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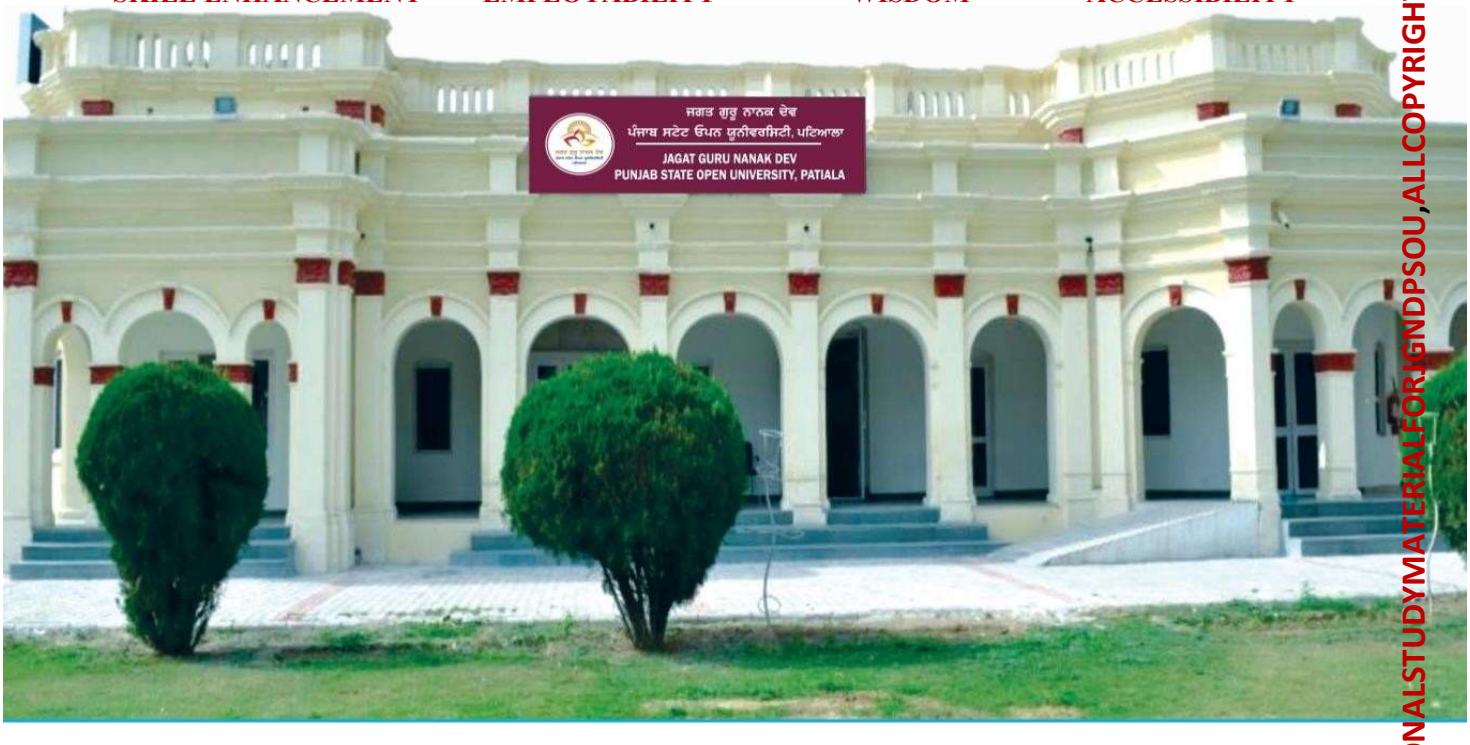
# JAGAT GURU NANAK DEV
# PUNJAB STATE OPEN UNIVERSITY, PATIALA

**(Established by Act No. 19 of 2019 of the Legislature of State of Punjab)**

## The Motto of the University
## (SEWA)

**SKILL ENHANCEMENT  EMPLOYABILITY  WISDOM  ACCESSIBILITY**




## B.Com. (Digital) SEMESTER-5

BCDB33507T: Management Information System



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**JAGATGURUNANAKDEV**

**PUNJABSTATEOPENUNIVERSITYPATIALA**

**(EstablishedbyActNo.19of2019ofLegislatureoftheStateofPunjab)**


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## PREFACE

Jagat Guru Nanak Dev Punjab State Open University, Patiala was established in December 2019 by Act 19 of the Legislature of State of Punjab. It is the first and only Open University of the State, entrusted with the responsibility of making higher education accessible to all especially to those sections of society who do not have the means, time or opportunity to pursue regular education.

In keeping with the nature of an Open University, this University provides a flexible education system to suit every need. The time given to complete a programme is double the duration of a regular mode programme. Well-designed study material has been prepared in consultation with experts in their respective fields.

The University offers programmes which have been designed to provide relevant, skill-based and employability-enhancing education. The study material provided in this booklet is self instructional, with self-assessment exercises, and recommendations for further readings. The syllabus has been divided in sections,and provided as units for simplification.

The Learner Support Centres/Study Centres are located in the Government and Government aided colleges of Punjab, to enable students to make use of reading facilities, and for curriculum-based counselling and practicals. We, at the University, welcome you to be a part of this institution of knowledge.

Prof. G.S. Batra,

Dean Academic Affairs

# B.Com (Digital)
# GENERIC ELECTIVE COURSE (GE)
# Semester-V
# BCDB33507T: Management Information System

Total Marks: 100 Credits: 6
External Marks: 70 Internal Marks: 30
Pass Percentage: 40%

**OBJECTIVE:**
To develop decision making and management skills for learners in any organization based on information provided by MIS.

**INSTRUCTIONS FOR THE PAPER SETTER/EXAMINER:**
1. The syllabus prescribed should be strictly adhered to.
2. The question paper will consist of three sections: A, B, and C. Sections A and B will have four questions from the respective sections of the syllabus and will carry 10 marks each. The candidates will attempt two questions from each section.
3. Section C will have fifteen short answer questions covering the entire syllabus. Each question will carry 3 marks. Candidates will attempt any ten questions from this section.
4. The examiner shall give a clear instruction to the candidates to attempt questions only at one place and only once. Second or subsequent attempts, unless the earlier ones have been crossed out, shall not be evaluated.
5. The duration of each paper will be three hours.

**INSTRUCTIONS FOR THE CANDIDATES:**
Candidates are required to attempt any two questions each from the sections A and B of the question paper and any ten short questions from Section C. They have to attempt questions only at one place and only once. Second or subsequent attempts, unless the earlier ones have been crossed out, shall not be evaluated

## Section A

### Unit I

**Introduction to Management Information Systems (MIS):** Definition of MIS, Evolution of MIS, Concepts of MIS, Importance of MIS, Objectives of MIS, Information Technology, Characteristics of MIS, Functions of MIS, Limitations of MIS.

### Unit II

**Structure of MIS:** MIS Structure based on physical components, processing functions, management activities, decision making and organizational functions.

### Unit III

**Classification of MIS:** Transactional Processing System (TPS), Management Information

System (MIS), Decision Support System (DSS), Executive Support System (ESS), Expert System and Office Automation System (OAS). Functional Information System**.**

**Unit IV**

**Information and System Concepts:** Data, Information, Characteristics of Information, Dimensions of Information, System, Types of System, Elements of System, Human as an Information Processing System.

**Unit V**

**Decision Making & MIS:** Decision Making, Simon's Model of Decision Making, Types of Decisions, Methods for Choosing among Alternatives, Decision Making and MIS.

# Section B

**Unit VI**

**System Development Approaches:** System Development Life Cycle (SDLC), Phases of SDLC, System Development Models: Waterfall Model, Prototyping, Iterative Enhancement Model and Spiral Model.

**Unit VII**

**System Analysis:** Requirement Determination, Strategies for Requirement Determination, Structured Analysis Tools: Data Flow Diagram (DFD), Data Dictionary, Structured English, Decision Trees, Decision Tables.

**Unit VIII**

**System Design:** Objectives of System Design, Conceptual Design, Design Methods, Detailed System Design.

**Unit IX**

**Implementation and Evaluation of MIS:** Implementation Process, Hardware and Software Selection, Evaluation of MIS, System Maintenance.

**Unit X**

**Information System Planning:** Planning Terminology, The Nolan Stage Model, The Four Stage Model of is Planning, Selecting a Methodology, Information Resource Management (IRM).

## Text & References:


- D.P. Goyal , Management Information Systems
- Robert G. Murdick, Joel E. Ross, James R. Claggett, Information Systems for Modern Management, Prentice Hall of India Pvt. Ltd.
- Gordon B. Davis, M.H. Olson, Management Information Systems: Conceptual Foundations, Structure & Development, McGraw-Hill Book Co.

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# UNIT – 1

# INTRODUCTION TO MANAGEMENT INFORMATION SYSTEM



## 1.1 Definition of MIS

The definition of MIS varies from person to person. Let us consider a few definitions to make the concept of MIS clear.

1. **It is the information system(s) developed by an organization to run its management system (comprising management functions, business functions and decision making processes).**
2. **According to Schwartz, 'MIS is system of people, equipment, procedures, documents and communication that collects, validates, operates on transformers, stores, retrieves, and present data for use in planning, budgeting, accounting, controlling and other management process.**
3. **Thomas R. Prince defined MIS as a computer based network containing one or more operating systems, provides relevant data to management for decision-making and also contains the necessary mechanism for implementing changes of responses made by management in the decision-making**.

## 1.2 MIS Evolution

MIS is an old management tool. It was in use by business managers well before the

emergence of the Computer, as a means for better management and scientific decision-making. With the coming up of large business corporations in USA towards the end of the eighteenth century need was felt to enlarge the MIS to cater to the growing and diversified information needs of the corporations to deal with complex and multi-variate problems

MIS provides for the identification of relevant information needs, the collection of relevant information, processing of the same to become usable by the business managers, and timely dissemination of processed information to the users of the information for properly managing the affairs of an enterprise by informed decisions

The MIS should not be identified just as a computer system. Computer, like many other developments, has enriched MIS and has made it more effective by enabling minute and accurate processing of massive information. But the system was there and it is, there now largely based on computer.

MIS in its present form has been evolved from the following disciplines in management.

**1. Managerial Accounting**

This branch of accounting is concerned with cost analysis and its behaviour which is useful for managerial decisions. Managerial accounting knowledge is of great help in ascertaining the information requirements, carrying analysis, in designing forms for procuring and providing information. In fact, a Managerial Accountant has a clearcut knowledge about the relevant and specific information requirement of executives for performing functions in different departments. For example, to determine the break-even point the information required is about fixed cost, variable cost, and selling price of the product. He also knows sources of information availability. All these facts known to Managerial Accountant's were utilized in the evolution of MIS. Thus one can say that MIS is an extension of managerial accounting.

**2. Management Science**

It means the application of scientific method and quantitative analysis techniques (or Operations Research Techniques) to management problems. Management Science techniques were incorporated in the MIS design to make quantitative and analytical Information available to the users of MIS. The information system so designed provided quantitative information and procedures, to facilitate model building for future plans and activities and to

simulate the real situations even before they occur.

**3. Management Theory**

There were several management theories-behavioural, empirical, decision, quantitative and management process. Out of these, decision theory and management process are more relevant to us. According to decision theory.the most important task of managers is to make decisions.

According to Management Process Theory, management performs the functions of planning, organizing, staffing, directing and controlling. The knowledge of these management theories enabled the MIS designers to ascertain the type of decisions made and functions performed by executives in business organizations.

**4. Computers**

Computers were not originally planned for processing information but today this is the major use for which they are applied in business situations. The reason for this is their speed of processing, calculating and retrieval of data. In fact, computer technology has been considered a major factor including MIS development. It has come as a significant tool in information processing storage.

From the above discussion, it is quite apparent that MIS is an old management tool and has been derived from various disciplines in management. It maintained and provided the necessary information to its executives for planning, controlling and decision-making purposes.

## 1.3 Concepts of MIS

With the advent of computers and communication technology, it has now become possible to transmit large amounts of information across long distances cheaply and timely. Therefore, environmental pressures have necessitated that **information be considered as a sixth important resource** along with the traditional five resources of money, men, materials, machines and methods.

Figure 1.1 shows the flow of information in a production organization alongwith other resources.

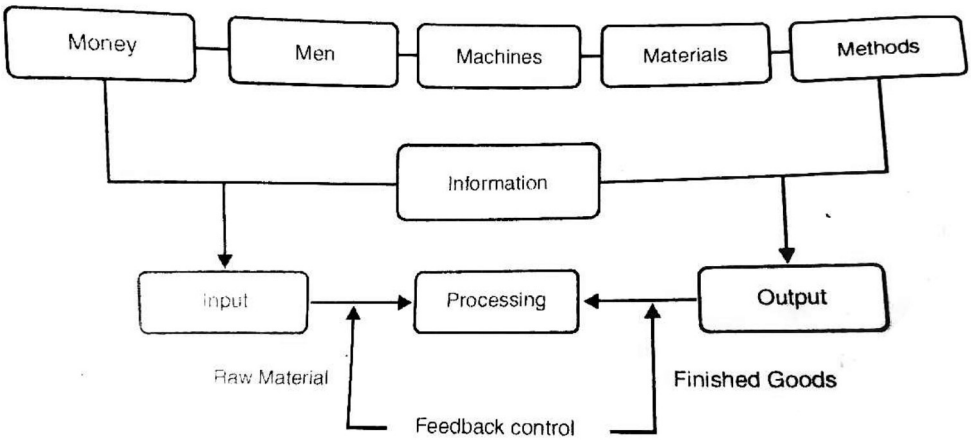



**Figure 1.1: Information as a Resource**

The MIS concept was very useful since the start of the first business organization, it remained manual, very simple and unrecorgnised, whereas today, it has got a greatly refined nomenclature, along with a well-designed computer based structure, which follows the systems approach.

Management Information System (MIS) is an acronym of three words, viz. **Management, Information and System**. The cope and purpose of MIS is better understood if each part of the term MIS is explained in detail separately.

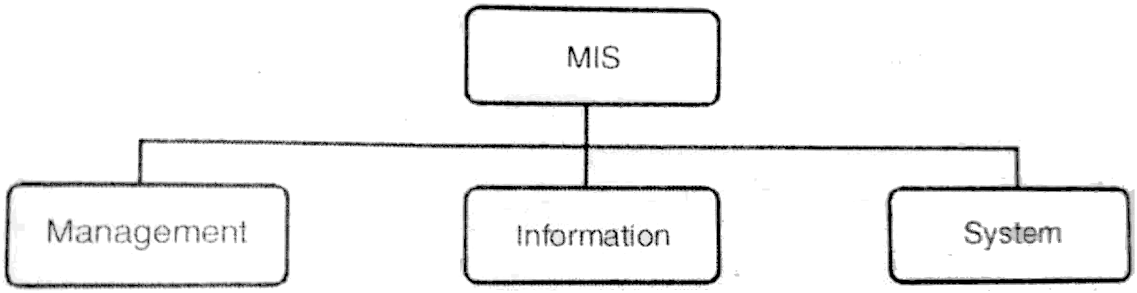



**Figure 1.2**

## 1.4 Importance of MIS

All managerial functions are performed through decision-making. For taking rational decision, timely and reliable information is essential. Today the need for an updated information has become inevitable to arrive at an effective decision in all walks of life. Whether it is industry, commerce, defence, banking, education, economics or politics, information is needed everywhere.

The **Management Information Systems (MIS)** is an integrated man-machine system that provides information to support the planning and control functions of managers in an

organization.

MIS plays more important role in today's environment because a manager has to take decisions under two main challenges:

(i) Due to **liberalization** and **globalization**, an organization has to compete not only locally but globally also. Therefore, a manager has to take quick decision, otherwise, his business will be taken away by his competitors.

(ii) In this information age wherein information is doubling up every one to two years, a manager has to process a large voluminous data; failing which he may end up taking a wrong decision that may prove to be very costly to the organization.

Hence, today MIS is considered to be of paramount importance. MIS helps decision makers by provide information at various stages of decision-making and thus greatly help the organizations, to achieve their pre-determined goals and objectives.

The importance of MIS can be studied under following points:

1. **Management-oriented:** MIS is always management-oriented and keeps in view that every level of management gets the desired information.
2. **Integrated:** MIS is developed with an eye on its installation costs, its effectiveness, production capacity, stock levels, customer service and need of capital. As such it takes an integrated view of the whole organization.
3. **For planning:** Every business makes short term and long term planning based on past and present information. Thus a good information system gives the various relevant information regarding sales and production quantities, production methods, capital investements, stock etc. With the help of these information, management can make future plans.
4. **For control:** An effective MIS helps the management to know the deviations of actual performance from the pre-set targets and the reasons thereof. Then the management takes the step to check the unfavourable variations and control the working of the organization.
5. **For increasing efficiency:** MIS is important in increasing the efficiency of the employees.
6. **Updated results:** MIS helps the management in getting the updated results of the

departments and various decisions.

7. **Highly computerized:** Being highly computerised. MIS gives accurate information regarding various activities of the organization and brings out the fact and the present condition of various departments and divisions.
8. **Fulfillment of statutory obligations:** The information regarding business activities are important not only for planning. management and control but legally those information should also be given to shareholders and creditors who have stake in the firm. A good MIS helps the management in fulfilling its legal obligations.
9. **Awareness and Intelligence:** MIS adds to the alertness, awareness and intelligence of managers by supplying information in the form of progress and review report of an on-going activity.
10. **Decision making:** Another role of MIS is to provide only that much information as called for by managers specifically for purposes of decision making.

## 1.5 Objectives of MIS

MIS has the following objectives:

(i) To facilitate the decision-making process in an organization by providing all levels of management with accurate, timely information to help the managers in selecting best course of action.

(ii) To provide each manager at every level, the planning and control tools and help in highlighting the critical factors to be closely monitored for successful operation of the enterprise.

(iii) To help the management in getting the required information for controlling the activities of the organization.

(iv) To create a process of communication wherein information is recorded, stored and retrieved for decision recording planning, operation and control with an organization.

(v) To provide a system of people equipment procedures, documents and communications that collects, validates, operates on transformers, stores, retrieves and presents data for use in planning, budgeting, accounting, controlling and other management processes.

Hence, the main objective of MIS is to provide the right information to the right manager at the right time all in a cost-effective manner.

## 1.6 Information Technology

Information Technology (IT) includes hardware, software, databases, networks and other devices. IT is combination of two technologies namely computers and communication technology. Earlier information systems were manual information systems where managers use tools such as paper, pencils or calculators to convert raw data into information. But, Now-a-days, information system is not a standalong Computer-based information system; rather it is networked where computers can exchange information quickly at a distance. Internet has farther revolutionised the business world.

The specific features of IT based information system are outlined as follows:

- Ability to process data into information with high accuracy and high speed.
- Super-human memory, tremendous volume of data and information and the large set of instructions can be stored in the computer and can be retrieved as and when needed.
- The input data in the computer can be processed into a number of different outputs and for a variety of purpose.
- The information processing and computer technology have been so advanced that managers are able to obtain real time information on on-going activities and events without any waiting period.
- Scope of analysis widened. The use of computer can provide multiple type of information accurately and in no time to decision makers. Such information equips an executive to carry out a thorough analysis of the problems and to arrive at the final decision.
- Increases the effectiveness of Information system. Information received in time is of immense value and importance to a concern.
- The use of computer for MIS enabled systems expert to provide more comprehensive information to executives on business matters.
- E-commerce is now very popular and common due to internet.
- Now-a-days organizations are moving towards digital organizations where are

business activities are, performed electronically and a much broader term is being used, which is known as e-Business.

## 1.7 Characteristics of MIS

MIS possesses the following characteristics:

1. **Flexibility:** All organizations are dynamic and changes occur for a wide range of reasons. A good MIS must be able to adopt to meet these changes.
2. **Reliability:** Reliability is crucial to performance and can be ensured only by thorough checking and testing. Good standards help to make the MIS reliable as do validation and security routines
3. **Simplicity:** Anyone can design a complicated system but it takes real skill and experience to design simple systems which are easy to operate and control.
4. **Economy:** The MIS should be cost-effective. There are many hidden costs in the design development and operation of systems the most important of which is the time of the people involved
5. **Helpfulness:** Unless the MIS helps in the planning, operation and control of the business, it is superfluous
6. **Consistency: I**nformation system should be consistent. There must be a link between all the data. Data should be collected by the same method and scale and should be presented at equal intervals.
7. **Management-oriented:** It means that the development of the information system efforts should start from an appraisal of management needs and overall business objectives.
8. **Management-directed:** Management should be responsible for setting system specifications and it must play a key role in the subsequent trade off decisions that occur in system development.
9. **Integrated:** Developed system of information should be an integrated one. It means that all the functional and operational information sub-system should be tied together into one entity. An integrated information system has the capability of generating more meaningful information to management.
10. **Common data flows:** It means the use of common input, processing and output procedures and media whenever possible or desirable.

11. **Heavy planning element:** An MIS usually takes 3 to 5 years and sometimes even longer to get established firmly within a company. Therefore, a heavy planning element must be present in MIS development. It means that MIS designer should keep in view future objectives and requirement of firm's information in mind.
12. **Sub system concept:** Even though the information system is viewed as a single entity, it must be broken down into digestable subsystems which can be implemented one at a time by developing a phasing plan.
13. **Common data base:** Although it is possible to achieve the basic objectives of MIS without a common data base, thus paying the price of duplicate storage and duplicate file updating Hence, the common data base is a definite characteristic of MIS.
14. **Computerized:** It is possible to have an MIS without using a computer. But its use increases the effectiveness of the system. In fact, its use equips the system to handle a wide variety of applications by providing quickly their information requirement. Other necessary attributes of the computer to MIS are accuracy and consistency in processing data and reduction in clerical staff. These needs in management information system makes the computer a prime requirement.
15. **Exception Based:** MIS should be developed on the exception-based reporting principle, which means an abnormal situation, i.e., the maximum, minimum or expected values vary beyond tolerance limits. In such situations, there should be exception reporting to the decision-maker at the required level.
16. **Relevance:** The information gives to each manager should be relevant to his responsibilities and authorities.
17. **Brevity:** Information should not only be clear but should also be brief. Brevity does not mean that certain matters be left out but it means that maximum informationshould be communicated in minimum words. Graphs, charts, tables, figures and other such media help in making the information brief.
18. **Accuracy:** Information should be accurate as far as possible and if not, then the level of inaccuracy should be within limits.

## 1.8 Functions of MIS

The main objective of MIS is to provide the right information to the right manager at

the right time. Therefore, to meet its objectives, MIS should perform the following functions as shown in fig. 1.14

- Data capturing
- Data processing
- Storage of information
- Retrieval of information
- Dissemination of information

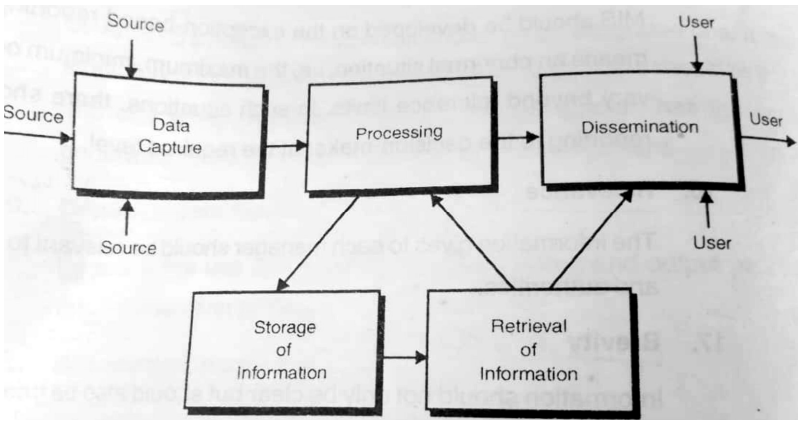



**Figure 1.14**

1. **Data Capturing:** MIS takes data from various sources of an organization. A source may be internal or external. Data capturing may be manual or through computer terminals.
2. **Data Processing:** Data processing means manipulating the captured data to convert it into the required management information. Data manipulation consists of such operation as classification, sorting, calculations, comparison and summarization.
3. **Storage of information:** Information is storage on secondary storage like magnetic disk, CD-Ron etc. In this activity, information and data are retained in an organized manner for later use.
4. **Retrieval of information:** Stored information may be retrieved as and when required by various managers or users. According to the requirements, the retrieved information is either disseminated as such or it is processed again.
5. **Dissemination of information:** Information, which is a finished product of MIS, is disseminated to the users in the organization.

## 1.9 Limitations of MIS

Limitations of MIS are:

1. One slacking sub-system would throw the entire integrated MIS out of gear.
2. Highly sensitive and requires continuous monitoring.
3. Budgeting of MIS is extremely difficult.
4. Quality of outputs of MIS is basically governed by the quality of inputs and process.
5. Is not a substitute for effective management? It is merely an important tool in the hands of executives for decision-making and problem solving.
6. May not have requisite flexibility to quickly update itself with changing needs of time.
7. Cannot provide tailor-made information packages suitable for the purpose of every type of decision made by executives.
8. Takes into account mainly quantitative factors, thus it ignores the non-quantitative factors like morale, attitudes of members of the organization.
9. Less useful for making non-programmed decision-making.
10. Effectiveness decreases due to frequent changes in top management organizational structure and operational team.

# UNIT - 2

# STRUCTURE OF MIS



## 2.1 Structure of MIS

There is no unique structure of MIS. Multiple approaches are used to explain the structure of MIS. MIS is described in term of following approaches

- Physical components
- Information system processing functions
- Decision support
- Levels of management activities
- Organization functions

### 2.1.1 MIS Structure based on Physical Components

Structure of MIS can be understood by looking at the physical components of an information system. The physical components of MIS may be.

**(a) Hardware**

Hardware represents the physical and tangible components of the computer I.e. the components that can be seen and touched. Input devices, output devices, CPU, secondary storage devices like floppy, hard disk etc, are examples of Hardware.

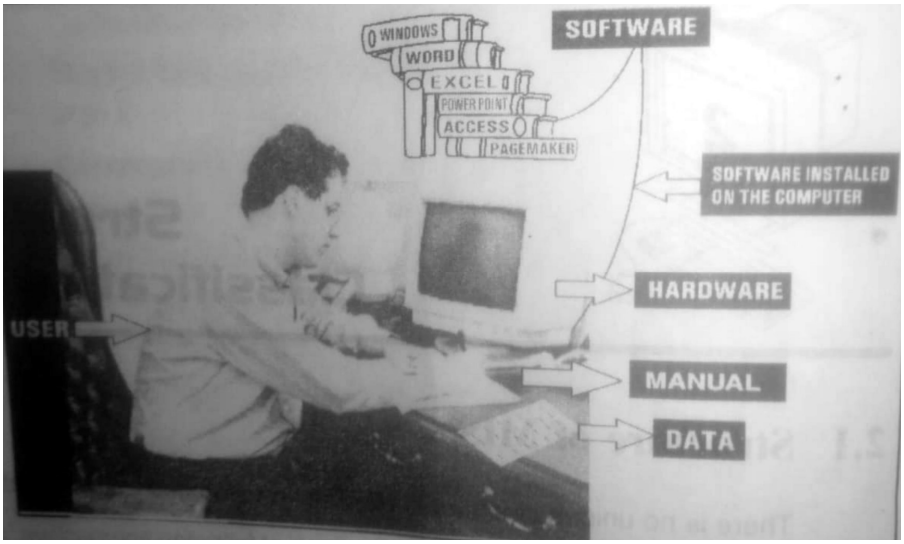



**Figure 2.1**

**(b) Software**

Software represents the set of programs that govern the operation of a computer system and make the hardware run.

There are two types of software (1) System Software, (ii) Application software

**(i) System Software**

The system software is collection of programs designed to operate, control and extend the processing capabilities of the computer itself. Example of System Software are Operating System, Interpreters, Compilers and Assemblers etc.

**(ii) Application Software**

Application software is the program or set of programs used to perform specific and general applications or task. All software prepared by us in the computer lab can come under the category of Application software. Examples of Application software are payroll software, student record software, inventory control software, Railway reservation software, Income tax software, Word processors, Spreadsheets, dBASE etc.

**(c) Database**

A database may be defined as a collection of interrelated data stored togetherwithout harmful or unnecessary redundancy to serve multiple applications. Therefore, the database contains all data utilized by application software. An Individual set of stored data is often referred to as a file.

**(d) Procedures**

**Formal operating procedures** are physical components because they exist in a physical form such as a manual or instruction booklet. Three types of procedures are required:

- User instructions
- Instructions for preparation of input by data preparation personnel
- Operating instructions for computer operations personnel

**(e) Operating Personnel**

Operating people of the information systems are computer operators, system analysts, programmers, data preparation personnel, information systems management, data administrators etc.

**(f) Input and Output**

Various physical inputs and outputs from the information system, existing in the forms like printout, reports etc.

### 2.1.2 MIS Structure based on Processing Functions

The processing functions of information systems are

**(a) To process transactions:** Transaction is defined as an activity taking place in an organization. For example, making a purchase or a sale or manufacturing a product Main function of information system is to process transaction as shown in fig 2.2

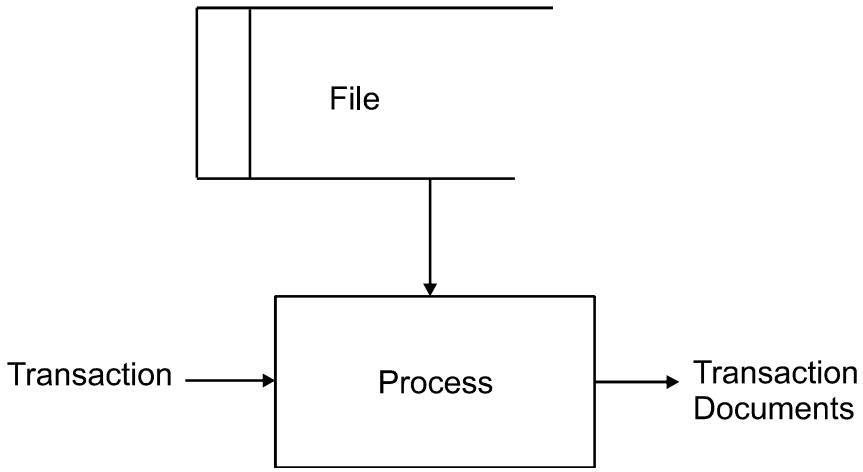



**Figure 2.2**

Transaction documents are items such as customer billings; purchase orders, payroll cheques etc.

**(b) To maintain master files**: A master file stores relatively permanent data about organization entities. For example customer ledger, purchase ledge, inventory, payroll etc. The master files include some information which is of a permanent nature and also data which is continuously updated by recent transaction. Information systems create and maintain master files as shownin fig 2.3

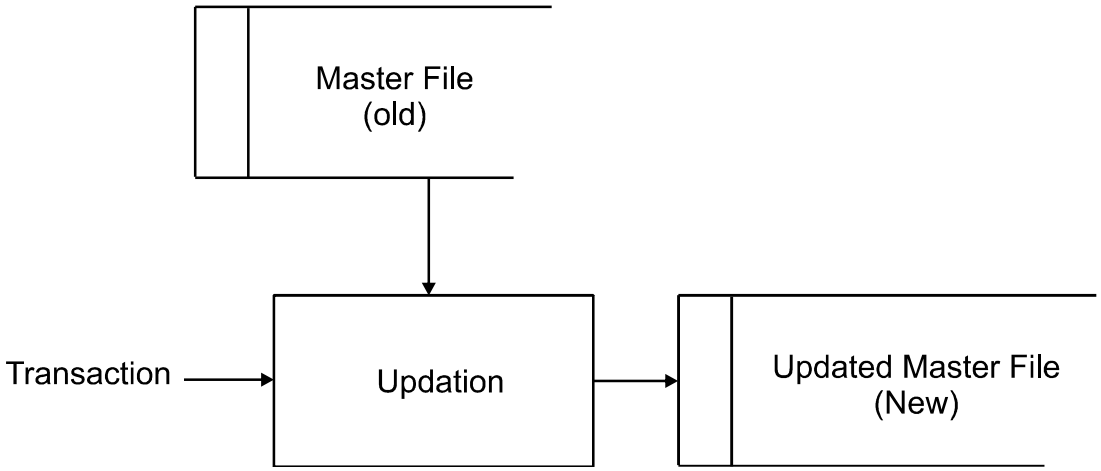



**Figure 2.3**

The normal means of updating a master file is by adding, deleting or amending records in the file

**(c) To produce reports:** A very important functions of information system is to produce reports as shown in fig 2.4.

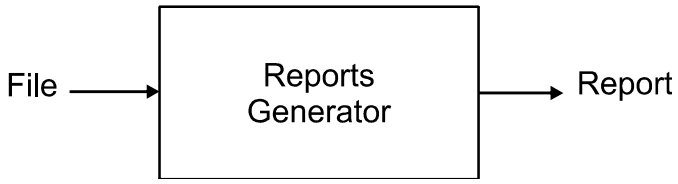



**Figure 2.4**

There are two types of report produced by information systems.

(i) **Preplanned reports (or scheduled reports):** Preplanned reports have a regular content and format and are usually run on regularly scheduled basis. Examples are sales analysis, inventory status, and budget analysis reports. Prepared at a given time, they reflect one of three conditions with respect to the time period they cover:

- status or condition at a point in time;
- summarize what has occurred during a period such as a week. month, or years;

- present results to date and project to the end of the period (such as a year).

(ii) **Adhoc Reports (or special reports):**Adhoc reports occur at irregular intervals and require data whose format has not been preplanned.

**(d) To Process Inquiries:** An Information System processes inquiries by using its database as shown in fig 2.5.

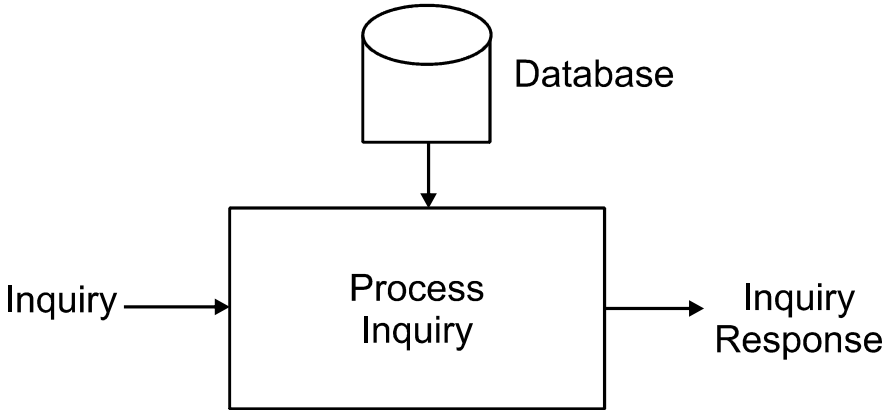



**Figure 2.5**

There are two types of inquiries:

(i) **Preplanned or regular inquiries:** Preplanned inquiries are generally associated with limited output and having pre-defined format. For example, Balance due from customer ABC, Basic pay of Employee XYZ etc. These inquiries are typically handled online, which means the inquiry is entered and response received immediately via terminal.

(ii) **Adhoc Inquiries:**Adhoc inquiry responses occur at irregular intervals and require data whose format has not been preplanned. In some big organisations, an information service centre may be available to process adhoc requests.

**(e) To Support User-machine dialog:** User-machine dialog differs from reports or inquiries. It is essentially a way in which a user can interact with a model to arrive at an analysis or a solution. User-machine interaction employs a terminal such as a visual display terminal or a standalone personal computer plus computer processing of a model such as an analysis, planning, or decision model. Examples are site planning models, capital investment analysis models and portfolio management models.

This functions of Information system is very useful for decision-maker.

### 2.1.3 MIS Structure based on Levels of Management Activities

The management can be grouped into three hierarchical levels

1. Top Management (or Strategic Management)
2. Middle Management (or Management Control)
3. Operating Management (or Operational Control)

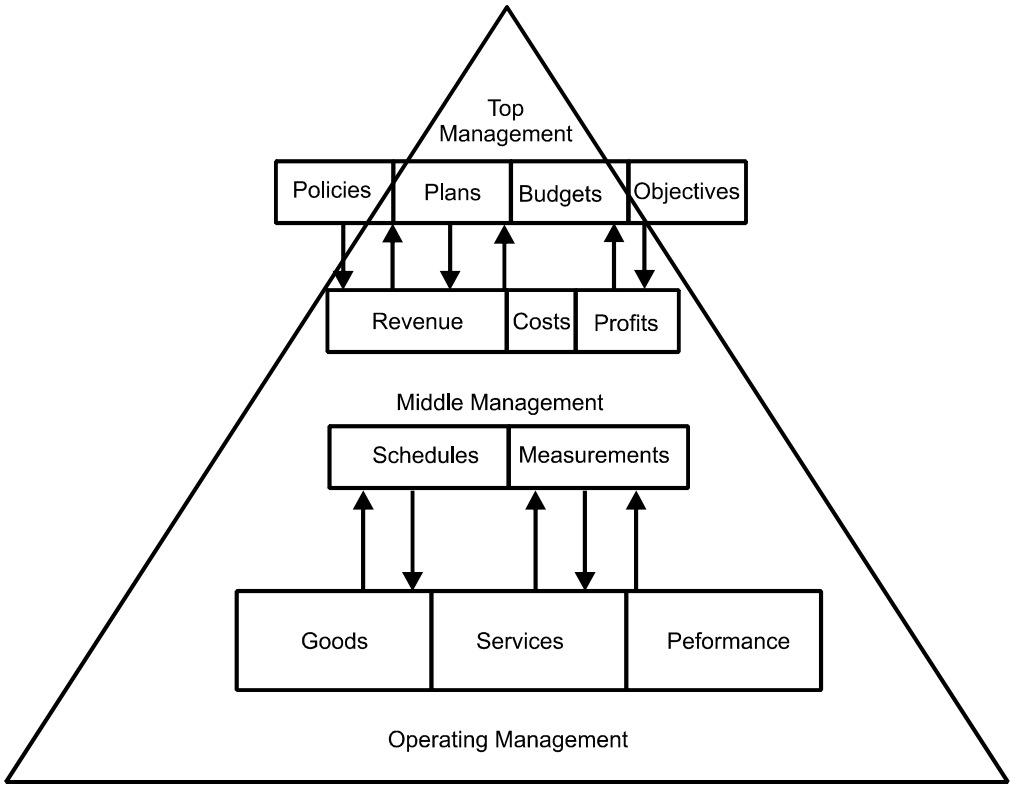



**Figure 2.6**

**1. Top Management (or Strategic Management)**

The basic role of the top management is to establish the policies, plans and objectives of the organization. Top management is also responsible for formulation of the budget framework under which various departments will operate

**2. Middle Management (or Management Control)**

Middle Management has the responsibility of implementing the policies and overall plans of the top management. The middle management operates on the parameters of cost, revenue and profit under direction from the top management. These are persistently reviewed, analysed and modified until a level of the pre-proposed standardization is attained. Thereafter, the middle management formulates the measurement yardsticks and issues specific job schedules with specified work plan and targets to the operating management

### 3. Operating Management (or Operational Control)

Operating Management has the responsibility of implantation day-to-day operations and decisions of the middle management to produce goods and services to meet the revenue, profit and other goals, which inturn will enable the organization to achieve its overall plans and objectives.

The different levels of management are important for two reasons:

(a) Information needs tend to be different at different levels of management,and

(b) Amount of time required for any function varies considerably with each group.

Figure 2.6summarisesthe interaction amongst the three levels of management.

## 2.1.4 MIS Structure based on its Support in Decision Making

Decisions vary with respect to the structure that can be provided for making them. Mainly, there are two types of decisions

(i) **Structured decisions:** Structured decisions are pre-planned. These decisions can be programmed. They are essentially repetitive, routine and involve a definite procedure for handing them. Hence, these decisions are **well-defined, repetitive and routine in nature.** For these, a predefined decision rules or algorithms are worked out so that every time the situation occurs, a new analysis is not required. For example office supplies, preparation of payroll, inventory control etc. Main characteristics of these decisions are:

- These decisions can be delegated
- The cost of taking such decision is less.
- These decision can be made with the help of computer systems.
- These decisions are well-defined, repetitive and routine in nature.
- The risk involved in taking decisions is very less.

(ii) **Unstructured decisions**: These type of decision are occasional and unique in nature. There are no predefined procedures available to solve these problems and a new analysis is required for each occurrence. Hence these are non-programmed decisions. For example, production scheduling, capital budgeting etc Main characteristics of these decisions are

- These decisions cannot be delegated.
- The cost of taking such decisions is high.

- These decision cannot be made with the help of computer system.
- These decisions are occasional and unique in nature.
- The risk involved in taking decision is very high.

Information system support will fit easily into this classification, but some decisions are more or less structured and have some elements that are programmable and some that are not. Such decisions are called **semi-structured** decisions.

### 2.1.5 MIS Structure based on Organizational Functions

There is no standard classification of functions, but a typical set of functions in a manufacturing organization includes production, sales and marketing, logistics, personnel, finance and accounting and information processing systems. Top management can also be considered as a separate function. Each of these functions has unique information needs and each requires information system support designed for it. Within each functional sub-system, there will be applications for transaction processing, operational control, management control and strategic planning as shownin fig 2.7.

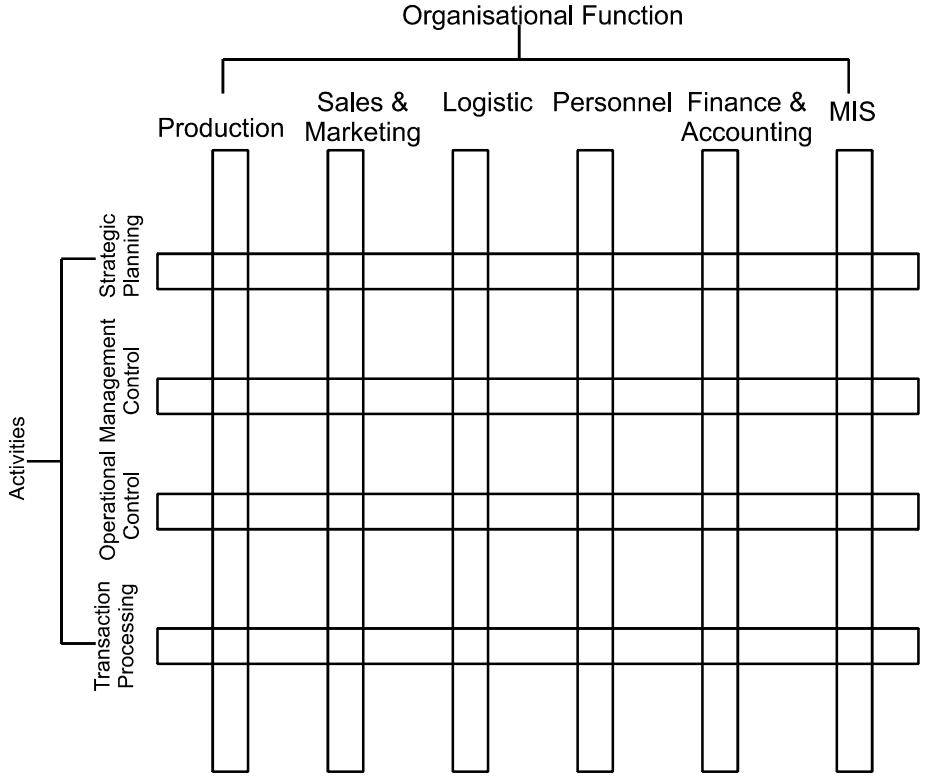



**Figure 2.7**

**(a) Sales and Marketing Subsystems:** The sales and marketing subsystems includes all activities related to the promotion and sales of products or services. The

transactions are sales orders, promotion orders, etc. The operational control activities include the hiring and training of the sales force, the day-to-day scheduling of sales and promotion efforts, and periodic analyses of sales volumes by region, product, customer, etc. Managerial control concerns comparisons of overall performance against a marketing plan. Strategic planning for the marketing function involves consideration of new markets and new marketing strategies.

**(b) Production Subsystem:** Production subsystem include product engineering, planning of production facilities, scheduling and operation of production facilities, employment and training of production personnel, and quality control and inspection. Operational control requires detailed reports comparing actual performance to the production schedule and highlighting areas where bottlenecks occur. Management control requires summary reports which compare overall planned or standard performance to actual performance for such classifications as cost per unit and labor used. Strategic planning for manufacturing includes alternative manufacturing approaches and alternative approaches to automation.

**(c) Logistics Subsystem:** Logistics subsystem includes activities as purchasing, receiving, inventory, control, and distribution. The transactions to be processed include purchase requisitions, purchase orders, manufacturing orders, receiving reports, tickets for inventory, shipping orders, and bills of lading. The operational control function uses information contained in reports such as past due purchases, past-duo shipments to customers, out-of-stock items, overstocked items, inventory turnover reports, vendor performance summaries, etc. Managerial control information consists of overall companions between planned and actual inventory levels, stock outs, inventory turnover, etc. Strategic planning involves the analysis of new distribution strategies, new policies with regard to vendors

**(d) Personnel Subsystem:** The personnel subsystem includes hiring, training, record keeping, payment and termination of personnel. Operational control for personnel requires decision procedures for action such as hiring, training, termination, changing pay rates and issuing benefits. Management control consists of overall comparisons between planned and actual performance for such classifications as

number of employees hired, cost of recruiting, composition of skills inventory, cost of training, salary paid, etc. Strategic planning for personnel is involved with evaluating alternative Strategies for recruiting, salary, training, benefits, and building location to ensure that the organization obtains and retains personnel necessary to achieve its objectives.

**(e) Finance and Accounting Subsystem:** Finance is responsible for ensuring adequate organizational financing at as low cost as possible. Accounting covers the classification of financial transactions and summarization into the standard financial reports, the preparation of budgets, and classification and analysis of cost data. Operational control requires daily error and exception reports, reports of unprocessed transactions etc. The managerial control utilizes information on budgeted versus actual cost of financial resources, cost of processing accounting data and error rates. The strategic planning involves a long-run strategy to ensure adequate financing, a long-range tax accounting policy to minimize the impact of taxes, etc

**(f) Information Processing Subsystem:** Operational control requires information on the daily schedule of jobs, error rates, and equipment failures; etc. Managerial control requires data on planned versus actual utilization, equipment costs, overall programmer performance, and progress compared to schedule for projects to develop and implement *new applications*. Strategic planning for information involves the organization of the function, the overall information system plan, selection of strategic uses of information, and the general structure of the hardware and software environment.

# UNIT – 3

# CLASSIFICATION OF MIS



## 3.1 Classification of MIS

The nature and scope of information required by managers at different levels in an organization varies considerably. Organizations require different types of information systems to meet their needs.

Managers at different levels in an organization make different kinds of decisions (operational, tactical and strategic) so that the types of information necessary to support their decisions are also different. Accordingly, different types of information systems are designed to meet various information needs of managers, as shown in fig. 2.8

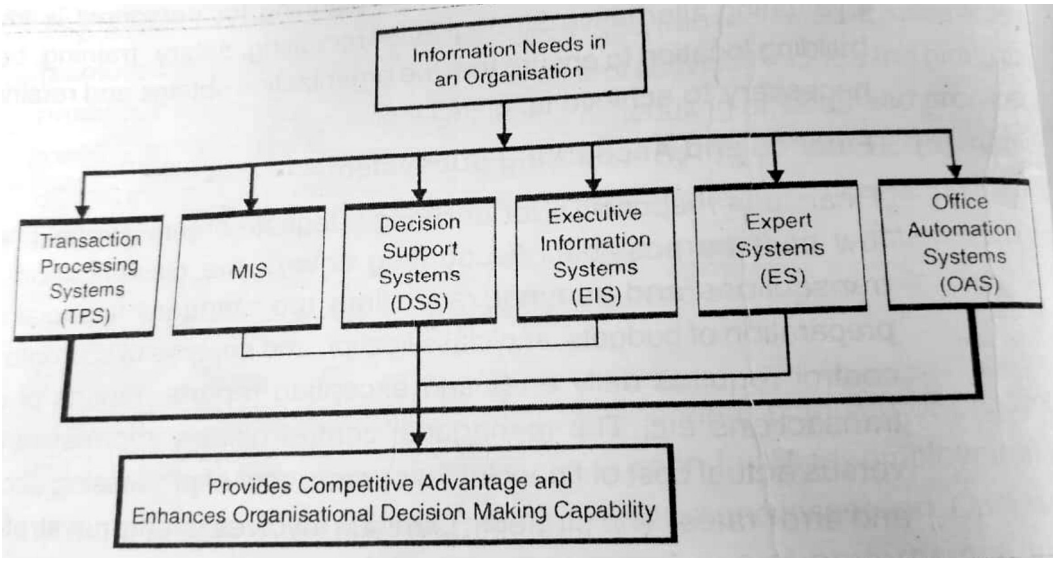



**Figure 2.8**

Information System can be classified as:

1. Transaction processing systems (TPS).
2. Office Automation system (OAS).
3. Management information systems (MIS).
4. Decision support systems (DSS).
5. Executive information systems (EIS).
6. Expert Systems (ES)

### 3.1.1 Transaction Processing Systems

Transaction Processing System is an information system that manipulates data from business transactions. Transaction Include events such as sales, purchases, deposits, withdrawals, refunds and payments. For example, when an organization sells something to a customer on credit, data about the customer, product, salespersons etc. must be stored and processed. A TPS performs routine, repetitive tasks. It is mostly used big lower-level managers to make operational decisions. Transaction can be internal or external. When a department orders office supplies from the purchasing department, an internal transaction occurs, when a customer place an order for a product, an external transaction occurs.

All TPS perform three functions viz. Book keeping, Issuance and Control reporting

(i) Book keeping involves keeping accurate record of company's financial transactions.

(ii) Issuance involves the generation of business documents such as invoices, vouchers and payables.

(iii) Control reporting involves reports on transactions for control of accounts purposes.

**Steps in Processing a Transaction**

In computerised TPS, There are following six steps in processing a transaction:

1. Data entry
2. Data validation
3. Processing and revalidation
4. Storage
5. Output generation
6. Inquiry processing

These steps are shown in fig. 2.9

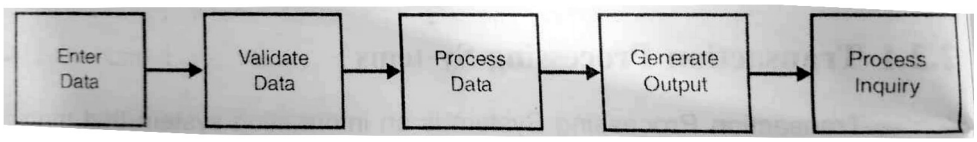



**Figure 2.9**

**(i)** **Data entry**: Transaction data must first be entered into the system. A number of input devices exist for entering data, including the keyboard, OCR (optical character reader, MICR (magnetic Ink character reader) etc. Now-a-days data entry is done commonly through the use of an online terminal without using any physical form.

**(ii)** **Data validation**: Data validation is essential in transaction processing. It ensures the accuracy and reliability of data by comparing actual data with predetermined standards or known results.

**(iii)** **Data processing and revalidation**: After the validation of accuracy and reliability of the data, the data are processed in following two modes: Online Transaction processing and batch processing.

*Online transaction processing* (OLTP). The term *online* means that the data input device is directly linked to the TPS and the data are processed as soon as it is entered into the system. The input device may be at a remote location and be linked to the system by networks or by telecommunication systems

*Batch processing.*In batch processing, transactions are accumulated over time and processed periodically. Processing may be done on a daily, weekly or monthly basis or any other time period appropriate lo the given application.

Regardless of the types of processing used, once it is complete, the output should be validated for accuracy and reliability

**(iv)** **Data storage**. Data storage is another important function because the value of usefulness of data diminish if data are not properly stored Commonly storage devices are magnetic disks, CD, DVD etc.

**(v)** **Output generation**: The output can be communicated to the decision-maker, after the data are input, validated, processed, revalidated, and stored, in the

following two ways

1. Documents and reports
2. Forms-screens or panels

Documents are a popular output method. Some examples of documents are invoices, paychecks, purchase invoices, sales receipts, and job orders.

In information system, a document is ususally a record of one transaction, whereas a report is a summary of two or more transactions Nevertheless, these terms are often used interchangeably.

Computer output can also appear on computer screens and panels Such soft-copy presentations are known as forms

**(vi)** **Inquiry Processing**: The inquiry processing capability can be provided by either batch or online processing systems. It requires use of telecommunication networks and database management query facility. It allows users to make inquiries and receive responses concerning the results of transaction activity For example, employees can check on the status of a sales order, the balance in an account, the amount of stock in inventory etc through their terminals The examples of important TPS are:

- Payroll processing
- order processing
- Inventory system
- invoicing system
- accounts receivable system
- purchasing system
- accounts payable system
- general ledger system

### 3.1.2 Management Information Systems

Information systems developed to provide accurate, timely, and relevant information that helps managers in effective decision making are known as Management Information

Systems (MIS).

These systems make use of the already processed transaction data which is outputted from TPS and generate information reports after processing data. The major group of users for this kind of systems are the middle level of management. The output of an MIS takes the form of summary reports and exception reports as shown in fig 2.10.

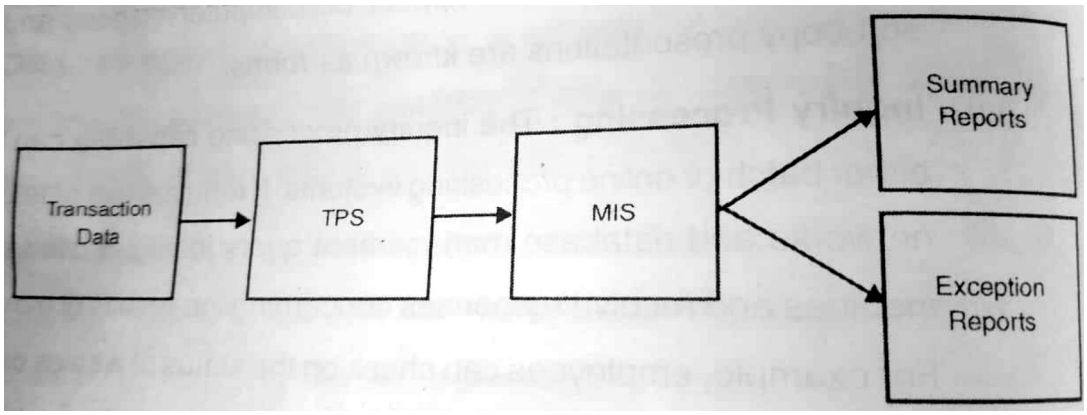



**Figure 2.10**

A **summary report** accumulates data from several transactions and presents the results in condensed form. For example, a bank manager may get a summary report listing the total amount of deposits and withdrawals made the previous day. Modern MISs require only simple instructions to generate prescribed reports. With the click of a mouse, managers can instruct computers to produce reports tailored to their needs at virtually any time. This flexibility gives them tighter control of processes and the ability to react to problems and seize opportunities quickly. An exception **report** outlines any deviations from expected output Its main purpose is to draw the attention of middle managers to any significant differences between actual performance and expected performance. For example, a sales manager may study an exception report that lists all sales personnel who sold less than FRs. 10,000 or more than Rs. 50,000 in the preceding month

The examples of MIS are:

- Personnel Information Systems
- Marketing Information Systems
- Sales Information Systems
- Production and operations system etc.

In contrast to TPS, a management information system is more comprehensive; it

encompasses processing in support of a wide range of organizational functions and management processes. Secondly, MIS is capable of providing analysis, planning and decision-making support

### 3.1.3 Decision Support Systems (DSS)

Decision support system are interactive, well-integrated systems that provide managers with data, tools and models to facilitate semi-structured decisions or tactical decisions Decision support systems help to find the optimal course of action and answer "What if?" questions. What if we purchased raw materials overseas? What if we merged our warehouses? What if we doubled our shifts and cut our staff? These questions seek answers like. "This is how this action will impact our revenue or our market share, or our costs DSSs are programmed to process raw data, make comparisons, and generate information to help managers to find the bestalternatives for financial investment, marketing strategy, credit approval, and the like. However, it is important to understand that a DSS is only a decision aid, not an absolute alterative to human decision making DSS goes one step further to a management information system as DSS supports decision-making. DSS uses MIS as shown in fig 2.11.

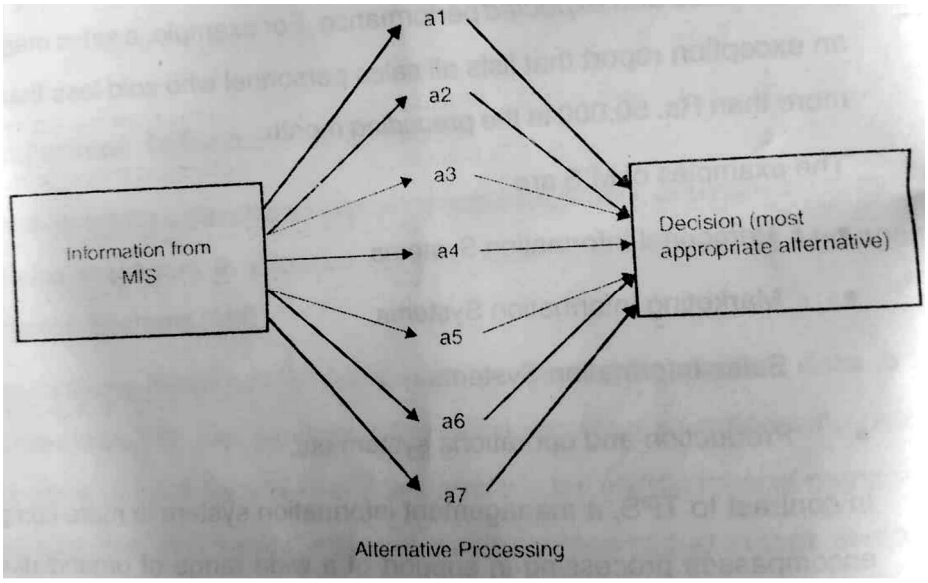



**Figure 2.11**

DSS can be differentiated from MIS in terms of its processing capabilities Whereas MIS processes data to convert it into information; DSS processes information to support the decision-making process of a manager. Secondly, DSS provides an interactive dialogue

environment, through which the user can interact with the system to add/alter the data as per his requirements. DSS are ideally suited for problems like location selection, identifying new products to be marketed, scheduling personnel. And analysing the effect that price increases for resources have on profits.

**Components of DSS**

The components or elements of DSS are.

- DSS generator
- Model management system
- database management systems
- dialogue management systems

The DSS generator is the software used to develop DSS and coordinate its processing tasks.

The database management module provides for the creation and maintenances of the DSS database using capabilities provided by database management packages.

The model management module provides the ability to create, maintain and manipulate the mathematical models of the system it may contain electronic spreadsheet packages and user-written programs.

The dialogue management module provides attractive user interface that supports interactive input and output by managers.

These components are shown as follows:

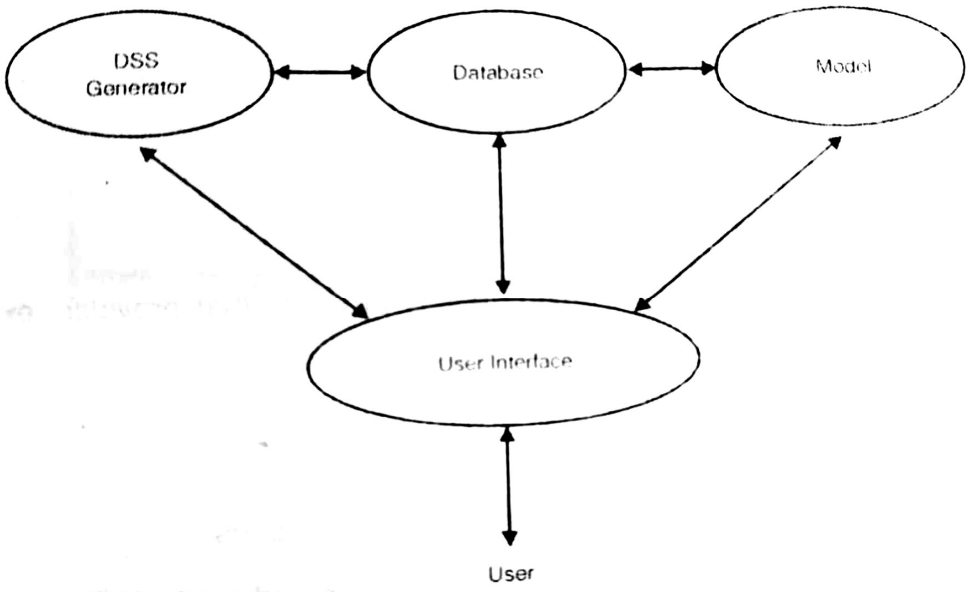


**Figure 2.12**

### 3.1.4 Executive Information Systems (EIS)

EIS are management information system that meet the requirements of the top management. EIS are forms of data retrieval systems that provide selected and summarised information for senior executives, engaged in long-range planning, crisis management, and other strategic decisions. It is a user-friendly interactive system It has excellent menus and graphic capabilities.

The main difference between a DSS and an EIS is that the goal of an EIS is not so much to generate alternatives for a given problem as it is to integrate data from different sources and present it in a useful format to the decision maker

The characteristics of DSS and EIS are:

1. DSS and EIS are intelligent support systems designed to provide middle and top managers with information necessary to make decisions that require intuition and judgement.
2. Both the systems are intuitive, interactive, user-friendly system.
3. Both the systems use internal and external data to solve problems
4. An EIS provides managers with information integrated from a variety of sources. A DSS uses various decision making models to provide managers with alternative solutions to a given problem
5. Both systems are equipped with decision making tools such as 'what it' analysis, statistical tools, optimising tools etc. In addition to these tools, an EIS is equipped with drill-down capabilities.

### 3.1.5 Expert Systems

An expert system is a knowledge based program that provides "expert quality solution to problems in a specific domain, Generally, the knowledge is extracted from human experts in the domain and it attempts to emulate their methodology and performance

An expert system can help to meet the following needs

1. New approaches to business organization and productivity
2. Knowledge
3. Expertise
4. Competence and

5. Smart automated equipment

There are three components of an expert system

**(a) Knowledge Base**: The components of an expert system that contains the system's knowledge is called its knowledge base

**(b) Inference Engine**: The inference engine components of an expert system controls how and when the information in the knowledge base is applied. Hence an inference engine runs an expert system, determining which rules are to be invoked, accessing the appropriate rules in the knowledge base, executing the rules, and determining when an acceptable solution has been found

**(c) User Interface**: The user interface component enables the user to communicate with an expert system. The communication performed by a user interface is bidirectional. At the simplest level user must be able to describe his/her problem to the expert system, and the system must be able to respond with its recommendations. The components of an expert system are illustrated in figure 2.13.

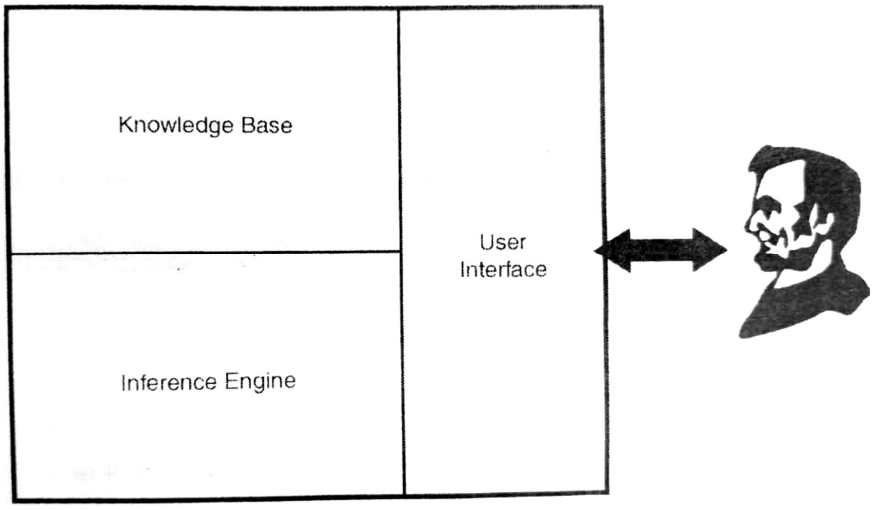



**Figure 2.13**

Three types of information support systems discussed above have several differences For example, a DSS is intended for middle managers who solve semi structured problems. EIS is intended for top managers who solve unstructured problems. Export systems are not for managers at any specific level, they are simply designed to assist in the solution of complex semistructured and unstructured problems. Expert systems, unlike DSS & EIS, can replace decision makers

The primary aim of both DSS and EIS is to facilitate and enhance the quality of decision making. The expert systems aim to gather and apply organizational knowledge for problem solving.

### 3.1.6 Office Automation Systems (OAS)

Office automation is the application of computer and related technologies like communication and networking to integrate the general office tasks so that the efficiency of office work is improved Office automation systems are meant to improve the productivity of managers at various levels of management by providing secretarial assistance and better communication facilities. Office automation systems are the combination of hardware, software and people in information system that process offices transactions and support office activities at all levels of the organization Main aim or advantages of OAS are:

- Improved efficiency of office tasks
- Fastest way of communication
- Better services to customers
- Accurate information to the management
- Increased productivity
- Elimination of manual work of filing and searching of documents
- Better management control
- Reduction in costs of conducting in-house meeting due to teleconferencing

Some office automation systems are

1. **Word Processing:** it is actually transforming the written text into an attractive, systematic and easy to read text. Generally we face a problem of spellings or grammatical mistakes, but you can eradicate this because a word processor itself chocks for any of these errors. You can change font style and size in a way that it looks more attractive. Another very important thing is that before you print it on the paper you can see its final lookup by using Print Preview command. So you can say that a word processor is nothing but a computer program that helps you to
    - type your text
    - correct spelling mistakes and grammatical errors
    - align text within margins
    - offer variety of font styles and font sizes

- see a preview of the text that you have typed in before printing

2. **Electronic Mail**: Electronic mail (e-mail) is most widely used technology for sending messages or documents from one location to another by using electronic workstations or computers. It is the quickest, cheapest and easiest means of telecommunication among a large number of people within or outside an organization.
3. **Electronic Calendaring**: It is the use of a networked computer to store and retrieve a manager's appointment calendar.
4. **Audio Teleconferencing**: Audio Teleconferencing is simply a conference phone calls system. With such type of conferencing, participants can only hear the voice and cannot see the participants. It is the least expensive medium for conducting meetings.
5. **Video Conferencing**: Video conferencing is the use of television equipment to link geographically dispersed conference participants to engage in lace-to- lace communication. With videoconferencing systems, the participants not only hear the voice but also see each other.
6. **Computer Conferencing**: Computer conferencing is the use of a networked computer to all members of a problem-solving team to exchange information concerning the problem that is being solved.
7. **Facsimile transmission**: Facsimile telegraphy, commonly known as Fax, is the most widely used office automation system for transmitting images of documents and photographs/graphics from one location to another through a telephone line. Main advantages of FAX are:
    - It is the fastest and cheapest means of sending messages locally or around the world
    - In computerised fax machines, it is possible to send documents stared on disk to another fax machines.
8. **Desktop publishing**: Desktop publishing is the use of a computer to prepare printed output, using software with sophisticated publishing capabilities. Main software for DTP are Pagemaker&Coreldraw

## 3.2 Functional Business Systems

Every business consists of several well-defined functions. These functions are often organized into areas or departments. These areas are known as the functional areas of business. In each functional area, a set of business functions is performed. Each of these functional areas has unique information needs and thus requires information system support designed specifically for it. Moreover, a management information system is essentially an integration of information systems that are designed to support the functional sub-systems of the business. Further, there is no standard classification of such sub-systems in an organization, but typical set of functions in a organization includes:

- Manufacturing
- Quality Control
- Marketing
- Accounting and Finance
- Human Resources

In each of the functional area, a data flow model portrays the local decision making environment. Figure 2.14 shows the data flow diagram, which consists of the following components:

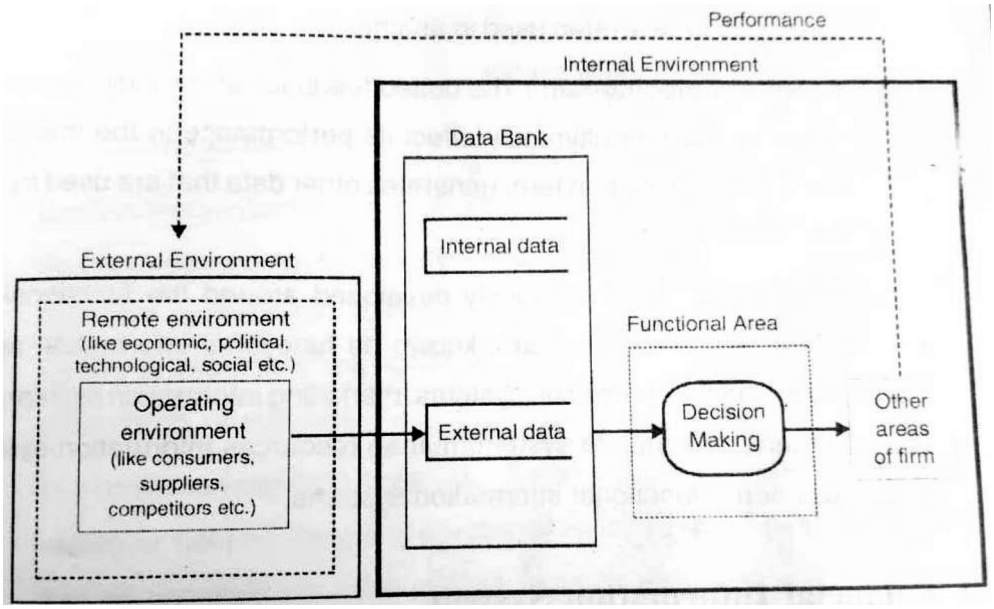



**Figure 2.14**

**(a) External Environment**: There are two components of external environment.

**(i) Operating environment**, which consists of consumers, suppliers, competitors, distributors and the labour supply:

(ii) **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.

**(b) Data Bank:** A data bank can include data existing in files and in computer databases. An organization'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.

**(c) Decision Making:** Decision making is the process consists of selecting those data needed to make a decision and then making the decision.

**(d) Other areas of the firm:** Information produced by decision making in one functional area is often used in another.

**(e) Feedback mechanism:** The dotted feedback arrow indicates that decisions made by the firm ultimately affect its performance in the marketplace. The firm's performance, in turn, generates other data that are used by elements in the environment.

Information systems are generally developed around the functional areas of a business organization, popularly known as functional information systems. For example, Financial information systems, marketing information system, production/ Manufacturing information system, human resources information system etc. Let us discuss some functional information systems.

# UNIT – 4

# INFORMATION AND SYSTEM CONCEPTS



## 4.1 Data

Data can be defined as a representation of facts, concepts or instruction in a formalized manner suitable for communication, interpretation or processing by human or electronic machine. Data is represented with the help of characters like alphabets (A-Z, a-z), digits (0-9) or special characters (+, -, >, <, = etc.)

## 4.2 Information

Information is organized or classified data so that it has some surprise value (meaningful values) to the receiver.

OR

Information is the process data on which decisions and actions are based as shown in figure 3.1.

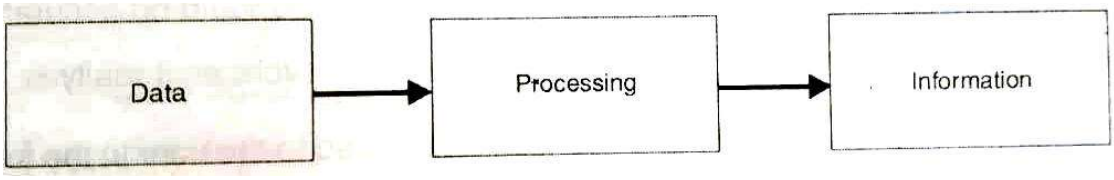



**Figure 3.1**

### 4.2.1 Types of Information

There are three types or categories of information.

**(a) Strategic Information** is used by top management to plan the objectives of their

organization and to assess whether the objectives are being met in practice. This relates to long-term planning policies of the organization as a whole. Such information includes overall profitability: the profitability of different segments of the business, future market prospects, the availability and cost of raising new funds, total cash needs and capital equipment needs etc. Information requirements of top management are met by strategic information tier by arranging information from internal and external sources.

**(b) Tactical or managerial Information** is used by middle management to ensure that the resources of the business are employed to achieve the strategic objectives of the organization. This relates to medium-time period planning and is of use at management control level. Such information includes productivity measurement (output per man-hour or per machine-hour) Budgetary control or variance analysis reports and cash flow forecasts manning levels and profit results within a particular department of the organization, labour turnover statistics within a department, short-term purchasing requirements etc A large proportion of this information will be generated from within the organization.

Another important function of tactical level is to supply information to strategic tier for the use of top management.

The management and information levels in a typical organization is shown in figure 3.2.

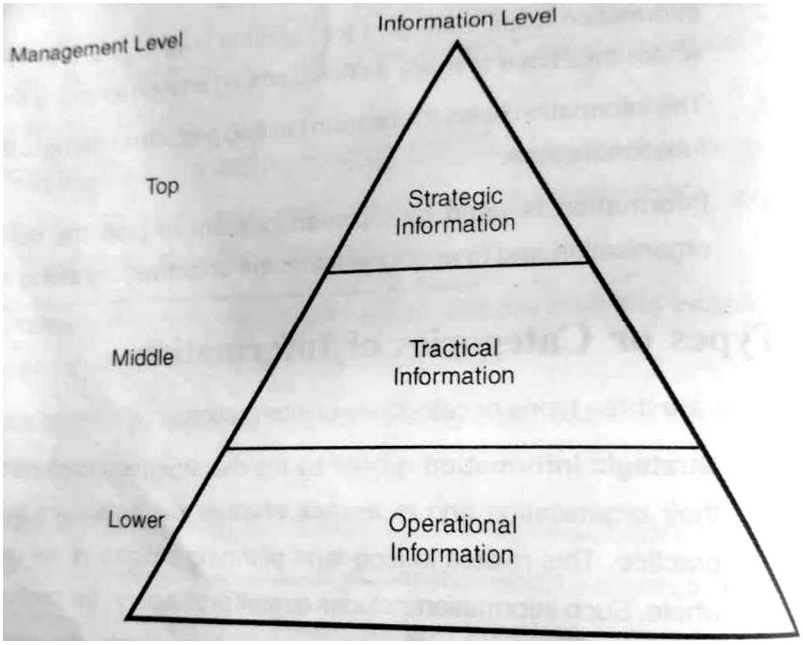



**Figure 3.2**

**(c) Operational Information** is used by operation level of management such as foremen or head clerks to ensure that specific tasks are planned and carried out properly within a factory or office etc. This relates to short periods which vary from an hour to a few days. In the payroll office, for example, operational information relating to day rate labour will include the hours worked each week by each employee, his rate of pay per hour, details of his deductions, Operational level require information for implementing and regulating operational plans for the purposes of conversion of inputs into outputs. Also it supplies routine and other information to tactical tier in summarised form.

### 4.2.2 Information Quality or Characteristics of Information

Important characteristics of useful and effective information are as follows:

**(a) Accuracy:** Information, if it is to be of value, should be accurate and should truly reflect the situation or behaviour of an event as it really is.

**(b) Form:** Information is of value if it is provided to the user in the form it is useful and best understood by him. For example, in a business enterprise, top management may require information on key matters in a summarized form and the operation managers in detailed form.

**(c) Relevance:** Information is said to be relevant if it answers specifically for the

recipient what, why, where, when, who and why? It refers to current utility of Information in decision making or problem solving. Thus, information gains in value if it is relevant.

**(d) Timeliness:** It means that information should be made available when it is needed for a particulars purpose and not before and in any case not after. For example, discount on bulk purchase offered by a supplier may be lost because of late reports

**(e) Completeness:** Information is considered as complete if it tells its user all what he wishes to know about a particular situation/problem. Incomplete information may result in wrong decisions

**(f) Purpose:** Information must have purpose at the time it is transmitted to a person or machine, otherwise it is simply data.

**(g) Reliability:** The information should be reliable and external force relied upon indicated.

**(h) Adequacy:** Adequacy means information must be sufficient in quantity, i.e. MIS must provide reports containing information which is required in the deciding processes of decision-making. Therefore, adequacy is a vital attribute of information which underscores that a report should cover all related aspects about a particular event or situation which the report is reporting.

**(i) Explicitness:** A report is said to be of good quality if it does not require further analysis by the recipient for decision-making. Thus, the reports should be such that a manager does not waste any time on the processing of the report, rather he should be able to extract the required information directly.

**(j) Exception-based:** Top managers need only exception reports regarding the performance of the organization. Exception reporting principle states that only those items of information which will be of particular interest to a manager are reported. Hence, reports should not provide details which are not required by managers. This approach results in saving precious time of the top management and enables the managers to devote more time in pursuit of alternatives for the growth of the organization.

### 4.2.3 Dimensions of Information

There are many dimension of information. Let us consider following three dimensions of information.

(a) Economic dimension

(b) Business dimension

(c) Technical dimension

**(a) Economic dimension:** Economic dimension of information refers to the cost of information and its benefits. A cost-benefit analysis is performed to determine the benefits andcost of information:

**(i) Cost of information:** Cost of information may include:

- cost of acquiring data.
- cost of maintaining data
- cost of generating information and
- cost of communicating information.

Cost also depends on the following:

- response time required to generate information
- required accuracy
- speed of generation
- required reliability etc.

**(ii) Value of information:** In decision theory, the value of information is the value of the change in decision behaviour because of the information. The change in the behaviour due to new information is measured to determine the benefits from its use. To arrive at the value of new information, the cost incurred to get this information is deducted from the benefits.

(a) **Business dimension:** Managers at different levels are required to perform different function in a business organization. Therefore, different types of information are required by managers at different levels of the management hierarchy as discussed in previous Article 35.

(b) **Technical dimension:** Technical dimension of information refers to the technical aspects of the database Various aspects of the database, which are considered under this dimension, include the capacity of database, response time, security, validity, data interrelationship etc. The technical dimensions of the data base are

such elements as access time, capacity, interrelationships of data elements, security and validity. The cost considerations involve the summation of the following three costs

(i) Cost to acquire data

(ii) Cost of maintain data

(iii) Cost to access data

Figure 3.3 shows the database concept, depicting three databases or classes of data.

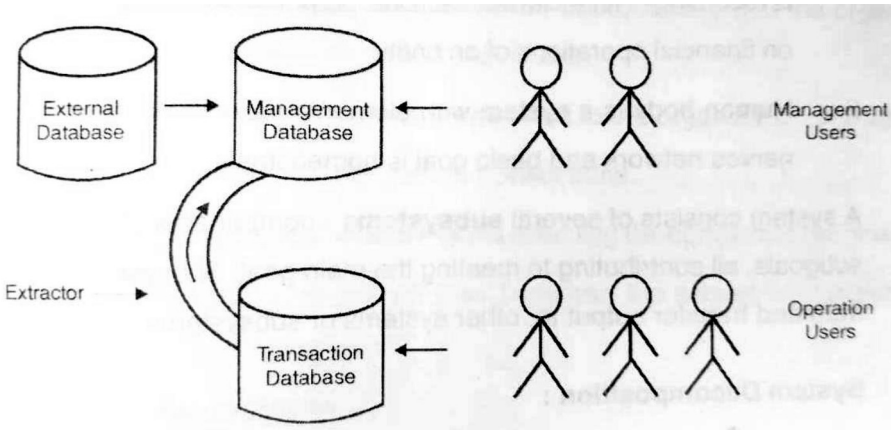



**Figure 3.3**

## 4.3 System

A system is an orderly grouping of interdependent components linked together according to a plan to achieve a specific objectives.

Basically, there are three major components in every system, namely, input, processing and output as shown in fig. 3.9

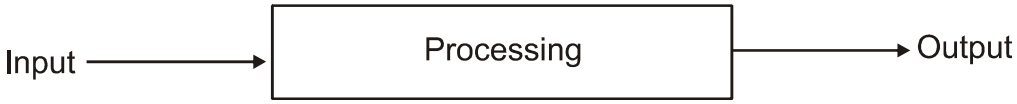



**Figure 3.9**

For example, a business system combines policies, personnel, equipment and computer facilities to co-ordinate the activities of a business organization.

### 4.3.1 Types of Systems

Systems have been classified in different ways. Common classifications are

(i) Open and Closed Systems

(ii) Deterministic and Probabilistic systems

(iii) Physical or Abstract systems

(iv) User-Machine Systems

#### 4.3.1.1 Open and Closed Systems

A closed system is one which is self contained. It has no interaction with its environment. No known system can continue to operate for a long period of time without interacting with its environment. An example of a relatively closed system is a computer program which processes predefined inputs in a predefined way. A relatively closed system is one which control its inputs, and so is protected from environmental disturbance.

An open system is a system that interacts freely with its environment. This type of system can adapt to changing internal and environmental conditions. A business organization is an excellent example of an open system.

A human being is another example of an open system. Open systems are usually adaptive, Le their interaction with the environment is such as to favour their continued existence

Main characteristics of open systems are:

**(i)** **Equifinality:** An open system can reach the same final result from different initial conditions and by various routes. In other words a system can accomplish its objectives with varying inputs and varying processes.

**(ii)** **Input from outside:** An open system is self-adjusting and self-regulating. For example, in a firm, an increase in the cost of goods forces a comparable increase in prices or decrease in operating costs.

**(iii)** **Entropy (or loss of energy):** All dynamic systems tend to rundown over time, resulting in entropy or loss of energy. Open systems resist entroy by seeking new inputs or modifying the processes to return to a steady state or equilibrium.

**(iv)** **Process, Output and Cycles:** Open systems produce useful output and operate in cycles, following a continuous flow path.

**(v)** **Differentiation:** Open systems have a tendency towards an increasing specialization of functions and a greater differentiation of their components.

#### 4.3.1.2 Deterministic and Probabilistic Systems

The behaviour of a deterministic system is completely known. There is no uncertainity involved in defining the outputs of the system knowing the inputs. This implies

that the interactions between various subsystems is known with certainty. Computer program is a good example of a deterministic system

In the probabilistic systems, the behaviourcan not be predicted with certainty, only probabilistic estimates can be given in this case, the interactions between various subsystems cannot be defined with certainty

An example of such a system is a warehouse and its contents. Given a description of the contents at one time, and of the average demand, length of time to process orders, etc, the contents at the next point in time could not be perfectly predicted.

#### 4.3.1.3 Physical and Abstract Systems

Physical systems are tangible or visible systems. That is, tangible system can be seen. Touched, counted etc. Physical systems may operate statically or dynamically For example, a programmed computer is a dynamic system because data, programs and output change as the user's demand changes In contrast, the physical parts of the computer centre are the tables, chairs, monitor, keyboard etc. which can be seen and counted, they are static.

Abstract systems are conceptual or nonphysical entities. Such systems just involve abstract conceptualization of physical situations. For example, a model is an abstract system as it is a conceptualization and a representation. Another example is an algorithm or an equation.

#### 4.3.1.4 User-Machine Systems

In user-machine systems, both, i.e, human as well as machine perform some activities in the accomplishment of a goal (e.g. decision-making) The machine elements (may be computer hardware and software), are relatively closed and deterministic, whereas the human elements of the system are open and probabilistic No doubt, some small systems that are purely mechanical, do exist, but they are usually a part of a larger system involving people: Various combinations of human and machine are possible. For example, in a system, the computer plays a major role and human controls the machine operation. At the other extreme, the machine performs a supporting role while the human perform the significant work. Therefore, both human and machine work together to achieve the goal. The division between human and machine will vary from system to system.

### 4.3.2 Elements of System

A simple way of looking at a system is:

A system's objectives are expressed in terms of the outputs it needs to produce. II feeds inputs, which are processed to generate the outputs.

In addition to the above elements (or components), four more elements play an important role. These are:

- Control
- Feedback
- Environment
- Boundaries and interface

Therefore, the key elements of a system are:

**(a) Outputs**: First of all, we must determine what the objectives or goals are. what do we intend to achieve, what is the purpose of our work; in other words, what is the main aim behind the system. Once we know our aim, we can try to achieve it in the best possible way.

**(b) Inputs**: Once we know the output, we can easily determine what the inputs should be. The essential elements of inputs are:

1. **Accuracy:** If the data is not accurate, the output will be wrong.
2. **Timeliness:** If data is not obtained in time, the entire system falls into arrears.
3. **Proper format:** The inputs must be available in proper format.
4. **Economy:** The data must be produced at the least cost.

**(c) Processes:** Here we come to the details of how the inputs and files are converted into outputs. This involves the programs and the way in which data is processed through the computer.

Processes may modify the input totally or partially, depending on the specifications of the output as shown in fig. 3.15

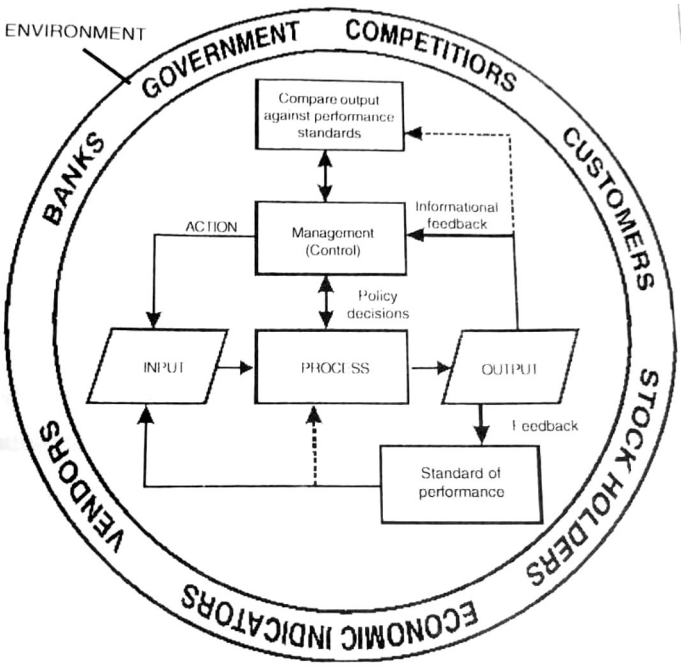



**Figure 3.15**

**(d) Control:** Control of the system is the decision-maker that controls the activities of accepting input, processing and producing the output. For example, in an organizational context, management as a decision-making body controls the inflow, handling and outflow of activities that affect the welfare of the business. Hence, each system should have the element control, which makes the system to operate within tolerable performance levels. For example, the normal temperatures of human body is 98.6°F. When there is a slight deviation in this temperature there is imbalance in the health condition.

**(e) Feedback:** in feedback, the output is fed back to input and/or to the control The feeding back of the output allows it to be measured against some standardsand making adjustments in the processing accordingly as shown in fig. 1.9.

Hence feedback is information on how well a system is performing and it isessential for system modifications

Feedback may be positive or negative, routine or informational Positive feedback increases the performance of the system. It is routine in nature, Negative feedback generally provides the controller with information for action

**(f) Environment:** The environment is the source of external elements that have an effect on the system. In fact, it often determines how a system must function. As

shown in Figure 1.9, the organization's environment, consisting of vendors, competitors, banks, government and others, may provide constraints and, consequently, influence the actual performance of the business.

**(g) Boundaries and Interface:** A system should be defined by its boundaries the limits that identify its components, processes, and interrelationships when. It interfaces with another system. For example, a teller system in a commercial bank is restricted to the deposits, withdrawals, and related activities of customers checking and saving accounts. It may exclude mortgage foreclosures, trust activities and the like.

### 4.3.3 Human as an Information Processing System

People receive input data by seeing or hearing them. These data are then stored in the brain, which also acts as a control and logic unit. The outputs from this type of information processing are oral or written reports and in some cases a variety of physical actions. The human mind, acting as a control and logic unit, can perform many operations on data adding, subtracting, multiplying, and dividing, storing results, repeating the operations on different sets of data, comparing two items, outputting results in a prearranged manner, and revising the processing operationsas a result of changed instructions.

The human mind is slow in performing the arithmetical computations required and is rather erratic in applying rules of logic. On the other hand, where judgement is required, the human mind is indispensable. Judgement is needed to make decisionsin data processing systems because of the difficulty of planning to handle all eventualities. In summary, human beings alone are inefficient data processors, but they become a vital element of all data processing systems because of the need for decisions and judgement. Similarities and differences of a computer system with human being is given in Table 2.1 and Table 2.2 respectively.

**TABLE 2.1**

**COMPUTER VS HUMAN-BEING (SIMILARITIES)**

| COMPUTER ELEMENT | OPERATION PERFORMED BY COMPUTER | CORRESPONDING ACTION PERFORMED BY A HUMAN-BEING |
|---|---|---|

| | | |
|---|---|---|
| Input | 1. Reads data in machine- readable form and stores in internal memory or in file storage. | 1. Reads data in written or printed form and memorize it or file it. |
| Main Memory | 2. Hold input data and Instructions temporarily before it is processed. | 2. Data and Instructions are stored in brain and can be recalled whenever needed. |
| ALU | 3. Performs arithmetic compu-tations.<br>4. Manipulates symbols (such as alphabetic characters or words).<br>5. Makes comparisons | 3. Perform arithmetic computations.<br>4. Manipulates symbols.<br>5. Makes comparisons. |
| Control Unit | 6. Chooses a path of instruction based on a comparison or an examination of the results to that point.<br>7. Retrieves any data from internal memory or file storage. | 6. Makes a decision-as to further processing based results to that point.<br>7. Remembers data or retrieves data from a file. |
| Output | 8. Outputs the results on an output device. | 8. Writes or speak the results. |

# Unit-6



## 6.1 SYSTEM DEVELOPMENT LIFE CYCLE (SDLC)

Every computer based system has a life cycle. Just as all living beings follow a life cycle. At one point investigations are made, requirements are analyzed and new specifications are proposed and a new system is developed. The life cycle of the new system starts again.

System development starts when management feels that a new system or an improvement in the existing system is required. The system development life cycle (SDLC) is the set of activities that analysts, designers and users carry to develop and implement an information system. It is a well defined process by which a system is conceived, developed and implemented.

***Key Points:***

- In the SDLC, basically the major activities related to software development are performed.
- In order to develop a system successfully, it is broken into smaller basic activities called phases.
- SDLC is a sequence of steps/phases to perform the well-defined activities to fulfill the desired goals. In SDLC output of one step/phase is the input of next step/phase.
- There is a criterion for each input/output phase. Input criteria specifies the conditions when to terminate the activities of the phase output criteria specifies the conditions when to terminate the activities of the phase.
- The goal of the SDLC is to detect the errors/defects in the starting of their origin in the phase. Validation and verification should be performed at the end of the phase to detect the errors.
- Due to importance of development process, various models have been proposed for developing software which is being discussed in this unit.
- Clear objective is defined in the starting of the development process to make it more effective and less expensive.

## 6.2 PHASES OF SDLC

SDLC has many phases and activities for system development. Each phase ends with a defined output which is the input for the next phase. The goal of SDLC is to develop a high

system in minimum cost by checking the progress at the end of each phase. In all the phases, complexity of tasks and project tracking etc. should be managed to maintain the quality of the system product. SDLC varies with large projects and small projects. Small projects have different phases, activities and issues as compared to large software projects.

The following are the phase of SDLC:

1. Preliminary Survey or Investigation
2. Feasibility Analysis
3. Requirement Analysis
4. Design
5. Coding
6. Testing
7. Implementation
8. Maintenance

1. **Preliminary Survey or Investigation:**

   It is one of the most difficult tasks of the system analyst. The purpose of the preliminary survey or investigation is to evaluate the project requests. It is very difficult to identify the real problem of the existing system.

   Preliminary survey and investigation is the collection of information that helps the committee members to evaluate the merits of the project request and make an informed judgment about the feasibility of the proposed project.

   During preliminary survey or investigation, the following are the analysis work should be accomplished by the system analyst:

   - The time limit for designing the new system
   - The size of the project.
   - The constraints/restrictions on cost, equipment to be used, areas of business which are to be left unchanged etc.
   - What the new system must achieve, for example: cost reduction, better service to customers, better management information etc.

   Without clear understanding of the problem in the system, any further work done will lead to wastage of effort at a later stage.

   The following are the primary methods to collect the data during preliminary investigation:

   a. **On-site Observations:** In this method, the analysts observe the activities of the system directly. The analyst can see the office environment, work load of the system and the users, methods of work and the facilities provided by the organization to the users. Observation is a time consuming method but it is the best technique to understand the system as a real world problem.
   b. Interviews**: Interviews are formal meetings with current users of the existing** system and potential users of the proposed system. Interview is a time

consuming process but it is the best technique for getting the qualitative information.

c. **Reviewing Organization Documents:** Normally organizations have a large volume of documents in the form of organization charts, administrative procedure manuals, policy manuals, job description documents, account books etc. that can provide valuable information to the analyst. By inspecting these documents, the analyst can easily understand the working of the current system. Record inspection is the best source of quantitative information.

2. **Feasibility Analysis:**

The next step is to examine the feasibility of the proposed system. Requirements Gathering: The Business Analyst (BA) or a representator of a company collects all the predefined information of the company like what type of software a company can develop and in how many days etc. and goes to the client. It involves evaluating the cost and benefits of the system. Costs include costs of design, development, implementation and maintenance of the system. Benefits will be realized from the timely and accurate generation of the required information to meet the stated objectives of the organization.

Then BA collects all the basic requirements and specifications of the client and prepare a document known as BDD (business development design), BRS (business requirement specification), URS (user requirement specification), and CRS (customer requirement specification) etc. All these documents are same, only name is different. These documents are the output of the feasibility study phase and input of the requirement analysis phase.

***Types of Feasibility Study:***

***(a) Technical feasibility study:*** In the technical feasibility study, possibility of project

development is measured. It is checked that whether the software project is technically sound or not.

***(b) Economic feasibility study:*** In the economic feasibility study, financial matters are discussed. It is the most important study that determines the cost and benefits of the proposed system and compares with the budget. The cost of the project includes the cost of hardware, software, development and implementation. For example: Is the software project is under budget or not? A software project should be under budget. Cost benefit analysis is determined to determine the benefits and servings that are expected. If benefits are found to be more than cost, then the analyst decides to continue the development of the proposed system otherwise considers it economically not feasible.

***(c) Schedule feasibility study:*** In the schedule feasibility study, time duration is decided. The company finds the probability to complete the project in fixed allowed time period ***(d) Motivational feasibility study:*** In the motivational feasibility study, the sufficient motivation of organization is checked with necessary user participations, resources etc.

3. **Requirement Analysis:**

When the analyst decides that the requested system is feasible and the management agrees to continue the development process, the next phase of SDLC is the

requirement analysis.The output of the feasibility study phase CRS (customer requirement specification) is used as input in the requirement analysis phase. Generally project manager analyze the requirements of the user and prepare the project plan.

Requirement analysis phase has 4 steps which are as follows:

***(a) Requirement Analysis:*** All the requirements of client (mentioned in CRS) are studied and analyzed in detail. To understand the requirements of clients for large projects with many features, different tasks are analyzed. But it is very difficult because of communication gap between client and developer. This type of difficulty is based on basically two aspects. In one aspect, developer tries to develop a software which meets client‘s requirements without understanding the client‘s problem domain. In second aspect, client does not aware about the issues/problems in the development of the software.

***(b) Deciding Technology:*** In this step, suitable technology is being declared for the development of software project. Companies select suitable technology based on many factors like requirements of clients, type of software project etc.

***(c) Estimating the Resources:*** In this step, resources like manpower, time, money etc. are

estimated for the development software project. All resources should be examined and improved in advance to reduce the difficulties in the software development.

***(d) Preparing SRS (Software requirement specification):***

- SRS (Software Requirement Specification) is a last and fourth step of requirement analysis phase. It is a document with the specific language to specify all the inputs, outputs, functional requirements, performance requirements with some constraints like economic issues, security etc.
- Definition: SRS is the specification for particular software product that perform certain functions in a specific environment.
- SRS is a complete description of the software which is going to be developed. It describes the complete scope of the product.
- SRS is prepared by Senior Analyst (SR).
- It is a type of agreement between the client and the company on what the software product is going to do.
- All functions/tasks of software development are based on the software requirement specification.

4. **Designing:**

In the design phase, a plan is proposed for software development according to the software requirement specification. The quality of software depends upon the design document. Design document is like a blue-print or plan for the software development which is used in later stages.

The design activity of a software development is divided into two levels.

***(a) High level designing/System design***

- It is also known as top-level design. It is done by Technical Manager (TM).

- In this designing, software is divided into number of modules. Modules are identified along with their specification and interaction among them. In this type of designing, focus is on identifying the modules.

***(b) Low level designing/Detailed design***

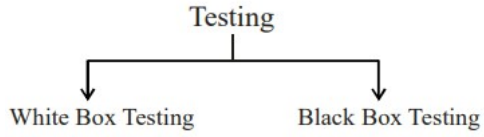
- It is also known as detailed design. It is done by Team Lead (TL).
- In this designing, modules are further divided into number of sub-modules.
- Internal logic of sub-modules are specifies in the high level descriptive language.
- The output of this phase is detail design document (DDD) which is further used in later phases to develop a high quality software.

**5. Coding:**

- Once the designing of software is complete, the coding phase comes, in which developers follow some coding standards for writing the programs.
- In this phase, design of a software product translates into simple and understandable code in a particular language.
- Developers prepare the source code which is easy to write, read and understand.
- Coding should be done with simplicity, clarity and well-written format. Effective coding can reduce the testing and maintenance effort.
- Coding part is very time consuming and difficult task. Coding should be done in structured programming which linearizes the control flow in the programs.

**6. Testing:**

- The quality of a software product is measured and controlled by the testing phase.
- Testing is a process of executing a program with the intent of detecting or finding errors. Proper planning is required for the testing.
- Testing is very difficult and time-consuming process.




- Before starting this process, test engineers study the CRS (customer requirement specification) document prepared in the first phase and prepare a review report.
- In the review report, test engineers mentioned those points which are not clear and

understandable. Test engineer send this review report to the Bussing Analyst (BA).

- Test Engineer prepare test plan before testing. Test plan specifies the scope, approach, resources and schedule of all testing activities.

- Test plan covers all the activities like items to be tested, types of testing to be performed, features to be tested, persons/resources responsible for testing, time scheduling issues/risks associated with the plan etc.
- Testing starts with the unit testing, in which a module is tested separately then integration testing is performed, which detect design errors and in last, system testing is performed to check the system performance according to the software requirement specification (SRS).
- The output of the testing phase is known as defect profile document (DPD). Test Engineers sends this document to the team of developers for removing the errors and controlling the quality of software.

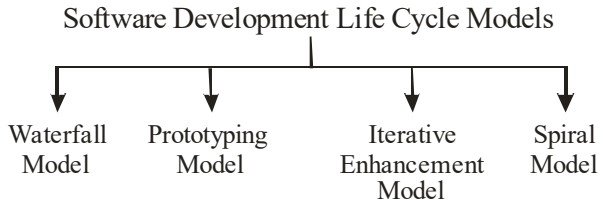
7. **Implementation:**
   - In this phase, after completing the software project, a mail is sent to the client. This mail is known as software delivery note.
   - It after receiving this mail, client test the software project known as user acceptance testing.
   - After this successful testing, software is installed in the client‘s environment.
8. **Maintenance:** During installation of software product in the client‘s environment, if any

   problem occurs or if client wants to make some changes in the software, then the maintenance people make changes to solve the problem and prepare the deployment document (DD) for further use.

## 6.3 SYSTEM DEVELOPMENT MODELS

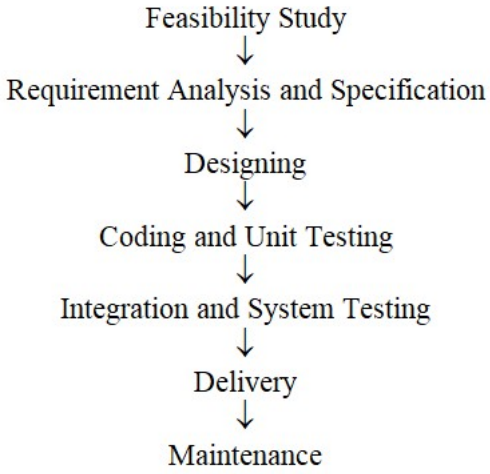
1. A software development life cycle models describe the necessary sequence of different activities helpful in software development.
2. Software development starts with the request of client and undergoes many stages until software product is developed and delivered to the client.
3. These models show series of identifiable activities of software development for the successful delivery of the software product.
4. In the SDLC models, several activities and several documents are carried out. Documents are normally made to collect all the input/output information. Different phases of software development are shown graphically with the textual description for easy understanding.
5. In short, these models give descriptive and diagrammatic representation of software development phases.
6. There are so many software development life cycle models like waterfall model, spiral model etc. The common aim of these models is to develop a good quality software.
7. No matter which life cycle model is followed, all models have basic activities, carrying process of these models may be in different orders, but goal will remain same.
8. These models are helpful in developing a high quality software with low budget and time constraints.

There are so many life cycle models. The following are some life cycle models commonly used by computer organizations:




### 6.3.1 WATERFALL MODEL

1. Waterfall model is the simplest and oldest process model.
2. It is represented by sequence of different stages.
3. The output of one stage flows into the second stage, the output of second stage flows into third stage and so on.
4. It is a definite structure of software development life cycle. Each phase is distinct and has a well-defined entry.
5. There is a provision for verification, validation and error correction at the end of every phase.
6. The part of waterfall model between the feasibility study and system testing is known as development part. After the development part, the software product is delivered to the customer. The maintenance phase comes after the delivery of the developed product to the customer.
7. This model is also known as the linear sequential model or the software life cycle model.
8. The waterfall model consists of following six stages:




(i) **Feasibility Study:** The feasibility study determines whether the developing model is financially and technically feasible or not. It is necessary to analyze the problem. More we understand the problem and the better we can identify alternative solutions. The feasibility study is usually done within limited time bounds. The outcome of feasibility study is a document that should contain at least the following factors:

- A definition of the problem.
- Determination of technical and economic viability.
- Alternative solutions and their expected benefits.
- Requirement of resources and detail about delivery

This report is called as feasibility study which is prepared by a group of software engineers. The client or the customer is also consulted through questionnaires. The report determines whether the project is feasible or not.

(ii) **Requirement Analysis and Specification:** In this phase, we exactly analyze the

requirements and needs of the project. The purpose of a requirement analysis is to identify the qualities required for the application, in terms of functionality, performance, ease of use portability, and so on. The result of this phase is known as the software requirement specification (SRS) document.

An SRS document must contain the following items:

- Detailed statement of problem.
- Possible alternative solution to problem.
- Functional requirements of the software system.
- Constraints on the software system.

The SRS document must be precise, consistent, and complete and covers features like problem statement, introduction to the problem, functional requirements of the system, non-functional requirements of the system, behavioral descriptions and validation criteria.

(iii) **Designing:** The objective of the design phase is to convert the requirements specified in the SRS document into a structure that is suitable for execution in some programming language. Two different design approaches are available: the traditional design approach and the object-oriented design approach.

- In Traditional Design Approach, two activities are carried out, first a structured analysis of the requirements specification and second structured design. During structured design, the results of structured analysis are transformed into the software design.
- In Object-Oriented Design Approach, the various objects and their relationships within the system are identified.

(iv) **Coding and Unit Testing:** Coding and unit testing is the phase in which we actually write programs using a programming language. The output of this phase is an implemented and tested collection of units. The unit testing is the testing of code to check correctness and remove the bugs. The debugging is a related activity performed in this phase.

(v) **Integration and System Testing:** During the integration and system testing phase, the modules are integrated in a planned manner. The different modules are integrated to develop a software product. During each integration step, the partially integrated system is tested finally, when all the modules have been successfully integrated and tested, system testing is carried out. The objective of system testing is to determine whether the software system performs per the requirements mentioned in the SRS document.

The system testing is done in three phases: Alpha, Beta, and Acceptance Testing.

- **Alpha Testing** is conducted by the software-development team at the developer's site.
- **Beta Testing** is conducted by a group of friendly customers in the presence of the software-development team.
- **Acceptance Testing** is performed by the customers themselves. If the software is successful in acceptance testing, the software product is installed at the customer's site.

(vi) **Delivery:** The delivery of software is done in two phases. In the first phase, the application is deployed on few customers' sites. The purpose of this procedure is to check the product performance at client site, on the basis of feedback from users, whether any changes is necessary or not. In the second phase, finally the product is distributed to the customer's officially.

(vii) **Maintenance:** The maintenance as the set of activities that are performed after the system is delivered to the customer. Its purpose is to monitor the performance of the software, and removing error if any faced by the customer in site.

**Advantages of Waterfall Model**

The various advantages of the waterfall model include:

1. It is a linear model.
2. It is a segmental model

3. It is systematic and sequential.
4. It is a simple one.
5. It has proper documentation.

**Disadvantages of Waterfall Model**

The various disadvantages of the waterfall model include:

1. It is difficult to define all requirements at the beginning of a project.
2. The model is not suitable for accommodating any change in later stage.
3. It does not good for large scale projects.
4. It involves heavy documentations.
5. We cannot go backward in the SDLC.
6. There is no prototyping model for clearly realizing the customer's needs.
7. There is no risk analysis.
8. If there is any mistake in any of seven phases then we cannot develop good software.
9. It is a document driven process that requires formal documents at the end of each phase.

## 6.3.2 PROTOTYPING

1. Prototyping model is an intuitive approach of the waterfall. It overcomes the limitations of waterfall model.
2. Multiple development cycles take place in prototyping, making it multi-waterfall cycle. Cycles are further divided into smaller and easily manageable iterations.
3. The interactions in the prototype enable the developer to better understand what needs to be done and to satisfy users.
4. The prototype model is helpful in understanding the currently known requirements. In the waterfall model, client has to specify his/her requirements before the designing and coding phase. Client's requirements are freezed in the requirement phase. But in the prototyping model, client can specify his/her requirements in more detailed manner.
5. In this model, the client can interact with the prototype and can get an actual feel of the system.
6. Prototyping model is suitable for those projects where it is very difficult to determine the specifications of complex and large projects like client's feedback regarding software product, what is correct and missing, what needs modification etc.
7. Developers make changes in the software product on client's suggestions. Clients use the new changed software product again and allowed to give his/her suggestions to the developers. This cycle repeats until client satisfies with the software product.
8. Prototyping ensures that end users constantly work with the system. Prototyping model is excellent for designing good human computer interface systems.
9. The steps of prototyping model are as follows:

(i) **Requirements gathering and analysis:** The model begins with requirement gathering and analysis in detail. In this phase, requirements are gathered and analyzed by the organization.

(ii) **Quick Design:** After analysis of requirements, quick design is created. It is a rough design not a detailed design. This quick design helps in developing a prototype and provides an idea of the software product to the user.

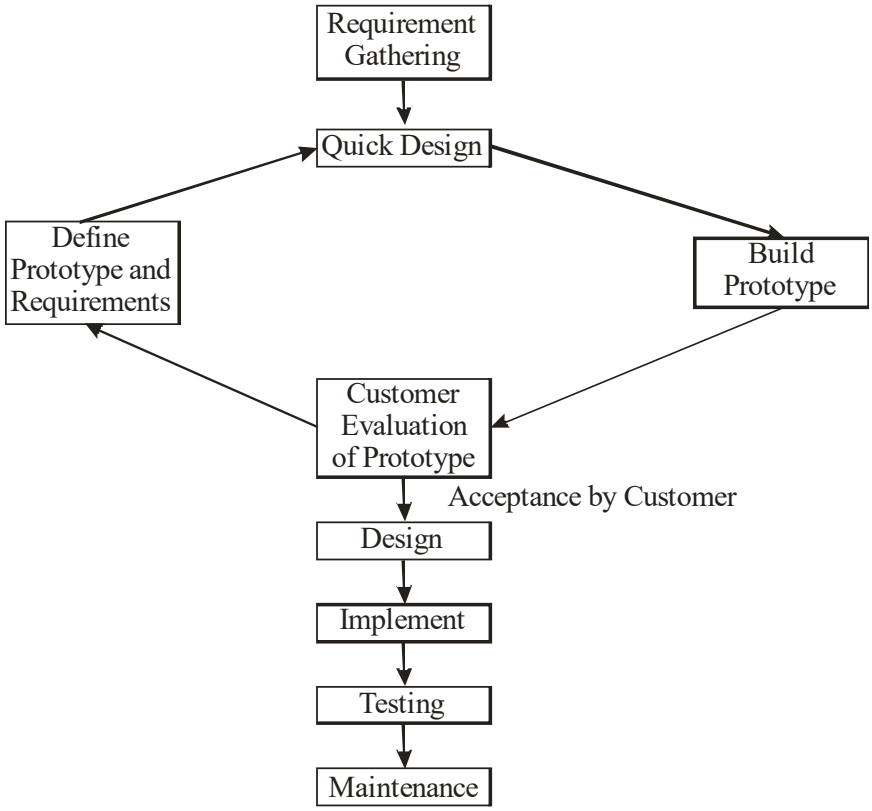
(iii) **Build Prototype:** With the help of quick design, a prototype is build which represents the working model of the required software product.

(iv) **User Evaluation:** A proposed prototype is evaluated by the user. User studies the strengths and weaknesses of this prototype. User provides his/her comments and suggestions like what is to be added or removed etc. to the developer.

(v) **Refine Prototype:** If after the evaluation of the prototype, user does not satisfy, then

prototype is refined according to the requirements. A new prototyped is developed and being evaluated by the user. After the satisfaction of user, final system is developed.

(vi) **Engineer Product:** Once the user accepts the software product is maintained on regular basis.




**Prototyping Model**

**Advantages of Prototyping Model:**

The various advantages of the prototyping model are as follows:

1. **Quick development:** Developer's approach is to generate software product quickly according to the client's requirements.
2. **Flexible:** Prototyping models are more flexible as compared to waterfall model. Clients can give suggestions to developers for the changes in the software product. In this way, model reduces the communication gap between client and developers.
3. **Easy to test and debug:** Developers can easily test and debug a smaller iteration rather than the whole software product.
4. **Manage risk:** During the small iteration, risky pieces are identified and handled easily.
5. **User Involvement:** Users are actively involved in the software development process.

**Disadvantages of Prototyping Model**

The various disadvantages of the prototyping model are as follows:

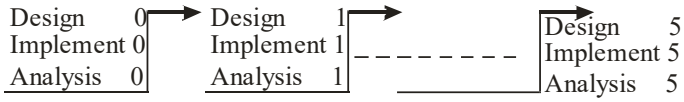
1. Each phase of iteration is rigid and do not overlap each other.
2. **High Cost:** Experienced developers and changing requirements are two main reasons of higher cost in prototyping model.
3. **Lower Quality:** During the development of software product according to prototyping model, the developer's focus is on quick development without thinking about the quality of software product. Development approach is to satisfy client's needs without bothering

about the quality of software product.

4. **Compromises in Implementation:** Developer's aim is to get prototyping quickly and to meet client's desires. To achieve this aim, developers make many implementation compromises like inappropriate operating system, an inefficient algorithm etc.
5. **Time Consuming Process:** It is a slow process. The aim of prototyping model is to satisfy the customer. But requirements of customer keeps changing according to external environment. Hence,it is time consuming process.

## 6.3.3 ITERATIVE ENHANCEMENT MODEL

1. Iterative enhancement model provides the benefits of both waterfall model and prototyping model.
2. According to the iterative enhancement model, each increment adds some functional capability to the system until the full system is implemented.




**Iterative Enhancement Model**

3. The basic idea behind this model is to develop a system through repeated cycles (iterative) and in smaller portions at a time.
4. This model is used when requirements of system are clearly defined and understood.
5. Iterative enhancement model supports changing requirements.
6. Parallel development can be planned and progress can be determined during iterative enhancement model.

**Advantages of Iterative Enhancement Model**

1. Iterative enhancement model is better in testing. It is because testing increment is very easy as compared to testing the entire system. It overcomes the limitation of waterfall model.
2. Like prototyping, this model also provides feedback to the client. This feedback is very useful for determining the final requirements of the system.
3. This model also provide results periodically and early. It allows the users to get some early experience of the software.
4. Risks are identified and managed during iteration. During smaller iteration, testing and debugging is easy.
5. This model is suitable for large and mission critical projects.

**Disadvantages of Iterative Enhancement Model:**

1. This model is not suitable for small projects.
2. During iterative enhancement model, management complexity is more and highly skilled resources or required for risk analysis.
3. Sometimes, the iteration may never end and the user may never really get the final product.

## 6.3.4 SPIRAL MODEL

1. Spiral model was developed by Barry Bohem in 1988. In this model, software is developed in spiral with many loops.
2. The number of loops in a spiral model are not fixed and can vary from project to project. Each loop is the phase of the software project.
3. At each loop, risks are identified and resolved by prototyping. At every spiral, risk analysis is done to evaluate the development efforts/labour and risks.
4. This model is very flexible because number of phases are not fixed for the software development.
5. Inner cycles/loops represent the requirement analysis alongwith the prototype, whereas

outer cycles represent the waterfall model.

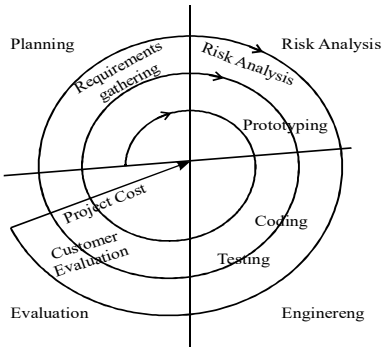
6. Generally, spiral model is combination of strengths of various models. It uses stepwise approach of waterfall model and prototyping for resolving the risks occurred during software development.
7. Spiral model is also called as metal model because both waterfall model and prototype model are used in it. It reduce risk as well as follow systematic approach.
8. **Phases of Spiral Model:** There are four phases in the spiral model. In the starting of this model, requirements are gathered to analyze the risk. Spiral model makes communication effective between customer and developer. In this model, angular component represent the progress and reduces the represent cost.

The four phases of spiral model are discussed as follows:

(i) **Planning:** In the planning phase, requirements are gathered. All methods and strategies are decided in this phase. The objectives, constraints and alternatives are also discussed in this phase.

(ii) **Risk Analysis:** A process is undertaken to identify the risks. In this phase, alternate solutions are also identified to resolve the risk. Prototyping is used at the end of this phase to resolve the risks which are identified and analyzed. In this phase, risks associated with these new alternative solutions are also analyzed. In this phase, keeping new risks in mind, strong decisions are taken to resolve the risks with prototype.

(iii) **Engineering:** It involves the actual development of software project. After finding and resolving all the risks through prototyping, software is being developed in the engineering phase.



**Spiral Model**

(iv) **Evaluation:** This phase allows the customer to evaluate the output of the project to date before the project continues to the next spiral.

**Advantages of Spiral Model**

1. Spiral model evaluates the risk analysis. It enhances the avoidance of risk.
2. It is good for large and mission critical objects.
3. Software is produced early in the software life cycle.
4. Strong approval and documentation control.

**Disadvantages of Spiral Model**

1. Sometimes, it is costly in use.
2. It is not suitable for small projects.
3. The success of spiral model depends upon the risk analysis phase.
4. Risk analysis requires highly specific expertise.
5. It is not suitable for low risk projects.
6. Spiral may continue indefinitely.