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Information System Concepts

Learning Objectives :

- To introduce the general concepts of systems, their objective, their elements and their classification;
- To explain the concept of information, its characteristics and its role in Information systems;
- To explain different types of Computer Based Information Systems like DSS, MIS, EIS etc.; and
- To explain different types of Office Automation Systems.

1.1 Introduction

The term system is in common parlance. People talk of transport system, educational system, solar system and many others. System concepts provide a framework for many organizational phenomenon including features of information system.

1.2 Definition of a System

The term system may be defined as an orderly arrangement of a set of interrelated and interdependent elements that operate collectively to accomplish some common purpose or goal. For example - Human body is a system, consisting of various parts such as head, heart, hands, legs and so on. The various body parts are related by means of connecting networks of blood vessels and nerves and the system has a main goal of "living". Thus, a system can be described by specifying its parts, the way in which they are related, and the goals which they are expected to achieve. A business is also a system where economic resources such as people, money, material, machines, etc are transformed by various organizational processes (such as production, marketing, finance etc.) into goods and services. A computer based information system is also a system which is a collection of people, hardware, software, data and procedures that interact to provide timely information to authorized people who need it.

1.3 Types of System

As shown in Fig. 1.3.1, we can distinguish systems on the basis of following parameters:

(i) Elements

(ii) Interactive Behavior

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(iii) Degree of Human Intervention

(iv) Working / Output

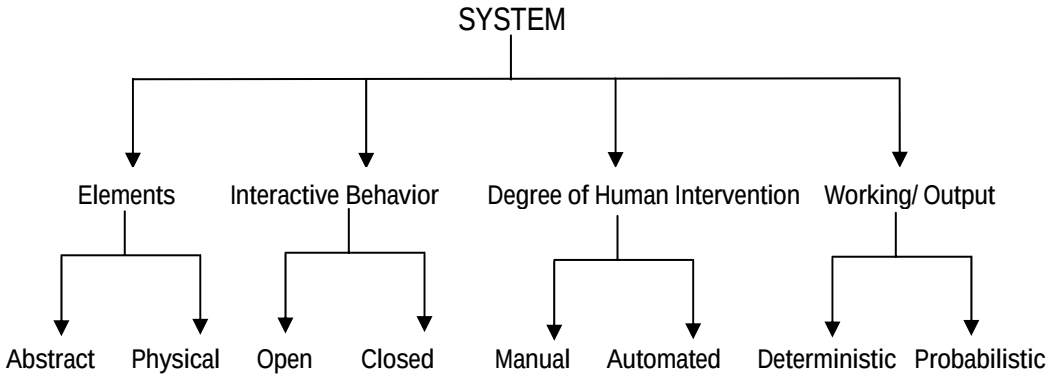

Fig. 1.3.1 : Classification Chart of System

1.3.1 According to Elements

(i) **Abstract System** : Abstract System also known as Conceptual System or Model can be defined as an orderly arrangement of interdependent ideas or constructs. For example, a system of theology is an orderly arrangement of ideas about God and the relationship of humans to God.

(ii) **Physical System** : A physical system is a set of tangible elements which operate together to accomplish an objective. Some of its examples are shown in Table 1.3.1.

Physical System	Description
Circulatory system	The heart and blood vessels which move blood through the body.
Transportation system	The personnel, machines, and organizations which transport goods.
Weapons system	The equipment, procedures, and personnel which make it possible to use a weapon.
School system	The buildings, teachers, administrators, and textbooks that function together to provide education to students.
Computer system	The equipment which function, together to accomplish computer processing.

Table 1.3.1 : Examples of Physical System

The examples illustrate that a system is not a randomly assembled set of elements; it consists of elements, which can be identified as belonging together because of a common purpose, goal, or objective. Physical systems are more than conceptual construct; they display activity or behavior. The parts interact to achieve an objective.

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1.3.2 According to Interactive Behavior : A system may be composed of a number of components that work together in a cascade to achieve a goal for which the system is designed. All systems work in a specific environment and based on how they perform within an environment, systems can be categorized in two classes:

(i) Open System : A system that interacts freely with its environment by taking input and returning output is termed as an Open System. With change of environment, an open system also changes to match itself with the environment. For example, the education system or any business process system will quickly change when the environment changes. To do this, an open system will interact with elements that exist and influence from outside the boundary of the system.

Information systems are open systems because they accept inputs from environment and sends outputs to environment. Also with change of environmental conditions, they adapt themselves to match the changes.

(ii) Closed System : A system that does not interact with the environment nor changes with the change in environment is termed as a Closed System. Such systems are insulated from the environment and are not affected with the changes in environment. Closed systems are rare in business area but often available in physical systems that we use in our day to work. For example, consider a 'throw-away' type sealed digital watch, which is a system, composed of a number of components that work in a cooperative fashion designed to perform some specific task. This watch is a closed system as it is completely isolated from its environment for its operation. Such closed systems will finally run down or become disorganized. This movement to disorder is termed on increase in entropy.

Organizations are considered to be relatively open systems as they continuously interact with the external environment, by processes or transformation of inputs into useful output. However, organizations behave as a relatively closed system in certain respects so as to preserve their identity and autonomy. They may ignore many opportunities so as to maintain their core-competence.

Organizations perform several operations on these inputs (consisting of finance, physical and mental labor, and raw material) and process out products or services. The process of exchange generates some surplus, in the form of profit, goodwill experience and so on, which can be retained in the organization and can be used for further input output process. Organizations are dependent upon their external environment for the inputs required by them and for disposing of their outputs in a mutually beneficial manner. Fig. 1.3.2 illustrates open system vs closed system.

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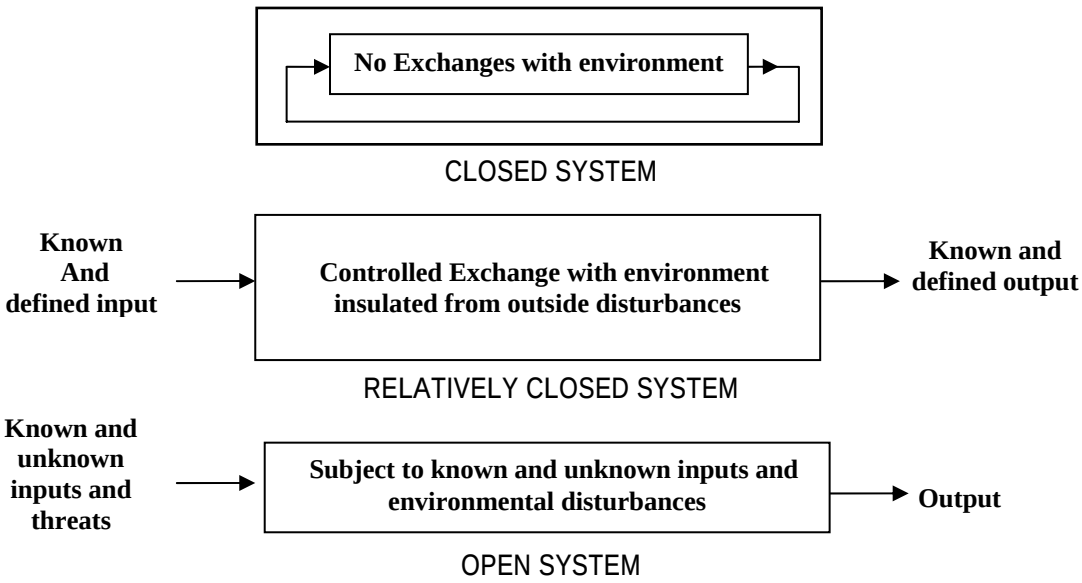

Fig. 1.3.2 : Closed System vs Open System

Entropy : Entropy is the quantitative measure of disorder in a system. Systems can run down and decay or can become disordered or disorganized. Presenting or offsetting an increase in entropy requires inputs of matter and energy to repair, replenish and maintain the system. This maintenance input is termed as Negative Entropy. Open systems require more negative entropy than relatively closed systems for keeping at a steady state.

In general, the life cycle of a closed system is much shorter compared to that of an open system because it decays faster for not having any input/ interaction from environment.

Open systems require more negative entropy than relatively closed systems for keeping at a steady state of organization and operation, but all the systems described in the text require it. Examples of system maintenance through negative entropy by inputs of matter and energy are shown in Table 1.3.2.

System	Manifestations of entropy	Negative Entropy
Automobile	Engine won't start tyres too thin.	Tune up engine, Replace tires.
Computer program	User dissatisfaction with features and errors.	Program enhancements.
Computer data files	Errors and omissions in data field. Not all relevant entities included.	Review and correct procedures procedure to identify omission and obtain data.

Table 1.3.2 : Systems and their Entropies

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1.3.3 According to Degree of Human Intervention

(i) Manual Systems : Manual Systems are the systems where data collection, manipulation, maintenance and final reporting are carried out absolutely by human efforts.

(ii) Automated Systems : Automated Systems are the systems where computers or microprocessors are used to carry out all the tasks mentioned above. However, none of the business system is 100% automated; rather, to some extent, it depends on manual intervention, may be in a negligible way.

Computers made it possible to carry out processing which would have been either too difficult or too much time-consuming or even impossible to do manually. A system may be even 100% manual. In earlier days, all accounting procedures and transactions, production details or sales data used to be maintained in different ledgers that were created by human efforts only and all these were manual systems. With introduction of computers and complexity in business procedures, these manual jobs were passed to computers in a major way and now a business system inherently involves a close man-machine interaction. The reasons for using computer in business area are as follows:

- Handling huge volume of data that is not manageable by human efforts.
- Storing enormous volume of data for indefinite period without any decay.
- Quick and accurate processing of data to match the competitive environment.
- Quick retrieval of information on query.
- Quick and efficient transportation of data/information to distant places almost at no cost.
- Availability of software tools for quick decision making in a complex situation.

1.3.4 According to Working/Output

(i) Deterministic System : A deterministic system operates in a predictable manner wherein the interaction among the parts is known with certainty. If one has a description of the state of the system at a given point in time plus a description of its operation, the next state of the system may be given exactly, without error. An example is a correct computer program, which performs exactly according to a set of instructions.

(ii) Probabilistic System : The probabilistic system can be described in terms of probable behavior, but a certain degree of error is always attached to the prediction of what the system will do. An inventory system is an example of a probabilistic system. The average demand, average time for replenishment, etc, may be defined, but the exact value at any given time is not known. Another example is a set of instructions given to a human who, for a variety of reasons, may not follow the instructions exactly as given.

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1.4. General Model of a System

A general model of a physical system is input, process and output. This is, of course, very simplified because a system may have several inputs and outputs as shown in Fig. 1.4.1 :

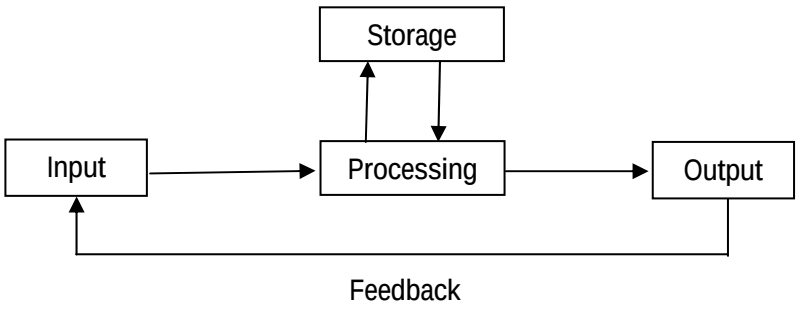

Fig. 1.4.1 : General Model of a System

A System may have many inputs and outputs.

- Input is the data flowing into the system from outside. For example : A newspaper takes a news feed from a news wire service such as Reunters.
- Processing is the action of manipulating the input into a more useful from. For example : The newspaper takes the pure text obtained from the news wire service and creates front page layout using pictures and formatted text.
- Output is the information flowing out of a system. For example : The raw news wire information is viewed on your website as a story, all nicely formatted in the company style.
- Storage is the means of holding information for use at a later date.
- Feedback occurs when the outcome has an influence on the input.

1.5 System Environment

The external world which is outside the system boundary is known as System Environment.

1.5.1 System Boundary : All systems function within some sort of environment, which is a collection of elements. These elements surround the system and often interact with it. For any given problem, there are many types of systems and many types of environments. Thus, it is important to be clear about what constitutes the system and the environment of interest.

For example, a physiologist looking at human system may be interested in studying the entire human body as a system, and not just a part of it (such as the central nervous system only). If the entire human body is the system of interest, the physiologist is likely to define the environment more broadly than he might if the focus was on just the central nervous system.

The features that define and delineate a system form its boundary. The system is inside the boundary; the environment is outside the boundary. In some cases, it is fairly simple to define

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what is part of the system and what is not; in other cases, the person studying the system may arbitrarily define the boundaries. Some examples of boundaries are discussed in Table 1.5.1.

System	Boundary
Human	Skin, hair, nails, and all parts contained inside form the system; all things outside are environment.
Automobile	The automobile body plus tires and all parts contained within form the system.
Production	Production machines, production inventory of work in process, production employees, production procedures, etc. form the system. The rest of the company is in the environment.

Table 1.5.1 : Examples of Systems and their Boundaries

1.5.2 Subsystem : A subsystem is a part of a larger system. Each system is composed of subsystems, which in turn are made up of other subsystems, each sub-system being delineated by its boundaries.

The interconnections and interactions between the subsystems are termed Interfaces. Interfaces occur at the boundary and take the form of inputs and outputs. Fig. 1.5.1 shows examples of subsystems and interfaces at boundaries.

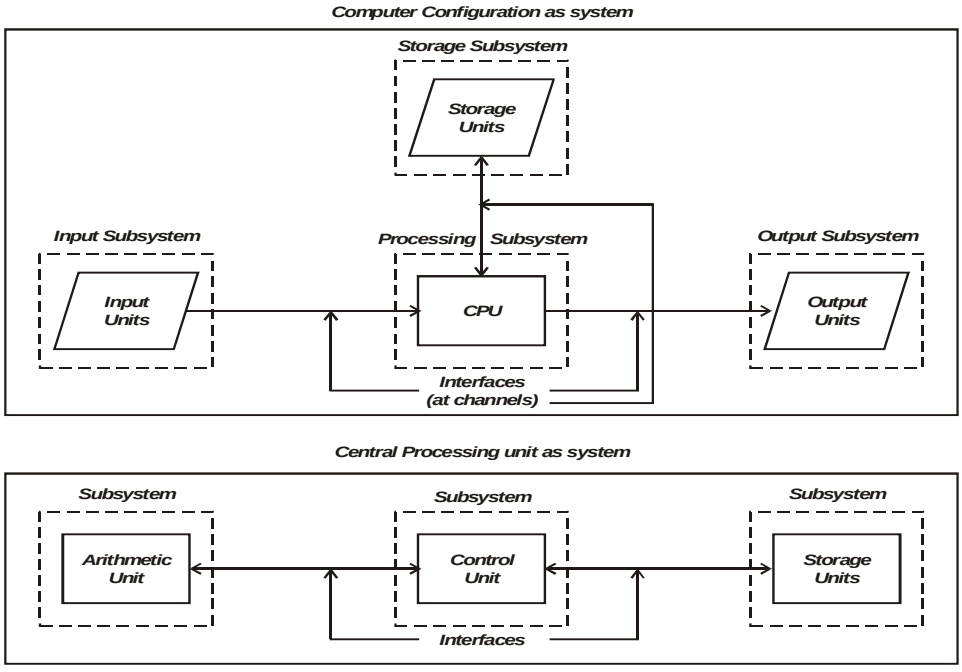

Fig. 1.5.1 : Components of a Computer System

1.5.3 Characteristics of Subsystems: The use of subsystems as building blocks is basic to analysis and development. This requires an understanding of the principles, which dictate how systems are built from subsystems.

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(i) Decomposition : A complex system is difficult to comprehend when considered as a whole. Therefore the system is decomposed or factored into subsystems. The boundaries and interfaces are defined, so that the sum of the subsystems constitutes the entire system. This process of decomposition is continued with subsystems divided into smaller subsystems until the smallest subsystems are of manageable size. The subsystems resulting from this process generally form hierarchical structures (Fig. 1.5.2). In the hierarchy, a subsystem is one element of supra-system (the system above it).

Decomposition into subsystems is used to analyze an existing system and to design and implement a new system. In both cases, the investigator or designer must decide how to factor, i.e., where to draw the boundaries. The decisions will depend on the objectives of the decomposition and also on individual differences among designers, the latter should be minimized.

An example of decomposition is the factoring of an information processing system into subsystems. One approach to decomposition might proceed as follows:

1. Information system divided into subsystem such as :
   a. Sales and order entry
   b. Inventory
   c. Production
   d. Personnel and payroll
   e. Purchasing
   f. Accounting and control
   g. Planning
   h. Environmental intelligence

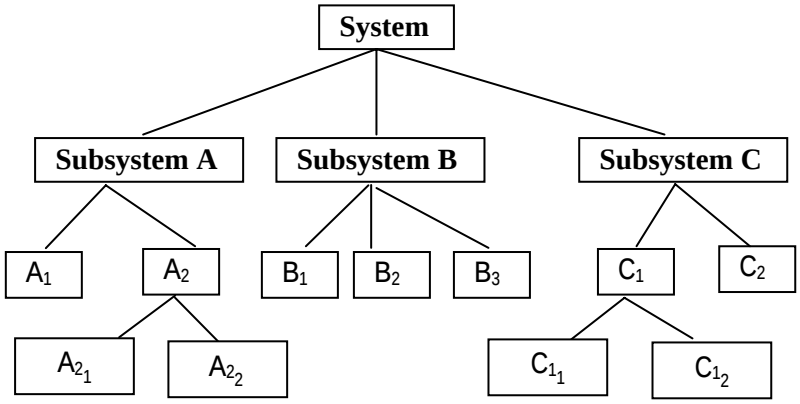

Fig. 1.5.2 : Hierarchical Relations of Subsystems

2. Each subsystem is divided further into subsystems. For example, the personnel and payroll subsystem might be divided into the following smaller subsystems:
   a. Creation and update of personnel pay-roll records

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b. Personnel reports

c. Payroll data entry and validation

d. Hourly payroll processing

e. Salaried payroll processing

f. Payroll reports for management

g. Payroll reports for government

3. If the task is to design and program a new system, the subsystems (major applications) defined in (2) might be further subdivided into smaller subsystems or modules. For example, the hourly payroll processing subsystem might be factored into modules for the calculation of deductions and net pay, payroll register and audit controls preparation, cheque printing, and register and controls output (Fig. 1.5.3).

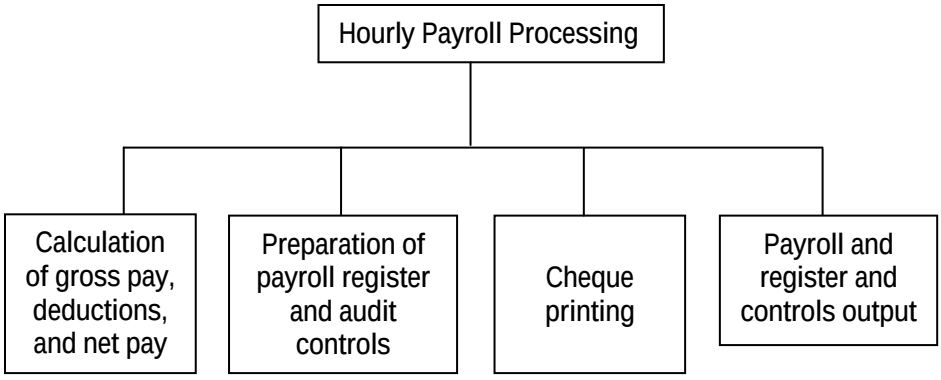

Fig. 1.5.3 : Hourly Payroll Processing Subsystem

(ii) Simplification : Simplification is defined as the process of organizing subsystems so as to reduce the number of interconnections, which is a potential interface for communication among subsystems. The number of interconnections if all the subsystems interact is in general 1/2n(n-1), where n is the number of subsystems.

(iii) Decoupling : If two different subsystems are connected very tightly, very close coordination between them is required. For example, if the raw material is put directly into production the moment it arrives at the factory, the raw materials system can be said to be tightly couple. Under these conditions, raw material delivery (input to production system and output from raw material system) must be precisely timed in order to avoid delays in production or to prevent new material from arriving too soon with no place to be stored.

- Inventories, buffer, or waiting lines : In the example of the raw material subsystem and production subsystem, a raw material inventory allows the two subsystems to operate somewhat independently (in the short run). Data buffers are used in some computer systems and some communications systems to compensate for different rates of input and output of data.

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- Slack and Flexible resources : When the output of one subsystem is the input to another, the existence of slack resources allows subsystems to be some what independent and yet allows each to respond to the demands of the other subsystem. For example, most data processing systems can provide an extra report or extra analysis because they have slack resources. The ability of an organization to respond can be employed for a variety of purposes. An information systems organization that uses the concept of a combination of systems analyst - programming that an organization with the same number of personnel that uses systems analysts and programming than an organization with the same number of personnel that uses systems analysts only for analysis and design and programmers only for programming.
- Standards : Standard allow a subsystem to plan and organize with reduced need to communicate with other subsystems. If, for example, the production department wishes to design a data processing module involving finished goods and a standard product code is used throughout the organization, there is no need to communicate negotiate with other departments about the codes to be used. A standard decoupling mechanisms to reduce to reduce need for communication and close connection among database description maintained by the data administrator (the data dictionary) allows use of the database without tedious and time-consuming checking with other subsystems also using the database.

1.5.4 Supra-System : A Supra-System refers to the entity formed by a system and other equivalent systems with which it interacts. For example, an organization may be subdivided into numerous functional areas such as marketing, finance, manufacturing, research and development, and so on. Each of these functional areas can be viewed as a subsystem of a larger organizational system because each could be considered to be a system in and of itself. For example, marketing may be viewed as a system that consists of elements such as market research, advertising, sales, and so on. Collectively, these elements in the marketing area may be viewed as making up the marketing Supra-System. Similarly the various functional areas (subsystems) of an organization are elements in the same supra- system within the organization.

1.5.5 System Stress and System Change : Systems whether living or artificial systems like organizational systems, information systems, change because they undergo stress. A stress is a force transmitted by a system's supra-system that causes a system to change, so that the supra-system can better achieve its goals. In trying to accommodate the stress, the system may impose stress on its subsystems and so on.

When a supra-system exerts stress on a system, the system will change to accommodate the stress, or it will become pathological; that ism it will decay and terminate.

A Supra-system enforces compliance by the system through its control over the supply of resources and information input to the system. If the system does not accommodate the stress the supra-system decreases or terminates the supply of matter energy and information input to the system. If the system does not accommodate the stress, the supra-system decreases or terminates the supply of matter energy and information input.

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Systems accommodate stress through a change in the form; there can be structural changes or process changes. For example - a computer system under stress for more share-ability of data may be changed through the installation of terminals in remote locations - a structural change. Demands for greater efficiency may be met by changing the way in which it sorts the data - a process change.

1.6 Information

Information is data that have been put into a meaningful and useful context. It has been defined by Davis and Olson as - "Information is data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or progressive decision". For example, data regarding sales by various salesmen can be merged to provide information regarding total sales through sales personnel. This information is of vital importance to a marketing manager who is trying to plan for future sales.

The term "data" and 'information' are often used interchangeably. However, the relation of data to information is that of raw material to finished product. A data processing system processes data to generate information on which business decisions are based. Therefore, the quality of information determines the quality of action or decision. The management plays the part of converting the information into action through the familiar process of decision-making. Therefore, Information plays a vital role in the survival of a business.

1.6.1 Attributes of Information : Some of the important attributes of useful and effective information are as follows :

(i) Availability : Availability or Timeliness is a very important property of information. If information is not available at the time of need, it is useless. Data is organized in the form of facts and figures in databases and files from where various information is derived for useful purpose.

(ii) Purpose : Information must have purposes at the time it is transmitted to a person or machine, otherwise it is simple data. Information communicated to people has a variety of purposes because of the variety of activities performed by them in business organizations. The basic purpose of information is to inform, evaluate, persuade, and organize.

It helps in creating new concepts, identifying problems, solving problems, decision making, planning, initiating, and controlling. These are just some of the purposes to which information is directed to human activity in business organizations.

(iii) Mode and format : The modes of communicating information to humans are sensory (through sight, hear, taste, touch and smell) but in business they are either visual, verbal or in written form.

Format of information should be so designed that it assists in decision making, solving problems, initiating planning, controlling and searching. Therefore, all the statistical rules of compiling statistical tables and presenting information by means of diagram, graphs, curves, etc., should be considered. Format of information dissemination is a matter of imagination and perception. It should be simple, relevant and should highlight important points but should not be too cluttered up.

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(iv) Decay : Value of information usually decays with time and usage and so it should be refreshed from time to time. For example, we access the running score sheet of a cricket match through Internet sites and this score sheet is continually refreshed at a fixed interval or based on status of the state. Similarly, in highly fluctuating share market a broker is always interested about the latest information of a particular stock/s.

(v) Rate : The rate of transmission/reception of information may be represented by the time required to understand a particular situation. A useful information is the one which is transmitted at a rate which matches with the rate at which the recipient wants to receive, Quantitatively, the rate for humans may be measure by the number of numeric characters transmitted per minute, such as sales reports from a district office. For machines the rate may be based on the number of bits of information per character (sign) per unit of time.

(vi) Frequency : The frequency with which information is transmitted or received affects its value. Financial reports prepared weekly may show so little changes that they have small value, whereas monthly reports may indicate changes big enough to show problems or trends.

(vii) Completeness : The information should be as complete as possible. For example - Hartz's model for investment decisions provides information on mean, standard deviation and the shape of the distribution of ROI and NPV. With this complete information, the manager is in a much better position to decide whether or not to undertake the venture.

(viii) Reliability : It is just not authenticity or correctness of information; rather technically it is a measure of failure or success of using information for decision-making. If an information leads to correct decision on many occasions, we say the information is reliable.

(ix) Validity : It measures the closeness of the information to the purpose which it purports to serve. For example, some productivity measure may not measure, for the given situation, what they are supposed to do e.g., the real rise or fall in productivity. The measure suiting the organization may have to be carefully selected or evolved.

(x) Quality : Quality refers to the correctness of information. Information is likely to be spoiled by personal bias. For example, an over-optimistic salesman may give rather too high estimates of the sales. This problem, however, can be circumvented by maintaining records of salesman's estimates and actual sales and deflating or inflating the estimates in the light of this.

(xi) Transparency : If information does not reveal directly what we want to know for decision-making, it is not transparent. For example, total amount of advance does not give true picture of utilization of fund for decision about future course of action; rather deposit-advance ratio is perhaps more transparent information in this matter.

(xii) Value of information : It is defined as difference between the value of the change in decision behavior caused by the information and the cost of the information. In other words, given a set of possible decisions, a decision-maker may select one on basis of the information at hand. If new information causes a different decision to be made, the value of the new information is the difference in value between the outcome of the old decision and that of the new decision, less the cost of obtaining the information.

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(xiii) Adequacy : To be useful, an information must be adequate so that the desired actions can be initiated. Required information should flow on different directions within the organization and to and from its environment. Further, the type of information that flows within the organization or across, it should have adequate and relevant contents.

1.6.2 Types of Information: Information, broadly, can be divided into two different types : Internal Information and External Information in the context of business organizations.

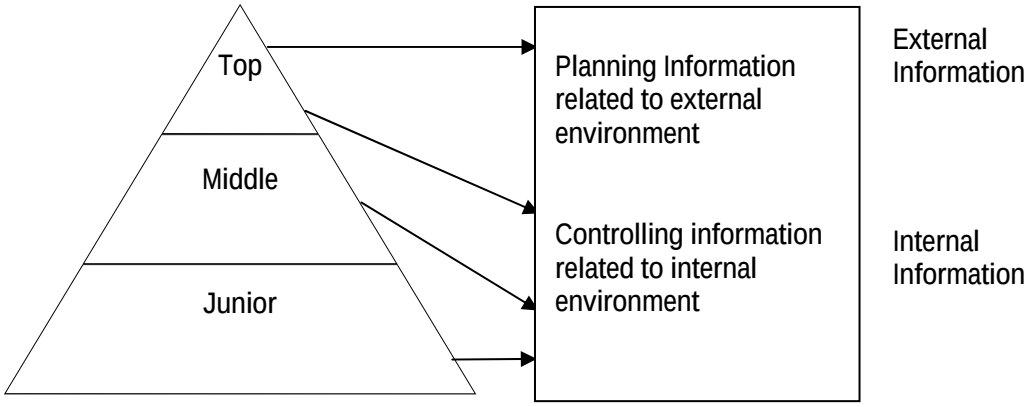

Fig. 1.6.1 : External and Internal Information

Internal information : The internal information can be defined as an information that has been generated from the operations of the organization at various functional areas. The internal information gets processed and summarized from junior to top most level of management. The internal information always pertains to the various operational units of the organization. Examples of internal information would be production figures, sales figures, information about personnel, accounts, material etc.

External information : The external information is collected from the external environment of the business organization. External information is considered to affect the organizational performance from outside the organization.

For example - Information such as Govt. policies, competition, economic status etc. are considered to be external information. Access to internal and external information by different levels of management is shown in Fig. 1.6.1.

1.7 Information System and its Role in Management

An Information System can be considered as an arrangement of a number of elements that provides effective information for decision-making and/or control of some functionalities of an organization. Information is an entity that reduces uncertainty about an event or situation. For example, correct information about demand of products in the market will reduce the uncertainty of production schedule. Enterprises use information system to reduce costs, control wastes or generate revenue. Computer Based Information System are complementary

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networks of hardware/software that people and organizations use to collect, fitter, process, create and distribute data. Hence onwards, the chapter focuses only to CBIS.

In modern business perspective, the information system has far reaching effects for smooth and efficient operations. Some of important implications of information system in business are as follows:

- Information system helps managers in effective decision-making to achieve the organizational goal.
- Based on well-designed Information system, an organization will gain edge in the competitive environment.
- Information systems help take right decision at the right time.
- Innovative ideas for solving critical problems may come out from good Information system.
- Knowledge gathered though Information system may be utilized by managers in unusual situations.
- Information system is viewed as a process, it can be integrated to formulate a strategy of action or operation.

1.7.1 Factors on which Information Requirements Depend : The factors on which information requirements of executives depend are as follows :

1. Operational function
2. Type of decision making
3. Level of management activity

(1) Operational function : The grouping or clustering of several functional units on the basis of related activities into a sub-systems is termed as Operational function. For example, in a business enterprise, marketing is an operational function, as it is the clustering of several functional units like market research, advertising, sales analysis and so on. Likewise, production finance, personnel etc. can all be considered as operational functions.

Information requirement depends upon operational function. The information requirement of different operational functions vary not only in content but also in characteristics. In fact, the content of information depends upon the activities performed under an operational function. For example, in the case of production, the information required may be about the production targets to be achieved, resources available and so on. Whereas in the case of marketing functions, the content of information may be about the consumer behavior, new product impact in the market etc.

(2) Type of decision making : Organizational decisions can be categorized as Programmed and Non-programmed ones.

Programmed Decisions : Programmed decisions or structured decisions refer to decisions made on problems and situations by reference to a predetermined set of precedents, procedures, techniques and rules. These are well-structured in advance and are time-tested

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for their validity. As a problem or issue for decision-making emerges, the relevant pre-decided rule or procedure is applied to arrive at the decision. For example, in many organizations, there is a set procedure for receipt of materials, payment of bills, employment of clerical personnel, release of budgeted funds, and so on.

Programmed decisions are made with respect to familiar, routine, recurring problems which are amenable for structured solution by application of known and well-defined operating procedures and processes. Not much judgment and discretion is needed in finding solutions to such problems. It is a matter of identifying the problem and applying the rule, thus simplifying the process of decision making.

Non-programmed Decisions : Non-programmed decisions or unstructured decisions are those which are made on situations and problems which are novel and non-repetitive and about which not much knowledge and information are available. They are non-programmed in the sense that they are made not by reference to any pre-determined guidelines, standard operating procedures, precedents and rules but by application of managerial intelligence, experience, judgment and vision to tackling problems and situations, which arise infrequently and about which not much is known. There is no simple or single best way of making decisions on unstructured problems, which change their character from time to time, which are surrounded by uncertainty and enigma and which defy quick understanding. Solutions and decisions on them tend to be unique or unusual. For example - problems such as a sudden major change in government policy badly affecting a particular industry, the departure of a top level key executive, drastic decline in demand for a particular high profile product, competitive rivalry from a previously little known manufacturer etc. do not have ready-made solutions.

(3) Level of management activity : Different levels of management activities in management planning and control hierarchy are Strategic level, Tactical level and Operational level.

- Strategic Level or Top level : Strategic level management is concerned with the developing of organizational mission, objectives and strategies. Decisions made at this level of organization in order to handle problems critical to the survival and success of the organization are called Strategic Decisions. They have a vital impact on the direction and functioning of the organization. For example - decisions on plant location, introduction of new products, making major new fund-raising and investment operations, adoption of new technology, acquisition of outside enterprises and so on go into making strategic decisions.
- Tactical Level or Middle level : Tactical level lies in middle of managerial hierarchy where managers plan, organize, lead and control the activities of other managers. Decisions made at this level called the Tactical decisions (which are also called operational decisions) are made to implement strategic decisions. A single strategic decision calls for a series of tactical decisions, which are of a relatively structured nature. Tactical decisions are relatively short, step-like spot solutions to breakdown strategic decisions into implemental packages. Tactical decisions are specific and functional; made in a relatively closed setting; more easily available and digestible; and less surrounded by uncertainty and complexity.

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- Operational level or Supervisory Level : This is the lowest level in managerial hierarchy wherein the managers coordinate the work of others who are not themselves managers. They ensure that specific tasks are carried out effectively and efficiently.

1.7.2 Components of Computer Based Information System

A Computer-based Information System (CBIS) is an information system in which the computer plays a major role. Such a system consists of the following elements as shown in Fig 1.7.1.

Hardware : The term hardware refers to machinery including the computer itself, which is often referred as Central Processing Unit (CPU) and all of its support equipment. Among the support equipment are input and output devices, storage devices, and communications devices.

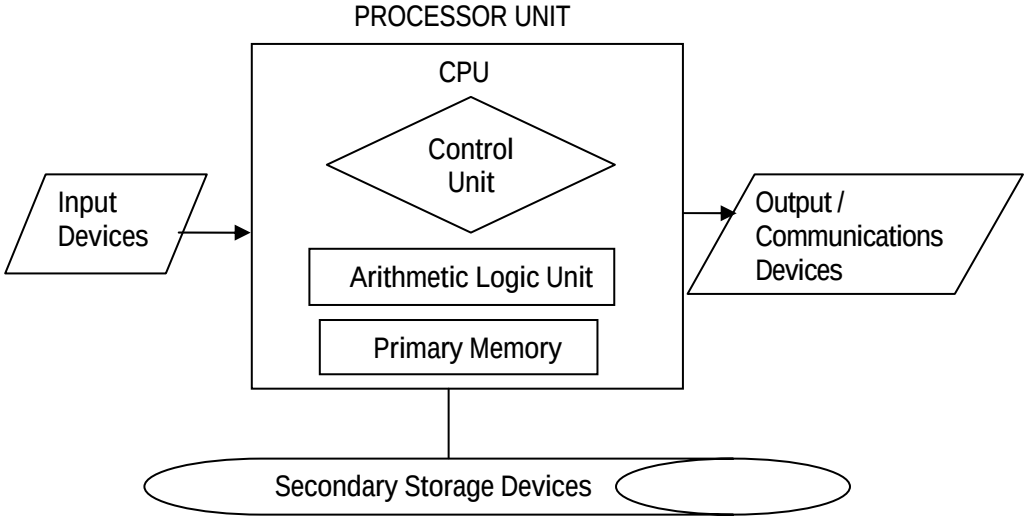

Fig 1.7.1 : The Hardware Components of CBIS

Software : The term software refers to the computer programs and the manuals (if any) that support them. Computer programs are machine-readable instructions that direct the circuitry within the hardware parts of the CBIS to function in ways that produce useful information from data.

Data : Data are facts that are used by programs to produce useful information. Like programs, data are generally stored in machine-readable form on disk or tape until the computer needs them.

Procedures : Procedures are the policies that govern the operation of a computer system. For instance, the steps that must be taken to enter a password and log onto computer terminal are a procedure. The actions needed to restore the computer system to its operational state after a major failure are another example of a procedure. Procedures often specify the actions that people should take in a step-by-step manner.

People : Every CBIS needs people if it is to be made useful. People are probably the components that influence the success or failure of information systems the most. Users,

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programmers, system analysts, and database administrators are just some of the people associated with the computer-based information systems.

Some of the characteristics of Computer Based Information Systems are as follows:

1) All systems work for predetermined objectives and the system is designed and developed accordingly.

2) In general, a system has a number of interrelated and interdependent subsystems or components. No subsystem can function in isolation; it depends on other subsystems for its inputs.

3) If one subsystem or component of a system fails, in most cases the whole system does not work. However, it depends on how the subsystems are interrelated.

4) The way a subsystem works with another subsystem is called interaction. The different subsystems interact with each other to achieve the goal of the system

5) The work done by individual subsystems is integrated to achieve the central goal of the system. The goal of individual subsystem is of lower priority than the goal of the entire system.

Major areas of computer-based applications are finance and accounting, marketing and sales, manufacturing, inventory/stock management, human resource management etc.

- Finance and Accounting: The main goal of this subsystem (considering Business functions as whole system) is to ensure financial viability of the organization, enforce financial discipline and plan and monitor the financial budget. Also it helps forecasting revenues, determining the best resources and uses of funds and managing other financial resources. Typical sub-application areas in finance and accounting are - Financial accounting; General ledger; Accounts receivable/payable; Asset accounting; Investment management; Cash management; Treasury management; Fund management and Balance sheet.

- Marketing and Sales :Marketing and sales activities have great importance in running a business successfully in a competitive environment. The objective of this subsystem is to maximize sales and ensure customer satisfaction. The marketing system facilitates the chances of order procurement by marketing the products of the company, creating new customers and advertising the products.

  The sales department may use an order processing system to keep status and track of orders, generate bills for the orders executed and delivered to the customer, strategies for rendering services during warranty period and beyond, analyzing the sales data by category such as by region, product, salesman or sales value. The system may also be used to compute commissions for dealers or salesmen and thus helps the corporate managers to take decisions in many crucial areas.

- Production or Manufacturing : The objective of this subsystem is to optimally deploy man, machine and material to maximize production or service. The system generates production schedules and schedules of material requirements, monitors the product

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quality, plans for replacement or overhauling the machinery and also helps in overhead cost control and waste control.

- Inventory /Stores Management : The inventory management system is designed with a view to keeping track of materials in the stores. The system is used to regulate the maximum and minimum level of stocks, raise alarm at danger level stock of any material, give timely alert for re-ordering of materials with optimal re-order quantity and facilitate various queries about inventory like total inventory value at any time, identification of important items in terms stock value (ABC analysis), identification most frequently moving items (XYZ analysis) etc.

  Similarly well-designed inventory management system for finished goods and semi-finished goods provides important information for production schedule and marketing/sales strategy.

- Human Resource Management: Human resource is the most valuable asset for an organization. Utilization of this resource in most effective and efficient way is an important function for any enterprise. Less disputes, right utilization of manpower and quiet environment in this functional area will ensure smooth sailing in business. Human resource management system aims to achieve this goal. Skill database maintained in HRM system, with details of qualifications, training, experience, interests etc helps management for allocating manpower to right activity at the time of need or starting a new project. This system also keeps track of employees' output or efficiency. Administrative functions like keeping track of leave records or handling other related functions are also included HRM system. An HRM system may have the following modules – Personnel administration; Recruitment management; Travel management; Benefit administration; Salary administration; Promotion management etc.

1.8 Types of Information Systems at Different Levels

It is a fact that much of management is primarily concerned with decision- making and so the importance of information system is further emphasized in this matter.

Management at different levels take decisions matching to their position or hierarchy in the organization and different types of information systems are designed and developed for them i.e. an information system for a departmental manager will be characteristically different from one designed for a corporate manager.

If we consider an organization having a pyramidal management structure with the corporate level managers at the top and operational managers at the bottom, typical categories of data are manipulated at different levels.

The Fig. 1.8.1 exhibits data available at different functional areas of an organization for management.

- At the lowest level, that is managed by operational level managers (like supervisor, section in-charge), all types of inputs available from various sources are collected. The routine office work, like maintaining inward register and public interaction are mostly

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done at this level. However, no decision-making process is carried out at this level. But proper organization of data for further processing is an important task to be completed at this level. So sufficiently trained manpower will be deployed at this stage.

- At the middle level of management the decision making-process starts. Inputs from different internal and external information sources are collected (normally passed from operational level managers) and processed for strategic decisions. Middle level managers who are expected to contribute significantly towards development of the organization will be the key personnel to carry out the processing activities of the strategic data. They will use various tools of analysis and typical software products to report to the higher level with options and possible effects.
- At the top level, the decisions are taken on the basis of the information passed from middle management.

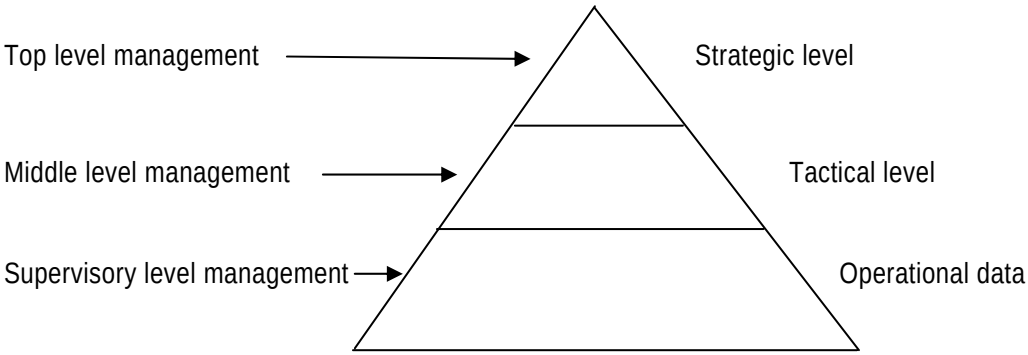

Fig. 1.8.1 : Information systems at different Levels

Primarily, Information systems can be classified into three broad categories upon their focus on the kind of activities in a business enterprise. These categories are shown in Fig. 1.8.2.

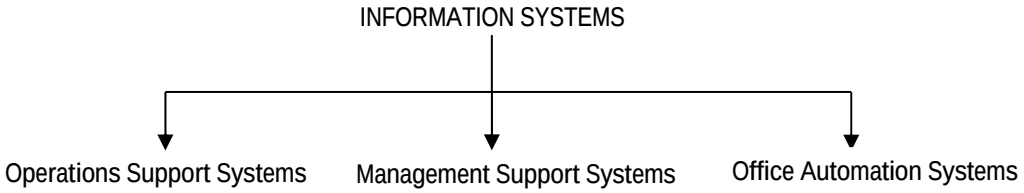

Fig. 1.8.2 : Categories of Information Systems

1.9 Operations Support Systems (OSS)

The objective of Operation Support System is to improve the operational efficiency of the enterprise. As these systems primarily are concerned with the operations, they use internal data primarily for managers at the lower levels. These are further classified into three categories:

– Transaction Processing Systems

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– Management Information Systems

– Enterprise Resource Planning Systems

1.9.1 Transaction Processing Systems (TPS): Transaction Processing System (TPS) at the lowest level of management is an information system that manipulates data from business transactions. Any business activity such as sales, purchase, production, delivery, payments or receipts involves transaction and these transactions are to be organized and manipulated to generate various information products for external use. For example, selling of a product to a customer will give rise to the need of further information like customer billing, inventory status and increase in account receivable balance. Transaction processing system will thus record and manipulate transaction data into usable information.

Typically, a TPS involves the following activities :

(i) Capturing data to organize in files or databases;

(ii) Processing of files / databases using application software;

(iii) Generating information in the form of reports;

(iv) Processing of queries from various quarters of the organization.

A TPS may follow periodic data preparation and batch processing (as in payroll application) or on-line processing (as in inventory control application). However in industries and business houses now-a-days on-line approach is preferred in many applications as it provides information with up-to-date status. However, the people involved in TPS usually are not in a position to take any management decision.

(I) TPS Components : The principal components of a TPS include inputs, processing, storage and outputs. The components or elements are part of both manual and computerized systems.

- Inputs : Source documents, such as customer orders, sales, slips, invoices, purchase orders, and employee time cards, are the physical evidence of inputs into the Transaction Processing System. They serve several purposes like - capturing data, facilitating operations by communicating data and authorizing another operation in the process, standardizing operations by indicating which data require recording and what actions need to be taken, and providing a permanent file for future analysis, if the documents are retained etc.
- Processing : This involves the use of journals and registers to provide a permanent and chronological record of inputs. Journals are used to record financial accounting transactions, and registers are used to record other types of data not directly related to accounting. Some of the more common special journals are – sales journal, purchase journal, cash receipts journal etc.
- Storage : Ledgers and files provide storage of data on both manual and computerized systems. The general ledger, the accounts/vouchers payable ledgers,

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and the accounts receivable ledger are the records of final account that provide summaries of a firm's financial accounting transactions.

- Outputs : Any document generated in the system is output. Some documents are both output and input. For example - a customer invoice is an output from the order-entry application system and also and input document to the customer. The trial balance lists the balances of all the accounts on the gametal ledger and tests the accuracy of the record keeping. Financial reports summarize the results of transaction processing and express these results in accordance with the principles of financial reporting.

(II) Features of TPS

(i) Large volume of data : As TPS is transaction – oriented, it generally consists large volumes of data and thus require greater storage capacity. Their major concern is to ensure that the data regarding the economic events in the organizations are captured quickly and correctly.

(ii) Automation of basic operations : Any TPS aims at automating the basic operations of a business enterprise and plays a critical role in the day-to-day functioning of the enterprise. Any failure in the TPS for a short period of time can play havoc with the functioning of the enterprise. Thus, TPS is an important source of up-to-date information regarding the operations in the enterprise.

(iii) Benefits are easily measurable : TPS reduces the workload of the people associated with the operations and improves their efficiency by automating some of the operations. Most of these benefits of the TPS are tangible and easily measurable. Therefore, cost benefit analysis regarding the desirability of TPS is easy to conduct. As the benefits from TPS are mainly tangible, the user acceptance is easy to obtain.

(iv) Source of input for other systems : TPS is the basic source of internal information for other information systems. Heavy reliance by other information systems on TPS for this purpose makes TPS important for tactical and strategic decisions as well.

1.9.2 Management Information Systems (MIS) : Management Information Systems (MIS) assist managers in decision making and problem solving in contract to TPS, which is operations oriented. They use results produced by the TPS, but they may also use other information. In any organization, decisions must be made on many issues that recur regularly and require a certain amount of information. Because the decision making process is well understood, the manager can identify the information that will be needed for the purpose. In turn, the information systems can be developed so that reports are prepared regularly to support these recurring decisions.

(I) Definition of Management Information System (MIS) : Many experts have defined MIS in different languages. A Management Information System has been defined by Davis and Olson as "An integrated user-machine system designed for providing information to

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support operational control, management control and decision making functions in an organization".

The information system makes use of resources such as hardware, software, personnel, procedure and supplies as well. MIS is designed to provide accurate, relevant and timely information to managers at different levels and in different functional areas throughout the

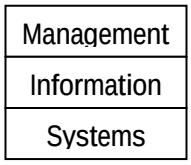

Fig. 1.9.1 : MIS Components

organization for decision-making purpose. MIS support the managers at different levels to take strategic (at top level) or tactical (at middle level) management decisions to fulfill the organizational goals. Nature of MIS at different levels has different flavors and they are available in the form of reports, tables, graphs and charts or in presentation format using some tools. MIS at the top level is much more comprehensive and condensed or summarized compared to that existing in the middle level management. In order to understand MIS, its constituent components (Fig. 1.9.1) must be well understood.

Management : A manager may be required to perform following activities in an organization:

(i) Determination of organizational objectives and developing plans to achieve them.

(ii) Securing and organizing the human and physical resources so that these objectives could be accomplished.

(iii) Exercising adequate controls over the functions.

(iv) Monitoring the results to ensure that accomplishments are proceeding according to plan.

Thus, management comprises the processes or activities that describe what managers do in the operation of their organization : plan, organize, initiate, and control operations. In other words, Management refers to a set of functions and processes designed to initiate and co-ordinate group efforts in an organized setting directed towards promotion of certain interest, preserving certain values and pursuing certain goals. It involves mobilization, combination, allocation and utilization of physical, human and other needed resources in a judicious manner by employing appropriate skills, approaches and techniques.

Information (as referred to MIS) : Information could be defined as sets of facts, figures and symbols processed for the current decision-making situation. The information is considered to be of significance in a particular situation.

System : A system is defined as a set of related components, activities, process and human beings interacting together so as to accomplish some common objective.

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Putting all these three components together, MIS can be defined as set of related processes, activities individuals or entities interacting together to provide processed data to managers at various levels and functional areas.

The functions of MIS can be shown with the help of Fig. 1.9.2. For example, in a competitive market for products manufactured by an enterprise, its management needs information on the pricing policy of the competitors, specially of competing products, sales techniques etc., to effectively combat the effect of the competition.

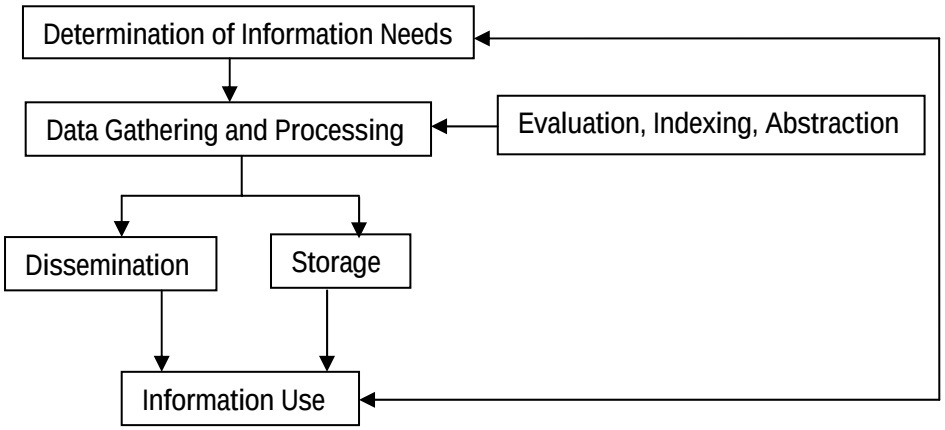

Fig. 1.9.2 : Functions of MIS

(II) Characteristics of an effective MIS : Some of the important characteristic for an effective MIS are eight in number and are briefly discussed below:

(i) Management Oriented : It means that effort for the development of the information system should start from an appraisal of management needs and overall business objectives. Such a system is not necessarily for top management only, it may also meet the information requirements of middle level or operating levels of management as well.

(ii) Management Directed : Because of management orientation of MIS, it is necessary that management should actively direct the system's development efforts. For system's effectiveness, it is necessary for management to devote their sufficient time not only at the stage of designing the system but for its review as well to ensure that the implemented system meets the specifications of the designed system.

(iii) Integrated : Development of information should be an integrated one which 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 by taking a comprehensive view or a complete look at the inter locking sub-systems that operate within a company.

(iv) Common Data Flows : It means the use of common input, processing and output procedures and media whenever required. Data is captured by system analysts only once and as close to its original source as possible. They, then, try to utilize a minimum of data processing procedures and sub-systems to process the data and strive to

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minimize the number of output documents and reports produced by the system. This eliminates duplication in data collections, simplifies operations and produces an efficient information system.

(v) Heavy Planning Element : An MIS usually takes 3 to 5 years and sometimes even longer period to get established firmly within a company. Therefore, a MIS designer must be present in MIS development who should keep in view future objectives and requirements of firm's information in mind.

(vi) Sub System Concept : Even though the information system is viewed as a single entity, it must be broken down into digestible sub-systems which can be implemented one at a time by developing a phasing plan. The breaking down of MIS into meaningful sub-systems sets the stage for this phasing plan.

(vii) Common Database : Database is the mortar that holds the functional systems together. It is defined as a "super-file" which consolidates and integrates data records formerly stored in many separate data files. The organization of a database allows it to be accessed by several information sub-systems and thus, eliminates the necessity of duplication in data storage, updating, deletion and protection.

(viii) Computerized : Though MIS can be implemented without using a computer, the use of computers increases the effectiveness of the system. In fact, its use equip the system to handle a wide variety of applications by providing their information requirements quickly. Other necessary attributes of the computer to MIS are accuracy and consistency in processing data and reduction in clerical staff. These attributes make computer a prime requirement in management information system.

(III) Misconceptions about MIS : Some of the myths about MIS are as follows :

(i) The study of MIS is about the use of computers. This statement is not true. MIS may or may not be computer based, computer is just a tool, just like any other machine. Installing a MIS depends largely on several factors such as – how critical is the response time required for getting an information; how big is the organization; and how complex are the needs of the information processing.

(ii) More data in reports means more information for managers. This is a misapprehension. It is not the quantity of data, but its relevance, which is important to managers in process of decision-making. Data provided in reports should meet information requirements of managers. It is the form of data and its manner of presentation that is of importance to business managers. Unorganized mass of data creates confusion.

(iii) Accuracy in reporting is of vital importance. The popular belief is that accuracy in reporting should be of high order. At the operating level, it is true. Other examples, where accuracy is really important, can be the dispensing of medicine; the control of aircraft; the design of a bridge etc. Accuracy, however, is a relevant but not an absolute ideal. Higher levels of accuracy involve higher cost. At higher decision levels, great accuracy may not be required. The degree of accuracy is closely related to the decision problem. Higher management is concerned with broad decisions on principles and objectives. A fairly correct presentation of relevant data often is adequate for top

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management decisions. For a decision on a new project proposal, top management is not interested in knowing the project cost in precise rupee terms. A project cost estimated at a fairly correct figure is all what it wants.

(IV) Pre-requisites of an effective MIS : The main pre-requisites of an effective MIS are as follows :

(i) Database : It can be defined as a "super-file" which consolidates data records formerly stored in many data files. The data in database is organized in such a way that access to the data is improved and redundancy is reduced. Normally, the database is sub-divided into the major information sub-sets needed to run a business. The main characteristic of database is that each sub-system utilizes same data and information kept in the same file to satisfy its information needs. The other important characteristics of database are as follows :

- It is user–oriented.
- It is capable of being used as a common data source, to various users, helps in avoiding duplication of efforts in storage and retrieval of data and information.
- It is available to authorized persons only.
- It is controlled by a separate authority established for the purpose, known as Data Base Management System (DBMS).

The maintenance of data in database requires computer hardware, software and experienced computer professionals. In addition, it requires a good data collection system equipped with experts having first-hand knowledge of the operations of the company and its information needs.

(ii) Qualified system and management staff : The second pre-requisite of effective MIS is that it should be manned by qualified officers. These officers who are expert in the field should understand clearly the views of their fellow officers. For this, the organizational management base should comprise of two categories of officers Systems and Computer experts and Management experts.

- Systems and Computer experts in addition to their expertise in their subject area should also be capable of understanding management concepts to facilitate the understanding of problems faced by the concern. They should also be clear about the process of decision making and information requirements for planning and control functions.
- Management experts should also understand quite clearly the concepts and operations of a computer. This basic knowledge of computers will be useful to place them in a comfortable position, while working with systems technicians in designing or otherwise of the information system.

(iii) Support of Top Management : The management information system to become effective, should receive the full support of top management. The reasons for this are as follows :

- Subordinate managers are usually lethargic about activities, which do not receive the support of their superiors (top management).

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- The resources involved in computer-based information systems are large and are growing larger in view of importance gained by management information system.

To gain the support of top management, the officers should place before top management all the supporting facts and state clearly the benefits, which will accrue from it to the concern. This step will certainly enlighten management, and will change their attitude towards MIS. Their wholehearted support and cooperation will help in making MIS an effective one.

(iv) Control and maintenance of MIS : Control of the MIS means the operation of the system as it was designed to operate. Some time, users develop their own procedures or short cut methods to use the system, which reduce its effectiveness. To check such habits of users, the management at each level in the organization should devise checks for the information system control.

Maintenance is closely related to control. There are times when the need for improvements to the system will be discovered. Formal methods for changing and documenting changes must be provided.

(v) Evaluation of MIS : An effective MIS should be capable of meeting the information requirements of its executives in future as well. This capability can be maintained by evaluating the MIS and taking appropriate timely action. The evaluation of MIS should take into account the following points.

- Examining whether enough flexibility exists in the system, to cope with any expected or unexpected information requirement in future.
- Ascertaining the views of users and the designers about the capabilities and deficiencies of the system.
- Guiding the appropriate authority about the steps to be taken to maintain effectiveness of MIS.

(V) Constraints in operating a MIS : Major constraints which come in the way of operating an information system are the following :

(i) Non-availability of experts, who can diagnose the objectives of the organization and provide a desired direction for installing and operating system. This problem may be overcome by grooming internal staff, which should be preceded by proper selection and training.

(ii) Experts usually face the problem of selecting the sub-system of MIS to be installed and operated upon. The criteria, which should guide the experts depend upon the need and importance of a function for which MIS can be installed first.

(iii) Due to varied objectives of business concerns, the approach adopted by experts for designing and implementing MIS is a non-standardized one.

(iv) Non-availability of cooperation from staff is a crucial problem which should be handled tactfully. This task should be carried out by organizing lecturers, showing films and also explaining to them the utility of the system. Besides this, some persons should also be involved in the development and implementation of the system.

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(VI) Effects of using Computer for MIS : The effect of applying computer technology to information system can be listed as below :

(i) Speed of processing and retrieval of data increases : Modern business situations are characterized by high degree of complexity, keen competition and high risk and reward factors. This invariably calls for systems capable for providing relevant information with minimum loss of time. Manual systems, howsoever well organized, often fail to match the demand for information for decision making. Computer with its unbelievably fast computational capability and systematic storage of information with random access facility has accounted as a major factor in inducing MIS development.

(ii) 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. Computer is capable of providing various types of sales reports for example; area wise sales commission of each salesman, product-wise sales, etc. Which are quite useful in analyzing the sales department working and to ascertain their weaknesses so that adequate measures may be taken in time. In this way, the use of computer has widened the scope of analysis.

(iii) Complexity of system design and operation increased : The need for highly processed and sophisticated information based on multitudes of variables has made the designing of the system quite complex. The computer manufacturers have developed some important programs (software) that can perform the task of developing programs to cater to the specialized needs of their customers, either on consultancy basis or on contract.

(iv) Integrates the working of different information sub-system : A suitable structure of MIS may be a federation of information sub-system, viz., production, material, marketing, finance, engineering and personnel. Each of these sub-systems are required to provide information to support operational control, management control and strategic planning. Such information may be made available from a common-data-base that meet out the information requirements of different information sub-system by utilizing the services of computers for storing, processing, analyzing and providing such information as and when required.

(v) Increases the effectiveness of Information system : Information received in time is of immense value and importance to a concern. Prior to the use of computer technology for information purposes, it was difficult to provide the relevant information to business executives in time even after incurring huge expenses. But now with the use of computer technology, it is not difficult to provide timely, accurate and desired information for the purpose of decision making.

(vi) More comprehensive information : The use of computer for MIS enabled systems expert to provide more comprehensive information to executives on business matters.

(VII) Limitations of MIS : The main limitations of MIS are as follows :

(i) The quality of the outputs of MIS is basically governed by the quantity of input and processes.

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(ii) MIS is not a substitute for effective management which means that it cannot replace managerial judgment in making decisions in different functional areas. It is merely an important tool in the hands of executives for decision making and problem solving.

(iii) MIS may not have requisite flexibility to quickly update itself with the changing needs of time, especially in fast changing and complex environment.

(iv) MIS cannot provide tailor-made information packages suitable for the purpose of every type of decision made by executives.

(v) MIS takes into account mainly quantitative factors, thus it ignores the non-quantitative factors like morale and attitude of members of organization, which have an important bearing on the decision making process of executives.

(vi) MIS is less useful for making non-programmed decisions. Such type of decisions are not of the routine type and thus require information, which may not be available from existing MIS to executives.

(vii) The effectiveness of MIS is reduced in organizations, where the culture of hoarding information and not sharing with other holds.

(viii) MIS effectiveness decreases due to frequent changes in top management, organizational structure and operational team.

1.9.3 Enterprise Resource Planning (ERP) Systems : Enterprise Resource Planning (ERP) is one of the latest high-end solutions that seek to streamline and integrate operation processes and information flows in the company to synergize the five major resources of an organization namely men, money, machine, materials and market. Formally, ERP can be defined as follows :

"An ERP system is a fully integrated business management system that integrates the core business and management processes to provide an organization a structured environment in which decisions concerning demand, supply, operational, personnel, finance, logistics etc. are fully supported by accurate and reliable real-time information."

(I) Objectives : The major objectives of ERP are to

- provide support for adopting best business practices
- implement these practices with a view towards enhancing productivity and
- empower the customers and suppliers to modify the implemented business processes to suit their needs.

An ERP system integrates various business processes as shown in Fig. 1.9.3.

(a) Business System : It includes the following aspects - Business Forecasting for product/ market groups; Target fixing and allocation by key parameters; Strategy formulation and implementation; Resource allocation to key result areas; Strategy monitoring and control and Information-based management for management applications.

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(b) Production : It includes the following aspects - Production planning and control; Work processes; Purchasing and procurement system; Inventory management; Inventory analysis and valuation; Excise/ custom interface; and Production information systems for production applications.

(c) Maintenance : It includes the following aspects - Plant maintenance planning; Breakdown, preventive, and conditional maintenance; Maintenance management – initiation, execution, control and costing; Monitoring performance of maintenance action; Maintenance contract management; and Maintenance information systems for maintenance applications.

(d) Quality Control : It includes the following aspects - Quality assessment against standards; Quality assessment by process, materials, and work center location; Analysis of quality by reasons and actions taken; Building quality assurance data for equipment/process/ technology selection; Monitoring quality across the organization from input to output for operating decisions and business decisions; and Quality control information systems for quality control applications.

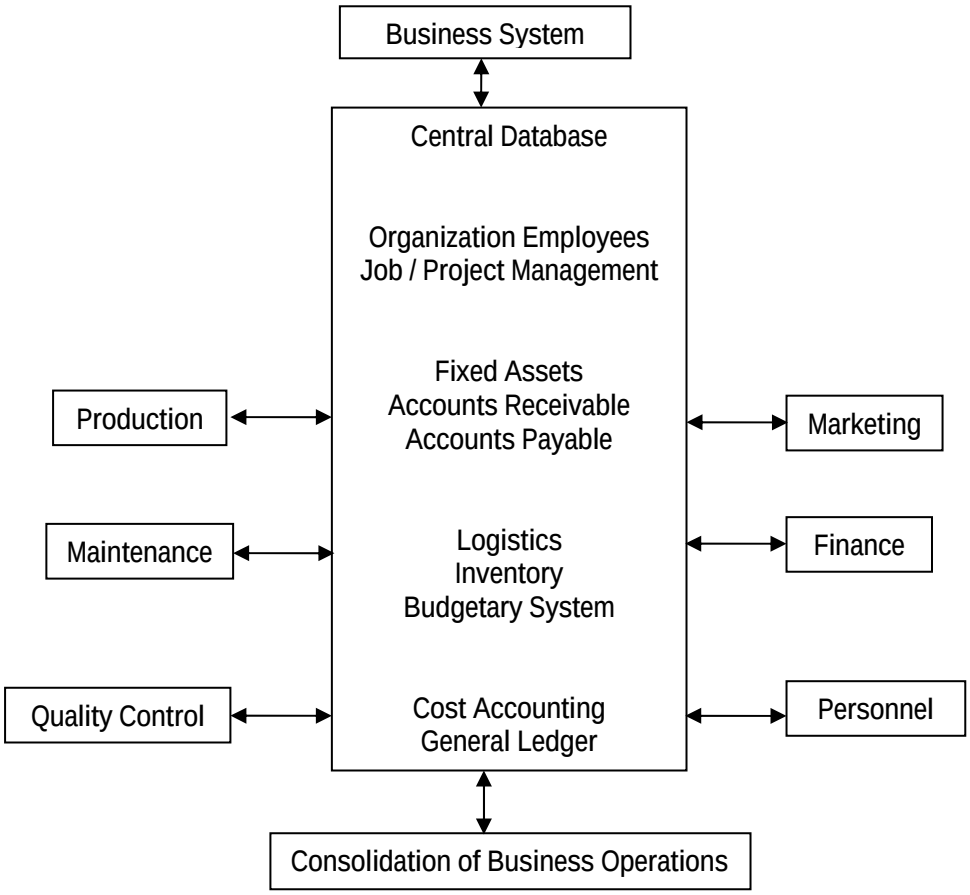

Fig. 1.9.3 : Enterprise Resource Planning Model

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(e) Marketing : It includes the following aspects - Market/customer/product analysis; Sales forecasting and budgeting; Marketing research information; Distribution and channel management; Order processing and analysis; Finished good store management; Dispatching and invoicing; Accounts receivable analysis and management; and Marketing information systems for marketing applications.

(f) Finance : It includes the following aspects - Financial planning and control; Management of long-term funds and working capital management; Ledgers, payables and receivables; Financial statement analysis; Cost accounting – cost center accounting and product / process costing; Cost analysis for management decisions; Tax management; Finance information systems for finance applications.

(g) Personnel : It includes the following aspects - Human resource planning, recruitment, and training; Employee performance appraisal and upgradation; Job evaluation and compensation management; Employee benefits and incentives; Employee health and safety; Disciplinary measures; Maintaining industrial peace; Personnel information systems for personnel applications.

(h) Consolidation of Business Operations : It includes the following aspects - Accounting by units and divisions with local focus; Consolidation by accounts in corporate functions; Comprehensive reporting systems for business decisions.

(II) Myths of ERP System : Some of the misconceptions about ERP System are as follows :

(i) There is a misconception that ERP is a computer system. Even though computers and Information technology are integral parts of an ERP system, ERP is primarily an enterprise-wide system which encompasses corporate mission; objectives; attitudes; beliefs; values; operating style; and people who make the organization.

(ii) There is a misconception that ERP is relevant for manufacturing organizations only. In contrast, ERP system is not limited to any particular industry segment but is relevant for all types of business activities which include manufacturing as well as services.

(III) Characteristics of ERP System : Some of the characteristics of ERP System are as follows :

(i) Flexible : ERP is a flexible system which may cover different languages, currencies, and accounting standards etc. Functions that comprehensively manage multiple locations of an organization can be packaged and implemented automatically.

(ii) Modular and Open : ERP system is modular and open which implies that any module can be interfaced or detached, whenever required, without affecting the other modules. It supports multiple hardware platforms for the organizations having heterogeneous collection of systems and also supports third party add-ons also by providing access to open database connectivity through the use of client/ server technology.

(iii) Integrated : ERP is an integrated system as it provides data automation – automatic data exchange among different applications - that takes place between related business components. The data of related business functions are automatically updated at the

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time a transaction occurs. Due to this feature, one is able to grasp business details in real time, and carry out various types of management decisions in a timely manner.

(iv) Best Business Practices : ERP aims at adopting best business practices applicable worldwide and imposes its own logic on an organization's strategy and its implementation. Best business practices available worldwide can also be adopted by an organization through benchmarking which is the process of identifying, understanding, and adapting outstanding practices from other organizations to help improve performance.

(IV) Features of ERP : Some of the major features of ERP and what ERP can do for the business system are as follows:

(i) ERP provides multi-platform, multi-facility, multi-code manufacturing, multi currency, and multi-lingual facilities.

(ii) It supports strategic and business planning activities, operational planning and execution activities and creation of resources. All these functions are effectively integrated for flow and updation of information immediately upon entry of any information.

(iii) It has end-to-end Supply Chain Management (SCM) to optimize the overall demand and supply of data.

(iv) It facilitates organization-wide integrated information system covering all functional areas like – production, marketing, finance and accounting and human resources.

(v) It performs core activities and increases customer service, thereby augmenting the corporate image.

(vi) It bridges the information gap across organizations.

(vii) It provides complete integration of system not only across departments but also across companies under the same management.

(viii) It allows automatic introduction of the latest technologies like electronic funds transfer (EFT), Electronic Data Interchange (EDI), Internet, Video conferencing, Electronic commerce (E-Commerce) etc.

(ix) It eliminates most of the business problems like material shortage, productivity enhancement, customer service, cash management, inventory management, quality management, prompt delivery etc.

It provides intelligent business tools like decision support systems, executive information systems, data mining and easy working systems to enable better decision making.

(V) Benefits of ERP : There are numerous benefits of ERP which can be categorized into following groups:

(i) Better use of Organizational Resources : ERP enables an organization to make better use of its resources which are scarce by their nature. Making better use of these resources is possible because ERP offers a model which indicates where the resources find best usage and how resources can be managed in that particular usage to produce

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the best result. Thus, through the application of ERP, organizational resources are put at a place where they have their optimum utilization.

(ii) Lower Operating Costs : ERP results into lower operating costs to the organization. Lowering operating costs is possible because of improved business performance through cycle time reduction, inventory reduction, order fulfillment improvement, increased business agility, etc. Lower operating costs mean improved profitability for the organization.

(iii) Proactive Decision Making : In today's competitive and dynamic environment, there is a need for proactive decision making rather than the reactive decision making. A proactive decision-making process emphasis that decisions must be made in advance of likely environmental changes and anticipated competitive moves by competitors.

(iv) Decentralized Decision Making : ERP enables an organization to decentralize its decision-making process. Thus, decisions are made at those points at which these are relevant for execution. Due to faster processing technology and structured query language (SQL), managers can see the information in their own perspective. Further, with intelligent ERP downloads, decisions can be made even at lower management levels. Thereby releasing the burden on higher management levels and freeing them for strategic thinking.

(v) Enhanced customer Satisfaction : To compete effectively in today's marketplace, organizations must focus on their customers. Customers have become increasingly aggressive in demanding quality and service because they have a wide range of choices. This requires organizations to define end-to-end approach for managing customers' requests. ERP provides the way for this in the form of efficient and effective processing of requests and emphasizing customer relationship management.

(vi) Flexibility in Business Operations : ERP provides flexibility in business operations, which is required to adjust according to environmental needs. In order to take care of changing needs , an organization has to design its business operations in such a way that enables these operations to change according to environmental needs. ERP provides flexibility in business operations because different languages, currencies, accounting standards, etc. cab be covered in one system.

(VI) Limitations of ERP : Though ERP system has many benefits, it has some limitations which are as follows :

(i) An ERP system provides current status only, such as open orders, Managers often need to look at past along with the current status to identify trends ad patterns that aid better decision making.

(ii) The methods used in the ERP applications are not integrated with other organizational or divisional systems. Further, they do not include external intelligence.

ERP packages are integrated software packages, covering all business finances that support the ERP operations. An ERP software is designed to model and automate many of the basic processes of a company with the objective of integrating information across the company.

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Some major ERP packages available in Indian market are as SAP, Oracle Applications, Ramco Marshals, eBPCs, Activera and Baan ERP.

1.10 Management Support Systems (MSS)

Management Support Systems (MSS) focus on the managerial uses of information resources and provide information to managers for planning and decision making. The information provided by these systems is based on both the internal and external data using various data analysis tools. There are three types of MSS, namely :

- Decision Support Systems (DSS)
- Executive Information (Support) System (EIS)
- Expert Systems

1.10.1 Decision Support Systems (DSS)

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

Typical information that a decision support application might gather and present would be

- an inventory of all the current information assets (including legacy and relational data sources, cubes, data warehouses, and data marts) of an organization;
- comparative sales figures between one week and the next,
- projected revenue figures based on new product sales assumptions;
- the consequences of different decision alternatives, given past experience in a context that is described.

In other words, a Decision Support System (DSS) can be defined as a system that provides tools to managers to assist them in solving semi-structured and unstructured problems in their own, somewhat personalized, way. A DSS is not intended to make decisions for managers, but rather to provide managers with a set of capabilities that enable them to generate the information required by them in making decisions. In other words, a DSS supports the human decision-making process, rather than providing a means to replace it.

Programmed Decision Systems : Systems that replace human decision making rather than support it are sometimes called Programmed Decision Systems. These systems are used to make routine, structured decisions, such as approving loans or credit, reordering inventory, triggering reminder notices, and selecting audit samples. In programmed decision systems, the focus is on doing something more efficiently, whereas in DSS, the focus is on helping decision makers become more effective.

(II) Characteristics of DSS : The DSS are characterized by at least three properties:

- They support semi-structured or unstructured decision-making.

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- They are flexible enough to respond to the changing needs of decision makers, and
- They are easy to use.

(i) Semi-structured and Unstructured Decisions : Structured decisions are those that are easily made from a given set of inputs. These types of decisions such as deciding to issue a reminder notice if a bill is overdue or deciding to sell a stock under a given set of market conditions can be programmed fairly easily. Unstructured decisions and semi-structured decisions, however, are decisions for which information obtained from a computer system is only a portion of the total knowledge needed to make the decision.

The DSS is particularly well adapted to help with semi-structured and unstructured decisions. However, it can be designed to support structured decision making as well. A manager, for instance, can browse through data at will (perhaps at a display terminal). When enough information is gathered from this process to supplement other information (perhaps some of it may be non computer-based), a decision can be reached.

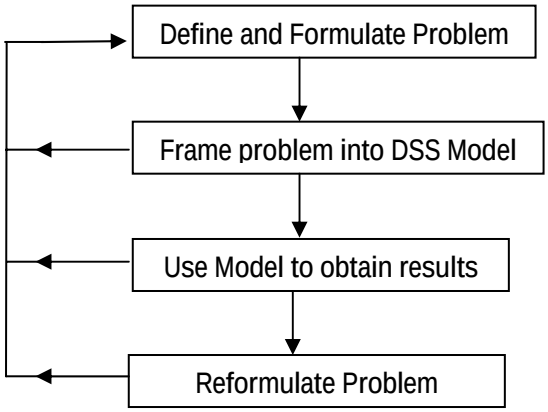

Fig. 1.10.1 : Steps in solving a problem with DSS

In Fig. 1.10.1, it is shown how a semi-structured problem might be solved by using a DSS.

- Firstly, the problem is defined and formulated.
- It is then modeled with DSS software.
- Next, the model is run on the computer to provide results. The modeler, in reviewing these results, might decide to completely reformulate the problem, refine the model, or use the model to obtain other results.

For example, a user might define a problem that involves simulating cash flows under a variety of business conditions by using financial modeling software. The DSS model is then run, providing results. Depending on what the results of the model indicate about cash flow, the user might decide to completely remodel the problem, make small modifications to the current model, run the model under a number of new assumptions, or accept the results. For instance, if the model revealed inadequate cash flows to

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support organizational operations, model modifications should be developed and run. The modification process might continue for several interactions until an acceptable cash flow is identified.

(ii) Flexibility to adapt to changing needs : Semi-structured and unstructured decisions often do not conform to a predefined set of decision-making rules. Because of this, their DSS must provide for enough flexibility to enable users to model their own information needs and should also be capable of adapting to changing information needs.

The DSS designer understands that managers usually do not know in advance what information they need and, even if they do, those information needs keep changing constantly. Thus, rather than locking the system into rigid information producing requirements, capabilities and tools are provided by DSS to enable users to meet their own output needs.

(iii) Ease of Learning and Use : Since DSS are often built and operated by users rather than by computer professionals, the tools that accompany them should be relatively easy to learn and use. Such software tools employ user-oriented interfaces such as grids, graphics, non-procedural fourth – generation languages (4GL), natural English, and easily read documentation, thus making it easier for users to conceptualize and perform the decision-making process.

(III) Components of DSS (see Fig. 1.10.2) A decision support system has four basic components listed below :

(i) The user : The user of a Decision Support System is usually a manager with an unstructured or semi-structured problem to solve. Manager and staff specialist (analyst) are the two broad classes of users. Typically, users do not need a computer background to use a decision support system for problem solving. The most important knowledge is a thorough understanding of the problem and the factors to be considered in finding a solution.

- Manager : These are the users who have basic computer knowledge and want the DSS to be very user friendly. The manager may be at any level of authority in the organization (e.g., either top management or operating management).
- Staff Specialist (Analysts) : These are the people who are more details oriented and willing to use complex system in their day to day work.

(ii) Databases : Decision Support Systems include one or more databases that contain both routine and non-routine data from both internal and external sources. The data from external sources include data about the operating environment surrounding an organization – for example, data about economic conditions, market demand for the organization's goods or services, and industry competition.

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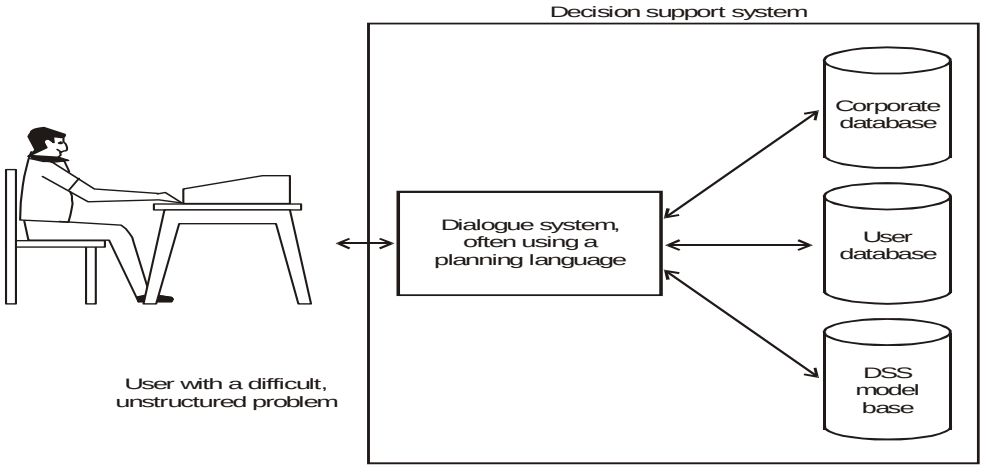

Fig. 1.10.2 : DSS Components

Decision Support System users may construct additional databases themselves. Some of the data may come from internal sources. An organization often generates this type of data in the normal course of operations – for example, data from the financial and managerial accounting systems such as account, transaction, and planning data. The database may also capture data from other subsystems such as marketing, production, and personnel. External data include assumptions about such variables as interest rates, vacancy rates, market prices, and levels of competition.

Implementation of Database : Database is implemented at three levels as listed below :

(a) Physical level : It involves the implementation of the database on the hard disk i.e. storage of data in the hard disk. The management of storage and access is controlled by operating system.

(b) Logical Level : It is designed by professional programs, who have complete knowledge of DBMS. It deals with the nature of data stored, the scheme of the data. Storage which is logically divided into various tables having rows and columns and the techniques for defining relationships with indexes.

(c) External level : The logical level defines schema which is divided into smaller units known as sub-schemas and given to the managers each sub-schema containing all relevant data needed by one manager.

(iii) Planning languages : Two types of planning languages that are commonly used in Decision Support Systems are – General-purpose planning languages and Special-purpose planning languages.

- General-purpose planning languages that allow users to perform many routine tasks – for example, retrieving various data from a database or performing statistical analyses. The languages in most electronic spreadsheets are good examples of general-purpose planning languages. These languages enable user to tackle a broad range of budgeting, forecasting, and other worksheet-oriented problems.

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- Special-purpose planning languages are more limited in what they can do, but they usually do certain jobs better than the general-purpose planning languages. Some statistical languages, such as SAS and SPSS, are examples of special purpose planning languages.

(iv) Model base : The planning language in a DSS allows the user to maintain a dialogue with the model base which is the "brain" of DSS because it performs data manipulations and computations with the data provided to it by the user and the database. There are many types of model bases, but most of them are custom-developed models that do some types of mathematical functions - for example, cross tabulation, regression analysis, time series analysis, linear programming and financial computations. The analysis provided by the routines in the model base is the key to supporting the user's decision.

(IV) Examples of Decision Support Systems in Accounting :Many DSS are developed in-house using either a general type of decision support program or a spreadsheet program to solve specific problems. Below are several illustrations of these systems.

- Cost Accounting System : The health care industry is well known for its cost complexity. Managing costs in this industry require controlling costs of supplies, expensive machinery, technology, and a variety of personnel. Cost accounting applications help health care organizations calculate product costs for individual procedures or services. One health care organization, for example, combines a variety of DSS applications in productivity, cost accounting, case mix, and nursing staff scheduling to improve its management decision making.
- Capital Budgeting System : Companies require new tools to evaluate high-technology investment decisions. Decision makers need to supplement analytical techniques, such as net present value and internal rate of return, with decision support tools that consider some benefits of new technology not captured in strict financial analysis. One DSS designed to support decisions about investments in automated manufacturing technology is AutoMan, which allows decision makers to consider financial, nonfinancial, quantitative, and qualitative factors in their decision-making processes. Using this decision support system, accountants, managers, and engineers identify and prioritize these factors. They can then evaluate up to seven investment alternatives at once.
- Budget Variance Analysis System : Financial institutions rely heavily on their budgeting systems for controlling costs and evaluating managerial performance. One institution uses a computerized DSS to generate monthly variance reports for division comptrollers. The system allows these comptrollers to graph, view, analyze, and annotate budget variances, as well as create additional one-and five-year budget projections using the forecasting tools provided in the system. The decision support system thus helps the comptrollers create and control budgets for the cost-center managers reporting to them.
- General Decision Support System : As mentioned earlier, some planning languages used in decision support systems are general purpose and therefore have the ability to analyze many different types of problems. In a sense, these types of decision support systems are a decision-maker's tools. The user needs to input data and answer questions about a specific

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problem domain to make use of this type of decision support system. An example is a program called Expert Choice which supports a variety of problems requiring decisions. The user works interactively with the computer to develop a hierarchical model of the decision problem. The decision support system then asks the user to compare decision variables with each other. For instance, the system might ask the user how important cash inflows are versus initial investment amount to a capital budgeting decision. The decision maker also makes judgments about which investment is best with respect to these cash flows and which requires the smallest initial investment. Expert Choice analyzes these judgments and presents the decision maker with the best alternative.

1.10.2 Executive Information Systems (EIS): An Executive Information System (EIS) – sometimes referred to as an Executive Support System (ESS) – is a DSS that is designed to meet the special needs of top-level managers. Some people use the terms "EIS" and "ESS" inter changeably, but others do not. Any distinction between the two usually is because Executive Support Systems are likely to incorporate additional capabilities such as electronic mail. In this section, we first cover those people in organizations that are considered to be executives and examine the types of decisions they make.

Executives : An executive can probably best be described as a manager at or near the top of the organizational hierarchy who exerts a strong influence on the course taken by the organization. The slots in a firm considered to be executive positions vary from company to company. For example, in many firms, the Chief Information Officer (CIO) is usually an executive who participates in key strategic decisions. In other firms, the CIO is a middle manager (who often has a title other than CIO). And sometimes, the person in charge of an organization's CBIS is basically a data processing director.

(I) Characteristics of EIS : Some of the characteristics of EIS are as follows :

(i) EIS is a Computer-based-information system that serves the information need of top executives.

(ii) EIS enables users to extract summary data and model complex, problems without the need to learn query languages statistical formulas or high computing skills.

(iii) EIS provides rapid access to timely information and direct access to management reports.

(iv) EIS is capable of accessing both internal and external data.

(v) EIS provides extensive online analysis tool like trend analysis, market conditions etc.

(vi) EIS can easily be given a DSS support for decision making.

(II) Executive Roles and Decision Making : Most executive decisions fall into one of three classes : Strategic planning, Tactical planning, and "Fire-fighting" activities (see Fig. 1.10.3). Also, executives need a certain degree of control to ensure that these activities are carried out properly.

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- Strategic Planning : Strategic planning involves determining the general, long-range direction of the organization. Typically, the CEO is ultimately responsible for the development of strategic plans.

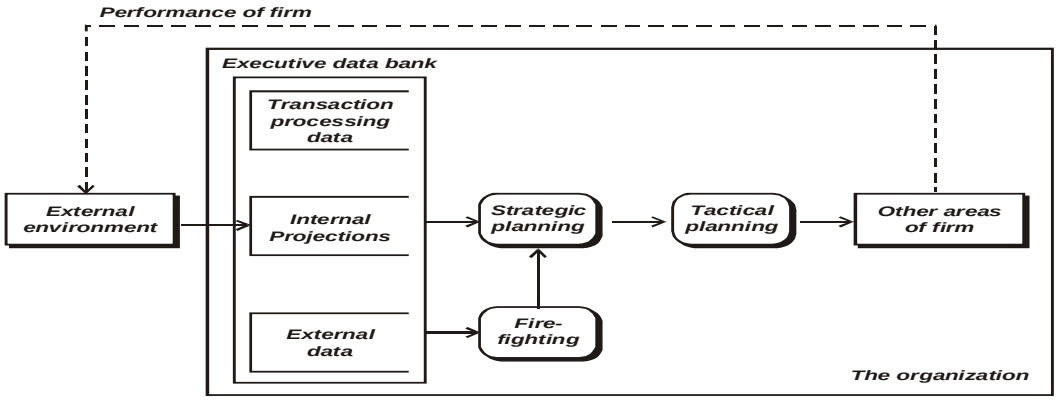

Fig. 1.10.3 : A data flow representation of the executive decision-planning environment.

- Tactical Planning : Whereas strategic planning addresses the general concerns of the firm, tactical planning refers to the how, when, where, and what issues involved with carrying out the strategic plan. Although executives will not normally be concerned with tactical details, they do need to worry about general tactics. For example, the vice-president of finance must address how the firm can best achieve a balance between debt and equity financing. And the marketing vice-president will need to consider which classes of products the company should produce to be successful in the marketplace.
- Fire Fighting : Major problems arise sometimes that must be resolved by someone at an executive level. For example, if a company is involved in a big lawsuit that threatens its financial solvency, an executive must get involved. Other possible fire-fighting activities include damage caused to a major facility, the announcement of an important product by a competitor, a strike, and a sharp reversal of the economy. Many of these events will call for key alterations in plans.

In addition to planning and fire-fighting, executive management also needs to exert some general control over the organization. For example, if the strategic plan calls for a 20 percent increase in profitability, feedback is needed to ensure that certain actions taken within the organization are accomplishing that objective. Thus, executives will also periodically review key performance data to see how they compare against planned amounts.

(III) The Executive Decision-Making Environment : The type of decisions that executives must make is broad. Often, executives make these decisions based on a vision they have regarding what it will take to make their companies successful. To a large extent, executives rely much more on their own intuition than on the sophisticated analytical skills. The intuitive character of executive decision-making is reflected strongly in the types of information found most useful to executives. Five characteristics of the types of information used in executive decision making are-lack of structure, high degree of uncertainty, future orientation, informal source, and low level of detail. These are discussed below:

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- Lack of structure : Many of the decisions made by executives are relatively unstructured. These types of decisions are not as clear-cut as deciding how to debug a computer program or how to deal with an overdue account balance. Also, it is not always obvious which data are required or how to weigh available data when reaching a decision.
- High degree of uncertainty : Executives work in a decision space that is often characterized by a lack of precedent. For example, when the Arab oil embargo hit in mid-1970s, no such previous event could be referenced for advice. Executives also work in a decision space where results are not scientifically predictable from actions. If prices are lowered, for instance, product demand will not automatically increase.
- Future orientation : Strategic-planning decisions are made in order to shape future events. As conditions change, organizations must change also. It is the executive's responsibility to make sure that the organization keeps pointed toward the future. Some key questions about the future include : "How will future technologies affect what the company is currently doing? What will the competition (or the government) do next? What products will consumers demand five years from now?" As one can see, the answers to all of these questions about the future external environment are vital.
- Informal Source : Executives, more than other types of managers, rely heavily on informal source for key information. For example, lunch with a colleague in another firm might reveal some important competitor strategies. Informal sources such as television might also feature news of momentous concern to the executive – news that he or she would probably never encounter in the company's database or in scheduled computer reports.
- Low level of detail : Most important executive decisions are made by observing broad trends. This requires the executive to be more aware of the large overview than the tiny items. Even so, many executives insist that the answers to some questions can only be found by mucking through details.

Dimensions of Difference	Executive Information System	Traditional Information System
Level of management	For top or near top executives.	For lower staff.
Nature of Information Access	Specific issues/problems and aggregate reports	Status reporting
Nature of information provided	Online tools and analysis.	Offline status reporting.
Information Sources	More external, less internal	Internal
Drill down facility to go through details at successive	Available.	Not available
Information format	Text with graphics	Tabular
Nature of interface	User-friendly	Computer-operator generated.

Table 1.10.1 : EIS vs Traditional Information Systems

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As shown in Table 1.10.1, Executive Information Systems differ from Traditional Information Systems in the following ways :

- Information tends to be presented by pictorial or graphical means.
- Information is presented in summary format, e.g. sales for the whole company. There is, however, the facility to 'drill down' to other levels of information to see how the sale figure were arrived at -by geographical location, by product group etc.

The powerful focus of an EIS is due to the saying "what gets measured gets done." Managers are particularly attentive to concrete information about their performance when it is available to their superiors. This focus is very valuable to an organization if the information reported is actually important and represents a balanced view of the organization's objectives.

Misaligned reporting systems can result in inordinate management attention to things that are not important or to things which are important but to the exclusion of other equally important things. For example, a production reporting system might lead managers to emphasize volume of work done rather than quality of work. Worse yet, productivity might have little to do with the organization's overriding customer service objectives.

(IV) Contents of EIS : A general answer to the question of what data is appropriate for inclusion in an Executive Information System is "whatever is interesting to executives".

EIS implementations begin with just a few measures that are clearly of interest to senior managers, and then expand in response to questions asked by those managers as they use the system. Over time, the presentation of this information becomes stale, and the information diverges from what is strategically important for the organization.

While the above indicates that selection of data for inclusion in an EIS is difficult, there are several guidelines that help to make that assessment. A practical set of principles to guide the design of measures and indicators to be included in an EIS is presented below :

(i) EIS measures must be easy to understand and collect. Wherever possible, data should be collected naturally as part of the process of work. An EIS should not add substantially to the workload of managers or staff.

(ii) EIS measures must be based on a balanced view of the organization's objective. Data in the system should reflect the objectives of the organization in the areas of productivity, resource management, quality and customer service.

(iii) Performance indicators in an EIS must reflect everyone's contribution in a fair and consistent manner. Indicators should be as independent as possible from variables outside the control of managers.

(iv) EIS measures must encourage management and staff to share ownership of the organization's objectives. Performance indicators must promote both team-work and friendly competition. Measures will be meaningful for all staff; people must feel that they, as individuals, can contribute to improving the performance of the organization.

(v) EIS information must be available to everyone in the organization. The objective is to provide everyone with useful information about the organization's performance.

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Information that must remain confidential should not be part of the EIS or the management system of the organization.

(vi) EIS measures must evolve to meet the changing needs of the organization.

1.10.3 Expert Systems: An Expert System is highly developed DSS that utilizes knowledge generally possessed by an expert to share a problem. Expert System are software systems that imitate the reasoning processes of human experts and provide decision makers with the type of advice they would normally receive from such expert systems. For instance, an expert system in the area of investment portfolio management might ask its user a number of specific questions relating to investments for a particular client like – how much can be invested. Does the client have any preferences regarding specific types of securities? And so on.

A characteristic of expert systems is the ability to declare or explain the reasoning process that was used to make decisions.

Some of the business applications of Expert Systems are as follows :

(i) Accounting and Finance : It provides tax advice and assistance, helping with credit-authorization decisions, selecting forecasting models, Providing investment advice.

(ii) Marketing : It provides establishing sales quotas, responding to customer inquiries, referring problems to telemarketing centers, assisting with marketing timing decisions, determining discount policies.

(iii) Manufacturing : It helps in determining whether a process is running correctly, analyzing quality and providing corrective measures, maintaining facilities, scheduling job-shop tasks, selecting transportation routes, assisting with product design and faculty layouts.

(iv) Personnel : It is useful in assessing applicant qualifications, giving employees assisting at filling out forms

(v) General Business : It helps in assisting with project proposals, recommending acquisition strategies, educating trainees, evaluating performance.

(I) Need for Expert Systems

(i) Expert labor is expensive and scarce. Knowledge workers employee who routinely work with data and information to carry out their day to day duties are not easy to find and keep and companies are often faced with a shortage of talent in key positions.

(ii) Moreover, no matter how bright or knowledgeable certain people are, they often can handle only a few factors at a time.

Both these limitations imposed by human information processing capability and the rushed pace at which business is conducted today put a practical limit on the quality of human decision making this putting a need for expert systems.

(II) Benefits of Expert Systems

(i) Expert Systems preserve knowledge that might be lost through retirement resignation or death of an acknowledged company expert.

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(ii) Expert Systems put information into an active-form so it can be summoned almost as a real-life expert might be summoned.

(iii) Expert Systems assist novices in thinking the way experienced professional do.

(iv) Expert Systems are not subject to such human fallings as fatigue, being too busy, or being emotional.

(v) Expert Systems can be effectively used as a strategic tool is the areas of marketing products, cutting costs and improving products.

Still Expert Systems are not always the answer to managerial or organizational problems. Some of the properties that potential applications should posses to qualify for Expert System development are as follows:

(i) Availability : One or more experts are capable of communicating how they go about solving the problems to which the Expert System will be applied.

(ii) Complexity : Solution of the problems for which the Expert Systems will be used is a complex task that requires logical inference processing, which would not be easily handled by conventional information processing.

(iii) Domain : The domain, or subject area, of the problem is relatively small and limited to a relatively well-defined problem area.

(iv) Expertise : Solutions to the problem require the efforts of experts. That is, only a few possess the knowledge, techniques, and intuition needed.

(v) Structure : The solution process must be able to cope with ill-structured, uncertain, missing, and conflicting data, and a dynamic problem-solving situation.

(III) Components of Expert Systems: An Expert System provides tools, information and methods for decision making in specific areas such as systems which generate competitive bids, systems to support loan approved, systems to support draining in specialized areas where experts are is scarcity and so on.

An Expert System is typically composed of the Knowledge Base, Inference Engine, the Knowledge Acquisition Subsystem and the User Interface.

(i) Knowledge Base (KB) : The knowledge base stores the rules data and relationships that are used to solve problems and contains specific facts about the expert area. For instance, the example where an insurance agent needs both expert tax and financial advice is a good candidate for an Expert System with two knowledge bases. With such a system, a set of rules must be developed to bridge the knowledge bases and resolve any conflicts.

The knowledge acquired from the expert has to be represented formally that deals with the structuring of the information, how to manipulate it to infer additional data, and knowledge acquisition. The power of a system tends to be related to the depth and breadth of the knowledge in the knowledge base. There are several types of representation techniques, like - Production Rule Systems, a Structured Object and Predicate Calculus or Logic.

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(ii) Inference Engine : The inference engine is the main processing element consisting of system of programs that requests data from the user, manipulates the knowledge base and provides a decision to the user. It performs this task in order to deduce new facts, which are then used to draw further conclusions. The inference engine is the active component of an expert system since it steers through knowledge and progresses the whole interaction. The inference engine chooses rules from the agenda to fire.

There are, in fact, various techniques which model different reasoning methods; these include backward and forward chaining; some operate with both.

- A forward-chaining mechanism first examines the KB and the problem at hand; then, it attempts to discover a solution. For instance, a medical Expert System may be used to examine a patient's symptoms and provide a diagnosis based on the symptomology, the Expert System might locate several diseases that the patient may here.
- With backward chaining, on the other hand, the Inference Engine starts with a hypothesis or goal, which it then checks against the facts and rules in the knowledge base for consistency. So, for instance, the Expert System might be given the goal to "find this patient's disease(s) and would work back from there, asking questions as necessary to confirm or a refute candidate diagnoses".

(iii) Knowledge Acquisition Subsystem (KAS) : The Knowledge Acquisition Subsystem is the software component of an Expert System that enables the Knowledge Engineer (KE) a specialized systems analyst responsible for designing and maintaining the expert System to build and refine an expert systems knowledge base. The KE works with the knowledge acquisition subsystem to model decision logic, derive industries and update the knowledge base.

Knowledge base development and maintenance can be done using special, reasonably user-friendly software. This software provides a convenient and efficient means of capturing and storing the contents of the knowledge base. Users are often presented with easy-to-operate menus and templates for entering rules, facts and relationship among facts. Once these are entered the software correctly stores the information in the knowledge base. Such software notes it much easier and less expensive to develop, update and refine the KB.

(iv) User Interface : A user interface is the method by which an expert system interacts with a user. These can be through dialog boxes, command prompts, forms, or other input methods. Some expert systems interact with other computer applications, and do not interact directly with a human. In these cases, the expert system will have an interaction mechanism for transactions with the other application, and will not have a user interface.

In most instances, the Expert System prompts the user to supply information about the problem and the user types in the requested data. The data entered are examined by the interface engine and compared to the facts, rules and relationships in the knowledge base. This examination and comparison process results in the system continuing to prompt the user for more information until the system has enough data about the current problem so that it can reach a conclusion. Thus the user interface for an Expert System is highly interactive.

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1.11 Office Automation Systems (OAS)

Office Automation System (OAS) are among the newest and most rapidly expanding computer based information systems. Different office activities can be broadly grouped into the following types of operations:

(i) Document Capture : Documents originating from outside sources like incoming mails, notes, handouts, charts, graphs etc. need to be preserved.

(ii) Document Creation : This consists of preparation of documents, dictation, editing of texts etc. and takes up major part of the secretary's time.

(iii) Receipts and Distribution : This basically includes distribution of correspondence to designated recipients.

(iv) Filling, Search, Retrieval and Follow up : This is related to filling, indexing, searching of documents, which takes up significant time.

(v) Calculations : These include the usual calculator functions like routine arithmetic, operations for bill passing, interest calculations, working out the percentages and the like.

(vi) Recording Utilization of Resources : This includes, where necessary, record keeping in respect to specific resources utilized by office personnel.

All the activities mentioned have been made very simple and effective by the use of computers. The application of computers to handle the office activities is also termed as office automation.

Benefits of Office Automation Systems

(i) Office Automation Systems improve communication within an organization and between organizations.

(ii) Office Automation Systems reduce the cycle time between preparation of messages and receipt of messages at the recipients' end.

(iii) Office Automation Systems reduce the costs of office communication both in terms of time spent by executives and cost of communication links.

(iv) Office Automation Systems ensure accuracy of communication flows.

Fig. 1.11.1 depicts categories of Computer based Office Automation systems.

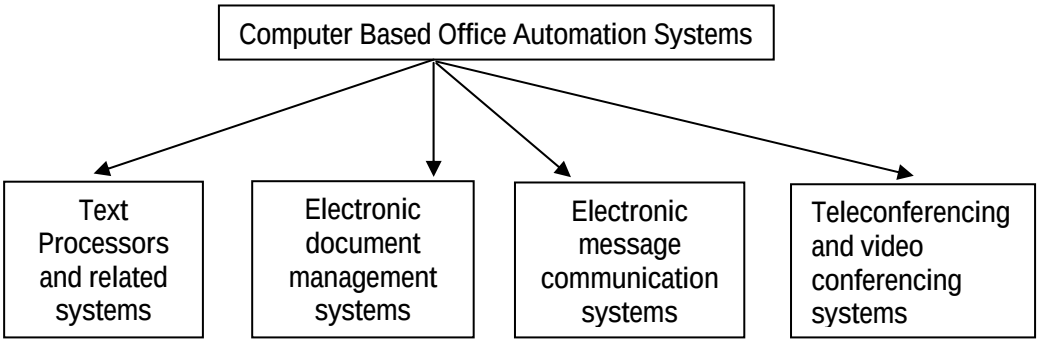

Fig 1.11.1 : Building Blocks of Office Automation Systems

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Each of these Office Automation Systems are briefly described as follows:

1.11.1 Text Processing Systems

- Text processing systems are the most commonly used components of the OAS. This is so because a large proportion of the office communication takes place in writing using words of a natural language.
- Text processing systems automate the process of development of documents such as letters, reports, memos etc. They permit use of standard stored information to produce personalized documents. Such automation reduces keying effort and minimizes the chances of errors in the document.
- The text processor may be simple word processing systems or desktop publishing systems. The desktop publishing systems help in quick production of multiple copies of the document with quality printing.
- The desktop publishing systems are often supported with laser printers, inkjet printers, scanners and other such devices for producing good quality documents.

1.11.2 Electronic Document Management Systems

- The computer based document management systems are at capturing the information contained in documents, stored for future reference and communicate the relevant parts to the users as and when required. These systems are linked to the office automation systems such as text processors, electronic message communication systems etc.
- These systems are very useful in remote access of documents that is almost impossible with manual document management systems, For example, a customer may have a complaint concerning delivery of goods not being in accordance with the delivery instructions in the order. The computer based document management system would enable the executive to access the document through his notebook computer connected to any telephone line and show it to the customer, his order document in the office.
- In the case of internal communication document management systems can prove to be very useful. For example, the loan application form filed in a branch of a bank can be accessed by the sanctioning officer for scrutiny at the head office or any office for scrutiny of loan proposals.
- With computer based document management systems, location of the executive becomes irrelevant for access to documents. Thus, these systems can be very useful in an office environment where traveling executives share work space in the office.

1.11.3 Electronic Message Communication Systems : Business enterprises have been using a variety of communication systems for finding and receiving messages. These include telephone, mail and facsimile (Fax), etc. The computer based message communication systems offer a lot of economy not only in terms of reduced time in sending or receiving the message but also in terms of reliability of the message and cost of communication.

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Components of Message Communication Systems

The three basic components based message communication systems are as follows :

(i) Electronic Mail : Various features of electronic mail are stated below :

- Electronic transmission : The transmission of messages with email is electronic and message delivery is very quick, almost instantaneous. The confirmation of transmission is also quick and the reliability is very high.
- Online development and editing : The email message can be developed and edited online before transmission. The online development and editing eliminates the need for use of paper in communication. It also facilitates the storage of messages on magnetic media, thereby reducing the space required to store the messages.
- Broadcasting and Rerouting : Email permits sending a message to a large number of target recipients. Thus it is easy to send a circular to all branches of a bank using Email resulting in a lot of saving of paper. The email could e rerouted to people having direct interest in the message with or without changing or and appending related information to the message.
- Integration with other Information systems : The E-mail has the advantage of being integrated with the other information systems. Such an integration helps in ensuring that the message if accurate and the information required for the message is accesses quickly.
- Portability : Email renders the physical location of the recipient and sender irrelevant. The email can be accessed fro any Personal computer equipped with the relevant communication hardware, software and link facilities.
- Economical : The advancements in communication technologies and competition among the communication service providers have made Email the most economical mode if sending messages. Since the speed of transmission is increasing, the time cost on communication media per page is falling further, adding to the popularity of email. The email is proving to be very helpful not only for formal communication but also n informal communication within the business enterprise.

(ii) Facsimile (Fax) : Facsimile (Fax) is electronic communication of images of documents over telephone lines. The computer based fax technology automates fax communication and permits sharing of fax facilities. It uses special software and fax servers to send and receive fax messages using common communication resources. These servers have the ability to receive fax messages and automatically reroute them to the intended recipient after viewing it at the central computer, similarly, the managers in an enterprise can leave the fax messages to the server which will send it to the intended recipient automatically.

(iii) Voice Mail : Voice mail a variation of the email in which messages are transmitted as digitized voice. The recipient of the voice mail has to dial a voice mail service or access the e-mail box using the specified equipment and he can hear the spoken message in the voice of

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the sender. The secured type of voice mail service may require the recipient to enter identification code before the access is granted to the stored information.

1.11.4 Teleconferencing and Video-conferencing Systems: Teleconferencing is conducted a business meeting involving more than two persons located at two or more different places. The teleconferencing helps in reducing the time and cost of meeting as the participants do not have to travel to attend the meeting. Teleconferencing may be audio or video conferencing with or without use of computer systems.

The computer based teleconferencing has the advantage of flexibility in terms of pre-recorded presentations and integration with other information systems. These systems are based on Personal computers featuring a digital camera and run on a visual communication software. The communication links are still quite expensive making the desktop video conferencing useful only for selected applications.

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