of advertising and promotion. Marketing information system helps in selecting media and promotional methods, allocate financial resources and control and evaluate results of various advertising and promotional campaigns. Example: INFOCAN's computer based marketing models produce sales forecasts.

Sales Management

With the help of computer based sales management system, quick and accurate sales analysis reports are available that help in analyzing sales by product, market territory, product line, customer, sales person and so on. These reports also help marketing managers in monitoring the sales performance of products and sales persons and help them to develop sales support programs to support sales results.

Product Management

Product manager needs information to plan and control the performance of specific products, product line and brands. He may also be interested in knowing the changes in need and preference of the customers so that the product is changed accordingly or new product is introduced. Sales management system also provides information related to the price of an existing product and what will be the price of the new product as well as from where these products are distributed after analyzing the current stage and resources available with the organisation.

Marketing Intelligence System

It is a set of Procedures and sources used by managers to obtain everyday information about developments in the marketing environment. Marketing intelligence system helps the marketing manager to improve the quality of market intelligence by suggesting the following:

- Train and motivate your sales force to spot and report new developments.
- Motivate the distributors, retailers and other intermediaries to report important intelligence.
- Purchase the products of competitors and learn their unique features.
- Company can buy the information from outsiders.
- Establish a marketing information centre to collect and circulate marketing intelligence.

Market Research

Market research is the systematic design, collection, analysis and reporting of data and findings, relevant to a specific marketing situation faced by the company. Market research information systems provide market intelligence to help managers make better forecasts and develop sound marketing strategies. Marketing information system helps market researchers to collect, analyze and maintain an wide range of information on a variety of market variables that are subject to continual change. Information on customers, prospectus customers preferences, competition, demographic trends also need to be analyzed. After collecting data from various sources a variety of sopihistical software tools such as multiple regression, game theory and so on help a manager to analyse market research data and forecast sales and other important market trends.

Customer Services and Support

An organization has to render services with products to their customers. The marketing information system suggests ways by which a company is going to render these services effectively and efficiently. They also encourage customers through market research campaigns to know how they want and in which mode they want these services. Figure shows Marketing information system :

The components and activities of Marketing Information System are :

Data Resources

These includes Customer orders, Credit notes, Debit notes, Delivery notes, Invoices, Order acceptance, Electronic Data Interchange(EDI).

People Resources

There are two broad categories of people resources:

End users

These are Owners, Clerks, Owners, Marketing experts, sales manager, sales representatives, marketing managers, top managers.

Information system specialist

Information system specialists are the persons who are involved in the designing and development of marketing information system. These are: System designer, System developers, Programmers, System analyst, marketing experts.

System software

Consists of operating system program which controls and supports the operation of computer system. Examples are : Windows, Unix, Linux and Dos.

Application software

Readymade accounting packages in the market are : BRANDAID, ACCESSOR, CALLPAN, Sales CTRL, Self made application program.

Utilities

These are MS office, MS Excel, MS Powerpoint

Procedures

- Instructions to fillout paper forms.
- Operating instructions for users. Example: Manuals of software packages.
- Software help module.

Hardware Resources

All the physical and tangible devices. Examples are: Computer, Printer, Scanner, Floppy, Mouse, Bar code, Paper for hard copy, CD's and Disk, etc.

Network Resources

This involves the usage of Communication Media, Network cards, Switches, Modem, Communication satellite system, Fiber-optic cable, interface card bridges etc.

Network Support

This involves the usage of Internet, Intranet of the organization and Extranet and software that supports these networks, Local area network, etc.

Input

Input is the 'hard data' related to: Sales person data, Customer order, Billing, Invoices, Calls made by sales persons, Market research data, Enquiries from customers, Order acceptance.

Processing

It comprises the complete marketing process.

- Planning of a market program.
- Select target market.
- Organizing, implementing and controlling market efforts.
- Handling customer queries of customers, dealers and so on.
- Analyzing marketing opportunities.

Output

It gives output as:

- Sales analysis report.
- Competition analysis report.
- Market analysis report.
- Customer complaint report.
- Sales forecasting report.
- Statutory reports for sales tax authorities.

Control and Feedback

The following are the various control applications that are used for controlling and feedback activity:

- Control applications for correcting ongoing performance.
- Take decisions on product positioning, pricing, design, etc.
- Report on various comparisons such as sales versus budgeted sales, marketing cost versus budgeted cost, etc.

Storage of Data Resources

It consists of:

- Maintaining records of sales persons, sales territory, distributors, etc.
- Marketing websites on internet.
- Maintaining records of customers.

For maintaining records and database there are many utilities available, examples are: MS Access, SQL server, Mysql, Oracle 9i

12.7 Human Resource Information System

Personnel management function has the primary objective of providing suitable manpower in number and with certain ability, skills, and knowledge, as the business organisation demands from time to time. Its aim is to control personnel cost through continuous increase in manpower productivity by resorting to the following techniques.

- Grievance handling.
- Structuring the organisation.
- Promotion and awards through performance appraisal.
- Human resource development through training and upgrading the skills.
- Motivation through leadership and job enrichment.

While designing human resource information system, designer has to keep one thing in mind that the proposed system is such that it supports all of these activities. Human resource information system has four major subsystems. Staffing, Training and Development, Compensation and Governmental Reporting.

Staffing System

Information system supports the staffing function that records and tracks human resources with in a company to maximize their use. The staffing function is a subsystem of human resource information system.

Training and Development System

Information system helps human resource manager to plan and monitor employees training and development program. They also analyse the career development status of the employees. It also monitors the performance appraisal system of the organisation. Computer based multimedia training programs and performance appraisal are available to support this area of human resource management.

Employee Skills Inventory System

It keeps records about employee skills to locate employee within a company who have required skills for specific work assignments and projects.

Personnel Record Keeping System

It monitors the addition, deletion and other changes to the records in a personnel database to update personnel database, main information is related to changes in job assignment and compensation, or hiring and terminations.

Compensation Analysis System

Information system also support and analyses the range and the distribution of employee compensation that is in terms of wages, salaries, incentives and fringe benefit within a company, makes comparison with the compensation given by other similar companies. This information is useful for planning changes in compensation. It helps in keeping company's compensation competitive and equitable and also controlling cost of compensation.

Governmental Reporting

Reporting to government agencies is the key responsibility of human resource manager. Company uses computer based information system to keep track of the statistics and produces reports required by the government agencies. For this software packages are available.

Forecasting Personnel Requirement System

This application provides forecast of personnel requirements in each major job category for various departments, for new and existing projects. It uses a computer based simulation model to evaluate alternative plans for recruitment, reassignment and retraining, etc.

Data Resources

These includes Appointment letter, Attendance and leave record, Personnel application form, Wage and salary agreements, Appraisal form, Industry data on manpower, skills, performance, Record of sources of recruitment

People resources

Two broad catagories of people are:

End users

These are Provident fund authorities**,** Administrative managers**,** Human resource development manager**,** ESI authorities**,** Top manager**,** Industrial relation manager.

Information System Specialist

Information system specialists are the persons who are involved in the designing and development of Human resource information system. These are Programmers, Human resource expert, System developer, System designer, System analyst

System Software

Consists of operating system program which controls and supports the operation of computer system. Examples are : Windows, Unix, Linux and Dos

Application Software

- Organisation has a self made application program.
- computer based simulation models & computer based multimedia training programmes.

Utilities

These are MS office, MS Excel, MS Powerpoint

Procedures

- Software help module
- Manual of software package
- Instruction to fillout paper, online form

Hardware Resources

All the physical and tangible devices. Examples are: Computer, Printer, Scanner, Floppy, Mouse, Bar code, Paper for hard copy, CD's and Disk, etc.

Network Resources

This involves the usage of Communication Media, Network cards, Switches, Modem, Communication satellite system, Fiber-optic cable, interface card bridges etc.

Network Support

This involves the usage of Internet, Intranet of the organization and Extranet and

software that supports these networks, Local area network, etc.

Input

Input is the 'hard data' related to: Salary/wages, Production data, Accidents, Leave, Attendance, Manpower, Bio-data, Loans and deductions, Statutory tax deductions.

Processing

It comprises the complete marketing process.

- Working calendar of the organisation along with holidays, working days,etc.
- Absenteeism, attendance, leave records of the employees.
- Query handling.
- Supports all the activities related to recruitment process, selection and induction process.
- Strength of a section, division.
- Analysis of salary, wages, structure.
- Making training and development schedule.

Output

It gives output as:

- Provident fund report.
- Standing reports submitted to the government agencies like income tax office, ESI authorities.
- Report on employee skills, qualifications and experience.
- Performance appraisal report.
- Report on forecast of manpower requirement.
- Statutory reports for sales tax authorities.
- Report on training and development program conducted, their success and failure.

Control and Feedback

The following are the various control applications that are used for controlling and feedback activity:

- Monitor portable absence versus work load.
- Projection of personnel cost against manpower increase.
- Reduction, transfer and development programmes with specific need.
- Preparation of training and development programmes with specific need.

Storage of Data Resources

It consists of:

- Maintaining records of sales persons, sales territory, distributors, etc.
- Marketing websites on internet.

- Maintaining records of customers.

For maintaining records and database there are many utilities available, examples are: MS Access, SQL server, Mysql, Oracle 9i

12.8 Production Information System

The objective of production management function is to provide manufacturing services to the organisation. This involves the manufacturing of product of a certain specified quality and with in certain cost in a stipulated time fulfilling the promises given to the customer. The production management function is supported by functions like production planning and control, industrial engineering, maintenance and quality control. It has a strong interface with materials management function. The organisation of the production management varies according to the type production, i.e. job shop or continuous. It also varies with the production policy of the organisation, like, whether the production is initiated against a customer order or for stock. The system and methodology differs with respect to the manufacturing technology of the organisations have adopted. The functional objectives of the production management are fullest utilization of the manufacturing capacity, minimal rejections, maximum uptime of plants and equipment and meeting the delivery promises.

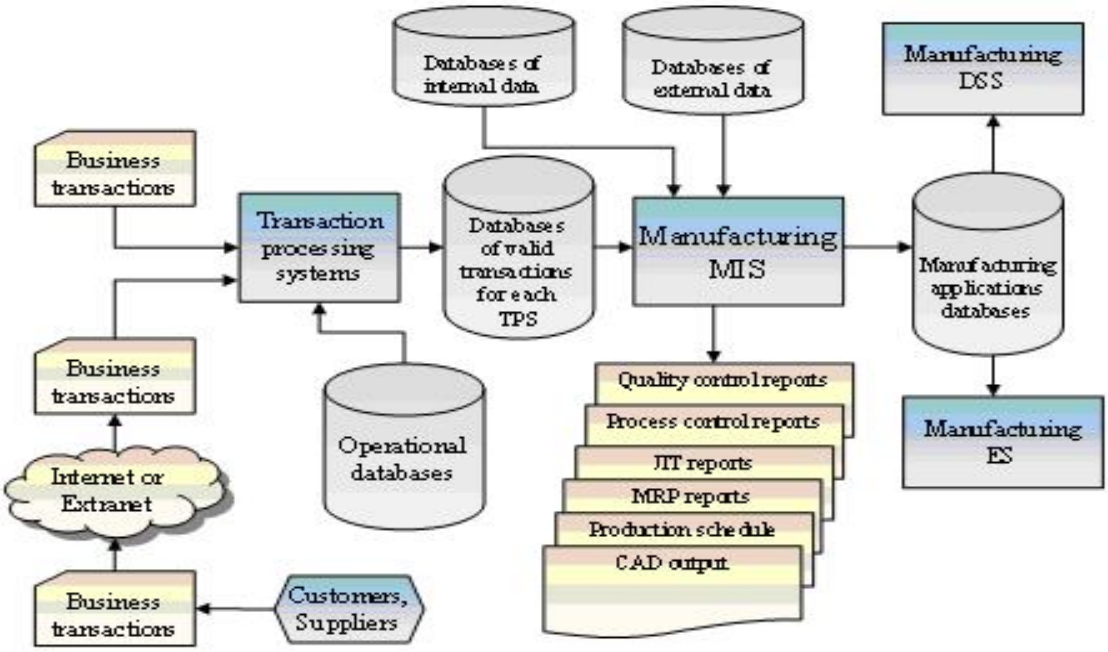

Figure 12.4

The production information system is related to production planning, production control, production scheduling, material requirement planning, quality control and product engineering. The production information system is divided in to various subsystems as shown in the figure.

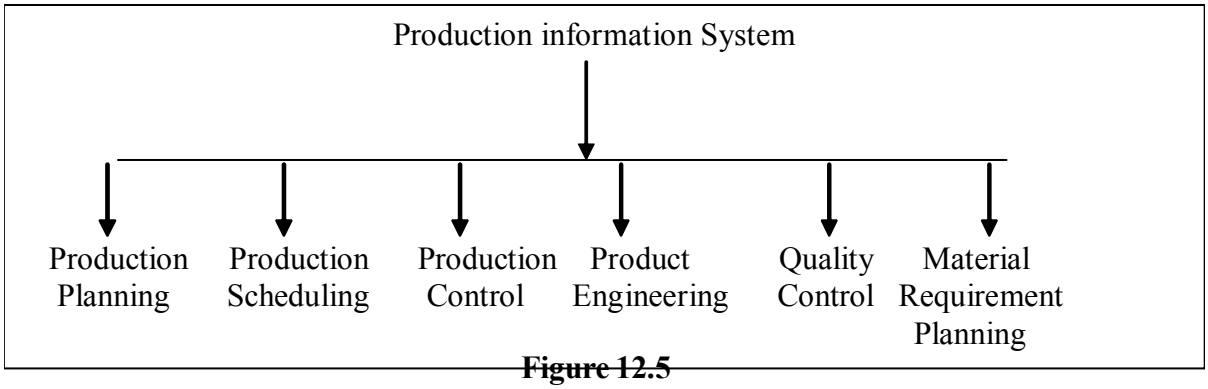

Figure 12.5

Production Planning

It determines what should be produced, when it should be produced, how it should be produced, why it should be produced, who is going to produce it and for whom it is being produced. It is primarily the responsibility of a plant manager, general foreman and foreman of production department to perform the task of planning by using the market research data for style, sizes, colours and any other specific feature required by customer, a production plan tells in how much quantity the parts are to be produced. The following are the activities of production planning:-

- Breaking up the job into various divisions, leading to listing all the operations which would be carried out.
- Drawing up the bills of materials and schedule of dates on which the various materials will be required.
- List of tools which are required to perform the production operations. Also identifying the tools for which special efforts to be made.
- Making drawings or processing patterns etc.
- Drawing up the scheduling chart.
- Making test runs to locate and remove technical faults.
- Dispatching – issuing instructions for the various activities to be taken up in their proper turn.
- Drawing up the route chart by which the task will be completed and listing the exact methods, tools, machine, material etc. This will be required for completing each operation.
- For production planning computer based PERT and CPM packages are available.

Production Scheduling

Planning the specific time at which the product items should be manufactured is known as production scheduling. The activities performed by production scheduling system are as follows:-

- Minimize the ideal time on the part of operators and equipments.
- Study the alternative methods of performing the activities so that time taken to perform can be further reduced.
- Determine the stage of production in sequential and rational order.
- Insure that completion dates of completing the production plan are met fully.
- Extent of need of subcontracting to the outside party.

Production Control

It includes the control of production program, production capacity and control of all the activities related to expediting, coordinating and controlling the operations of various production departments or shops. The other issues with which the production management has to deal, are optimum utilisations of the production capacity and labour force. It has to insure that plant, machines and equipments, those having high investments are fully utilised. Production control system again has three subsystems of time standards, cost standards and quality standards. Time standards are incorporated in the operations list and are controlled by the department foreman by coordinating the task of workers and machines. Cost standards are controlled by shop foreman he controls various costs by properly assigning the jobs to workers on the basis of their

qualifications, skills, experience, efficiency and quality. He also has to look after the material is properly used so that minimum wastage is there.

These are some of the areas where control of the production management is essential:-

- Utilsation of key facilities below a limit.
- Backlog of a large number of orders and failure to meet promised delivery date.
- Excessive work in process inventory.
- Continuous significant deviation from standards or norms of production rate.
- Excessive product rejection on account of material and/ or process.
- Hold up of key jobs beyond a certain limit.

Quality Control

It includes testing or inspecting completed items of production or defects in semi finished products, defects in material and so on. Inspection is done by taking sample from the each lot. For quality control, there is a separate quality control department. There are many quality control techniques such as inspection, statistical quality control and control charts etc.

Material Requirement Planning

The goal of this subsystem is to provide material for production, maintenance and services at economical rates in an appropriate quantity and quality with least stock outs and with no extra cost of carrying the inventory. The main function of plant manager under material requirement planning is to produce stock and control inventory. He has the responsibility of studying new alternatives to reduce the cost of material, reduction of inventory and disposal of non moving inventory in order to reduce the overall cost of the material.

Product Engineering

It involves the entire development of the product through all initial stages until actual manufacturing starts. Preparations of drawings, specifications, experimental and developmental efforts are the activities in the product engineering. Production engineers use computer aided engineering to simulate, analyse and evaluate the models of product design. CAD packages refine engineer initial drawings and provide three dimensional computer graphics that can be rotated on the screen to display all sides of the product being designed. The computer generated design can than be converted in to a finished mathematical model of the product.

Data Resources

These includes Production order, Material requirement report, Material requisition list, Bill of material report. etc

People resources

Two broad catagories of people are:

End users

These are Production manager, Material manager, Top manager**,** Plant manager**,** Shift manager, Clerks, Labourers, etc.

Information System specialist

Information system specialists are the persons who are involved in the designing and development ofProduction information system. These are Programmer, Production and material experts, System developer, System designer, System analyst, etc.

System Software

Consists of operating system program which controls and supports the operation of computer system. Examples are : Windows, Unix, Linux and Dos

Application Software

Readymade accounting packages in the market are: CAD, CAM, PERT/CPM Package, Coral Draw, etc.

Utilities

These are MS office, MS Excel, MS Powerpoint

Procedures

- Hand Manuals of the software packages.
- Instruction to fillout paper, online form

Hardware Resources

All the physical and tangible devices. Examples are: Computer, Printer, Scanner, Floppy, Mouse, Bar code, Paper for hard copy, CD's and Disk, etc.

Network Resources

This involves the usage of Communication Media, Network cards, Switches, Modem, Communication satellite system, Fiber-optic cable, interface card bridges etc.

Network Support

This involves the usage of Internet, Intranet of the organization and Extranet and software that supports these networks, Local area network, etc.

Input

Input is the 'hard data' related to: Source of raw material, Sources of labour, Assembly order, Production order, etc.

Processing

It comprises the complete marketing process.

- Analyzing the bill of material report.
- Shift report, daily production report.
- Analyzing the production schedule report.
- Analyzing the production planning report.

Output

It gives output as:

- Finished goods inventory report.

- Work in progress report.
- Report on machine break down,
- Production status report, etc.

Control and Feedback

The following are the various control applications that are used for controlling and feedback activity:

- Target and actual production variance report.
- Back log of a large number of order report.
- Plan loading report.
- Capacity utilization report.

Storage of Data Resources

It consists of: Data warehouse related to product and labour force details. For maintaining records and database there are many utilities available, examples are: MS Access, SQL server, Mysql, Oracle 9i

12.9 Research and Development Information System

Research is defined as a scientific and systematic search for relevant information on a particular topic. It is an art of scientific investigation. A manager in a business organization basically applies the method of science to the art of management under the research and development department. In today's dynamic business environment when technology is changing very fast, competition is global; almost all business or other organizations work under the condition of uncertainty. This uncertainty is not eliminated fully, can be minimized by using research methodologies. So every organization today has top cope with this type of environment needs a systematic supply of information coupled with tools of analysis for making sound decisions which involves minimum risk.

It is only the research methodology that plays a very important role.

It is not necessary that every organization has a separate research and development department. To have a separate research and development department depends upon a number of factors such as, size of organization, management attitude towards this activity and so on. Some organizations conduct research with the help of outside agencies, it is not important how an organization conduct research but to conduct the research work in order to survive and grow in the dynamic business environment. Research is the central part of the organization which facilitates almost all the functional areas of the management.

Research and development information system is the systematic design, selection, analysis, reporting of data and findings that are relevant to a specific business situation being faced by the business organization. Production system, human resource system, finance and marketing information systems are the sub systems of research and development information system because it provides decision support to each of these areas of management.

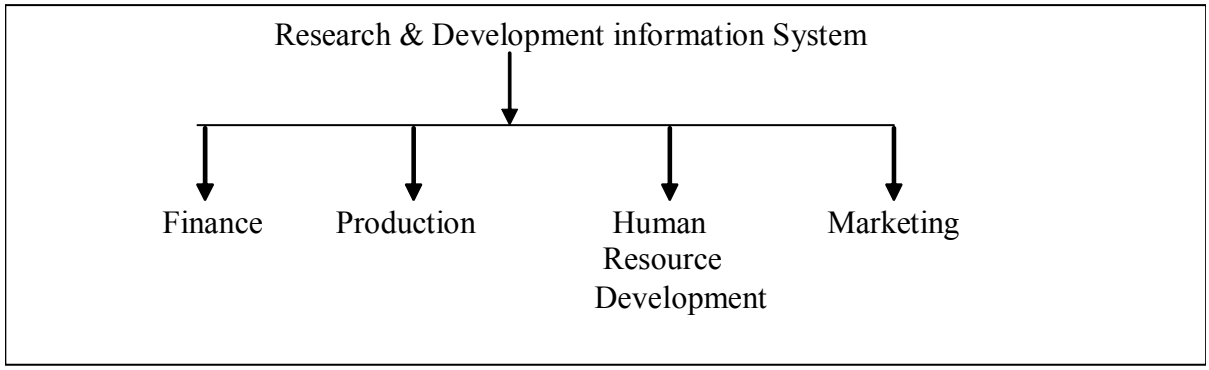

Figure 12.6

Finance

Finance department use research tools for financial planning and control it also use research tools for gathering and analyzing information for their internal operations and for making in-depth studies on economic conditions of business.

Production Research

Production research helps an organization to decide what to produce, how to produce, when to produce and for whom to produce in the field of production. There are various other research tools that are also helpful in quality control as well as in inventory control.

Marketing Research

Marketing research is the process of systematic collection, compilation, analysis and interpretation of relevant data for making marketing decisions. Research tools are applied effectively for research tools are applied for the study of demand forecasting, consumer behavior, measuring advertising effectiveness, product positioning etc.

Human Resource Department

This department uses research tolls to study wage rates, incentive schemes, employ turnover rates, cost of living, employment trends, performance and potential appraisal, manpower planning, training program design etc.

Data Resources

These includes Interview, Questionnaires, Periodicals, commercial data, Electronic data interchange (EDI).

People Resources

Two broad catagories of people are:

End Users

These are research managers, Top managers, Business owner, assistants, foreman's.

Information System Specialist

Information system specialists are the persons who are involved in the designing and development of research & development information system. These are statisticians, survey designers, programmers, System developer, System designer, System analyst.

System Software

Consists of operating system program which controls and supports the operation of computer system. Examples are : Windows NT, Red Hat Linux and IRIX.

Application Software

Readymade accounting packages in the market are: CAD, CAM, MAYA, Coral Draw, etc.

Utilities

These are MS office, MS Excel, MS Powerpoint.

Procedures

- Hand manuals of the software packages.

- Online help.

Hardware Resources

All the physical and tangible devices. Examples are: Computer, Printer, Scanner, Floppy, Mouse, Barcode, Paper for hard copy, CD's and Disk, etc.

Network Resources

This involves the usage of Communication Media, Network cards, Switches, Modem, Communication satellite system, Fiber-optic cable, interface card bridges etc.

Network Support

This involves the usage of Internet, Intranet of the organization and Extranet and software that supports these networks, Local area network, etc.

Input

Input is the 'hard data' related to: questionaire, interview and mechanical devices like audiometer, eye cameras and so on.

Processing

It comprises the complete marketing process.

- Selection of appropriate module.
- Selection of an appropriate statistical measurement technique.
- Data is organized and coding of data is done.
- Mapping of the future activities for which researchers are conducting the research.

Output

It gives output as:

- Report on inter-related information which is obtained by linking of the files.
- Exception-based reports which depicts the deviations, fluctuation, variances and changes when they occur.
- Regular analytical reports which highlights the analysed results.

Control and Feedback

The following are the various control applications that are used for controlling and feedback activity:

- Monitoring & Review of what is happening at R&D sites and collect their regular feedback.
- Resolve uncertain situations and solves the problem.
- Control and coordinate the day-to-day activities in a systematic manner.

Storage of Data Resources

It consists of Maintaining records related to marketing, financial, human resource and production. For maintaining records and database there are many utilities available, examples are: MS Access, SQL server, Mysql, Oracle 9i

12.10 Summary

Finance, Marketing, Production, Human Resource and Research and development are the major functional areas of a business organization. Finance and accounting information system accepts data related to business transactions and after processing it give reports to various stake holders. It supports financial manager in decision making process and covers cash management, product management, investment management, order processing inventory control and so on. Marketing information system provides information support for the management of the marketing function. It helps the marketing manager in market research, product development and pricing decisions, sales force management, planning advertising and sales strategies and so on. Human resource information system supports human resource management function in a business organization. It includes information system for staffing the organization, training and development of the personnel and so on. Production information system supports the production manager to take decision regarding production planning, production scheduling and production control. Research and development information system provides information support to finance, marketing, production and human resource management department so that they may find innovative and creative ways to perform their business operations successfully.

12.11 Key Words

- **Network** : A system that transmits data to and from a number of locations that are geographically dispersed.
- **Functional areas of business management :** Finance and accounting management, Marketing management, production management, human resource management, research and development.
- **Internet:** It is a network of network which connects several computers globally.
- **Intranet**: It is a private computer network maintained by an organization for internal communication.
- **Extranet**: An extension of an intranet which makes the latter accessible to outside companies/ individuals with or without intranet.
- **Hardware**: Parts of computer such as CPU, disk drive, CRT or printer.
- **Software** : Programs that instruct computer how to process data and documentation that explains how these programs should be used.
- **Decision support system:** A set of computer programs capable of handling unstructured or semi-structured problems through the use of one or more corporate databases, user databases, model databases, and a special dialogue or planning language.
- **Data Flow Diagram**: It is derived from a context diagram. It graphically portrays the inputs, outputs, data stores, and processes associated with each subsystem of the overall system. It breaks down single process shown in the context diagram.
- **End-user:** Usually non-technical individuals who use computer resources to accomplish daily tasks.
- **Management information system:** A specific type of information system developed after EDP systems that focuses on outputting useful, decision-oriented information useful to managers as opposed to operational workers.

12.12 Self Assessment Test

1. Which applications in these functional areas should be online and real time?
2. Which data items are common across the functions? For example, employee number is common to personnel, finance, marketing and materials. How would you exploit this factor in the variety of application development?
3. Which reports are produced by the following information systems:(a) Finance and accounting (b) Human resource information system.
4. How internet and intranet support marketing information system in a business? Give suitable examples.
5. How Research and development activities are important in any business Organization? Is Research and development information system a facilitator to other business operations? If yes, give suitable examples.
6. Outline the main features of HRIS development.
7. Explain various inputs of Finance and account information system and their usefulness.

12.13 References

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